

Operating Instructions HART® Supplement

TB82 Series Transmitters

Board Rev.E & earlier

TB82PH pH, Redox (ORP)
TB82EC Four-Electrode
TB82TE Two-Electrode
TB82TC Toroidal



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

INSTRUCTION MANUALS

DO NOT INSTALL, MAINTAIN, OR OPERATE THIS EQUIPMENT WITHOUT READING, UNDERSTANDING AND FOLLOWING THE PROPER ABB INSTRUCTIONS AND MANUALS, OTHERWISE INJURY OR DAMAGE MAY RESULT.

RADIO FREQUENCY INTERFERENCE

MOST ELECTRONIC EQUIPMENT IS INFLUENCED BY RADIO FREQUENCY INTERFERENCE (RFI). CAUTION SHOULD BE EXERCISED WITH REGARD TO THE USE OF PORTABLE COMMUNICATIONS EQUIPMENT IN THE AREA AROUND SUCH EQUIPMENT. PRUDENT PRACTICE DICTATES THAT SIGNS SHOULD BE POSTED IN THE VICINITY OF THE EQUIPMENT CAUTIONING AGAINST THE USE OF PORTABLE COMMUNICATIONS EQUIPMENT.

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.

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Safety Summary

**GENERAL
WARNINGS****Equipment Environment**

All components, whether in transportation, operation or storage, must be in a noncorrosive environment.

Electrical Shock Hazard During Maintenance

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. Installations in hazardous locations other than those listed on the nameplate can lead to unsafe conditions that can injure personnel and damage equipment.

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.

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.

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.

**SPECIFIC
CAUTIONS**

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

SECTION 1 - INTRODUCTION

OVERVIEW

The TB82 HART Advantage Series transmitter 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 multidrop). Using HART communications, many functions normally requiring the use of the local user-interface can be accessed remotely using secondary HART communication devices.

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 HART Advantage Series 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.

EQUIPMENT DESCRIPTION

The TB82 HART Advantage Series 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 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.

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. |
| Multidrop Compatibility | Multiple transmitters can be wired to a single pair of wires from the main control system. |

EQUIPMENT APPLICATION

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

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 secondary 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.

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 secondary 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 secondary HART communication device.
Multidrop	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

REFERENCE DOCUMENTS

Table 1-2. Reference Documents

Number	Document
WBPEEUI520002	Type TB82PH Product Instruction Manual
WBPEEUI520003	Type TB82EC Product Instruction Manual
E67-82-3	Type TB82TE Product Instruction Manual
E67-82-4	Type TB82TC Product Instruction Manual
P-E21-001	Installing a four to 20 mA Transmitter in a Hazardous Location

NOMENCLATURE

Position	5	6	7	8	9	10	11	12	13	
Type	TB82	G	G	G	G	G	G	G	G	Advantage Series Transmitter
										Input
	P	H								pH/ORP/pION
	E	C								Four-Electrode Conductivity
	T	C								Toroidal Conductivity
	T	E								Two-Electrode Conductivity
										Programming
			1							Basic
			2							Advanced
										Digital Communications
				0						None
				1						HART™
										Lightning Arrestor
					0					None
					1					Included
										Housing Type
						0				Powder Coated, Anodized
										Aluminum
										Mounting Hardware
							0			None
							1			Pipe
							2			Hinge
							3			Panel
							4			Wall
										Agency Approval
								0		None
								1		FM
								2		CSA
								3		CENELEC
								4		SAA
										Label
									0	None
									1	Stainless Steel
									2	Mylar

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

SPECIFICATIONS

Table 1-3. Specifications

Property	Characteristic/Value
Supply voltage ^{1,2}	13.5 to 53 Vdc (13.5 to 42 Vdc for agency certified transmitters). Add 0.5 Vdc for Lightning Suppressor Power Supply Version. Installation Category II.
Output signal Analog Digital	4 to 20 mA HART Communications - HCF Revision 5.0 or greater.
Loop load limits	Refer to Figure 1-1

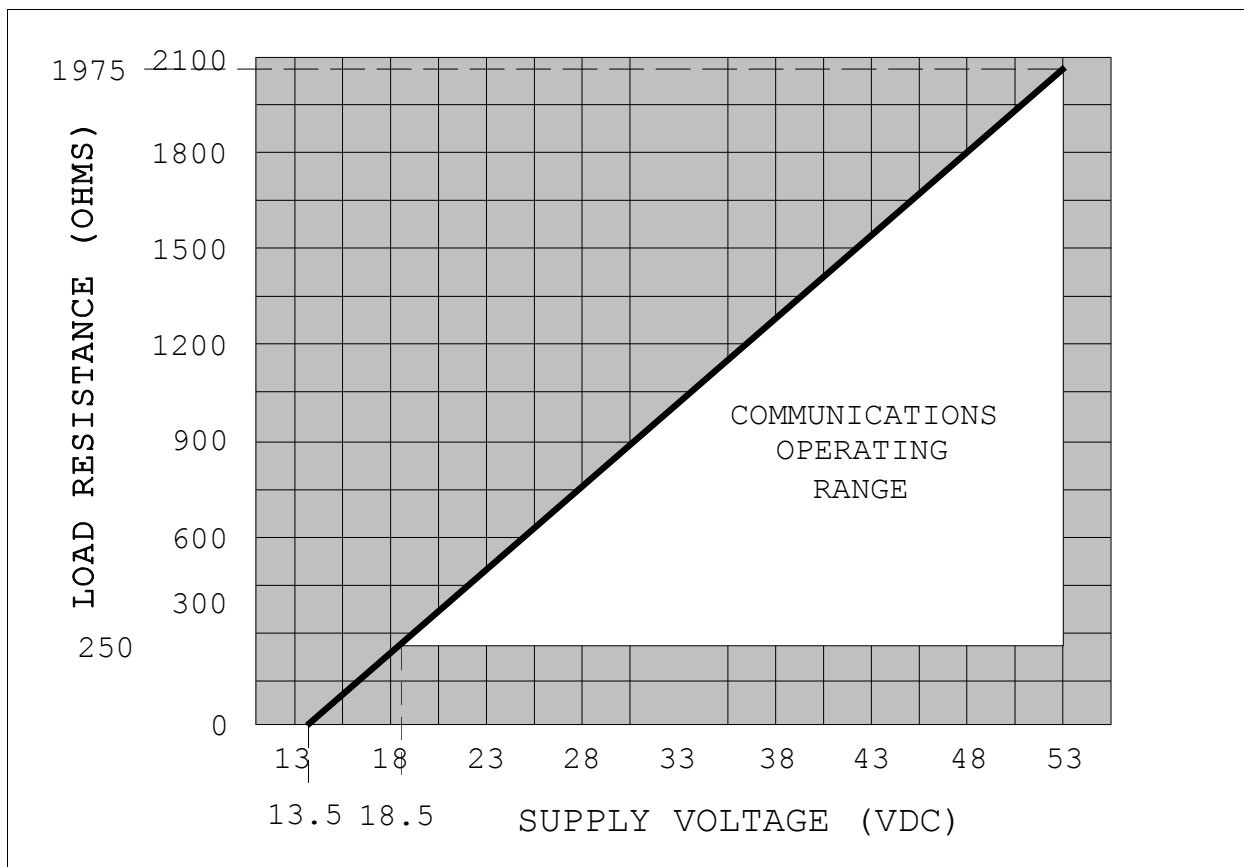


Figure 1-1. Supply Voltage Requirements

Note: Add 0.5 Vdc to all minimum supply voltage values if using the lightning arrester option. Also, use of the Test connections will increase the voltage requirements to the transmitter by 1 Vdc.

HART COMMAND SETS

The TB82 HART Advantage Series transmitter conforms to the HART Communication Specification and supports the HART commands listed in Appendix A, HART Commands.

SECTION 2 - TRANSMITTER FUNCTIONALITY AND OPERATOR INTERFACE CONTROLS

INTRODUCTION

This section contains an overview of the TB82 HART Advantage Series transmitter.

FUNCTIONAL OPERATION

The TB82 HART Advantage Series supports digital HART communications. 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 four 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 multidrop 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 secondary HART communication device can link into the transmitter's signal wiring.

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 multidrop 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 multidrop 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.

SECTION 3 - INSTALLATION

INTRODUCTION

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

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.

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 avoid of corrosive materials or gases thus allowing for routine maintenance.

HAZARDOUS LOCATIONS

WARNING

<p>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.</p>

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

Refer to the *Installing a 4 to 20 mA Transmitter in a Hazardous Location* application guide for additional information when using equipment in a hazardous area.

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.

WIRING CONNECTIONS AND CABLING

CAUTION

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

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.

Analog Mode Signal/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.

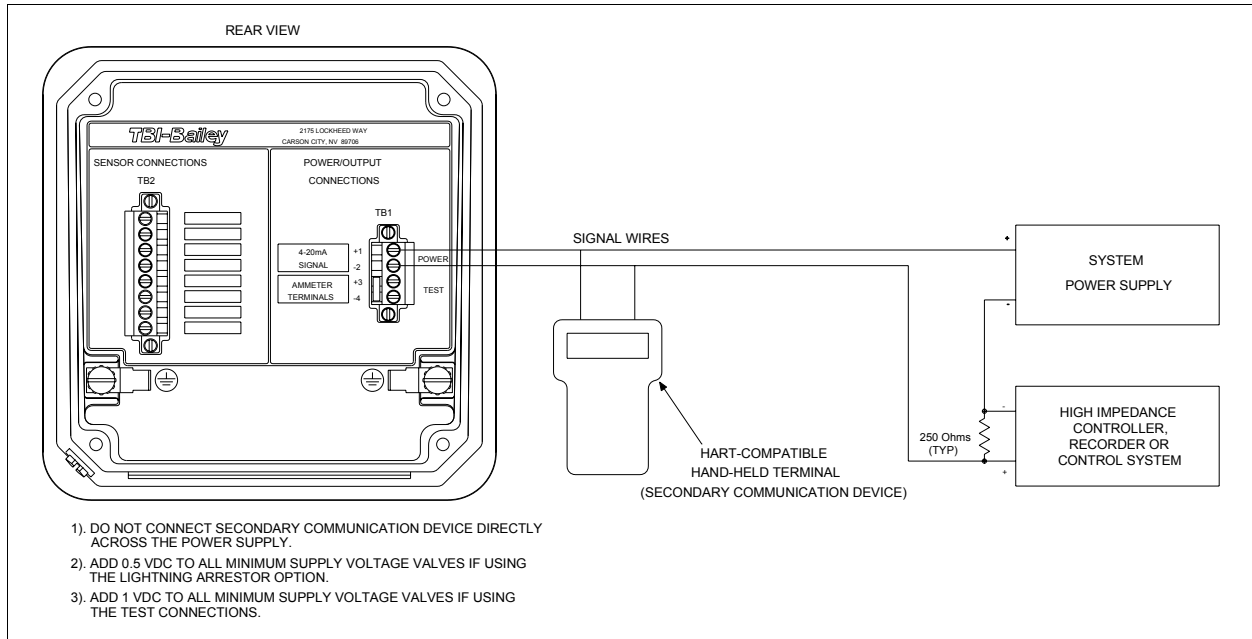


Figure 3-1. Analog Mode Wiring Diagram

The signal wiring supplies all power to the transmitter. The power supply limits are 13.5 Vdc to 53 Vdc (13.5 to 42 Vdc for agency certified installation). The minimum supply voltage (Figure 1-1) is determined by the loop resistance (R) as follows:

$$\text{MinimumSupply} = 13.5 \text{ Volts} + 0.020 \text{ Amps} \times R (\text{ohms}) .$$

Load resistance must include any meters external to the TB82 HART Advantage Series, 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 overrange 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 14.5 Vdc instead of 13.5 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 temporary meter.

3) If using the optional lightning arrestor, add 0.5 Vdc to the minimum lift-off voltage.

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.

Multidrop Mode Signal/Power Wiring

Refer to Figure 3-2 for a typical wiring configuration for multidrop installations. In the multidrop 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.

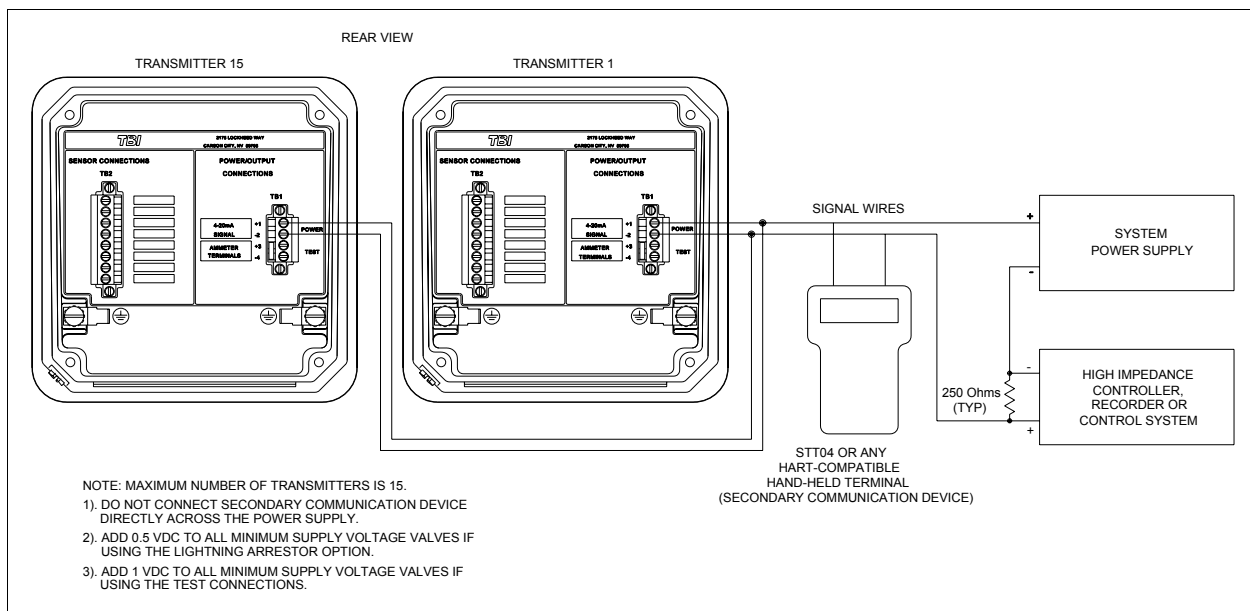


Figure 3-2. Digital Mode Wiring Diagram

In the multidrop 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:

$$\text{MinimumSupply}' 13.5\%(0.004\text{Amps}\times\text{Rohms}\times T) .$$

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 uses multidrop minimum currents greater than 4 mA. Consult the vendor product instruction for multidrop 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 14.5 Vdc instead of 13.5 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 temporary meter.

3) If using the optional lightning arrestor, add 0.5 Vdc to the minimum lift-off voltage.

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.

Sensor Wiring

See the applicable Product Instruction Manual for sensor wiring instructions.

GROUNDING

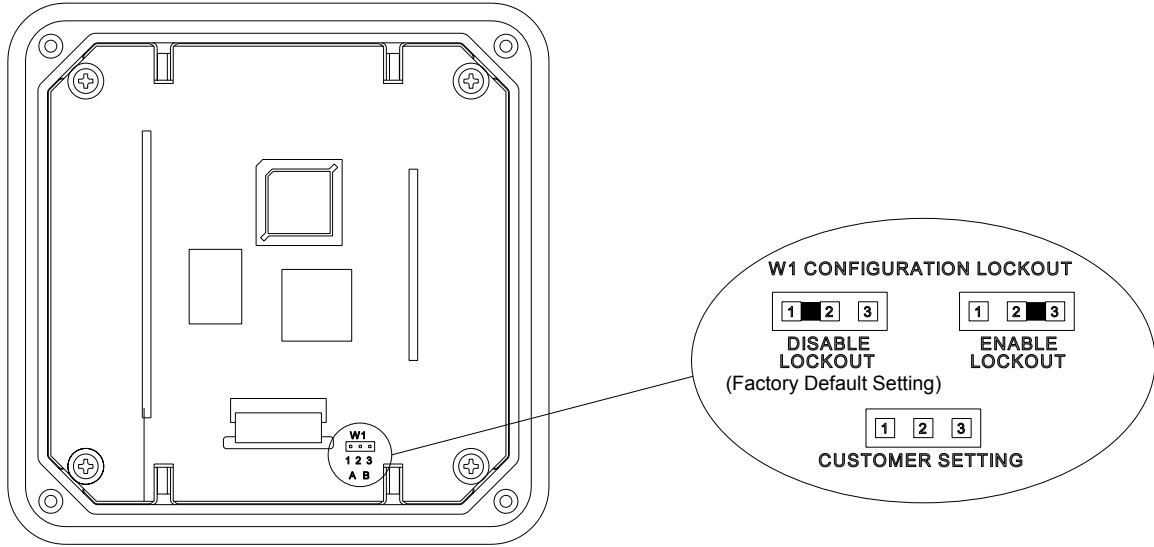
Signal wiring should be grounded at any one point in the signal loop or may be ungrounded (floating) if electrical noise is minimal. The transmitter enclosure must be grounded to an earth ground having less than 0.2 ohms of resistance. Internal and external earth ground terminals are provided and shown in Figure 3-6. The transmitter should only have one ground connection.

CONFIGURATION LOCKOUT JUMPER

The TB82 HART Advantage Series transmitter has a lockout feature that, once engaged, limits access to certain transmitter functions. When the lockout feature is enabled, local access using the integral keypad to the Configure Mode is prohibited. All other modes of operations can still be accessed using the local interface.

When using a secondary HART communication device, an enabled lockout prevents access to Universal and Common Practice Commands and will generate a Write Protect error. Since many of these functions are not part of the Configure Mode, they will be available to an operator at the local user-interface. All Device Specific Commands are unaffected by the lockout feature. See Appendix C, HART Commands, for a listed of supported commands. See Figure 3-3 for LockOut Jumper location.

FRONT BEZEL ASSEMBLY W/
MICROPROCESSOR/DISPLAY PCB ASSEMBLY



REAR VIEW SHOWN

Figure 3-3, Configuration Lockout Jumper Location On Microprocessor/Display PCB Assembly

SECTION 4 - OPERATING PROCEDURES

INTRODUCTION

This section addresses the operating procedures unique to the TB82 HART Advantage 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 Multidrop (i.e., a Polling Address set from one to 15) installations. See Appendix A, HART Commands, for more information on Polling Addresses.

MEASURE MODE OF OPERATION

The Measure Mode is the primary operating environment of the TB82 HART and Non-HART Advantage 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.

CALIBRATE 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 secondary HART communication device such as the STT04. Since these functions are specific to the TB82 HART products, the Device Description Language (DDL) must be installed into secondary HART communication device, such as third party Hand Held Terminals (HHT), before they can support TB82 HART calibration routines.

When using a secondary HART communications device, temperature may be monitored either in degrees Celsius or Fahrenheit. The displayed Engineering Unit on these devices is

controlled by the Temperature Calibration State. In this operating state, the operator must set the desired temperature unit before the temperature can be calibrated. The unit chosen by the operator will then prescribe the Engineering Unit seen when monitoring the temperature using a secondary HART communication device. For example, an 82 HART transmitter that used Fahrenheit as the Engineering Unit during a temperature calibration will report the temperature in degrees Fahrenheit when queried by a secondary HART device.

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

Refer to the appropriate TB82 Product Instruction for calibration procedures when using the integral user-interface or the secondary HART communications device product instruction and Appendix C, Device Description Menu Flow, when using a remote communication device.

OUTPUT/HOLD MODE OF OPERATION

The Output/Hold Mode provides control over the output functions of the TB82 HART Advantage Series transmitter. When the TB82 HART transmitter is set in either HART Analog or Digital modes, the Hold, Rerange 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, secondary HART communication devices can access many of these output functions. For details on supported commands sets, refer to the secondary HART communication device product instruction manual.

Since the Spike signal can interfere with 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.

CONFIGURE MODE OF OPERATION

The TB82 HART Advantage Series transmitter must be configured using the local user-interface. Though a few configuration items such as range, damping, and safe mode values are supported by the Universal and Common Practice command sets, many items are not supported. Since these items are typically adjusted only once, configuration setup should be completed before placing the transmitter into service.

When using an STT04 Smart Transmitter Terminal, the configuration functions allow the operator to select an Analyzer Type (i.e., 82PH pH, 82PH ORP, 82PH pION, 82PH ICON, 82EC COND, 82EC CONC, 82TC COND, 82TC CONC, 82TE COND, and 82TE CONC). Though a selection must be made, the Analyzer Type in the configuration created by the STT04 must match the configured Analyzer Type of the TB82 HART transmitter. The STT04 can not change the Analyzer Type of the transmitter.

The TB82 HART transmitter has a configuration lockout jumper. When the lockout feature is enabled and a secondary HART communication device attempts to use a Universal or Common Practice Command that will perform a write to the TB82 HART transmitter, a Device In Write Protect Mode error will be displayed on the secondary device. All Device Specific Commands are unaffected by an enabled Configuration Lockout. Refer to Section 3, Installation, for Configuration Lockout information.

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.

SECURITY MODE OF OPERATION

The Security Mode provides the ability to password protect certain operating modes. When a mode of operation such as Output/Hold is secured and a secondary 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 secondary device.

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

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. 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).

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 directly above the NT in the ADVANTAGE text on the keypad. In the User State, two mode and four reset functions are available. To activate HART communications capability, enter the HART State of Operation and select ENABLE.

SECTION 5 - TROUBLESHOOTING

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.

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 secondary communication device or release Hold condition using the local user-interface.
No	PV analog output saturated	PV is greater than +111% or less than -3.75% 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 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 configuration lockout or Mode of Operation is secured.	Disable Configuration Lockout by changing jumper setting.
			Remove security from affected Mod of Operation.

OUTPUT TROUBLESHOOTING

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

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.

Fault	Probable Cause	Corrective Action
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.

SECTION 6 - REPLACEMENT PROCEDURES

INTRODUCTION

Due to the modular design of the TB82 Advantage Series transmitter, the transmitter can be easily upgraded to support HART communications. This section contains the necessary procedures to convert a non-HART version of the TB82 Advantage Series transmitter to a HART version. Use Figure 15-1 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 nonhazardous. Disconnecting equipment in a hazardous location with source power on can produce an ignition-capable arc that can injure personnel and damage equipment.
----------------	--

ROM AND POWER SUPPLY PCB REMOVAL/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 with flat and lock washers that retain the Power Supply and Input PCB assemblies.

-
4. Locate the ROM on the Microprocessor PCB assembly, and using the provided pullers, slide puller hooks into the two slots on the ROM socket.
 5. Apply equal pressure on each puller to lift the ROM from its socket.
 6. Properly orient the new ROM in the socket by ensuring the clipped corner on the ROM matches the clipped corner on the socket.
 7. Once properly oriented and laying flat on the socket, press the ROM into the socket.
 8. Install the new HART Power Supply and existing Input PCB assemblies using the four 6-32 machine screws with flat and lock washers.
 9. Clean gasket and sealing lip surfaces with isopropanol or equivalent, and lubricate with Silicone grease or equivalent. Replace gasket if damaged or the sealing lip impression is severe.
 10. 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.
 12. 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.

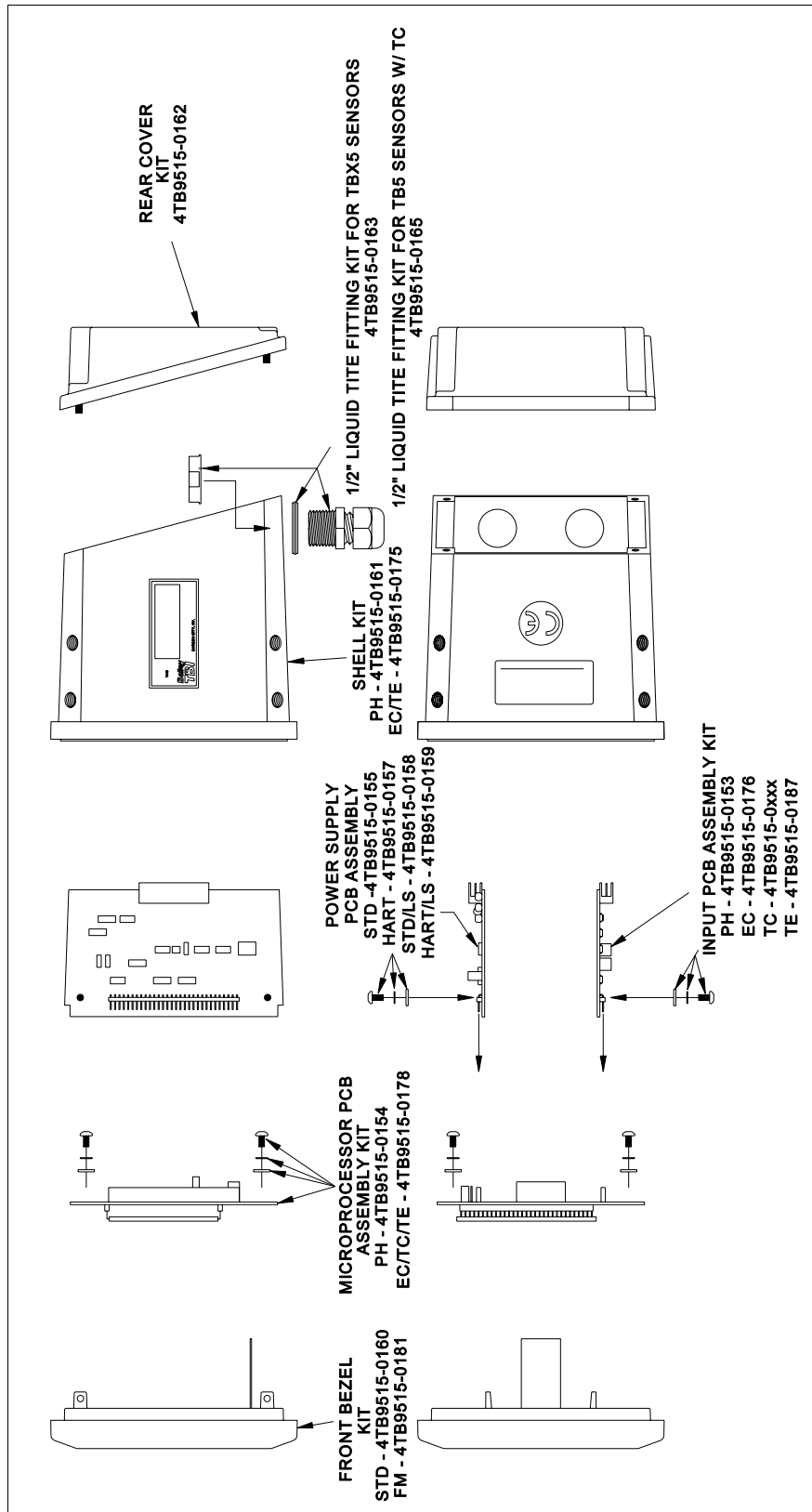


Figure 15-1. TB82 Advantage Series Exploded View Showing Kit Assignments.

SECTION 7 - SUPPORT SERVICES

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 HART Advantage Series transmitter can be obtained by contacting:

ABB Inc.
9716 S. Virginia St., Suite E
Reno, NV 89511
Phone: 1(775)850-4800
Fax: 1(775)850-4808
Web Site: www.abb.com/instrumentation

RETURN MATERIALS PROCEDURES

If any equipment should need to be returned for repair or evaluation, please contact ABB at (775)883-4366, or your local ABB representative for 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 (i.e., packing box).

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

REPLACEMENT PARTS

When making repairs at your facility, order spare parts kits from a 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 you order standard parts from ABB, use the part numbers and descriptions from **RECOMMENDED SPARE PARTS KITS** sections. Order parts without commercial descriptions from the nearest ABB sales office.

RECOMMENDED SPARE PARTS KITS

Table 16-1. Spare Parts Kits

Part Number	Description
4TB9515-0227	TB82PH HART Upgrade Kit w/o Lightning Suppression
4TB9515-0228	TB82PH HART Upgrade Kit w/ Lightning Suppression
4TB9515-0231	TB82EC/TE/TC HART Upgrade Kit w/o Lightning Suppression
4TB9515-0232	TB82EC/TE/TC HART Upgrade Kit w/ Lightning Suppression
4TB9515-0157	HART Power Supply PCB Assembly Kit
4TB9515-0159	HART Power Supply With Lightning Suppressor PCB Assembly Kit

APPENDIX A - HART COMMANDS

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 a 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.

Table A-1 lists all the commands available from each command set supported by the TB82 HART Advantage Series transmitters. This table includes the command number and description. Each command is discussed later in this section on an individual basis.

SUPPORTED HART COMMANDS

Table A-1. HART Commands

Command Set	Command Number	Description
Universal	0	Read unique identifier.
	1	Read PV.
	2	Read PV current and percent of range.
	3	Read dynamic variables and PV current.
	6	Write polling address.
	11	Read unique identifier associated with tag.
	12	Read message.
	13	Read tag, descriptor, and date.
	14	Read PV sensor information.
	15	Read PV output information.
	16	Read final assembly number.
	17	Write message.
	18	Write tag, descriptor, and date.
19	Write final assembly number.	

Command Set	Command Number	Description
Common Practice	34	Write PV damping value.
	35	Write PV range values.
	36	Write Upper Range value.
	37	Write Lower Range value.
	38	Reset configuration changed flag.
	40	Enter/exit fixed PV current mode.
	42	Perform master reset.
	43	Set PV zero.
	44	Write PV units.
	45	Trim PV current DAC zero.
	46	Trim PV current DAC gain.
	48	Read additional transmitter status.
	59	Write number of response preambles.
Device Specific	128	Reset Calibration to factory values.
	129	Read Calibration constants.
	130	Write Calibration constants.
	131	Write PV Calibration Temperature value.
	132	Write Lower Process Calibration Value.
	133	Write Upper Process Calibration Value.
	135	Read One Point Capture.
	136	Write measured PV to entered PV value.
	138	Write measured Temperature to entered Temperature value.
	140	Read current Temperature Compensation mode.
	141	Write Temperature Compensation mode.
	142	Read Manual Temperature Compensation temperature value.
	143	Write Manual Temperature Compensation temperature value.

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:

- C Primary variable (PV).
- C PV current.
- C PV percent of range.
- C PV sensor information.
- C PV output information.
- C Unique identifier.
- C Dynamic (Secondary) variable.
- C Message.
- C Tag.
- C Descriptor.
- C Date.
- C Final Assembly number.

Additionally, the HART universal command set allows programming of:

- C Device tag.
- C Descriptor.
- C Date.
- C Final Assembly number.
- C Message.
- C 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 Advantage Series transmitters.

HART MANUFACTURER ID AND DEVICE TYPES

All HART products contain unique identifiers that specify the product manufacturer and device type. In accordance with this requirement, the TB82 HART Manufacturer ID is 18 (i.e., ABB Instrumentation) and the Device Types are listed in Table A-2.

Device Description	Device Type Code
TB82PH pH Analyzer	80
TB82PH ORP Analyzer	81
TB82PH pION Analyzer	82
TB82PH ICONC Analyzer	83
TB82EC COND Analyzer	84
TB82EC CONC Analyzer	85
TB82TE COND Analyzer	86
TB82TE CONC Analyzer	87
TB82TC COND Analyzer	88
TB82TC CONC Analyzer	89

HART COMMAND SETS

The remainder of this appendix describes the individual commands from the HART command sets supported by the TB82 HART Advantage Series transmitters.

Universal Command Set

This section describes commands available for use with the TB82 HART transmitter through the HART Universal Command set.

READ UNIQUE IDENTIFIER

Command 0 Use READ UNIQUE IDENTIFIER to view:

- C Expanded device type code.
- C Manufacturer identification code.
- C Manufacturer device type code.
- C Number of preambles required for the requested message from the communication device to the transmitter.
- C HART universal command set specification revision level implemented by the transmitter.
- C Device Specific Command set specification revision level implemented by the transmitter.
- C Transmitter software revision level.
- C Electronics hardware revision level.
- C Flags.
- C Device identification number.

READ PV

Command 1 Monitors the input of the transmitter. The input displays in engineering units and updates at least once per second.

READ PV CURRENT AND PERCENT OF RANGE

Command 2 Monitors the output of the transmitter. The output is returned as a percent and in milliamps.

READ DYNAMIC VARIABLES AND PV CURRENT

Command 3 Displays the PV (in user-defined units), loop current (in milliamperes) and temperature (in degrees Celsius).

WRITE POLLING ADDRESS (SELECT OUTPUT MODE)

Command 6 Controls the PV analog output and identifies transmitter in multidrop installations.

The analog mode is selected by using WRITE POLLING ADDRESS to set the polling address to zero. In this mode, the transmitter provides a four to 20 mA signal.

The multidrop mode is selected by using WRITE POLLING ADDRESS to set the polling address to a whole number value between one and 15. In this mode, the transmitter does not provide a four to 20 mA signal in proportion to the input, as the transmitter PV value is digitally transmitted. The analog output remains locked at four milliamperes.

READ UNIQUE IDENTIFIER ASSOCIATED WITH TAG

Command 11 Views the expanded device type code, revision levels, and device identification number of a transmitter containing the tag sent with this command.

READ MESSAGE

Command 12 Reads the user-defined message entered into the transmitter via WRITE MESSAGE.

READ TAG, DESCRIPTOR, AND DATE

Command 13 Views the user-defined information entered into the transmitter via WRITE TAG, DESCRIPTOR, AND TAG.

READ PV SENSOR INFORMATION

Command 14 Views the sensor serial number, range limits and span engineering units, lower and upper range limits, and the minimum span of the sensor.

READ PV OUTPUT INFORMATION

Command 15 Views the PV alarm selection code, PV transfer function code, PV range values units code, PV lower and upper values, PV damping value, write protect code and private label distributor code associated with the transmitter or PV.

READ FINAL ASSEMBLY NUMBER

Command 16 Allows the user-defined final assembly number entered via WRITE FINAL ASSEMBLY NUMBER to be reviewed.

WRITE MESSAGE

Command 17 Allows an operator to leave a message of up to 32 characters to another operator, store calibration and maintenance schedules, or virtually any other user-defined purpose beneficial to the operation. The transmitter is delivered with this parameter left blank.

WRITE TAG, DESCRIPTOR, AND DATE

Command 18 Allows an operator to assign a user-defined, eight-character alphanumeric tag to the transmitter. The transmitter is delivered with this parameter left blank.

Other functions available with this command are the assignment of a user-defined descriptor and date. The descriptor can have up to 16 characters of descriptive data about the transmitter. The transmitter is delivered with this parameter left blank.

The factory default for the date is the date of manufacture. This can also be adjusted by the operator to a new value (e.g., installation date, configuration date, calibration date, etc.).

WRITE FINAL ASSEMBLY NUMBER

Command 19 Enters a user-defined number as a reference for this transmitter or group of devices. This can be used for inventory or maintenance purposes. The factory default is zero.

Common Practice Command Set

This section describes commands available for use with the TB82 HART transmitter through the HART Common Practice Command set.

WRITE PV DAMPING VALUE

Command 34 Adjusts the damping of the transmitter output. Damping adjustments do not affect the calibration or accuracy of the transmitter. Damping can be used to smooth out a fluctuating process signal by providing a single (1J) time constant values from 0.0 to 99.9 seconds. The default value is 0.5 seconds.

WRITE PV RANGE VALUES

Command 35 Reranges the current (four to 20 mA) output to represent a different portion (turndown) of the input span.

WRITE PV UPPER RANGE VALUE

Command 36 Sets the PV Upper Range value (Span) to the current PV reading. This command does not affect the Lower Range value.

WRITE PV LOWER RANGE VALUE

Command 37 Sets the PV Lower Range value (Zero). This command will also automatically adjust the Upper Range value. The adjustment will be equivalent to the amount of the span plus the new zero value or to the Upper Range value limit depending on which value is the lesser of the two conditions.

RESET CONFIGURATION CHANGED FLAG

Command 38 The configuration changed status flag appears whenever the configuration of the transmitter has been altered. This command resets the configuration changed status flag.

ENTER/EXIT FIXED PV CURRENT MODE

Command 40 For system troubleshooting purposes, the transmitter output can be set to a constant, specified as a percent of the output current. Enter a percent of the output current that is desired to fix the output at that level. Entering a value of zero milliamperes cancels the fixed output.

PERFORM MASTER RESET

Command 42 Sends a message to the microprocessor in the transmitter that causes it to reset and conduct a self-test. The transmitter will not be able to respond to another command until the reset is complete.

SET PV ZERO

Command 43 Sets the PV value to zero. This command trims the PV so that it reads zero for the existing process variable applied to the transmitter. The resulting offset must be within the limits defined of the transmitter. This command does not affect the span of the transmitter, nor does it compensate for slight inaccuracies in the four to 20 mA current loop. To adjust for these inaccuracies, refer to Trim DAC Zero and Gain Commands 45 and 46, respectively.

WRITE PV UNITS

Command 44 Selects the primary engineering units for the PV, PV range, PV sensor limits and PV minimum span.

The primary engineering unit codes selectable via this command are listed in Table A-3 and A-4.

NOTE: When the PV units are sent, the transmitter scales all of the associated range values to the new primary engineering units. Therefore, the desired primary engineering units must be sent (WRITE PV UNITS) before sending new range values.

Table A-3. Primary Engineering Units

Analyzer Type	Code	Units
82PH pH	59	pH
82PH ORP	36	mV
82PH pION	36	mV
82PH ICON	139	ppm
	240	ppb
82EC COND	66	mS/cm
	67	μS/cm
82EC CONC	139	ppm
	240	ppb
	57	%
	251	No Unit (Not Used)
82TC COND	66	mS/cm
82TC CONC	139	ppm
	240	ppb
	57	%
	251	No Unit (Not Used)
82TE COND	66	mS/cm
	67	μS/cm
82TE CONC	139	ppm
	240	ppb
	57	%
	251	No Unit (Not Used)

NOTE: Only 82EC, 82TC and 82TE COND analyzer types have adjustable engineering units. All other analyzer types have fixed engineering units that are defined by the transmitter configuration.

Table A-4. Secondary Engineering Units

Other Units	Code
mA	39
S	37
°C	32
°F	33
Unknown Unit	252

TRIM PV CURRENT DAC ZERO

Command 45 **NOTE:** This command only applies to analog mode transmitters.

This command is used in conjunction with TRIM PV CURRENT DAC GAIN to compensate for slight inaccuracies in the four to 20 mA current loop.

TRIM PV CURRENT DAC GAIN

Command 46 **NOTE:** This command only applies to analog mode transmitters.

This command is used in conjunction with TRIM PV CURRENT DAC ZERO to compensate for slight inaccuracies in the four to 20 mA current loop.

READ ADDITIONAL TRANSMITTER STATUS

Command 48 The status of the transmitter, determined from results of the continuous self-diagnostics, is reported every time communications with the transmitter are established. If the transmitter indicates there is additional status information, it can be obtained via this command.

WRITE NUMBER OF RESPONSE PREAMPLS

Command 59 Defines the number of preambles to be sent by a transmitter before the start of the response. This value includes the five preambles minimum contained in the start of a message signal. The factory default is five preambles. Refer to the communication device instruction to determine the number of preambles required for its proper operation.

Device Specific Command Set

This section describes commands available for use with the TB82 HART transmitter through the Device Specific Command set.

The Device Specific command set allows for the use of feature unique to the transmitter. Table A-5 is a summary of this command set including the response dat bytes, data type, and a description of the function of each command.

In Table A-5, data bytes represented by only the pound sign (#) indicate data sent from the transmitter to the communication device. Data bytes represented by the word input followed by the pound sign (#) indicate data sent from the communication device to the transmitter.

Table A-5. Device Specific Command Set Information

Command Number	Command	Data Type	Data Bytes	Data Name
128	Reset to Factory Calibration	N/A	N/A	N/A
129	Display Calibration PV & Temperature Data	IEEE Floating Point	#0-#3	PV Slope Value
			#4-#7	PV Offset Value
			#8-#11	Temperature Slope Value
			#12-#15	Temperature Offset Value
130	Write Calibration PV & Temperature Data	IEEE Floating Point	Input #0-#3	PV Slope Value
			Input #4-#7	PV Offset Value
			Input #8-#11	Temperature Slope Value
			Input #12-#15	Temperature Offset Value

Command Number	Command	Data Type	Data Bytes	Data Name
131*	Process Temperature Calibration	IEEE Floating Point	#0	Temperature Unit
			#1-#4	Temperature Calibration Value
			Input #0	Temperature Unit
			Input #1-#4	Temperature Calibration Value
132*	Two Point PV Calibration - Low Value	IEEE Floating Point	#0	Low Value Unit
			#1-#4	PV Low Calibration Value
			Input #0	Low Value Unit
			Input #1-#4	PV Low Calibration Value
133*	Two Point PV Calibration - High Value	IEEE Floating Point	#0	High Value Unit
			#1-#4	PV High Calibration Value
			Input #0	High Value Unit
			Input #1-#4	PV High Calibration Value
135	One Point PV Capture	IEEE Floating Point	#0	PV Unit
			#1-4#	Captured PV Value
136	One Point PV Calibration	IEEE Floating Point	#0	PV Unit
			#1-#4	PV Calibration Value
			Input #0	PV Unit
			Input #1-#4	PV Calibration Value
138	Temperature Calibration	IEEE Floating Point	#0	Temperature Unit
			#1-#4	Temperature Calibration Value
			Input #0	Temperature Unit
			Input #1-#4	Temperature Calibration Value
140*	Read Temperature Compensation Mode	Bytes	#0	Temperature Compensation Mode
141*	Write Temperature Compensation Mode	Bytes	Input #0	Temperature Compensation Mode
142*	Read Manual Temperature Compensation	IEEE Floating Point	#0	Temperature Unit
			#1-#4	Manual Temperature Compensation Value
143*	Write Manual Temperature Compensation	IEEE Floating Point	Input #0	Temperature Unit
			Input #1-#4	Manual Temperature Compensation Value

* - Commands are only valid with TB82PH product variations.

RESET TO FACTORY CALIBRATION

Command 128 Resets PV and Temperature calibration data to factory values.

READ PV AND TEMPERATURE CALIBRATION DATA

Command 129 Reads PV and Temperature calibration data from the transmitter.

WRITE PV AND TEMPERATURE CALIBRATION DATA

Command 130 Writes PV and Temperature calibration data to the transmitter.

PROCESS TEMPERATURE CALIBRATION

Command 131 Reads the temperature measured by the transmitter, and writes a new value to the transmitter if changed. This temperature value is used in calculations for Two Point PV Calibrations.

TWO POINT PV CALIBRATION - LOW VALUE

Command 132 Writes the Low PV Calibration value to the transmitter. This value is used in calculation for Two Point PV Calibrations.

TWO POINT PV CALIBRATION - HIGH VALUE

Command 133 Writes the High PV Calibration value to the transmitter. This value is used in calculations for Two Point PV Calibrations.

READ ONE POINT PV CAPTURE

Command 135 Reads the live PV value for use with the one-point calibration routine.

TEMPERATURE CALIBRATION

Command 138 Writes the Temperature value to the transmitter. This value is used in calculations for One Point Temperature Calibrations.

READ TEMPERATURE COMPENSATION MODE

Command 140 Reads the current temperature compensation mode of the transmitter. A zero is for Automatic compensation and a one is for Manual compensation.

WRITE TEMPERATURE COMPENSATION MODE

Command 141 Writes the desired temperature compensation mode to the transmitter. A zero is for Automatic compensation and a one is for Manual compensation.

WRITE TEMPERATURE COMPENSATION MODE

Command 142 Read manual temperature compensation value.

WRITE TEMPERATURE COMPENSATION MODE

Command 143 Writes manual temperature compensation value.

APPENDIX B - ADDITIONAL STATUS CODES

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 and B-3 lists the status bits, their associated messages, probable causes, and recommended corrective actions.

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 Table B-2 or B-3. 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.

BINARY FORMAT

If the status code is returned in binary format, refer to Table B-2 or B-3 to determine the error message for each binary status bit that is set (displayed as a one).

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 or B-3 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 or B-3, the probable cause and corrective action can be determined from the error code and description.

Table B-2. Additional Status Bits for TB82PH Product Variation

Status Group	Bit	Fail Mode	Transmitter Code	Text String
1	0	Yes	EC1	HI.PV.AD
	1	Yes	EC2	LO.PV.AD
	2	Yes	EC7	FC.PCB
	3	Yes	EC4	TC.PCB
	4	Yes	EC5	DO.PCB
	5	No	PC1	LO.GLS.Z
	6	No	PC2	HI.REF.Z
	7	No	PC3	DRTY.SN

Status Group	Bit	Fail Mode	Transmitter Code	Text String
2	0	No	PC4	GND LP
	1	No	PC5	OPEN
	2	No	PC6	HI.LOOP
	3	No	PC7	LO.LOOP
	4	No	PC8	HI.PV
	5	No	PC9	LO.PV
	6	No	PC10	HI.TEMP
	7	No	PC11	LO.TEMP
3	0	No	PC12	HI.T.AD
	1	No	PC13	LO.T.AD
	2	No	PC14	+HI OFF
	3	No	PC15	-HI OFF
	4	No	PC16	HI EFF
	5	No	PC17	LO EFF
	6	No	PC20	BAD.SEE
	7	No	PC21	NO.F.CAL
4	0	No	PC22	BLNK.EE
	1	No	PC23	SEE.EMI
	2	No	PC24	ROM.EMI
	3	No	PC25	ROM.SUM
	4	No	PC30	PV.F.CAL
	5	No	PC31	BA.F.CAL
	6	No	PC32	PT.F.CAL
	7	No	PC33	RZ.F.CAL

Status Group	Bit	Fail Mode	Transmitter Code	Text String
5	0	No	PC34	PV.CHKS
	1	No	PC35	BA.CHKS
	2	No	PC36	PT.CHKS
	3	No	PC37	RZ.CHKS
	4	No	PC40	HI.R.CKT
	5	No	PC41	LO.R.CKT
	6	No	PC42	HI.RZ.AD
	7	No	PC43	LO.RZ.AD
6	0	No	PC44	HI.G.CKT
	1	No	PC45	LO.G.CKT
	2	No	PC46	HI.GL.AD
	3	No	PC47	LO.GL.AD
	4	No	PC48	HI.C.CKT
	5	No	PC49	LO.C.CKT
	6	No	PC50	HI.CA.AD
	7	No	PC51	LO.CA.AD
15	0	No	PC18	CAL.MOD
	1	N/A	N/A	N/A
	2	N/A	N/A	N/A
	3	No	N/A	CAL.MODE
	4	No	N/A	CAL.EFF
	5	No	N/A	CAL.OFF
	6	No	N/A	TMP.EFF
	7	No	N/A	TMP.OFF

Table B-3. Additional Status Bits for TB82EC/TE Product Variation

Status Group	Bit	Fail Mode	Transmitter Code	Text String
1	0	Yes	EC1	HI.PV.AD
	1	Yes	EC2	LO.PV.AD
	2	Yes	EC3	PH.PCB
	3	Yes	EC4	TC.PCB
	4	Yes	EC6	TE.PCB
	5	No	EC7	EC.PCB
	6	No	PC1	POLAR
	7	No	PC2	CABLE
2	0	No	PC3	DRTY.SN
	1	No	PC4	GND.LP
	2	No	PC6	HI.LOOP
	3	No	PC7	LO.LOOP
	4	No	PC8	HI.PV
	5	No	PC9	LO.PV
	6	No	PC10	HI.TEMP
	7	No	PC11	LO.TEMP
3	0	No	PC12	HI.T.AD
	1	No	PC13	LO.T.AD
	2	No	PC20	BAD.SEE
	3	No	PC21	NO.F.CAL
	4	No	PC22	BLNK.EE
	5	No	PC25	ROM.SUM
	6	No	PC30	RO.F.CAL
	7	No	PC31	R1.F.CAL

Status Group	Bit	Fail Mode	Transmitter Code	Text String
4	0	No	PC32	R2.F.CAL
	1	No	PC33	R3.F.CAL
	2	No	PC34	R4.F.CAL
	3	No	PC35	G0.F.CAL
	4	No	PC36	G1.F.CAL
	5	No	PC37	G2.F.CAL
	6	No	PC38	G3.F.CAL
	7	No	PC39	G4.F.CAL
5	0	No	PC40	W0.F.CAL
	1	No	PC41	W1.F.CAL
	2	No	PC42	W2.F.CAL
	3	No	PC43	W3.F.CAL
	4	No	PC44	W4.F.CAL
	5	No	PC45	BA.F.CAL
	6	No	PC46	PT.F.CAL
	7	No	PC47	RT.F.CAL
6	0	No	PC48	PK.F.CAL
	1	No	PC50	R0.CHKS
	2	No	PC51	R1.CHKS
	3	No	PC52	R2.CHKS
	4	No	PC53	R3.CHKS
	5	No	PC54	R4.CHKS
	6	No	PC55	G0.CHKS
	7	No	PC56	G1.CHKS

Status Group	Bit	Fail Mode	Transmitter Code	Text String
15	0	No	PC57	G2.CHKS
	1	No	PC58	G3.CHKS
	2	No	PC59	G4.CHKS
	3	No	PC60	W0.CHKS
	4	No	PC61	W1.CHKS
	5	No	PC62	W2.CHKS
	6	No	PC63	W3.CHKS
	7	No	PC64	W4.CHKS
16	0	No	PC65	BA.CHKS
	1	No	PC66	PT.CHKS
	2	No	PC67	RT.CHKS
	3	No	PC68	PK.CHKS
	4	No	PC70	HI.G.L.AD
	5	No	PC71	LO.G.L.AD
	6	No	PC72	HI.D.S.AD
	7	No	PC73	LO.D.S.AD
17	0	N/A	UNDEFINED	N/A
	1	N/A	UNDEFINED	N/A
	2	No	N/A	PV LO OFFSET
	3	No	N/A	PV LO SLOPE
	4	No	N/A	PV HIGH OFFSET
	5	No	N/A	PV HIGH SLOPE
	6	No	N/A	TEMP OFFSET WARNING
	7	No	N/A	TEMP SLOPE WARNING

APPENDIX C - DEVICE DESCRIPTION MENU FLOW

GENERAL

At the writing of this manual, the Device Description was not available. Contact ABB for more information on its availability.

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