Operating instructions – HART® supplement OI/TB82/HART–EN Rev. D

Type TB82EC, TE, TC and pH Advantage Series™ Conductivity and pH/ORP/pION transmitters

Power and productivity
for a better world™

CONTENTS

USE OF INSTRUCTIONS

Warning
An instruction that draws attention to the risk of injury or death.

Caution
An instruction that draws attention to the risk of damage to the product, process or surroundings.

Note
Clarification of an instruction or additional information.

Information
Further reference for more detailed information or technical details.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it must be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of Technical Communications Department, ABB Inc.

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

1 INTRODUCTION

1.1 Overview

The TB82 series HART transmitters provides either a four to 20 mA analog signal (conventional analog), a four to 20 mA analog signal with a superimposed digital signal (HART point to point analog), or a polled digital signal (HART multi-drop). Using HART communications, many functions normally requiring the use of the local user-interface can be accessed remotely using HART communication devices.

1.2 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 the installation of analytical equipment.

Application Technician
Should have a solid background in analytical 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 the primary instruction book and this supplement before attempting any procedure pertaining to the operation of the TB82 series HART 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.

1.3 Equipment Description

The TB82 series HART transmitter contains signal conditioning, microprocessor/display, and power supply PCB assemblies. These electronic assemblies use the latest technology, allowing for accurate and reliable operation and troubleshooting from a local or remote location.

Communication devices that support revision 5.0 or greater of the HART Communication Foundation Specification (HCF) provide access to the TB82 HART transmitter over the output signal wiring. Changing operational parameters, initiating a calibration, and checking transmitter status are easily accomplished without use of the transmitter's local user-interface.

1.4 Features

Remote Communications
HART communications provide the ability to digitally communicate process variable information over a transmitter bus or over a four to 20 mA output thus retaining the compatibility and reliability of an analog transmitter required by many existing systems.

Reduced Installation and Service Costs
Remote communications, modular plug-in electronics and long-term stability reduce installation and service time.

Direct Replacement of Existing Analog Two-wire Transmitters
Older strictly analog mode transmitters can be easily replaced with the TB82 HART transmitter using the same four to 20 mA wiring systems while increasing the capability of the measurement loop through the use of HART communications.

Simultaneous Digital Communication with Analog Output
Modulated communication information does not interfere with the isolated four to 20 mA process variable signal.

Multi-Drop Capability
Multiple transmitters can be wired to a single pair of wires from the main control system.

1.5 Equipment Application

Uses for the TB82 HART Series transmitter include process control applications in power generation, gas, water, chemical, petroleum, pulp and paper, and food industries.

1.6 Instruction Content

Introduction
This section provides a product overview, the purpose of this publication, and a description of each section within this supplement. This section also has a glossary of terms and abbreviations, a list of reference documents on related equipment and/or subjects, and the product identification (nomenclature).

Transmitter Functionality and Operator Interface Controls
This section provides a short description on the functionality of the TB82 HART transmitter.

Installation
This section provides HART specific information on transmitter installation.

Operating Procedures
This section includes information on each mode of operation. This information describes the unique characteristics of the TB82 HART transmitter necessary to support HART communication devices.

Troubleshooting
This section provides brief troubleshooting guide specific to HART function that can help identify and resolve problems.

Appendix A
This section provides a description of the Universal, Common Practice, and Device Specific command sets supported by the TB82 HART transmitters.

1.7 Glossary of Terms and Abbreviations

Table 1-1 Glossary of Terms and Abbreviations

Term	Description
DDL	Device Description Language. The Device Description Language describes the data and operating procedures for a specific field device, including commands, menus and display formats and can be added to HART communication devices thus enabling support of the Device Specific command sets from that product.
HART®	Highway Addressable Remote Transducer
HHT	Hand Held Terminal. A typical HART communication device.
Multi-drop	An operation mode where up to 15 transmitter can share a common set of signal wires. Each transmitter will roughly draw 4 mA of current and will digitally communicate over the same pair of wires.
Point to Point	An operation mode that uses a typical analog transmitter installation where each transmitter is powered by a separate pair of wires. The analog and digital communication signals travel on this pair of wires.
PV	Process Variable

1.8 Reference Documents

Table 1-2 Reference Documents

Number	Document
WBPEEUI520002A2	TB82PH pH/ORP Product Instruction Manual
WBPEEUI520002A3	TB82EC 4-Electrode Conductivity Product Instruction Manual
E67-82-3	TB82TE 2-Electrode Conductivity Product Instruction Manual
E67-82-4	TB82TC Toroidal Conductivity Product Instruction Manual

1.9 Product Nomenclature

Base Model – 1st to 4th characters	Model TB82	**PH**	**X**	**X**	**1**	**0**	**X**	**X**	**X**
Input Type – 5th to 6th Character									
pH, ORP, pIon		PH							
Programming Options – 7th character									
Basic			1						
Advanced			2						
Digital Communications – 8th character									
None (Analog Only)				0					
HART				1					
FOUNDATION fieldbus				2					
PROFIBUS PA				3					
Lightning Suppressor – 9th character									
Included					1				
Housing Type – 10th character									
Powder Coated Aluminum						0			
Mounting Options – 11th character									
None							0		
Pipe							1		
Wall/Hinge (Rear Mount)							2		
Panel							3		
Wall (Side Mount)							4		
Agency Approvals2 – 12th character									
None								0	
FM (Factory Mutual)								1	
CSA (Canadian Standards Association)								2	
ATEX 100A								3	
Tag – 13th character									
None									0
Stainless									1
Mylar									2

1.10 Specifications

Table 1-3 Specifications

Property	Characteristic/Value
Supply Voltage	14 VDC required for liftoff HART: 14 to 53 VDC (14-42 VDC for certified applications). For HART communication, a 250 Ω resistor is required; 19.0 VDC minimum required.
Output Signal Analog Digital	 4 to 20 mA HART communications – HCF Revision 5.0 or greater Multi-drop current draw: 4 mA
Loop Load Limits	Refer to Figure 1-1
Certifications	**ATEX 100A** ATEX Category II 1G; EEX ia, Zone 1; Group IIC, T4 when used with appropriate barriers **Canadian Standards Association (CSA)** Intrinsic safety: Class I, II, III; Division 1; applicable Groups A, B, C, D, E, F and G; T4 when used with appropriate barriers. T3C Non-incendive: Class I, Division 2, Groups A, B, C, and D. Class II, Division 2, Groups E, F and G. Class III, Division 2 **Factory Mutual (FM)** Intrinsic Safety: Class I, II, III; Division 1; applicable Groups A, B, C, D, E, F and G; T4 when used with appropriate barriers. T3C (Max ambient Temperature: 60° C) Non-incendive: Class I, Division 2, Groups A, B, C, and D. Class II, Division 2, Groups F and G. Class III, Division 2. T5 Fieldbus Intrinsically Safe Concept (FISCO) Fieldbus products (FF and PA) meets the requirements for the FISCO model
EMC Requirements	CE Certified – complies with all applicable European Community product requirements, specifically those required to display the CE markings on the product nameplate.
HART Burst Mode	Not supported
HART Protocol Revision	5
Device Revision	1
Software Revision	E10

Specifications subject to change without notice

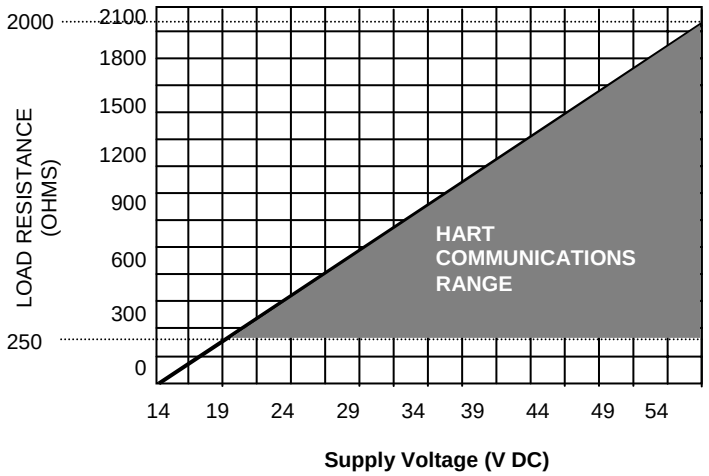

Figure 1-1 Supply Voltage Requirements, HART and Analog Versions

1.11 HART Manufacturer ID and Device Type

All HART products contain unique identifiers that specify the product manufacturer and device type. In accordance with this requirement, the ABB Manufacturer ID is 26 (1A hexadecimal) and the Device Types Codes are listed in Table 1-4.

Table 1-4 Device Type Codes

Model Name	Device Type Code	Hexadecimal	Device Description (DD) Path
TB82PH-Combined	35	23	…\00001A\0023
TB82EC-Combined	36	24	…\00001A\0024
TB82TE-Combined	37	25	…\00001A\0025
TB82TC-Combined	38	26	…\00001A\0026

1.12 Engineering Units and Dynamic Variables

Table 1-5 HART Engineering Unit Codes

Analyzer Type	Code	Units
TB82PH	59	pH
	36	mV
	139	ppm
	169	ppb
	32	° C
	33	° F
	163	Kilo Ohm
TB82EC, TB82TE, TB82TC	66	mS/cm
	67	µS/cm
	139	ppm
	169	ppb
	57	%
	251	No Unit
	32	° C
	33	° F

Table 1-6 Dynamic Variables, TB82PH

Variable	Description	Units
Primary (PV)	pH, ORP, pION or ion concentration based on PV-Type selection on the device.	pH in pH units ORP and pION in mV units Ion Concentration in ppm or ppb units
Secondary (SV)	Process Temperature	° C or ° F
Tertiary (TV)	Reference Impedance	Kilo ohm
Quaternary (QV)	Sensor Input	mV

Table 1-7 Dynamic Variables, TB82EC, TB82TC, TB82TE

Variable	Description	Units
Primary (PV)	Conductivity or concentration based on PV-Type selection on the device. Temperature-compensated.	mS/cm or µS/cm for Conductivity %, ppm, ppb or no-units for Concentration.
Secondary (SV)	Process Temperature	° C or ° F
Tertiary (TV)	Concentration or conductivity which ever is not the PV (as selected by PV-Type)	mS/cm or µS/cm for Conductivity %, ppm, ppb or no-units for Concentration.
Quaternary (QV)	Temperature -uncompensated conductivity	mS/cm or µS/cm

1.13 HART Command Sets

The TB82 HART transmitter conforms to the HART Communication Specifications and supports the HART commands listed in Apendix A.

2 TRANSMITTER FUNCTIONALITY AND OPERATOR INTERFACE CONTROLS

2.1 Introduction

This section contains an overview of the TB82 HART series transmitters.

2.2 Functional Operation

Since HART communications does not affect a four to 20 mA direct current output signal, any one of three types of installations is supported by the TB82 HART transmitter. These include a conventional four to 20 mA analog output signal used in point to point installations, a 4 to 20 mA analog output signal with a superimposed digital HART signal also used in point to point installations, or a digital HART signal that is used in multi-drop installations.

Since HART communications uses a digital signal, many transmitter functions can be accessed without requiring the use of the local transmitter user-interface. The added flexibility allows an operator to monitor or control the transmitter from any point that a HART communication device can link into the transmitter's signal wiring.

2.3 Communications

An AC voltage imposed on the signal wires allows communications between the transmitter and the primary or secondary communication device. A minimum of 230 ohms loop resistance is required to support communications, although typical installations use 250 ohms.

The secondary communication device connects to the target transmitter anywhere there is access to the signal leads. The clip leads connect across the signal leads independent of signal direction or polarity. Since the communication signal is an AC waveform with a zero DC average, this signal does not affect the analog output signal. Two different frequency levels transmit a logic zero or logic one.

Configuring the transmitter in the multi-drop mode causes the microcontroller to set the output of the transmitter to four milliamperes for lower power consumption. The transmitter then provides a digital process variable signal when polled.

Refer to Figures 3-1 and 3-2 for typical wiring arrangements for analog and multi-drop mode installations. Both operating modes require that the secondary communication device be connected between the loop resistance and the transmitter. The resistance cannot be connected directly across the power supply.

2.4 Analog Output

Table 2-1 Analog Output Properties

Condition	Analog Output Value		Description
Linear over range	Up: Down:	20.75 mA 3.9 mA	Upper and lower value where the AO saturates while following the input
Device Malfunction indication	Up: Down:	21.5 mA 3.8 mA	Analog output values used to indicate device malfunction based on Analog Output alarm high/low setting
Multi-drop current	4 mA		
Maximum current	21.5 mA		

3 INSTALLATION

3.1 Introduction

This section of the manual will aide the user in all levels of the installation process specific to the TB82 HART Series transmitter. The intent of this section is to provide simple procedures for placing the transmitter into service.

3.2 Special Handling

Besides the normal precautions for storage and handling of electronic equipment, the transmitter has special static sensitive device (SSD) handling requirements. This equipment contains semiconductors subject to damage by discharge of static electricity; therefore, avoid direct contact with terminal block conductors and electronic components on the circuit board.

3.3 Location Considerations

When mounting the unit, 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 the best results.

The installation site should have minimal mechanical vibrations and shocks. The location should not be close to power switches and relays, in direct sunlight, or exposed to severe weather conditions. The area should also be avoided of corrosive materials or gases thus allowing for routine maintenance.

3.4 Hazardous Locations

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

Refer to Table 1-3 Specifications, in Section 1.10 for a list of certifications and approvals applicable to the TB82 HART Series transmitter.

3.5 Radio Frequency Interference

Most electronic equipment is affected to some extent by radio frequency interference (RFI). Caution should be exercised with regard to the use of portable communications equipment in areas where this electronic equipment is being used. Post appropriate cautions in the plant as required.

3.6 Wiring Connections and Cabling

Caution
To prevent possible signal degradation, a separate metal conduit run is recommended for the sensor, signal/power wiring.

Under ideal conditions, the use of conduit and shielded wire may not be required. However, to avoid noise problems and ensure uninterrupted communications, the sensor and signal/power wiring should be enclosed in separate grounded,

metallic conduit. Just prior to entering the housing, rigid conduit should be terminated and a short length of shielded flexible conduit should be installed to reduce any stress to the housing.

Signal/power wiring must bear a suitable voltage rating, be rated to 75° C (167° F), and meet all NEC or equivalent requirements for the installation site.

3.7 Analog Mode Signal and Power Wiring

The signal terminals, located in the back of the instrument housing (Figure 3-1 and -2), accept wire sizes 12 to 24 AWG. Pin-style terminals are recommended for all connections.

The terminal block label is marked POWER for the signal connections and shows the polarity. All wiring should not be run in conduit or open trays where power wiring or heavy electrical equipment could 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.

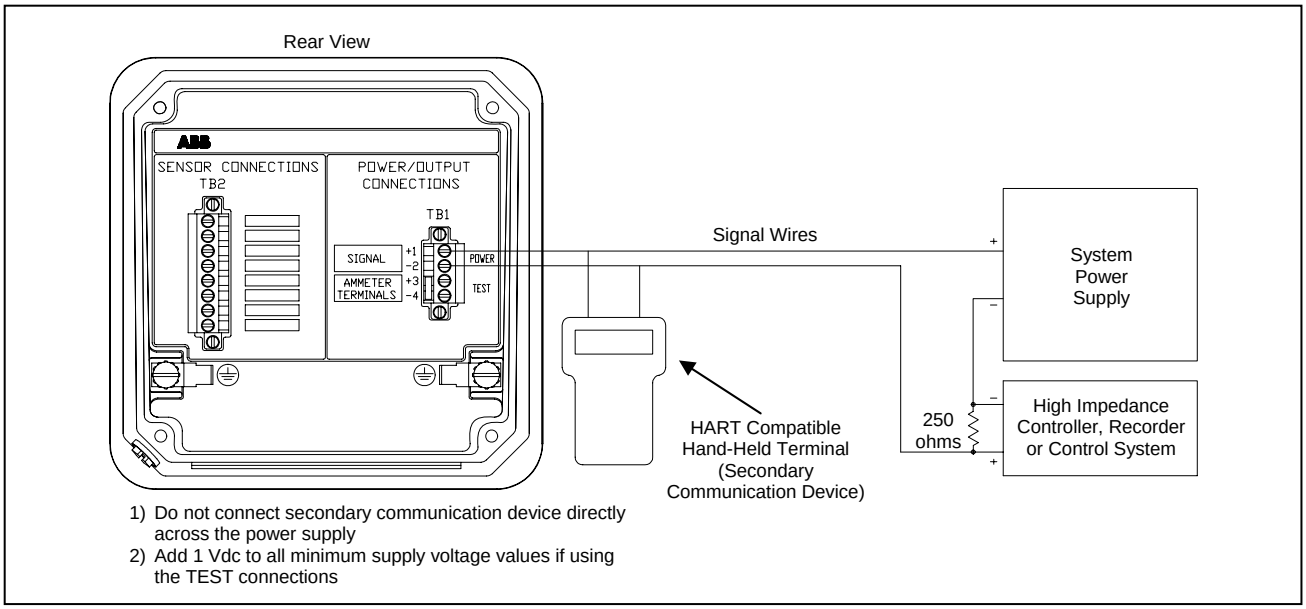

Figure 3-1 Analog Mode Wiring Diagram

The signal wiring supplies all power to the transmitter. The power supply limits are 14.0 Vdc to 53 Vdc (14.0 to 42 Vdc for agency certified installation). The minimum supply voltage (Figure 1-1) is determined by the loop resistance (R) as follows:

Minimum Supply = 14.0 Volt + 0.020 Amps x R (ohms)

Load resistance must include any meters external to the TB82 HART series transmitter, the wiring, and the system input.

Note:

1) The equation for minimum supply voltage is based on a maximum output current of 20 mA. In some cases such as a fail high or process variable over range condition, the output current limits to 21.5 mA. To support these cases, use 0.0215 instead of 0.020.

2) If the jumper is removed from the TEST terminals (i.e., TB1-3 and 4), the minimum lift-off voltage is 15 Vdc instead of 14 Vdc. Also, do not connect any permanent receiving devices (meters, recorders, etc.) to the TEST terminals. Only remove the jumper from the TEST terminals when attaching a meter temporarily.

The HART polling address for a transmitter in analog mode is zero. A secondary communication device can be connected anywhere there is access to the signal wires, as long as it is not connected directly across the power supply.

Note: Only one secondary device can communicate on the loop at any given time.

3.8 Multi-drop Mode Signal and Power Wiring

Refer to Figure 3-2 for a typical wiring configuration for multi-drop installations. In the multi-drop mode of operation, the analog four to 20 mA signal is not used. Instead, the transmitter draws a constant four milliamperes of current to maintain operation.

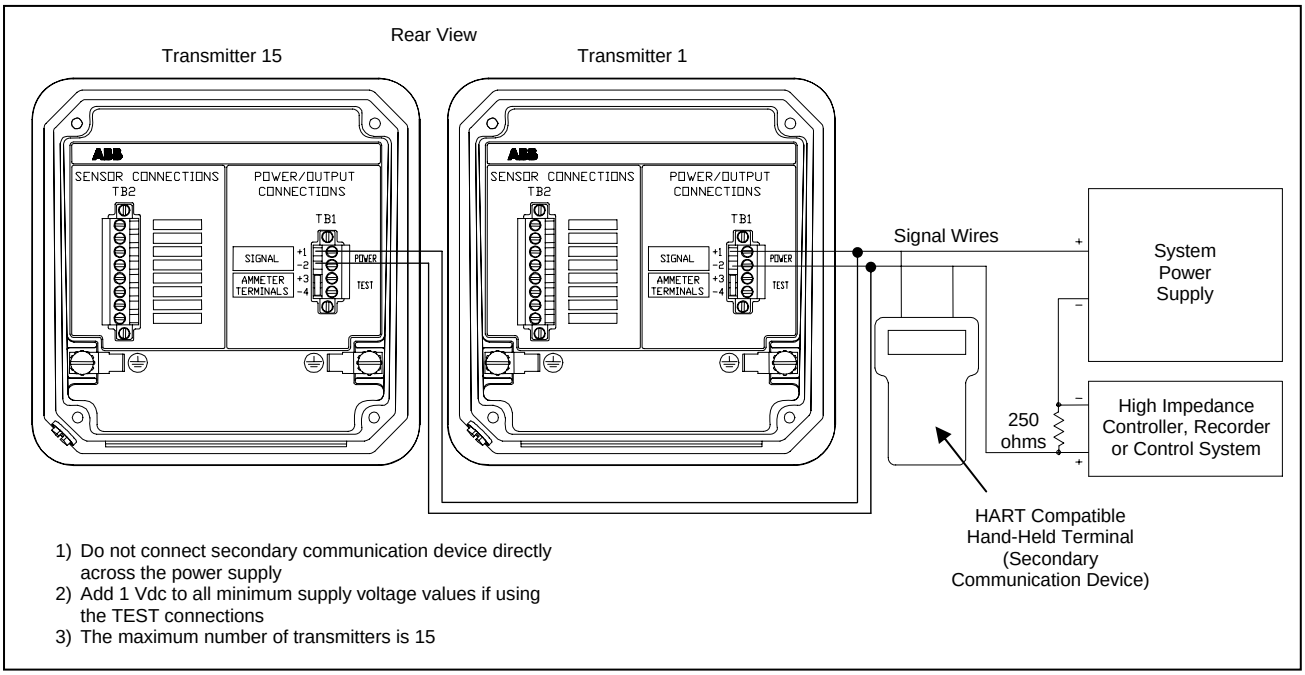

Figure 3-2 Digital Mode Wiring Diagram

In the multi-drop mode, the process variable signal of each transmitter on the signal bus is digitally polled. The primary communication device sequentially polls each transmitter output on the bus. Each transmitter has its own unique address that is assigned during configuration. The address (1 through 15) allows the primary communication device to distinguish between transmitters on the bus.

Each transmitter present on the bus is wired from the control system to the positive (+) and negative (-) terminals (i.e. TB1-1 and 2, respectively) of the transmitter. Connect all transmitters on the bus in parallel.

The minimum power supply voltage required for the loop is typically determined by:

Minimum Supply = 14.0 Volts (0.004 Amps x R x T)

Where:

R is the Load Resistance in ohms, and
T is the number of transmitters on the bus

Note:

1) The equation for minimum supply voltage is based on a maximum output current of 4 mA. In some cases, other transmitter may use multi-drop minimum currents greater than 4 mA. Consult the vendor product instruction for multi-drop current values for other equipment on the bus.

2) If the jumper is removed from the TEST terminals (i.e., TB1-3 and 4), the minimum lift-off voltage is 15.0 Vdc instead of 14.0 Vdc. Do not connect any permanent receiving devices (meters, recorders, etc.) to the TEST terminals. Only remove the jumper from the TEST terminals when attaching a temporary meter.

The load resistance must include the system input resistance and the resistance of the wire. Analog meters or measurement devices should not be on the bus since the transmitters on the bus are not delivering an analog process variable.

A secondary communication device can be connected anywhere there is access to the signal wires, as long as it is not connected directly across the power supply.

Note: Only one secondary device can communicate on a bus at any given time.

3.9 Sensor Wiring

See the applicable Product Instruction Manual for sensor wiring instructions.

3.10 Grounding

Signal wiring should be grounded at any one point in the signal loop or may be 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 shown in Figure 3-3. The transmitter should only be grounded at one location.

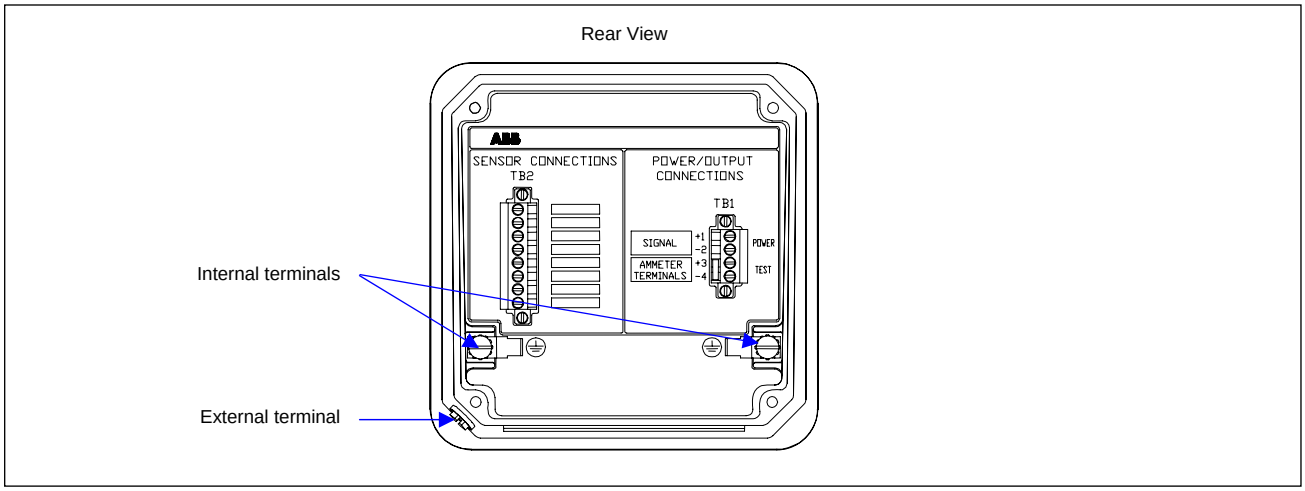

Figure 3-3 Location of ground terminals

3.11 Lockout Write Protection Switch

The TB82 Series transmitter has a lockout (write protection) feature that, once engaged, limits access to certain transmitter functions. When the lockout feature is enabled, local write-access using the integral keypad to the Calibrate, Output/Hold, Configure Mode, Security and Secondary Display are prohibited. All other modes of operations can still be accessed using the local interface.

When using a HART communication device, an enabled lockout prevents access to Universal, Common Practice and Device Specific Commands that write to the device and will generate a Write Protect error. See Appendix A, HART Commands, for a list of supported commands. See Figure 3-4 for Lockout Switch location and settings.

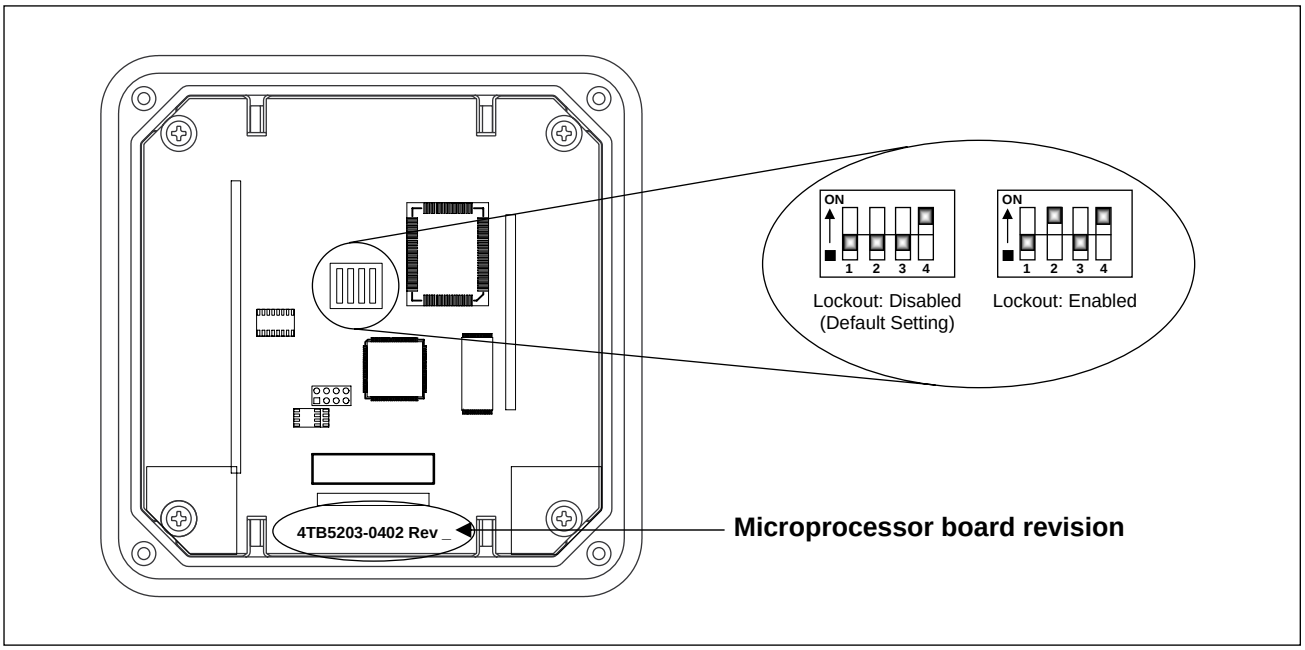

Figure 3-4 Lockout switch

4 OPERATING PROCEDURES

4.1 Introduction

This section addresses the operating procedures unique to the TB82 HART Series transmitter. The Modes of Operation will be individually discussed emphasizing areas affected by use of HART communications both in Analog (i.e., a Polling Address set to zero) and Multi-drop (i.e., a Polling Address set from one to 15) installations. See Appendix A, HART Commands, for more information on Polling Addresses.

Note:
The TB82 HART transmitter has a lockout (write protection) dip switch. When the lockout feature is enabled and a HART communication device attempts to use a Universal, Common Practice or Device Specific Command that will perform a write to the TB82 HART transmitter, a Device in Write Protect Mode error will be displayed on the HART communication device. Refer to Section 3.11 for Lockout (write protection) information.

4.2 Measure Mode of Operation

The Measure Mode is the primary operating environment of the TB82 HART and Non-HART Series transmitter. When the transmitter is in this mode operation, it provides real time information on process variable(s). Since HART communications does not affect the function of this mode of operation, consult the appropriate Product Instruction (i.e., TB82PH, TB82EC, TB82TC, or TB82TE operating manual) on details regarding the functions available under this mode of operation.

4.3 Calibration Mode of Operation

The Calibrate Mode provides various States of Operation used to adjust the input and output characteristics of the transmitter. These calibration functions can be accessed using the integral user-interface of the TB82 HART transmitter or a HART communication device such as the ABB DHH800-MFC Communicator. Since these functions are specific to the TB82 HART products, the Device Description Language (DDL) must be installed into HART communication device, such as third party Hand Held Terminals (HHT), before they can support TB82 HART calibration routines.

All Calibration States of Operation are available for a transmitter in Analog mode. When in Multi-drop mode, the Output Calibration State of Operation is not available since the transmitter is set to a fixed output current of 4 mA.

When the local user-interface is in the Calibration Mode of Operation, the HART interface is write-protected.

Refer to the appropriate TB82 Product Instruction for calibration procedures when using the integral user-interface or the HART communications device product instruction.

4.4 Output/Hold Mode of Operation

The Output/Hold Mode provides control over the output functions of the TB82 HART Series transmitter. When the TB82 HART transmitter is set in either HART Analog or Digital modes, the Hold, Re-range and Damping States are available at the local user-interface on the transmitter. These functions are accessed in the same manner as described in the main product instruction manual shipped with the TB82 HART product. Since many of these functions are included in the Universal and Common Practice command sets, HART communication devices can access many of these output functions. For details on supported commands sets, refer to the HART communication device product instruction manual.

Since the Spike signal can interfere will HART communications signal, the Spike Output State is not supported when HART Communications are enabled. See Utility Mode of Operation under this section for more information on enabling the HART Communications.

4.5 Configure Mode of Operation

The TB82 HART Series transmitter may be configured either through the local user-interface as well as through the HART interface. HART interface uses Universal, Common Practice and Device Specific commands to configure the device.

The TB82 HART transmitter has a lockout (write protection) dip switch. When the lockout feature is enabled and a HART communication device attempts to use a Universal, Common Practice or Device Specific Command that will perform a write to the TB82 HART transmitter, a Device in Write Protect Mode error will be displayed on the HART communication device. Refer to Section 3.11 for Lockout (write protection) information.

When the local user-interface is in the Configure-Modify state, the HART interface is write-protected.

Refer to Appendix A, HART Commands, for a list of supported HART commands, and to the appropriate Product Instruction (i.e., TB82PH, TB82EC, TB82TC or TB82TE manual) for transmitter configuration information.

4.6 Security Mode of Operation

The Security Mode provides the ability to password protect certain operating modes. Security options can be modified through the local user-interface as well as through HART Device Specific commands. When a mode of operation such as Output/Hold is secured and a HART communication device attempts to write a value supported by that mode of operation, a Device In Write Protect Mode error will be displayed by the HART communication device.

For information on setting transmitter security, see the appropriate transmitter Product Instruction (i.e., TB82PH, TB82EC, TB82TC or TB82TE manual).

4.7 Secondary Display Mode of Operation

The Secondary Display Mode sets the parameter that is shown in the secondary display region when the transmitter is in the Measure Mode of Operation. Secondary Display options can be modified through the local user-interface as well as through HART Device Specific commands.

For information on setting a new parameter in the secondary display region, see the appropriate transmitter Product Instruction (i.e., TB82PH, TB82EC, TB82TC, and TB82TE manual).

4.8 Utility Mode of Operation

The Utility Mode provides access to powerful functions that are not normally needed during normal operating conditions. These functions are separated into two States of Operation: Factory and User. Factory functions are strictly reserved for ABB personnel.

The Utility Mode is accessed using the hidden fifth key located between the ABB logo and TB82; refer to Figure 6-1. In the User State, two mode and four reset functions are available. The TB82 transmitter may also be upgraded for HART communications, Refer to Section 6.

When the local user-interface is in the Utility Mode of Operation, the HART interface is write-protected.

5 TROUBLESHOOTING

5.1 Introduction

The status of the transmitter is reported every time HART communications are established. Any errors returned at this time are general errors.

If a general error indicates there is additional status information, see Appendix B, use Read Additional Transmitter Status to access the additional errors identified in status groups one through fourteen.

Both general and additional errors are returned to the communication device as status bits. The general errors appear in text format (Table 5-1). The display of the additional status bits is a function of the communication device. They could be displayed in text, binary or hexadecimal format (refer to Appendix B).

Table 5-2 is dedicated to potential output signal irregularities that may or may not return a status code.

5.2 General Errors

Table 5-1 lists the general error messages pertaining to the transmitter that can be displayed on the communication device. Each column contains the following information:

1. Fail Mode - Indicates if the error causes the transmitter to enter the fail mode
2. General Error Message - Lists the errors as they appear on the display of the communication device
3. Probable Cause - Provides a brief explanation of the cause of the error
4. Corrective Action - Lists corrective actions to implement

Table 5-1 General Error Messages

Fail Mode	General Error Message	Probable Cause	Corrective Action
Yes	Field device malfunction	Transmitter entered fail mode	Review Appendix B, Read Additional Transmitter Status
No	Configuration changed	Configuration has been changed and the Configuration Changed flag has not been reset	Verify that configuration should have been changed. If so, use Reset Configuration Changed Flag function on communication device
No	More status available	Additional status bits are set	Review Appendix B, Read Additional Transmitter Status
No	PV analog output fixed	Transmitter is in the fixed output mode	Use Enter/Exit Fixed PV Current Mode to enter a value of 0 mA to cancel fixed output on a HART communication device or release Hold condition using the local user-interface
No	PV analog output saturated	PV is greater than +104.68% or less than -0.625% of its range and the analog output cannot show changes in its process input	Check sensor wiring
			Check that transmitter range is appropriate for application
			Perform the DAC trim adjustment
No	Non-PV out of limits	Temperature value (SV), TV or QV value is over or under range	Check sensor wiring
			Check that transmitter range is appropriate for application
			Correct process input
No	PV out of limits	Process Variable is over or under range	Correct process input
No	DEV in Write Protect Mode	Transmitter is set for lockout (write protection) or Mode of Operation is secured or device local HMI is in CONFIG, CALIBR or USER mode of operation	Disable Lockout by changing dip switch setting. Refer to Section 3.11
			Remove security from affected Mod of Operation
			Exit from CONFIG, CALIBR or USER mode of operation on the local HMI

5.3 Output Troubleshooting

Table 5-2 lists possible output irregularities, their probable causes and the recommended corrective action.

Table 5-2 Output Troubleshooting

Fault	Probable Cause	Corrective Action
High output	PV out of limits	Check process conditions have not exceeded transmitter range values.
		Verify range values have been correctly entered into the transmitter.
		Verify sensor connections/cabling are correct and free of corrosion, moisture, shorts, and/or opens.
		Verify sensor is operating properly.
	Temperature out of limits	Check process conditions have not exceeded transmitter range values.
		Verify sensor connections/cabling are correct and free of corrosion, moisture, shorts, and/or opens.
		Check to verify sensor is operating properly.
	Faulty Sensor	Test Sensor to verify it is operating properly. Replace if necessary.
	Transmitter electronics failure	Replace faulty electronic assembly.
	Safe Mode condition has been enabled	Check Error Code description in appropriate product instruction, and implement suggested corrective action.
Erratic output	Electro-Magnetic Interference	Verify transmitter and sensor wiring is not in run in near high voltage or power devices or wiring.
		Improve wiring installation using shielded conduit or equivalent.
		Verify Protective Ground Electrode system is sound.
	Entrapped air in process piping	Remove air in process piping.
		Move sensor location to avoid air entrapped.
	Faulty transmitter and/or sensor wiring	Verify transmitter and sensor connections/cabling are correct and free of corrosion, moisture, shorts, and/or opens.
	Faulty Sensor	Test Sensor to verify it is operating properly. Replace if necessary.
	Transmitter electronics failure	Replace faulty electronic assembly.
Low output or no output	Power Supply	Check output of power supply and voltage at the transmitter.
	Process Piping	Check for blockage in piping.
		Check that blocking valves are fully open and that bypass valves are tightly closed.
		Check for entrapped gas in piping.
		Check for sediment packed around sensor.
	Faulty transmitter and/or sensor wiring	Verify transmitter and sensor connections/cabling are correct and free of corrosion, moisture, shorts, and/or opens.
	Faulty Sensor	Test Sensor to verify it is operating properly. Replace if necessary.
	Transmitter electronics failure	Replace faulty electronic assembly.

Warning

All error conditions that cause a safe mode condition to be enabled are considered catastrophic. When such an error has been reported, the transmitter should be replaced with a known-good transmitter. The non-functional transmitter should be returned to the factory for repair. Contact the factory for processing instructions.

6 HART UPGRADE AND REPLACEMENT PROCEDURES

6.1 Introduction

Due to the modular design of the TB82 Series transmitter, it maybe easily upgraded to support HART communications. This section contains the necessary procedures to convert a non-HART version of the TB82 Series transmitter to a HART version. Use Figure 6-2 as a reference during removal and installation procedures.

Note: Refer to Section 3, Installation, for special handling procedures when removing of electronic assemblies.

Warning

Substitution of any components other than those assemblies listed in this section will compromise the certification listed on the transmitter nameplate. Invalidating the certifications can lead to unsafe conditions that can injure personnel and damage equipment.

Warning

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

6.2 HART Upgrade / Activation

The TB82 series transmitter may be upgraded to communicate via HART with a unique activation code (for microprocessor boards Revision F or higher). Follow the procedure in Section 6.3, Microprocessor Board Replacement, if the board needs to be replaced. For upgrade pricing and activation codes, please contact the local ABB office with the complete TB82 model and Serial numbers. Allow for one to two business day to process activation requests.

1. To verify the Microprocessor Board Revision, turn off power to the transmitter. Allow at least 1 minute for the transmitter to discharge.
2. Remove the Front Bezel Assembly by unscrewing the four captive screws and lightly pulling the bezel from the shell.
3. Verify the Microprocessor Board (Part Number 4TB5201-0182) is Revision F or higher, refer to Figure 3-4. If the Microprocessor Board needs to be replaced, skip to Section 6.3
4. Clean gasket and sealing lip surface with isopropyl alcohol or equivalent, and lubricate with silicone grease or equivalent. Replace gasket if damaged or the sealing lip impression is severe.
5. Insert the assembled Bezel Assembly into the shell ensuring the Power Supply and Input PCB Assemblies correctly mate into the outer card guides inside the Shell Assembly.
6. Secure the Bezel Assembly to the Shell Assembly by tightening the four captive screws. Ensure both assemblies are correctly mated and the gasket is providing a seal.
7. Apply power to the TB82 transmitter.

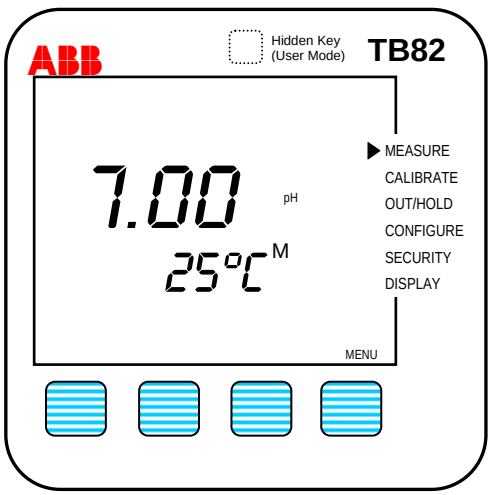

Figure 6-1 TB82 Hidden Key

8. Locate and press the hidden key to enter the User Mode
9. The secondary display should show *USER*. Press the Select key
10. Select *MODE* and press the Next key to change from *BASIC* to *ADVNCD*. Press the Enter key
11. Press the Next key until the secondary display shows *HART*. Press Select
12. Press Select again when the display shows *OPTION*
13. Press ▲ until the secondary display shows *ON*. Press the Enter key
14. To turn on HART, have the 9-digit HART activation code available. If not, please contact the ABB Factory.
15. The 9-digit activation code is entered into TB82 in 3-digit segments. Use the ▲ key to change the digit and ▶ key to advance to the next digit. Press the Enter key to proceed to the second and third 3-digit segments.
16. If successful, the secondary display will show *ACCEPT*. If the incorrect code was entered, the display will show *REJECT*. Repeat Step 15 or contact ABB for assistance. Have the complete model and serial numbers available.
17. Press Exit to Measure to return to normal operation

6.3 Microprocessor Board Replacement

1. Turn off power to the transmitter. Allow at least 1 minute for the transmitter to discharge.
2. Remove the Front Bezel Assembly by unscrewing the four captive screws and lightly pulling the bezel from the shell.
3. Remove the four 6-32 machine screws and washers that retain the Power Supply and Input Cards.
4. Disconnect the keypad ribbon cable by gently pinching together the two tabs and pulling upward.
5. Remove the four screws holding the Microprocessor Board to the Bezel Assembly and remove the board.
6. Install the new Microprocessor Board
7. Install the screws that secure the Microprocessor Board to the bezel
8. Attached the keypad ribbon cable to the Microprocessor Board
9. Install the Power Supply and Input Cards.
10. To complete installation refer to Section 6.2, Step 4 to complete the HART Upgrade

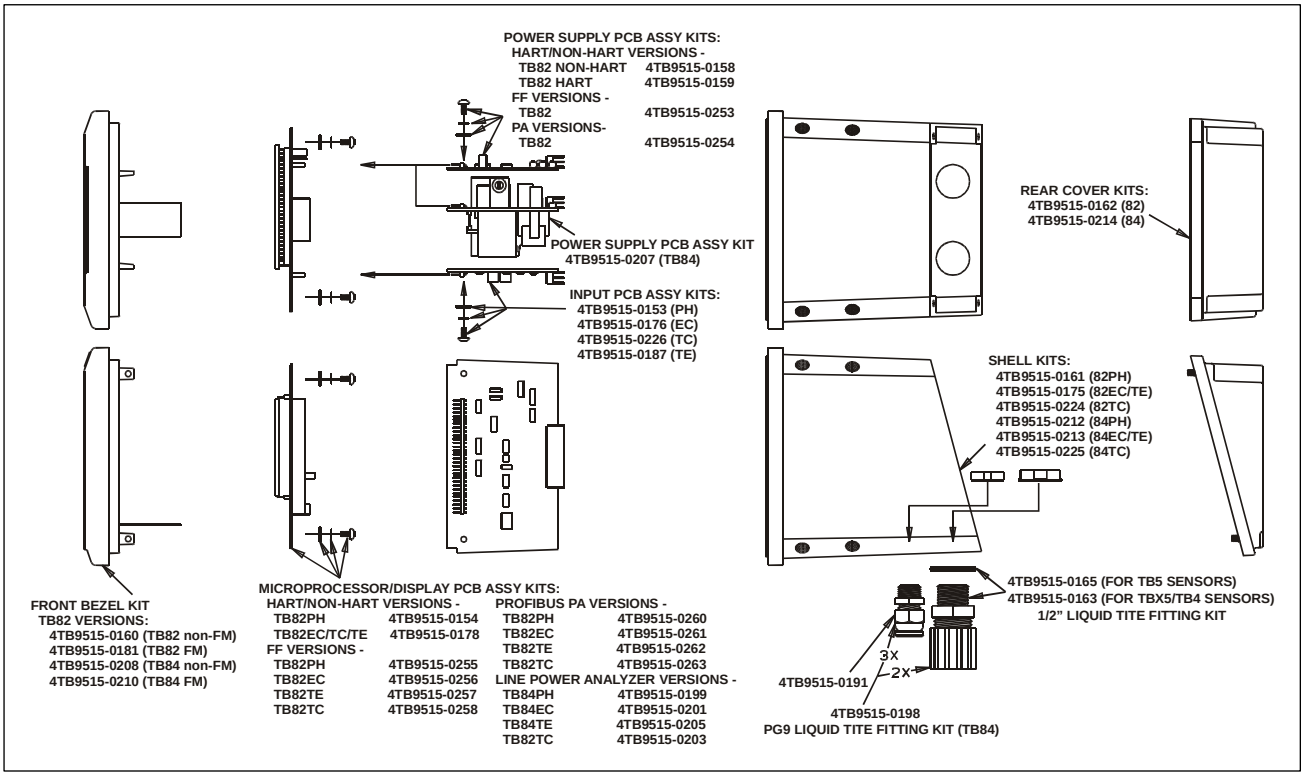

Figure 6-2 TB82 series parts list

7 SUPPORT SERVICES

7.1 Introduction

ABB is ready to help in the use and repair of its products. 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 TB82 Series transmitter can be obtained by contacting:

ABB Inc.
9716 S. Virginia Street, Suite E
Reno, Nevada 89511
USA
Phone: +1 775 850 4800
Facsimile: +1 775 850 4808
Web Site: www.abb.com/instrumentation

7.2 Return Materials Procedures

If any equipment should need to be returned for repair or evaluation, please contact ABB at +1 (775) 850 4800, or your local ABB representative for a Return Authorization Number (RAN). At the time the RAN is given, repair costs will be provided, and a customer purchase order will be requested. The RA 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 non-acceptance of the shipment.

7.3 Replacement Parts

When making repairs or ordering spare part kits from an ABB sales office, provide the following 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 parts from ABB, use the part numbers and descriptions from RECOMMENDED SPARE PARTS KITS sections.

APPENDIX A HART COMMANDS

A.1 General

This appendix contains descriptions of the various HART commands available through the HART universal, common practice, and device specific command sets and is intended as are reference to complement the communication device instruction manual. It does not provide step-by-step procedures for the communication device. Refer to the appropriate communication device product instruction for detailed procedures.

Tables A-1 to A-6 lists all the commands available from each command set supported by the TB82 HART Series transmitters. This table includes the command number and description.

Device Specific command details such as data bytes and response codes are described in the HART Device Description (DD) registered with the HART Communication Foundation.

A.2 Supported HART Commands

Table A-1 Universal HART Commands

Command Number	Description
0	Read Unique Identifier
1	Read Primary Variable
2	Read Loop Current and Percent of Range
3	Read Dynamic Variables And Loop Current
6	Write Polling Address
11	Read Unique Identifier Associated With Tag
12	Read Message
13	Read Tag, Descriptor, Date
14	Read Primary Variable Transducer Information
15	Read Device Information
16	Read Final Assembly Number
17	Write Message
18	Write Tag, Descriptor, Date
19	Write Final Assembly Number

Table A-2 Common Practice HART Commands

Command Number	Description	TB82PH pH, ORP, pION	TB82PH IonConc	TB82EC	TB82TE	TB82TC
33	Read Device Variables	Yes	Yes	Yes	Yes	Yes
34	Write Primary Variable Damping Value	Yes	Yes	Yes	Yes	Yes
35	Write Primary Variable Range Value	Yes	Access restricted	Yes	Yes	Yes
36	Set Primary Variable Upper Range Value	Yes	Access restricted	Yes	Yes	Yes
37	Set Primary Variable Lower Range Value	Yes	Access restricted	Yes	Yes	Yes
38	Reset Configuration Changed Flag	Yes	Yes	Yes	Yes	Yes
40	EEPROM Control	No	No	No	No	No
42	Enter/Exit Fixed Current Mode	Yes	Yes	Yes	Yes	Yes
43	Perform Self Test	Yes	Yes	Yes	Yes	No
44	Perform Device Reset	Yes	Yes	Yes	Yes	Yes
45	Trim Loop Current Zero	Yes	Yes	Yes	Yes	Yes
46	Trim Loop Current Gain	Yes	Yes	Yes	Yes	Yes
47	Write Primary Variable Transfer Function	Yes	Access restricted	No	No	No
48	Read additional transmitter status	Yes	Yes	Yes	Yes	Yes
49	Write Primary Transducer Serial Number	Yes	Yes	Yes	Yes	Yes
59	Write number of response preambles	Yes	Yes	Yes	Yes	Yes

Table A-3 TB82PH Device Specific Commands

Command Number	Description
130	Read PV Sensor Configuration
131	Write Primary Variable Type
132	Write pH Sensor Type
133	Write Reference Impedance Limit
134	Write pH Iso-potential and Asymmetric Points
135	Write Sensor Diagnostic option
136	Read IONCON Configuration
137	Write IONCON Configuration
140	Read Temperature Sensor and Compensation Configuration
141	Write Temperature Sensor Type
142	Write Temperature Compensation Type
143	Write Manual Temperature Setpoint
144	Write Solution Coefficient Value
150	Read Primary Variable Transfer Function Curve Part 1
151	Read Primary Variable Transfer Function Curve Part 2
152	Write Primary Variable Transfer Function Curve Part 1 (access restricted in ion concentration mode)
153	Write Primary Variable Transfer Function Curve Part 2 (access restricted in ion concentration mode)
160	Read LCD Secondary and Security Settings
161	Write LCD Secondary Option
162	Write Security Lock Option
163	Write Security Password
170	Read PV, Temperature Calibration Slope and Offset
171	Write PV Calibration Slope and Offset
172	Write Temperature Calibration Slope and Offset
173	Reset PV Calibration Command
174	Reset Temperature Calibration Command
175	Read Calibration Status
176	Temperature Calibration Command
177	One-Point PV Value Capture Command
178	One-Point PV Calibration Command
179	Two-Point PV Calibration Start/Exit Command
180	Read Two-Point PV Calibration Low and High Points Command
181	Two-Point PV Calibration Low Value Command
182	Two-Point PV Calibration High Value Command
183	Two-Point PV Calibration Temperature Value Command
185	Write Secondary Variable Engineering units

Table A-4 TB82EC Device Specific Commands

Command Number	Description
130	Read PV Sensor Configuration
131	Write Primary Variable Type
132	Write Sensor Group
133	Write Sensor Diagnostic Option
135	Read Concentration Configuration
136	Write Concentration Solution
137	Write Concentration Display Text
138	Write Concentration Units
139	Write Concentration Range
140	Read Temperature Sensor and Compensation Configuration
141	Write Temperature Sensor Type
142	Write Temperature Compensation Type
143	Write Manual Temperature Setpoint
144	Write Automatic Temperature Compensation Option
145	Write Pure H2O Option
146	Write Temperature Compensation Coefficient
147	Write Variable Reference Temperature
150	Read Temperature Compensation Curve Part 1
151	Read Temperature Compensation Curve Part 2
152	Write Temperature Compensation Curve Part 1
153	Write Temperature Compensation Curve Part 2
155	Read Concentration Curve Part 1
156	Read Concentration Curve Part 2
157	Write Concentration Curve Part 1
158	Write Concentration Curve Part 2
160	Read LCD Secondary and Security Settings
161	Write LCD Secondary Option
162	Write Security Lock Option
163	Write Security Password
170	Read PV, Temperature Calibration Slope and Offset
171	Write PV Calibration Slope and Offset
172	Write Temperature Calibration Slope and Offset
173	Reset PV Calibration Command
174	Reset Temperature Calibration Command
175	Read Calibration Status
176	Temperature Calibration Command
177	PV Value Capture Command
178	PV Calibration Command
185	Write Secondary Variable Engineering Units
186	Write Tertiary Variable Engineering Units
187	Write Quaternary Variable Engineering Units

Table A-5 TB82TC Device Specific Commands

Command Number	Description
130	Read PV Sensor Configuration
131	Write Primary Variable Type
135	Read Concentration Configuration
136	Write Concentration Solution
137	Write Concentration Display Text
138	Write Concentration Units
139	Write Concentration Range
140	Read Temperature Sensor and Compensation Configuration
141	Write Temperature Sensor Type
142	Write Temperature Compensation Type
143	Write Manual Temperature Setpoint
144	Write Automatic Temperature Compensation Option
146	Write Temperature Compensation Coefficient
147	Write Variable Reference Temperature
150	Read Temperature Compensation Curve Part 1
151	Read Temperature Compensation Curve Part 2
152	Write Temperature Compensation Curve Part 1
153	Write Temperature Compensation Curve Part 2
155	Read Concentration Curve Part 1
156	Read Concentration Curve Part 2
157	Write Concentration Curve Part 1
158	Write Concentration Curve Part 2
160	Read LCD Secondary and Security Settings
161	Write LCD Secondary Option
162	Write Security Lock Option
163	Write Security Password
170	Read PV, Temperature Calibration Slope and Offset
171	Write PV Calibration Slope and Offset
172	Write Temperature Calibration Slope and Offset
173	Reset PV Calibration Command
174	Reset Temperature Calibration Command
175	Read Calibration Status
176	Temperature Calibration Command
177	Read Zero and Span calibration Points
178	Zero Point PV calibration command
179	Span Point PV calibration command
180	Read calculated PV Slope and Offset during calibration
181	PV Calibration Accept, Reject Option Command
182	PV Calibration Exit Command
185	Write Secondary Variable Engineering Units
186	Write Tertiary Variable Engineering Units
187	Write Quaternary Variable Engineering Units

Table A-6 TB82TE Device Specific Commands

Command Number	Description
130	Read PV Sensor Configuration
131	Write Primary Variable Type
132	Write Cell Constant
133	Write Sensor Diagnostic Option
135	Read Concentration Configuration
137	Write Concentration Display Text
138	Write Concentration Units
139	Write Concentration Range
140	Read Temperature Sensor and Compensation Configuration
141	Write Temperature Sensor Type
142	Write Temperature Compensation Type
143	Write Manual Temperature Setpoint
144	Write Automatic Temperature Compensation Option
145	Write Pure H20 Option
146	Write Temperature Compensation Coefficient
147	Write Variable Reference Temperature
150	Read Temperature Compensation Curve Part 1
151	Read Temperature Compensation Curve Part 2
152	Write Temperature Compensation Curve Part 1
152	Write Temperature Compensation Curve Part 2
155	Read Concentration Curve Part 1
156	Read Concentration Curve Part 2
157	Write Concentration Curve Part 1
158	Write Concentration Curve Part 2
160	Read LCD Secondary and Security Settings
161	Write LCD Secondary Option
162	Write Security Lock Option
163	Write Security Password
170	Read PV, Temperature Calibration Slope and Offset
171	Write PV Calibration Slope and Offset
172	Write Temperature Calibration Slope and Offset
173	Reset PV Calibration Command
174	Reset Temperature Calibration Command
175	Read Calibration Status
176	Temperature Calibration Command
177	PV Value Capture Command
178	PV Calibration Command
185	Write Secondary Variable Engineering Units
186	Write Tertiary Variable Engineering Units
187	Write Quaternary Variable Engineering Units

A.3 Operator Interface

HART communication devices can be either primary or secondary.

> **Note:** The HART Communication Foundation Specification refers to communication devices as masters and to transmitters as slaves.

A Primary Communication Device is typically a permanently connected panel mount controller or DCS. A Secondary Communication Device is usually a temporarily connected hand-held terminal or computer.

All communication devices that support revision 5.0 or greater of the HART Communication Foundation Specification support the HART Universal Command set. This command set enables the communication device to read the transmitter characteristics:

- Primary variable (PV)
- PV current
- PV percent of range
- PV sensor information
- PV output information

- Unique identifier
- Dynamic (Secondary) variable
- Message
- Tag
- Descriptor
- Date
- Final Assembly number

Additionally, the HART universal command set allows programming of:

- Device tag
- Descriptor
- Date
- Final Assembly number
- Message
- Polling address

For increase access to the transmitter configuration and data, the communication device must also support the HART Common Practice and Device Specific command sets used with the TB82 HART Series transmitters.

APPENDIX B ADDITIONAL STATUS CODES

B.1 Introduction

The additional error status bits provide supplement information on the condition of the transmitter. The display method of these status bits is a function of the communication device. They could be displayed in text format, as a binary status code, or as a hexadecimal status code. Hexadecimal status codes must be converted to their binary equivalents. Refer to Hexadecimal Format and Table B-1 to convert from hexadecimal to binary format.

Table B-2, B-3, B-4 and B-5 lists the status bits, error codes and their associated messages.

B.2 Text Format

These messages are dependent on the particular communication device. If the message displays in text format, it may or may not be an exact match to the text in Tables B-2 to B-5. Although the phrasing may differ, the general meaning of the message is the same. Each error message associated with a particular status bit would have the same probable cause and corrective action. See Transmitter instruction manual for Error and Problem Code definitions and corrective action recommendations.

B.3 Binary Format

If the status code is returned in binary format, refer to Tables B-2 to B-5 to determine the error message for each binary status bit that is set (displayed as a one).

B.4 Hexadecimal Format

If the error code is returned in hexadecimal format:

1. Convert the hexadecimal number to its binary equivalent.

Each byte consists of two sets of four bits. Each set of four bits is represented as one hexadecimal digit. Use Table B-1 to convert each hexadecimal digit to its four-bit binary equivalent.

2. Refer to Table B-2 to B-5 to determine the error message for each binary status bit that is set (displayed as a one).

Table B-1 Hexadecimal to Binary Conversion

Hexadecimal Digit	Binary Value	Decimal Value
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
A	1010	10
B	1011	11
C	1100	12
D	1101	13
E	1110	14
F	1111	15

Command 48
Accessing READ ADDITIONAL TRANSMITTER STATUS yields the additional status information in hexadecimal format. If the hexadecimal status code returned is 2000000000000016, the use of Table B-1 yields:

$2_{16} = 0010_2$

and

$0_{16} = 0000_2$

So the full additional status code in binary format is:

Bit	7654 3210	7654 3210	7654 3210	7654 3210	7654 3210	7654 3210	7654 3210
Byte	0010 0000	0000 0000	0000 0000	0000 0000	0000 0000	0000 0000	0000 0000
	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 14

Bit five of Byte 0 is set for a TB82PH transmitter. Using Table B-2 indicates the transmitter has detected a Low Glass Impedance. Using Table B-2 to B-5, the probable cause and corrective action can be determined from the error code and description.

B.5 TB82PH Extended Status Codes

Table B-2 TB82PH Status Codes

Byte	Bit	Description
0	0	EC1 PV.AD - Process Variable A/D over or under range
	1	EC4 TC.PCB - Incorrect Input board
	2	EC5 DO.PCB - Incorrect input board
	3	EC6 TE.PCB - Incorrect input board
	4	EC7 EC.PCB - Incorrect Input board
	5	PC1 LO.GLS.Z - Low pH measuring electrode impedance
	6	PC2 HI.REF.Z - High reference electrode impedance
	7	Not used
1	0	PC4 GND LP - Ground loops present or shorted sensor cable
	1	PC5 OPEN - Open sensor cable or sensor out of solution
	2	PC6 HI.LOOP - Current loop above upper range
	3	PC7 LO.LOOP - Current loop below lower range value
	4	PC8 HI.PV - PV above transmitter range
	5	PC9 LO.PV - PV below transmitter range
	6	PC10 HI.TEMP - Temperature above transmitter range
	7	PC11 LO.TEMP - Temperature below transmitter range
2	0	PC12 TEMP.AD - Open, missing or shorted Temperature Sensor
	1	Not Used
	2	PC14 +HI.OFF - Large positive sensor offset (>180 mV)
	3	PC15 -HI.OFF - Large negative sensor offset (<-180 mV)
	4	PC16 HI.EFF - High sensor efficiency (>110%)
	5	PC17 LO.EFF - Low sensor efficiency (<60%)
	6	PC2O BAD.SEE - Bad SEEPROM or bad input PCB assembly
	7	PC21 NO.F.CAL - Missing factory calibration or nonfunctional SEEPROM
3	0	PC22 BLNK.EE - Blank microprocessor EEPROM
	1	PC23 SEE.EMI - Unverifiable SEEPROM bus read operation
	2	Not used
	3	Not used
	4	PC30 PV.F.CAL - Out of range or missing factory calibration for PV
	5	PC31 BA.F.CAL - Out of range or missing factory calibration for 3-k ohm Balco temp. sensor
	6	PC32 PT.F.CAL - Out of range or missing factory calibration for PT100 temp. sensor
	7	PC33 RZ.F.CAL - Out of range or missing factory calibration for reference impedance measurement
4	0	PC34 PV.CHKS - Incorrect or missing PV checksum
	1	PC35 BA.CHKS - Incorrect or missing 3-k ohm Balco temp. sensor checksum
	2	PC36 PT.CHKS - Incorrect or missing PT100 temp. sensor checksum
	3	PC37 RZ.CHKS - Incorrect or missing reference impedance measurement checksum
	4	PC40 HI.R.CKT - Reference impedance circuit failure-high range error
	5	PC41 LO.R.CKT - Reference impedance circuit failure-low range error
	6	PC42 RZ.AD - Reference impedance above or below transmitter A/D range
	7	Not used
5	0	PC44 HI.G.CKT - pH measuring electrode impedance circuit failure-high range error
	1	PC45 LO.G.CKT - pH measuring electrode impedance circuit failure-low range error
	2	PC46 GL.AD - pH measuring electrode impedance above or below transmitter A/D range
	3	Not used
	4	PC48 HI.C.CKT - Cable diagnostic circuit failure-high range error
	5	PC49 LO.C.CKT - Cable diagnostic circuit failure-low range error
	6	PC50 CA.AD - Cable diagnostic signal above or below transmitter A/D range
	7	Not used
14	0-2	Not used
	3	In calib. Mode - Device is in PV calibration mode
	4-7	Not used

B.6 TB82EC Extended Status Codes

Table B-3 TB82EC Status Codes

Byte	Bit	Description
0	0	EC1 PV.AD - Process Variable A/D over or under range
	1	Not used
	2	EC3 PH.PCB - pH/ORP/pION input PCB with Conductivity/concentration firmware
	3	EC4 TC.PCB - Toroidal conductivity input PCB with 4-electrode conductivity/concentration firmware
	4	EC6 TE.PCB - 2-electrode conductivity input PCB with 4-electrode conductivity/concentration firmware
	5-7	Not used
1	0	PC3 DRTY.SN - Dirty Sensor detected
	1	PC4 GND LP - Ground loops present or shorted sensor cable
	2	PC6 HI.LOOP - Current loop above upper range
	3	PC7 LO.LOOP - Current loop below lower range value
	4	PC8 HI.PV - PV above transmitter range
	5	PC9 LO.PV - PV below transmitter range
	6	PC10 HI.TEMP - Temperature above transmitter range
	7	PC11 LO.TEMP - Temperature below transmitter range
2	0	PC12 TEMP.AD - Open, missing or shorted Temperature Sensor
	1	Not used
	2	PC2O BAD.SEE - Bad SEEPROM or bad input PCB assembly
	3	PC21 NO.F.CAL - Missing factory cal or nonfunctional SEEPROM
	4	PC22 BLNK.EE - Blank microprocessor EEPROM
	5	Not used
	6	PC30 R0.F.CAL - Out of range or missing factory cal for conductivity circuit range zero
	7	PC31 R1.F.CAL - Out of range or missing factory cal for conductivity circuit range one
3	0	PC32 R2.F.CAL - Out of range or missing factory cal for conductivity circuit range two
	1	PC33 R3.F.CAL - Out of range or missing factory cal for conductivity circuit range three
	2	PC34 R4.F.CAL - Out of range or missing factory cal for conductivity circuit range four
	3	PC35 G0.F.CAL - Out of range or missing factory cal for ground loop circuit range zero
	4	PC36 G1.F.CAL - Out of range or missing factory cal for ground loop circuit range one
	5	PC37 G2.F.CAL - Out of range or missing factory cal for ground loop circuit range two
	6	PC38 G3.F.CAL - Out of range or missing factory cal for ground loop circuit range three
	7	PC39 G4.F.CAL - Out of range or missing factory cal for ground loop circuit range four
4	0-4	Not used
	5	PC45 BA.F.CAL - Out of range or missing factory cal for 3-k ohm Balco temp. compensator
	6	PC46 PT.F.CAL - Out of range or missing factory cal for PT100 temp. compensator
	7	PC47 RT.F.CAL - Out of range or missing factory cal for 4.75-k ohm RTD network temp. compensator
5	0	Not used
	1	PC50 R0.CHKS - Incorrect or missing conductivity circuit range zero checksum
	2	PC51 R1.CHKS - Incorrect or missing conductivity circuit range one checksum
	3	PC52 R2.CHKS - Incorrect or missing conductivity circuit range two checksum
	4	PC53 R3.CHKS - Incorrect or missing conductivity circuit range three checksum
	5	PC54 R4.CHKS - Incorrect or missing conductivity circuit range four checksum
	6	PC55 G0.CHKS - Incorrect or missing ground loop circuit range zero checksum
	7	PC56 G1.CHKS - Incorrect or missing ground loop circuit range one checksum
14	0	PC57 G2.CHKS - Incorrect or missing ground loop circuit range two checksum
	1	PC58 G3.CHKS - Incorrect or missing ground loop circuit range three checksum
	2	PC59 G4.CHKS - Incorrect or missing ground loop circuit range four checksum
	3-7	Not used
15	0	PC65 BA.CHKS - Incorrect or missing 3-k ohm Balco temp. compensator checksum
	1	PC66 PT.CHKS - Incorrect or missing PT100 temp. compensator checksum
	2	PC67 RT.CHKS - Incorrect or missing 4.75-k ohm network temp. compensator checksum
	3	Not used
	4	PC70 G.L.AD - Ground loop signal above or below transmitter A/D range
	5	Not used
	6	PC72 D.S.AD - Dirty sensor signal above or below transmitter A/D range
	7	Not used

B.7 TB82TE Extended Status Codes

Table B-4 TB82TE Status Codes

Byte	Bit	Description
0	0	EC1 PV.AD - Process Variable A/D over or under range
	1	Not used
	2	EC3 PH.PCB - pH/ORP/pION input PCB with Conductivity/concentration firmware
	3	EC4 TC.PCB - Toroidal conductivity input PCB with 2-electrode conductivity/concentration firmware
	4	TB82_UNDEFINED, TB82_UNDEFINED, IGNORE_IN_HANDHELD
	5	EC7 EC.PCB - Electrode conductivity input PCB with 2-electrode conductivity/concentration firmware
	6	PC1 POLAR - Sensor Polarization detected
	7	Not used
1	0	Not used
	1	Not used
	2	PC6 HI.LOOP - Current loop above upper range
	3	PC7 LO.LOOP - Current loop below lower range value
	4	PC8 HI.PV - PV above transmitter range
	5	PC9 LO.PV - PV below transmitter range
	6	PC10 HI.TEMP - Temperature above transmitter range
	7	PC11 LO.TEMP - Temperature below transmitter range
2	0	PC12 TEMP.AD - Open, missing or shorted Temperature Sensor
	1	
	2	PC2O BAD.SEE - Bad SEEPROM or bad input PCB assembly
	3	PC21 NO.F.CAL - Missing factory cal or nonfunctional SEEPROM
	4	PC22 BLNK.EE - Blank microprocessor EEPROM
	5	Not used
	6	PC30 R0.F.CAL - Out of range or missing factory cal for conductivity circuit range zero
	7	PC31 R1.F.CAL - Out of range or missing factory cal for conductivity circuit range one
3	0	PC32 R2.F.CAL - Out of range or missing factory cal for conductivity circuit range two
	1	PC33 R3.F.CAL - Out of range or missing factory cal for conductivity circuit range three
	2	PC34 R4.F.CAL - Out of range or missing factory cal for conductivity circuit range four
	3	PC35 G0.F.CAL - Out of range or missing factory cal for secondary process variable range zero
	4	PC36 G1.F.CAL - Out of range or missing factory cal for secondary process variable range one
	5	PC37 G2.F.CAL - Out of range or missing factory cal for secondary process variable range two
	6	PC38 G3.F.CAL - Out of range or missing factory cal for secondary process variable range three
	7	PC39 G4.F.CAL - Out of range or missing factory cal for secondary process variable range four
4	0-4	Not used
	5	PC45 BA.F.CAL - Out of range or missing factory cal for 3-k ohm Balco temp. compensator
	6	PC46 PT.F.CAL - Out of range or missing factory cal for PT100 temp. compensator
	7	Not used
5	0	PC48 PK.F.CAL - Out of range or missing factory cal for PT1000 temp. compensator
	1	PC50 R0.CHKS - Incorrect or missing conductivity circuit range zero checksum
	2	PC51 R1.CHKS - Incorrect or missing conductivity circuit range one checksum
	3	PC52 R2.CHKS - Incorrect or missing conductivity circuit range two checksum
	4	PC53 R3.CHKS - Incorrect or missing conductivity circuit range three checksum
	5	PC54 R4.CHKS - Incorrect or missing conductivity circuit range four checksum
	6	PC55 G0.CHKS - Incorrect or missing secondary process variable range zero checksum
	7	PC56 G1.CHKS - Incorrect or missing secondary process variable range one checksum
14	0	PC57 G2.CHKS - Incorrect or missing secondary process variable range two checksum
	1	PC58 G3.CHKS - Incorrect or missing secondary process variable range three checksum
	2	PC59 G4.CHKS - Incorrect or missing secondary process variable range four checksum
	3-7	Not used
15	0	PC65 BA.CHKS - Incorrect or missing 3-k ohm Balco temp. compensator checksum
	1	PC66 PT.CHKS - Incorrect or missing PT100 temp. compensator checksum
	2	Not used
	3	PC68 PK.CHKS - Incorrect or missing PT1000 temp. compensator checksum
	4	PC70 G.L.AD - Secondary process variable signal above or below transmitter A/D range
	5-7	Not used

B.8 TB82TC Extended Status Codes

Table B-5 TB82TC Status Codes

Byte	Bit	Description
0	0	EC1 PV.AD - Process Variable A/D over or under range
	1	Not used
	2	EC3 PH.PCB - pH/ORP/pION input PCB with Conductivity/concentration firmware
	3	
	4	EC6 TE.PCB - 2-electrode conductivity input PCB with Toroidal conductivity/concentration firmware
	5	EC7 EC.PCB - Electrode conductivity input PCB with Toroidal conductivity/concentration firmware
	6	Not used
	7	Not used
1	0	Not used
	1	Not used
	2	PC6 HI.LOOP - Current loop above upper range
	3	PC7 LO.LOOP - Current loop below lower range value
	4	PC8 HI.PV - PV above transmitter range
	5	PC9 LO.PV - PV below transmitter range
	6	PC10 HI.TEMP - Temperature above transmitter range
	7	PC11 LO.TEMP - Temperature below transmitter range
2	0	PC12 TEMP.AD - Open, missing or shorted Temperature Sensor
	1	Not used
	2	PC2O BAD.SEE - Bad SEEPROM or bad input PCB assembly
	3	PC21 NO.F.CAL - Missing factory cal or nonfunctional SEEPROM
	4	PC22 BLNK.EE - Blank microprocessor EEPROM
	5	Not used
	6	PC30 R0.F.CAL - Out of range or missing factory cal for conductivity circuit range zero
	7	PC31 R1.F.CAL - Out of range or missing factory cal for conductivity circuit range one
3	0	PC32 R2.F.CAL - Out of range or missing factory cal for conductivity circuit range two
	1	PC33 R3.F.CAL - Out of range or missing factory cal for conductivity circuit range three
	2	PC34 R4.F.CAL - Out of range or missing factory cal for conductivity circuit range four
	3-7	Not used
4	0-4	Not used
	5	PC45 BA.F.CAL - Out of range or missing factory cal for 3-k ohm Balco temp. compensator
	6	PC46 PT.F.CAL - Out of range or missing factory cal for PT100 temp. compensator
	7	Not used
5	0	PC48 PK.F.CAL - Out of range or missing factory cal for PT1000 temp. compensator
	1	PC50 R0.CHKS - Incorrect or missing conductivity circuit range zero checksum
	2	PC51 R1.CHKS - Incorrect or missing conductivity circuit range one checksum
	3	PC52 R2.CHKS - Incorrect or missing conductivity circuit range two checksum
	4	PC53 R3.CHKS - Incorrect or missing conductivity circuit range three checksum
	5	PC54 R4.CHKS - Incorrect or missing conductivity circuit range four checksum
	6	Not used
	7	Not used
14	0-7	Not used
15	0	PC65 BA.CHKS - Incorrect or missing 3-k ohm Balco temp. compensator checksum
	1	PC66 PT.CHKS - Incorrect or missing PT100 temp. compensator checksum
	2	Not used
	3	PC68 PK.CHKS - Incorrect or missing PT1000 temp. compensator checksum
	4-7	Not used
16	0	In calib. mode - Device is in PV calibration mode
	1-7	Not used

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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E-67-82HART-3

Sales (TB82EC, TE and TC)

Sales (TB82pH)

Service

Software

OI/TB82/HART–EN Rev. D 10.2012

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