

S T A N D A R D



HART Communication Protocol Specification

HCF_SPEC-13, Revision 7.4

Release Date: 29 June, 2012

Release Date: 29 June, 2012

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Preface

HART Protocol Revision 7.3 includes an update to the *Common Tables Specification* (HCF_SPEC-183). As per HCF standard practice, the *Common Tables Specification* is periodically updated and released to add new Manufacturer ID, Expanded Device Type Codes and other necessary table enumerations.

In addition, HART Protocol Revision 7.3 includes a revision to the *Device Families Command Specification* (HCF_SPEC-160). The *Device Families Command Specification* is the top-level specification for all Device Family specifications. The revision reflects an update to the *Temperature Device Family Specification* (HCF_SPEC-160.4) and the addition of the new *Level Device Family Specification* (HCF_SPEC-160.11).

Introduction

Designed to complement traditional 4-20mA analog signaling, the HART Protocol supports two way digital communications for process measurement and control devices. Applications include remote process variable interrogation, cyclical access to process data, parameter setting and diagnostics. This document defines the specification documents that comprise the HART Communication Protocol. Specification of the HART protocol is based largely on the OSI 7-Layer Communication Model (see Figure 1).

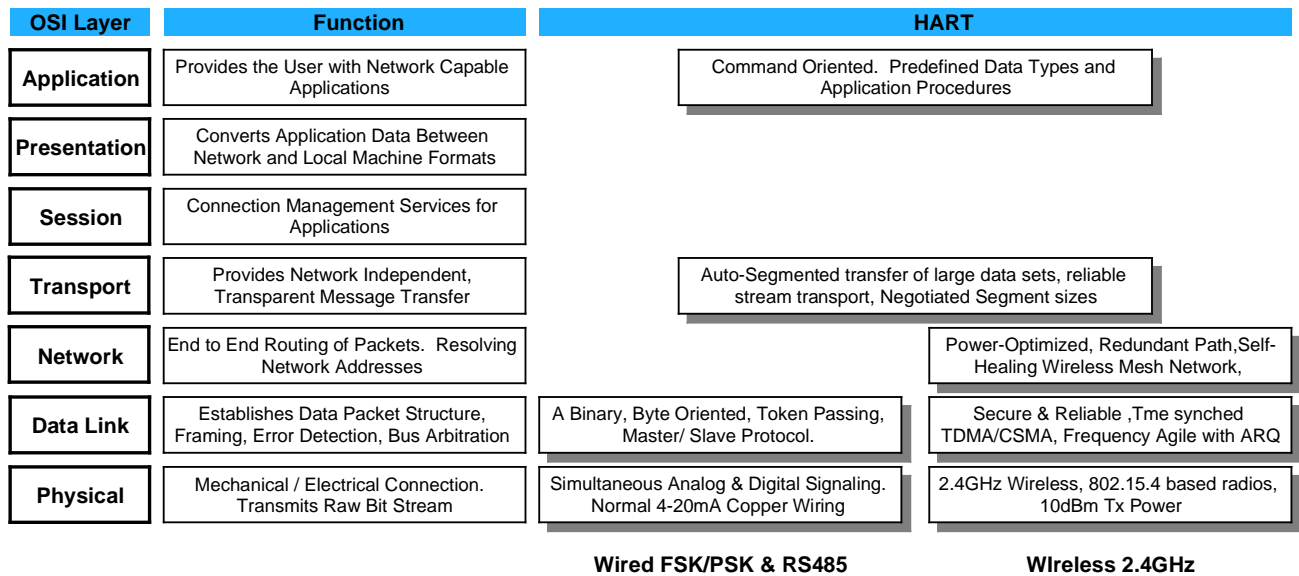


Figure 1. OSI 7-Layer Model

The HART protocol specifications directly address 5 layers in the OSI model: the Application, Transport, Network, Data-Link and Physical Layers.

The HART Application Layer is extensive and plays a major role in ensuring the interoperability of devices from different companies. The Application Layer defines the commands, responses, data types and status reporting supported by the Protocol. The *Command Summary* (HCF_SPEC-099), *Common Tables* (HCF_SPEC-183) and *Command Response Code* (HCF_SPEC-307) *Specifications* establish mandatory Application Layer practices (e.g. data types, common definitions of data items, and procedures). The *Universal Command Specification* (HCF_SPEC-127) specifies the minimum Application Layer content for all HART compatible devices.

The Application Layer also standardizes optional capabilities. The *Common Practice Command Specification* (HCF_SPEC-151) defines many (optional) commands useful to a broad range of devices. The *Device Families Specification* (HCF_SPEC-190) further standardizes commands, status alerts and procedures for various types of devices based on the device's primary function, sensor technology and/or process application.

The popularity of HART Communication has also stimulated industry demands for expanding application of the HART protocol into new domains beyond continuous measurement and control type devices. The *Discrete Applications Specification* (HCF_SPEC-285 - still under development)

responds to industry demands for defining application of the HART Protocol to smart discrete (on-off) type devices.

The synergy between HART Communication and the low power, short message requirements for wireless sensor applications have also led to wireless capabilities being added to the HART Protocol. This exciting new capability known as WirelessHART™ expands the possibilities and opens the door to new opportunities for both end users and suppliers in process automation.

WirelessHART® - the new interoperable wireless communication standard for process measurement and control device applications.

WirelessHART establishes the wireless communication standard for process applications. WirelessHART further extends the application of HART Communications and the benefits it provides to industry by enhancing the HART Technology to support wireless process automation applications while meeting the following goals:

- Preserve and enhance industry's existing investment in HART Technology.
- Leverage proven, established technologies, standards, and practices wireless communication.
- Maximize coexistence by ensuring reliable WirelessHART communications while minimizing interference to other wireless technologies.

WirelessHART is an optional HART Physical Layer that provides a low cost, wireless connection to HART-enabled field devices. The principal objectives of WirelessHART includes:

- Compatibility with existing HART Application Layer
- Leverage existing host applications and the large installed base
- Must be HART-like: simple, reliable, easy-to-use, high-value
- Supply end-users with new capabilities
- Provide more flexibility for installing and operating process instrumentation and controls

WirelessHART is very interoperable and allows compliant devices from different manufactures to be mixed to create an integrated, functioning system.

1. SCOPE

This document identifies the revision level of the HART Communication Protocol; phrases commonly used throughout the Protocol; and the documents that comprise the HART Protocol Specification. Any product claiming compliance with the HART Protocol must meet all specifications defined by this document and the indicated revision level of the specification documents included by reference. Referenced documents define the different elements of the protocol (i.e., Data Link Layer, Physical Layer, and Application Layer).

In addition, this document defines the mechanisms for identifying the HART Communication Protocol Specification, the revision level of the specification and approval of changes to the specification.

1.1 Conformance Requirements

HART protocol revisions include many different specifications all of which are designed to work together as set. Mixing specifications from different Protocol revisions is not allowed. Any product claiming compliance with the HART Protocol must adhere to all specifications in a specific HART Protocol revision. New and revised HART field device implementations should use the latest HART Protocol revision.

Devices claiming HART Protocol compliance must adhere to all HART Protocol specifications including the device type and device revision numbering. Device types and device revision numbers must be assigned as specified in the *Command Summary Specification* and *Token-Passing Data Link Layer Specification*.

Devices claiming HART Protocol compliance must comply with the requirements in the *Token-Passing Data Link Layer Specification* and support at least one of the Physical Layers that it specifies.

Manufacturers' Device-Specific Documents (see Section 2.2) are not formally part of the HART Protocol Specifications. While these documents are developed and controlled by the respective device manufacturer, they must comply with the Device-Specific Command revision criteria found in the *Command Summary Specification*.

1.2 Terms and Conditions

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2. REFERENCES

2.1 The HART Communication Protocol Specification

The HART Communication Protocol Specification is a set of documents that define the HART Communication Protocol. This version of the specification is defined by the documents identified in Table 1.

Table 1. HART Protocol Specification Revision 7.4 Documents

Document Title	Doc. Rev.	Doc. Number
HART Communication Protocol Specification	7.4	HCF_SPEC-13
FSK Physical Layer Specification	8.1	HCF_SPEC-54
C8PSK Physical Layer Specification	1.0	HCF_SPEC-60
2.4GHz DSSS O-QPSK Physical Layer Specification	1.0	HCF_SPEC-065
TDMA Data-Link Layer	1.1	HCF_SPEC-075
Token-Passing Data Link Layer Specification	9.0	HCF_SPEC-81
Network Management Specification	2.0	HCF_SPEC-085
Command Summary Specification	9.0	HCF_SPEC-99
Universal Command Specification	7.1	HCF_SPEC-127
Common Practice Command Specification	10.0	HCF_SPEC-151
Wireless Command Specification	2.0	HCF_SPEC-155
Device Families Command Specification	1.1	HCF_SPEC-160
Common Tables Specification	22.0	HCF_SPEC-183
Block Data Transfer Specification	1.0	HCF_SPEC-190
Discrete Applications Specification	2.0	HCF_SPEC-285
Wireless Devices Specification	1.1	HCF_SPEC-290
Command Response Code Specification	6.0	HCF_SPEC-307

2.2 Related HART Documents

The Protocol Specifications frequently reference the manufacturers' device-specific document. Device-specific documents are developed and controlled by the respective manufacturer and should follow the requirements of the following HART Communication Foundation document:

Requirements for Device-Specific Documentation. HCF_LIT-18

2.3 Related Communication Documents

ANSI X3.4-1983. *Code for Information Interchange (ASCII).*

ISO 7498-1984. *Open Systems Interconnection – Basic Reference Model.*

ISO 646. *Information Processing – ISO 7-bit coded character set for information interchange.*

ISO 8859-1-1987. *Information Processing –8-bit single-byte coded graphic character sets. Part 1 Latin alphabet No. 1.*

IEEE 754. *Standard for Binary Floating-Point Arithmetic.*

3. DEFINITIONS

Definitions of standard terms used throughout the Protocol Specifications are included here as a reference. All specification documents use these terms as defined below. However, individual Specification documents may define terms that are unique to that document as long as they do not conflict with the following definitions:

ACK	Message type 0x06. A Slave acknowledge to the Master's STX. See the <i>Data Link Layer Specification</i> for more information.
Actuator	A field device whose primary purpose is to vary its output thus affecting the connected process. An actuator typically uses the analog 4-20mA Loop Current as a setpoint.
Analog Channel	A continuously variable electrical signal connecting a field device to the remainder of the data acquisition or control system. Some field devices support multiple analog channels (input or output). Each Analog Channel transmits a single Dynamic Variable to or from the field device.
Application Layer	Topmost layer in the Open System Interconnect (OSI) model. In the HART Protocol this layer includes: the definitions of data types; revision rules; application procedures; and the HART Commands.

ASCII	<p>ASCII (American Standard Code for Information Interchange) is a character code defined by ANSI (the American National Standards Institute). It represents the U.S alphabet (upper and lower case), numbers 0 to 9, and many punctuation characters as 7-bit binary codes. A number of codes are allocated for control functions such as start of text, end of text, carriage return, tab, and backspace.</p> <p>Many HART commands use a 6-bit subset of ASCII (see Packed ASCII). In most cases HART uses ASCII interchangeably with ISO Latin-1.</p>
BACK	<p>Message type 0x01. A Slave Burst message. See the <i>Data Link Layer Specification</i> for more information.</p>
Bridge Device	<p>A device that acts as a bridge between the HART network and another network. The other network could be another HART network.</p>
Broadcast Address	<p>A broadcast address is used by a master to send a command to all devices on the loop. However, only a single slave responds to the command. The slave must use other means (e.g. parameters in the data field) to determine if it responds to the command. The Broadcast Address is 38 bits of zeros in place of the Unique Identifier in the long frame address.</p>
Burst Mode	<p>A special mode of a slave device which repeatedly sends the response to a selected HART command without the need for a request from a master.</p>
Burst Mode Device	<p>A slave device that repeatedly issues the reply to a selected command. Once a slave is in this (optional) mode, the reply is sent without any further action by any master. A bursting slave is like a tertiary master because it also initiates channel activity.</p>
Busy	<p>The device is busy and cannot execute this command at this time. A device indicates Busy by returning Response Code 32 when allowed by the command specification. The requested command is not executed if a Busy response is returned.</p>
Data Field	<p>The sixth field in a HART message. The length of the Data field is indicated by the Byte Count field. The Data field contains the Application Layer content and is divided into sub-fields (See the <i>Command Summary Specification</i>).</p>
Data Link Layer	<p>Layer 2 in the OSI model. This layer is responsible for the error-free communication of data. The Data Link Layer defines the message structure, error detection strategy and bus arbitration rules.</p>

Delayed Response	<p>Allows the slave device to release the communication link (pass the token) while continuing to execute a command. If a slave is unable to respond to a command within the Slave Time-Out period, a Delayed Response (DR) sequence should be initiated. The DR begins with the slave notifying the master during Slave Time-Out that it is unable to complete the command but will continue the command's execution. Later, the master reissues exactly the same command request to complete the DR. This is quite different from returning a Busy response. See the <i>Command Summary Specification</i> for more information.</p> <p>The command specification will indicate if a delayed response is allowed for the command.</p>
Delayed Response Mechanism	<p>See Delayed Response. This mechanism allows a slave to defer the completion of a command, thus allowing more processing time than the Data Link Layer grants a slave. See the <i>Command Summary Specification</i> for more information.</p> <p>The command specification will indicate if a delayed response is allowed for the command.</p>
Device	<p>A HART compatible Slave or Master.</p>
Device ID	<p>The integer returned in bytes 9-11 of Identity Commands (see the <i>Command Summary Specification</i>). This number is different for every device manufactured with a given Device Type.</p>
Device Reset	<p>A hard reset of the device. This is equivalent to a cycling the power off and then back on to the device.</p>
Device Revision	<p>The integer returned in byte 5 of Identity Commands (see the <i>Command Summary Specification</i>). This defines the revision level of the command set supported by the field device including the device-specific commands.</p> <p>The <i>Command Summary Specification</i> defines when a new Device Type number must be allocated (as opposed to the Device Revision being incremented).</p>
Device Type	<p>The integer returned in bytes 1-2 of Identity Commands (see the <i>Command Summary Specification</i>). This defines the command set supported by a device.</p> <p>The <i>Command Summary Specification</i> defines when a new Device Type number must be assigned (as opposed to the Device Revision being incremented). Device Type codes are controlled and must be allocated by the HART Communication Foundation.</p>

Device Variable	A uniquely defined data item within a Field Device that is always associated with cyclical process information. A Device Variable's value varies in response to changes and variations in the process. All HART compatible field devices contain Device Variables. However, simple field devices may use only Dynamic Variables and not expose the underlying Device Variables at the Protocol Application Layer interface.
DR_CONFLICT	<p>Delayed Response – Conflict</p> <p>The requested command would cause a conflict with a currently executing delayed response command. See the <i>Command Summary Specification</i> for more information.</p>
DR_DEAD	<p>Delayed Response – Dead.</p> <p>This is only valid for intelligent I/O devices. The host is informed that the slave did not reply to the request. See the <i>Command Summary Specification</i> for more information.</p>
DR_INITIATE	<p>Delayed Response – Initiate.</p> <p>The command could not be serviced in the time given by the Data Link Layer. A Delayed Response was initiated. See the <i>Command Summary Specification</i> for more information.</p>
DR_RUNNING	<p>Delayed Response – Running.</p> <p>The execution of the Delayed Response is not yet finished. The process is still running. See the <i>Command Summary Specification</i> for more information.</p>
Dynamic Variable	The connection between the process and an analog channel. All HART field devices may contain Primary, Secondary, Tertiary, and Quaternary Variables that are mapped to the first 4 analog channels in a field device. These are collectively called the Dynamic Variables. The Primary Variable is always supported and is connected to the first 4-20mA channel, the same channel that always supports HART communication. The SV, TV, and QV may or may not be supported and, furthermore, may not have an associated Analog Channel.
Enumeration	A numerical list where each number corresponds to a specific function or text string. Basically an enumeration is a look-up table (e.g., of engineering unit codes) with each row containing a number and the corresponding function or text string.
Extended Command Number	A 16 bit command number transmitted in the HART Data field. Messages containing an Extended Command Number contain the number 31 in the normal HART Command field.

Field Device	Field Devices are connected to the Process and their Device Variables vary as process conditions change. From a Data Link Layer perspective, HART compatible Field Devices are either a Slave or Burst Mode Device .
Fixed Current Mode	In this mode the field device's Loop Current value is fixed to the value issued by the master. For transmitters, this causes the first analog output to be forced to a fixed value. For actuators, the input loop current value measured by the actuator is set to a fixed value.
Floating Point	Floating point represents a real number consisting of an exponent, and a mantissa. HART requires floating point numbers and calculations to conform to the IEEE 754 standard. The HART Protocol uses this representation for many data items including all Dynamic and Device Variables.
Generic Generic Master	Host A host meeting the requirements of, at least, Host Conformance Class 3 (see the <i>Command Summary Specification</i>)
HART Message	The fundamental content transmitted across a HART Physical Layer. The HART Message consists of the following fields: Delimiter, Address, Expansion, Command, Byte Count, Data, and Check Byte. The Expansion and Data fields are not found in all HART Messages. The <i>Data Link Layer Specification</i> explains the construction and framing of HART Messages.
Host	One of (possibly) several applications that can be executed sequentially or simultaneously on a Master .
IEEE 754	A standard established by the Institute of Electrical and Electronic Engineers governing floating point number formats and calculations. See Floating Point .
ISO Latin-1	<p>A character code set defined by the International Standards Organization. It represents the U.S and Western European alphabet (upper and lower case), numbers 0 to 9, and many punctuation characters as an 8-bit binary codes. A number of codes are allocated for control functions such as start of text, end of text, carriage return, tab, and backspace.</p> <p>ISO Latin-1 is an extension of ACSII using the eighth bit to add 127 special Western European characters.</p>
Long Frame	A HART message with a 5 byte address field. All HART commands must support Long Frame messages. See Short Frame .
Long Tag	A 32 character ISO Latin-1 string used to identify the field device. See Tag .

Loop Current	The value measured by a milli-ammeter in series with the field device. The Loop Current is a near DC analog 4-20mA signal used to communicate a single value between the control system and the field device. (Note: Voltage Mode Field Devices use "Volts DC" as their engineering units where "Loop Current" values are used)
Major Revision	A major revision indicates a set of functional capabilities. If a functional change is made, then the major revision number must be incremented.
Manufacturer ID	The integer returned in byte 17-18 of Identity Commands. See the <i>Command Summary Specification</i> for details on Identity Commands. Manufacturer IDs are controlled and must be allocated by the HART Communication Foundation.
Master	A device that initiates communication activity on a HART network by issuing commands to a Field Device . HART supports a primary and a secondary master.
Minor Revision	A minor revision indicates changes made that have no impact on functionality (e.g., clarifications, spelling corrections, etc.).
Multi-drop	A digital communications mode where multiple devices may share the same pair of wires for power and communications.
Not-A-Number	A floating point number that cannot be interpreted. A single, specific non-signaling NaN (0x7F, 0xA0, 0x00, 0x00) is allowed in some Command Specifications to indicate that the field device does not support certain data values."" See the <i>Command Summary Specification</i> for more information
Packed ASCII	A 6-bit alphanumeric character using a HART-specific subset of the ASCII character set. This allows four characters to be packed into three bytes. This subset includes the digits 0 to 9, uppercase letters A to Z, and common punctuation characters. Lowercase and accented letters are not included.
Parity	A mechanism used to detect data transmission errors. When a bit is added that will cause the number of ones in a bitstream to be either odd or even. The HART Protocol requires odd parity on individual bytes transmitted.
Physical Layer	Layer 1 in the OSI model. The Physical Layer is responsible for transmission of the raw bit stream and defines the mechanical and electrical connections and signaling parameters for devices.

Polling Address	An integer used to identify the field device. The Polling Address is used to construct the Short Frame address. The Polling Address is set to 0 in point to point installations. All field devices in multi-drop installations are generally configured to a different Polling Address to allow automatic identification by a master.
Preamble	A synchronization pattern generated at the beginning of a HART message to allow the proper start-up of the receiver. For asynchronous Physical Layers like the FSK Physical Layer, the preamble consists of five or more 0xFF bytes.
Re-Range	Actions performed to change the relationship between the physical signal associated with an Analog Channel and the digital value it is communicating. For example, re-ranging affects the relationship between the Loop Current (or Percent Range) and the Primary Variable. See Trim .
Request Data Bytes	The sub-field returned in the Data field that contains the Application Layer message data being transmitted from the Master to the Slave.
Request Message	An STX . A message sent from a Master to a Slave
Response Data Bytes	The sub-field returned in the Data field that contains the Application Layer message data being transmitted from the Slave to the Master. The first byte in the HART Data Field that is not a Response Code, Communication Status, Device Status or Extended Command Number.
Response Message	An ACK or BACK . The message returned by a Slave after receiving a message from a Master.
Shed Time	The maximum amount of time after successfully receiving a good message after which communications is assumed lost. Some Field Devices use a Shed Time-Out (e.g. on Command 113) to detect loss of communication with a master and take appropriate actions.
Short Frame	A HART message with a 1 byte address field. Only Command 0 Short Frame messages maybe answered by a field device. See Long Frame .
Slave	A passive device that communicates only in response to a message from a master.

Slave Time-Out	This time out is the maximum amount of time within which a slave must begin a response. If a response cannot be generated within this time period, the transaction is considered to have failed by the master. See the <i>Data Link Layer Specification</i> for more information.
STX	Message type 0x02. The start of a transaction. See the <i>Data Link Layer Specification</i> for more information.
Sub-Device	A HART compatible device communicated to via a Bridge Device . See the <i>Command Summary Specification</i> for more information.
Tag	The Tag is a 8 character (6 byte) Packed ASCII string used to identify the field device. In most plants the Tag indicates the mounted location and function of the field device. The term originated when physical tags were attached to instruments for this purpose. See Long Tag
Time Constant	A measure of the responsiveness to an input step change. The time constant difference between the start of the step change to when the response has reached 63% of the final steady-state value.
Transmitter	A field device whose primary purpose is to perform process measurements. Typically the transmitter communicates its Primary Variable via the analog 4-20mA Loop Current to the control system.
Trim	A two-point calibration of a Device Variable used to set zero and span. See Re-Range .
Unique Identifier	The concatenation of the Device Type and Device ID used in constructing the long frame address (see the <i>Data Link Layer Specification</i>). These data, when combined, uniquely identify a specific field device. No two devices ever manufactured may have the same combination of these data.
Units Code	An integer that indicates the engineering units (e.g. millibars, meters per second, or degrees Celsius) for the associated data item. In HART, all floating point numbers have a specified or implied Units Code. See <i>Common Tables Specification</i> for the required Units Code Tables.
Valve	See Actuator

4. PROTOCOL REVISION RULES

This section defines the rules and procedures for revising the HART Protocol. Unless otherwise stated in an individual specification document, all revisions to protocol specification documents follow the rules stated in this section.

4.1 Specification Identification

Document and revision numbers combine to uniquely identify HART Protocol Specification documents.

4.1.1 Document Number

All specification documents are numbered. The format of specification document numbers is HCF_SPEC-x, where 'x' is a number that is unique to a specific document title. The document number remains the same throughout the life of a document, with one exception. The document number of the document titled '*HART Communication Protocol Specification*' will increment when any major revision indicator of the Protocol is incremented.

4.1.2 Revision Number

All specification documents have a major and minor revision number. The revision number has a format of 'y.z'. Where 'y' indicates a major revision number and 'z' a minor revision. The initial value for any major revision (i.e., new specification document) is 1. When any major revision occurs, the minor revision number is reset to 0.

As a specification is changed, the major and minor revision numbers are incremented as follows:

- The major revision number increments for functional changes that add or modify the capabilities included in a HART Protocol Specification document.
- The minor revision number increments for non-functional changes to a HART Protocol Specification document (e.g., clarification, spelling correction, etc.).

4.2 HART Communication Protocol Revision Level

The revision level of the *HART Communication Protocol Specification* indicates the revision level of the HART Communication Protocol.

4.2.1 Major Revisions

Incrementing the major revision number of this document indicates a substantive, functional change to the HART Protocol. The following rules identify major revisions to the HART Protocol:

- A major revision to the document titled *Universal Command Specification* always changes the major revision level of the HART Protocol and the *HART Communication Protocol Specification*.
- A major revision of any of the following specification documents may require a major revision of the HART Protocol and this document:

Data Link Layer Specification

FSK Physical Layer Specification

C8PSK Physical Layer Specification

Command Summary Specification

Common Practice Command Specification

Command Response Code Specification

Common Tables Specification

The HCF Board of Directors will review changes to any of the above documents and determine whether a major revision of the HART Protocol has occurred. If a change to the above documents is not considered a major protocol revision, the change will be determined a minor revision and the Protocol revision level will be changed accordingly.

- The addition of a new specification sub-document will be a major revision to the HART Protocol and the *HART Communication Protocol Specification*.

The major revision number of the documents titled '*HART Communication Protocol Specification*' and the '*Universal Command Specification*' must be identical.

4.2.2 Minor Revisions

Unless otherwise determined by the HCF Board of Directors, the following will be considered a minor revision of the HART Protocol:

- Any minor revision to any specification documents, or
- Any revision (major or minor) of the following documents

Common Tables Specification

Device Families Command Specification

Block Transfer Specification

4.3 Modifications to Protocol Specifications

Proposals for modifications to any HART Specification may be submitted by any HCF member company, the HCF staff, or as the result of a defect report forwarded to the HCF. All proposals are forwarded to the HCF Executive Committee. The Executive Committee may reject the proposal, accept the proposal or forward the proposal to an HCF Technical Working Group. The Working Group may reject a proposal, modify the proposal or accept the proposal. A complete and accepted proposal is forwarded to the Executive Committee.

Once a proposal is accepted by the Executive Committee, it is balloted to the HCF voting members. Once balloting is complete the proposal is once again reviewed by the appropriate Working Group. All comments are reviewed and, if possible, incorporated into the proposal. Serious flaws indicated in the comments may result in the rejection of the proposal by the Working Group, even if a majority of member companies favor the proposal. The Working Group must make every effort to incorporate comments to maximize consensus for the proposal.

Once these steps are complete, the proposal is authorized for incorporation into the Protocol Specification documents as outlined in the proposal. The Working Group shall determine whether the changes to the Specification documents constitute a major or minor revision. The modified Specification documents shall be marked "Preliminary" until balloted and approved by the HCF voting members.

4.4 Approval

Any change to the HART Protocol Specification requires the approval of HCF voting members. All proposed changes will be balloted and approved in accordance with HCF by-laws. In addition, the HCF Board of Directors must ratify any changes to the HART Protocol Specification. Once ratified, "Preliminary" shall be removed from the specification documents and the resulting Protocol Revision released.

All approved Specification documents shall be signed by the Working Group Chairman, The Chairman of the Executive Committee and the HCF Director. The signature sheets shall be kept on file at the HCF offices.

5. HART COMMUNICATION PROTOCOL REVISION MATRIX

shows the documents, along with their revision level, that comprise each HART Communication Protocol revision. The HART Implementation Matrix provides the history of the HART Communication Protocol Specification. This matrix allows any HART Communication Protocol Specification revision to be reconstructed.

Note: Prior to the release of HART Protocol Revision 5.5, new document numbers were incremented with each document revision. With the release of Revision 5.5, this practice is no longer used.

In an earlier revision system, some document revisions did not have a 'z' component of the 'y.z' revision number. If the 'z' component is not applicable to a particular document, the '-' character is used in its place.

Table 2. HART Protocol Revision Number Cross Reference

HART Protocol Revision	Physical and Data Link Layer	FSK Physical Layer	C8PSK Physical Layer	2.4GHz DSSS O-QPSK Physical Layer	Voltage Modulation Physical Layer	TDMA Data-Link Layer	Token-Passing Data Link Layer	Network Management	Command Summary
2.1	3.-	NA	NA	NA	NA	NA	NA	NA	3.1
2.2	3.-	NA	NA	NA	NA	NA	NA	NA	3.1
3.1	3.-	NA	NA	NA	NA	NA	NA	NA	4.1
3.2	3.-	NA	NA	NA	NA	NA	NA	NA	4.1
4.1	4.-	NA	NA	NA	NA	NA	NA	NA	5.1
4.2	4.-	NA	NA	NA	NA	NA	NA	NA	5.1
5.0	NA	7.0	NA	NA	NA	NA	7.0	NA	6.0
5.1	NA	7.1	NA	NA	1.0	NA	7.0	NA	7.0
5.2	NA	7.2	NA	NA	1.0	NA	7.0	NA	7.0
5.3	NA	7.2	NA	NA	1.0	NA	7.0	NA	7.0
5.4	NA	7.2	NA	NA	1.0	NA	7.0	NA	7.0
5.5	NA	7.2	NA	NA	1.0	NA	7.1	NA	7.0
5.6	NA	8.0	NA	NA	NA	NA	7.1	NA	7.0
5.7	NA	8.0	NA	NA	NA	NA	7.1	NA	7.1
5.8	NA	8.0	NA	NA	NA	NA	7.1	NA	7.1
5.9	NA	8.1	NA	NA	NA	NA	7.1	NA	7.1
5.10	NA	8.1	NA	NA	NA	NA	7.1	NA	7.1
6.0	NA	8.1	1.0	NA	NA	NA	8.0	NA	8.0
6.1	NA	8.1	1.0	NA	NA	NA	8.0	NA	8.0
6.2	NA	8.1	1.0	NA	NA	NA	8.0	NA	8.0
6.3	NA	8.1	1.0	NA	NA	NA	8.0	NA	8.0
6.4	NA	8.1	1.0	NA	NA	NA	8.1	NA	8.1
6.5	NA	8.1	1.0	NA	NA	NA	8.1	NA	8.1
7.0	NA	8.1	1.0	1.0	NA	1.0	8.2	1.0	9.0
7.1	NA	8.1	1.0	1.0	NA	1.1	8.2	1.1	9.0
7.2	NA	8.1	1.0	1.0	NA	1.1	8.2	1.2	9.0
7.3	NA	8.1	1.0	1.0	NA	1.1	8.2	1.2	9.0
7.4	NA	8.1	1.0	1.0	NA	1.1	9.0	2.0	9.0

Table 2. HART Protocol Revision Number Cross Reference (continued)

HART Protocol Revision	Universal Command	Common Practice Command	Wireless Command	Device Families (See Note 2)	Common Tables	Block Transfer (See Note 2)	Discrete Applications	Wireless Devices	Command Response Code
2.1	3.-	3.1	NA	NA	1.1	NA	NA	NA	(See Note 1)
2.2	3.1	3.2	NA	NA	1.2	NA	NA	NA	(See Note 1)
3.1	3.-	4.1	NA	NA	2.1	NA	NA	NA	1.-
3.2	3.1	4.1	NA	NA	2.1	NA	NA	NA	1.1
4.1	4.1	5.1	NA	NA	3.1	NA	NA	NA	2.1
4.2	4.1	5.2	NA	NA	3.1	NA	NA	NA	2.1
5.0	5.0	6.0	NA	NA	4.0	NA	NA	NA	3.0
5.1	5.1	7.0	NA	NA	5.0	NA	NA	NA	4.0
5.2	5.1	7.0	NA	NA	6.0	NA	NA	NA	4.0
5.3	5.1	7.0	NA	NA	7.0	NA	NA	NA	4.0
5.4	5.1	7.0	NA	NA	8.0	NA	NA	NA	4.0
5.5	5.1	7.0	NA	NA	8.0	NA	NA	NA	4.0
5.6	5.1	7.0	NA	NA	9.0	NA	NA	NA	4.0
5.7	5.2	7.1	NA	NA	9.0	NA	NA	NA	4.1
5.8	5.2	7.1	NA	NA	10.0	NA	NA	NA	4.1
5.9	5.2	7.1	NA	NA	11.0	NA	NA	NA	4.1
5.10	5.2	7.1	NA	NA	12.0	NA	NA	NA	4.1
6.0	6.0	8.0	NA	1.0	13.0	1.0	NA	NA	5.0
6.1	6.0	8.0	NA	1.0	14.0	1.0	NA	NA	5.0
6.2	6.0	8.0	NA	1.0	15.0	1.0	NA	NA	5.0
6.3	6.0	8.0	NA	1.0	16.0	1.0	NA	NA	5.0
6.4	6.1	8.0	NA	1.0	16.0	1.0	NA	NA	5.0
6.5	6.1	8.0	NA	1.0	17.0	1.0	NA	NA	5.0
7.0	7.0	9.0	1.0	1.0	18.0	1.0	1.0	1.0	6.0
7.1	7.1	9.1	1.1	1.0	19.0	1.0	1.0	1.1	6.0
7.2	7.1	9.1	1.1	1.0	20.0	1.0	1.0	1.1	6.0
7.3	7.1	9.1	1.1	1.1	21.0	1.0	1.0	1.1	6.0
7.4	7.1	10.0	2.0	1.1	22.0	1.0	2.0	1.1	6.0

Notes:

1. Command Response Codes were included in the *Common Tables Specification* in HART Revision 2.1 and 2.2.
 2. This Specification consists of a main specification and several of sub-specifications. For a complete listing of the sub-specifications and their revisions refer to the listed (i.e., Device Families or Block Transfer) specification.
- NA Not Applicable

6. HART COMMUNICATION PROTOCOL DOCUMENT LIST

In an earlier revision system, some document revisions did not have a 'z' component of the 'y.z' revision number. If the 'z' component is not applicable to a particular document, the '-' character is used in its place.

References with Rosemount Inc. Document Numbers (format DXXXXXXX) are included for historical purposes.

Table 3. HART Communication Protocol Specification

HART Communication Protocol Document Title	Doc Rev	Document Number	Rosemount Inc. Document Number
HART Communication Protocol Specification	7.4	HCF_SPEC-13	
HART Communication Protocol Specification	7.3	HCF_SPEC-13	
HART Communication Protocol Specification	7.2	HCF_SPEC-13	
HART Communication Protocol Specification	7.1	HCF_SPEC-13	
HART Field Communications Protocol Specification	7.0	HCF_SPEC-13	
HART Field Communications Protocol Specification	6.5	HCF_SPEC-12	
HART Field Communications Protocol Specification	6.4	HCF_SPEC-12	
HART Field Communications Protocol Specification	6.3	HCF_SPEC-12	
HART Field Communications Protocol Specification	6.2	HCF_SPEC-12	
HART Field Communications Protocol Specification	6.1	HCF_SPEC-12	
HART Field Communications Protocol Specification	6.0	HCF_SPEC-12	
HART-Smart Communications Protocol Specification	5.9	HCF_SPEC-11	
HART-Smart Communications Protocol Specification	5.8	HCF_SPEC-11	
HART-Smart Communications Protocol Specification	5.7	HCF_SPEC-11	
HART-Smart Communications Protocol Specification	5.6	HCF_SPEC-11	
HART-Smart Communications Protocol Specification	5.5	HCF_SPEC-11	
HART-Smart Communications Protocol Specification	5.4	HCF_SPEC-11	
HART-Smart Communications Protocol Specification	5.3	HCF_SPEC-10	
HART-Smart Communications Protocol Specification	5.2	HCF_SPEC-9	
HART-Smart Communications Protocol Specification	5.1	HCF_SPEC-8	
HART-Smart Communications Protocol Specification	5.0	HCF_SPEC-7	
HART-Smart Communications Protocol Specification	4.2	HCF_SPEC-6	D8900029 IR: 19 Jul 88, CR: 21 Oct 91, PD: 21 Oct 91, Rev B
HART-Smart Communications Protocol Specification	4.1	HCF_SPEC-5	D8900029 IR: 19 Jul 88, CR: 3 Nov 90, PD: 10 Apr 91, Rev A
HART-Smart Communications Protocol Specification	3.2	HCF_SPEC-4	D8900026 IR: 18 Jul 88, CR: 9 Jul 91, PD: 9 Jul 91, Rev B
HART-Smart Communications Protocol Specification	3.1	HCF_SPEC-3	D8900026 IR: 18 Jul 88, CR: 13 Mar 90, PD: 8 Apr 91, Rev A
HART-Smart Communications Protocol Specification	2.2	HCF_SPEC-2	D8700046 IR: 23 Dec 87, CR: 13 May 91, PD: 13 May 91, Rev B
HART-Smart Communications Protocol Specification	2.1	HCF_SPEC-1	D8700046 IR: 23 Dec 87, CR: 13 Mar 90, PD: 22 Mar 91, Rev A

Table 4. Physical and Data Link Layer Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	Rosemount Inc. Doc Number
Physical ¹ and Data Link Layer Specification	6.-	HCF_SPEC-44	D8900033 IR: 28 Jun 89, CR: 28 Jun 89, PD: 30 Jun 89, Rev A
Physical ² and Data Link Layer Specification	5.-	HCF_SPEC-43	D8900032 IR: 30 Jun 88, CR: 30 Jun 88, PD: 30 Jun 88, Rev A
Physical ³ and Data Link Layer Specification	4.-	HCF_SPEC-42	D8900031 IR: 20 Mar 88, PD: 28 Mar 88, Rev A
Physical ⁴ and Data Link Layer Specification	3.-	HCF_SPEC-41	D8600076 IR: 14 Sep 87, CR: 23 Dec 87, PD: 23 Dec 87, Rev A

Table 5. FSK Physical Layer Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	Rosemount Inc. Doc Number
FSK Physical Layer Specification	8.1	HCF_SPEC-54	
FSK Physical Layer Specification	8.0	HCF_SPEC-54	
FSK Physical Layer Specification	7.2	HCF_SPEC-53	⁵
Physical ⁶ Layer Specification	7.1	HCF_SPEC-52	D8900097 IR: 29 Dec 89, CR: 20 Jun 90, PD: 25 Jun 90, Rev B
Physical ⁷ Layer Specification	7.0	HCF_SPEC-51	D8900097 IR: 29 Dec 89, CR: 29 Dec 89, PD: 29 Dec 89, Rev A

Table 6. C8PSK Physical Layer Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	
C8PSK Physical Layer Specification	1.0	HCF_SPEC-60	

Table 7. 2.4GHz DSSS O-QPSK Physical Layer Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	
2.4GHz DSSS O-QPSK Physical Layer Specification	1.0	HCF_SPEC-65	

Table 8. Voltage Modulation Physical Layer Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	Rosemount Inc. Doc Number
Voltage ⁸ Modulation Physical Layer Specification	1.0	HCF_SPEC-71	D9000062, IR: 5 Nov 90, CR: 5 Nov 90, PD: 5 Nov 90, Rev A.

¹ FSK Physical Layer

² FSK Physical Layer

³ FSK Physical Layer

⁴ FSK Physical Layer

⁵ Was HUG-3, Revision A

⁶ FSK Physical Layer

⁷ FSK Physical Layer

⁸ Superseded by HCF_SPEC-54, Revision 8.0

Table 9. TDMA Data-Link Layer

HART Communication Protocol Document Title	Doc Rev	Doc Number	
TDMA Data-Link Layer	1.1	HCF_SPEC-75	
TDMA Data-Link Layer	1.0	HCF_SPEC-75	

Table 10. Token-Passing Data Link Layer Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	
Token-Passing Data Link Layer Specification	9.0	HCF_SPEC-81	
Token-Passing Data Link Layer Specification	8.2	HCF_SPEC-81	
Data Link Layer Specification	8.1	HCF_SPEC-81	
Data Link Layer Specification	8.0	HCF_SPEC-81	
Data Link Layer Specification	7.1	HCF_SPEC-81	
Data Link Layer Specification	7.0	HCF_SPEC-81	

Table 11. Network Management Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	
Network Management Specification	2.0	HCF_SPEC-85	
Network Management Specification	1.2	HCF_SPEC-85	
Network Management Specification	1.1	HCF_SPEC-85	
Network Management Specification	1.0	HCF_SPEC-85	

Table 12. Command Summary Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	Rosemount Inc. Doc Number
Command Summary Information	8.2	HCF_SPEC-99	
Command Summary Information	8.1	HCF_SPEC-99	
Command Summary Information	8.0	HCF_SPEC-99	
Command Summary Information	7.1	HCF_SPEC-99	
Command Summary Information	7.0	HCF_SPEC-99	
Command Summary Information	6.0	HCF_SPEC-98	
Command Summary Information	6.-	HCF_SPEC-97	D8900036, IR: 30 Jun 89, CR: 30 Jun 89, PD: 5 Jul 89, Rev NA
Command Summary Information	5.1	HCF_SPEC-96	D8900035, IR: 19 Jul 88, CR: 3 Nov 90, PD: 5 Mar 91, Rev B
Command Summary Information	5.-	HCF_SPEC-95	D8900035, IR: 19 Jul 88, CR: NA, PD: 28 Jun 88, Rev A
Command Summary Information	4.1	HCF_SPEC-94	D8900034, IR: 23 Mar 88, CR: 13 Mar 90, PD: 4 Mar 91, Rev B
Command Summary Information	4.-	HCF_SPEC-93	D8900034, IR: 23 Mar 88, CR: 23 Mar 88, PD: 14 Apr 88, RevA
Command Summary Information	3.1	HCF_SPEC-92	D8700027, IR: 30 Apr 87, CR: 13 Mar 90, PD: 26 Feb 91, Rev B
Command Summary Information	3.-	HCF_SPEC-91	D8700027, IR: 30 Apr 87, CR: 9 Dec 87, PD: 22 Dec 90, Rev A

Table 13. Universal Command Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	Rosemount Inc. Doc Number
Universal Command Specification	7.1	HCF_SPEC-127	
Universal Command Specification	7.0	HCF_SPEC-127	
Universal Command Specification	6.1	HCF_SPEC-127	
Universal Command Specification	6.0	HCF_SPEC-127	
Universal Command Specification	5.2	HCF_SPEC-127	
Universal Command Specification	5.1	HCF_SPEC-127	D8900038 IR: 8 Feb 90, CR: 18 Oct 90, PD: 19 Apr 91, Rev C
Universal Command Specification	5.0	HCF_SPEC-126	D8900038 IR: 8 Feb 90, CR: 8 Feb 90, PD: 12 Feb 90, Rev A
Universal Command Specification	5.-	HCF_SPEC-125	D8700028 IR: 30 Jun 89, CR: 30 Jun 89, PD: 5 Jul 89, Rev C
Universal Command Specification	4.1	HCF_SPEC-124	D8900037 IR: 10 Jun 90, CR: 3 Nov 90, PD: 3 Nov 90, Rev B
Universal Command Specification	4.-	HCF_SPEC-123	D8900037 IR: 10 Jun 88, CR: 10 Jun 88, PD: 10 Jun 88, Rev A
Universal Command Specification	3.1	HCF_SPEC-122	D8700028 IR: 9 Dec 87, CR: 13 May 87, PD: 13 May 91, Rev B
Universal Command Specification	3.-	HCF_SPEC-121	D8700028 IR: 30 Apr 87, CR: 9 Dec 87, PD: 9 Dec 87, Rev NA

Table 14. Common Practice Command Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	Rosemount Inc. Doc Number
Common Practice Command Specification	10.0	HCF_SPEC-151	
Common Practice Command Specification	9.1	HCF_SPEC-151	
Common Practice Command Specification	8.0	HCF_SPEC-151	
Common Practice Command Specification	7.1	HCF_SPEC-151	
Common Practice Command Specification	7.0	HCF_SPEC-151	D8900050 IR: 11 Oct 90, CR: 11 Oct 90, PD: 21 Nov 90, Rev A
Common Practice Command Specification	6.0	HCF_SPEC-150	D8900041 IR: 8 Feb 90, CR: 8 Feb 90, PD: 15 Feb 90, Rev A
Common Practice Command Specification	6.-	HCF_SPEC-149	D8900041 IR: 30 Jun 89, CR: 30 Jun 89, PD: 5 Jul 89, Rev NA
Common Practice Command Specification	5.2	HCF_SPEC-148	D8900040 IR: 19 Jul 88, CR: 21 Oct 91, PD: 21 Oct 91, Rev C
Common Practice Command Specification	5.1	HCF_SPEC-147	D8900040 IR: 19 Jul 88, CR: 3 Nov 90, PD: 23 Feb 91, Rev B
Common Practice Command Specification	5.-	HCF_SPEC-146	D8900040 IR: 10 Jun 88, CR: 10 Jun 88, PD: 28 Jun 88, Rev NA
Common Practice Command Specification	4.1	HCF_SPEC-145	D8900039 IR: 18 Jul 88, CR: 13 Mar 90, PD: 28 Mar 91, Rev B
Common Practice Command Specification	4.-	HCF_SPEC-144	D8900039 IR: 7 Jan 88, CR: 18 Jul 88, PD: 18 Jul 88, Rev A
Common Practice Command Specification	3.2	HCF_SPEC-143	D8700029 IR: 30 Apr 87, CR: 13 May 91, PD: 13 May 91, Rev B
Common Practice Command Specification	3.1	HCF_SPEC-142	D8700029 IR: 30 Apr 87, CR: 13 Mar 90, PD: 23 Feb 91, Rev A
Common Practice Command Specification	3.-	HCF_SPEC-141	D8700029 IR: 30 Apr 87, CR: 30 Apr 87, PD: 22 Dec 87, Rev A

Table 15. Wireless Command Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	
Wireless Command Specification	2.0	HCF_SPEC-155	
Wireless Command Specification	1.1	HCF_SPEC-155	
Wireless Command Specification	1.0	HCF_SPEC-155	

Table 16. Device Families Command Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	
Device Families Command Specification	1.1	HCF_SPEC-160	
Device Families Command Specification	1.0	HCF_SPEC-160	

Table 17. Common Tables Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	Rosemount Inc. Doc Number
Common Tables	22.0	HCF_SPEC-183	
Common Tables	21.0	HCF_SPEC-183	
Common Tables	20.0	HCF_SPEC-183	
Common Tables	19.0	HCF_SPEC-183	
Common Tables	18.0	HCF_SPEC-183	
Common Tables	17.0	HCF_SPEC-183	
Common Tables	16.0	HCF_SPEC-183	
Common Tables	15.0	HCF_SPEC-183	
Common Tables	14.0	HCF_SPEC-183	
Common Tables	13.0	HCF_SPEC-183	
Common Tables	12.0	HCF_SPEC-183	
Common Tables	11.0	HCF_SPEC-183	
Common Tables	10.0	HCF_SPEC-183	
Common Tables	9.1	HCF_SPEC-183	
Common Tables	8.0	HCF_SPEC-183	
Common Tables	7.0	HCF_SPEC-182	
Common Tables	6.0	HCF_SPEC-181	1
Common Tables	5.0	HCF_SPEC-180	D9000051 IR: 18 Oct 90, CR: 18 Oct 90, PD: 21 Nov 90, Rev A
Common Tables	4.0	HCF_SPEC-179	D8900044 IR: 9 Feb 90, CR: 9 Feb 90, PD: 15 Feb 90, Rev A
Common Tables	4.-	HCF_SPEC-178	D8900044 IR: 30 Jun 89, CR: 30 Jun 88, PD: 5 Jul 89, Rev NA
Common Tables	3.1	HCF_SPEC-177	D8900043 IR: 10 Jun 88, CR: 3 Nov 90, PD: 28 Feb 91, Rev B
Common Tables	3.-	HCF_SPEC-176	D8900043 IR: 10 Jun 88, CR: 10 Jun 88, PD: 28 Jun 88, Rev A
Common Tables	2.1	HCF_SPEC-175	D8900042 IR: 23 Mar 88, CR: 13 Mar 90, PD: 27 Feb 91, Rev B

¹ Was HUG-2 Revision; A

HART Communication Protocol Document Title	Doc Rev	Doc Number	Rosemount Inc. Doc Number
Common Tables	2.-	HCF_SPEC-174	D8900042 IR: 7 Jan 88, CR: 23 Mar 87, PD: 14 Apr 88, Rev A
Common Tables	1.2	HCF_SPEC-173	D8700051 IR: 30 Apr 87, CR: 13 May 91, PD: 27 Feb 91, Rev C
Common Tables	1.1	HCF_SPEC-172	D8700051 IR: 30 Apr 87, CR: 13 Mar 90, PD: 27 Feb 91, Rev B
Common Tables	1.-	HCF_SPEC-171	D8700051 IR: 3 Apr 87, CR: 9 Dec 87, PD: 22 Dec 87, Rev NA

Table 18. Block Transfer Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	
Block Transfer Specification	1.0	HCF_SPEC-190	

Table 19. Discrete Applications Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	
Discrete Applications Specification	2.0	HCF_SPEC-285	
Discrete Applications Specification	1.0	HCF_SPEC-285	

Table 20. Wireless Devices Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	
Wireless Devices Specification	1.1	HCF_SPEC-290	
Wireless Devices Specification	1.0	HCF_SPEC-290	

Table 21. Command Response Code Specification

HART Communication Protocol Document Title	Doc Rev	Doc Number	Rosemount Inc. Doc Number
Command Response Code Specification	5.0	HCF_SPEC-307	
Appendix 1. Command Specific Response Code Definitions	4.1	HCF_SPEC-307	
Appendix 1. Command Specific Response Code Definitions	4.0	HCF_SPEC-307	D9000052, IR: 18 Oct 90, CR: 4 Jan 91, PD: 15 Jan 91
Appendix 1. Command Specific Response Code Definitions	3.0	HCF_SPEC-306	D8900046, IR: 11 Feb 90, CR: 11 Feb 90, PD: 15 Feb 90, Rev A
Appendix 1. Command Specific Response Code Definitions	3.-	HCF_SPEC-305	D8900046, IR: 30 Jun 89, CR: 30 Jun 90, PD: 5 Jul 89, Rev NA
Appendix 1. Command Specific Response Code Definitions	2.1	HCF_SPEC-304	D8900045 IR: 10 Jun 88, CR: 3 Nov 90, PD: 4 Apr 91, Rev B
Appendix 1. Command Specific Response Code Definitions	2.-	HCF_SPEC-303	D8900045 IR: 10 Jun 88, CR: 4 May 88, PD: 28 Jun 88, Rev A
Appendix 1. Command Specific Response Code Definitions	1.1	HCF_SPEC-302	D8900027 IR: 23 Mar 88, CR: 9 Jul 91, PD: 9 Jul 91, Rev B
Appendix 1. Command Specific Response Code Definitions	1.-	HCF_SPEC-301	D8900027 IR: 10 Mar 88, CR: 23 Mar 88, PD: 15 Apr 88, Rev A

ANNEX A. REVISION HISTORY

A1.Changes from Revision 7.3 to 7.4

The document titled Token-Passing Data Link Layer Specification, HCF_SPEC-081, Revision 8.2 was modified and a new revision, 9.0, created.

The document titled Network Management Specification, HCF_SPEC-085, Revision 1.2 was modified and a new revision, 2.0, created.

The document titled Common Practice Command Specification, HCF_SPEC-151, Revision 9.0 was modified and a new revision, 10.0 created.

The document titled Wireless Command Specification, HCF_SPEC-155, Revision 1.1 was modified and a new revision, 2.0, created.

The document titled Discrete Applications Specification, HCF_SPEC-285, Revision 1.0 was modified and a new revision, 2.0, created.

The document titled Common Tables Specification, HCF_SPEC-183, Revision 21.0 was modified and a new revision, 22.0, created.

Consequently, modifications were made to Table 1, Table 2, Table 3 and Table 16.

A2.Changes from Revision 7.2 to 7.3

The document titled Device Families Command Specification, HCF_SPEC-160, Rev. 1.0 was modified and a new revision, 1.1, created. Consequently, modifications were made to Table 1, Table 2, Table 3 and Table 16 to include document revision 21.0 of the Common Tables.

The document titled 'Common Table', HCF_SPEC-183, Document Revision: 20.0 was modified and a new revision, 21.0, created. Consequently, modifications were made to Table 1, Table 2, Table 3 and Table 17 to include document revision 21.0 of the Common Tables.

A3.Changes from Revision 7.1 to 7.2

The document titled 'Network Management Specification', HCF_SPEC-085, Document Revision: 1.1 was modified and a new revision, 1.2, created. Consequently, modifications were made to Table 1, Table 2, Table 3 and Table 11 to include document revision 1.2 of 'Network Management Specification'.

The document titled 'Common Table', HCF_SPEC-183, Document Revision: 19.1 was modified and a new revision, 20.0, created. Consequently, modifications were made to Table 1, Table 2, Table 3 and Table 17 to include document revision 20.0 of 'Common Tables'.

A4.Changes from Revision 7.0 to 7.1

Diligent efforts of the HCF Staff and Technical Working Groups (WG) during the development of test requirements and Test Specifications, plus valuable feedback from numerous product developers identified anomalies in the specifications that have been captured, tracked and resolved. Resulting corrections and clarifications were documented in Addendums to the following specifications.

- *TDMA Data-Link Layer* (HCF_SPEC-075)
- *Network Management Specification* (HCF_SPEC-085)
- *Universal Command Specification* (HCF_SPEC-127)
- *Common Practice Command Specification* (HCF_SPEC-151)
- *Wireless Command Specification* (HCF_SPEC-155)
- *Wireless Devices Specification* (HCF_SPEC-290)

In addition, this revision includes an updated version of the *Common Tables Specification* (HCF_SPEC-183) and updates to the cover page of each specification reflecting the new HART logo.

A5.Changes from Revision 6.5 to 7.0

The document titled: *HART Field Communications Protocol Specification*, HCF_SPEC-12, Revision: 6.5, was updated with the release of HCF_SPEC-13, Document Revision 7.0, to reflect the following changes:

The allocation of extended device type codes are now performed by the HCF.

Support for WirelessHART was added.

A6.Changes from Revision 6.4 to 6.5

The last revision to the document titled: 'HART-SMART Communications Protocol Specification' HCF_SPEC-12, was Document Revision 6.4. This document has been updated with Revision 6.5 to reflect changes to the documents that define the protocol. These documents are:

The document titled 'Common Table', HCF_SPEC-183, Document Revision: 16.0 was modified and a new revision, 17.0, created. Consequently, modifications were made to Table 1, Table 2, Table 3 and Table 17 to include document revision 17.0 of 'Common Tables'.

A7.Changes from Revision 6.3 to 6.4

The last revision to the document titled: 'HART-SMART Communications Protocol Specification' HCF_SPEC-12, was Document Revision 6.3. This document has been updated with Revision 6.4 to reflect changes to the documents that define the protocol. These documents are:

The document titled: 'Data Link Layer Specification', Document Revision: 8.0, HCF_SPEC-81, was modified and a new revision created.

The document titled: 'Command Summary Specification', Document Revision: 8.0, HCF_SPEC-99, was modified and a new revision created.

The document titled: 'Universal Command Specification', Document Revision: 6.0, HCF_SPEC-127, was modified and a new revision created.

Changes were made to Table 1, Table 2, Table 3, Table 10, Table 12, and Table 13.

A8.Changes from Revision 6.2 to 6.3

The last revision to the document titled: 'HART-SMART Communications Protocol Specification' HCF_SPEC-12, was Document Revision 6.2. This document has been updated with Revision 6.3 to reflect changes to the documents that define the protocol. These documents are:

The document titled 'Common Table', HCF_SPEC-183, Document Revision: 15.0 was modified and a new revision, 16.0, created. Consequently, modifications were made to Table 1, Table 2, Table 3 and Table 17 to include document revision 16.0 of 'Common Tables'.

A9.Changes from Revision 6.1 to 6.2

The last revision to the document titled: 'HART-SMART Communications Protocol Specification' HCF_SPEC-12, was Document Revision 6.1. This document has been updated with Revision 6.2 to reflect changes to the documents that define the protocol. These documents are:

The document titled 'Common Tables', HCF_SPEC-183, Document Revision: 14.0 was modified and a new revision, 15.0, created. Consequently, modifications were made to Table 1, Table 2, Table 3 and Table 17 to include document revision 15.0 of 'Common Tables'.

A10.Changes from Revision 6.0 to 6.1

The last revision to the document titled: 'HART-SMART Communications Protocol Specification' HCF_SPEC-12, was Document Revision 6.0. This document has been updated with Revision 6.1 to reflect changes to the documents that define the protocol. These documents are:

The document titled 'Common Tables', HCF_SPEC-183, Document Revision: 13.0 was modified and a new revision, 14.0, created. Consequently, modifications were made to Table 1, Table 2 and Table 13 to include document revision 14.0 of 'Common Tables'.

A11.Changes from Revision 5.9 to 6.0

The document titled: *HART Field Communications Protocol Specification*, HCF_SPEC-11, Document Revision: 5.9, was updated with the release of HCF_SPEC-12, Document Revision 6.0, to reflect the following changes:

These new sections were added as part of the format revisions for all HART Protocol Specification documents: Scope, References, Definitions, Symbols/Abbreviations.

The Scope section was added.

Section 1.2, Terms and Conditions, was fine-tuned

Common definitions used throughout the HART Protocol Specifications are now defined in Section 3, Definitions.

Section 4, Protocol Revision Rules, was revised to reflect actual HCF practices and harmonized with HCF by-law requirements.

A12.Changes from Revision 5.8 to 5.9

The last revision to the document titled *HART Field Communications Protocol Specification*, was HCF_SPEC-11, Document Revision: 5.8. This document was updated with Revision 5.9 to reflect the following changes:

The document titled Common Tables Specification has been updated from Revision 10.1 to Revision 11.1 to reflect the assignment of additional manufacturer codes and units codes. For details of specific changes refer to the change summary within the revised document.

The document titled FSK Physical Layer Specification has been updated from Revision 8.0 to Revision 8.1. For details of specific changes refer to the change summary within the revised document.

A13.Changes from Revision 5.7 to 5.8

The last revision to the document titled *HART Field Communications Protocol Specification*, was HCF_SPEC-11, Document Revision: 5.7. This document was updated with Revision 5.8 to reflect the following changes:

The document titled Common Tables Specification has been updated from Revision 9.0 to Revision 10.1 to reflect the assignment of additional manufacturer codes and units codes. For details of specific changes refer to the change summary within the revised document.

Paragraph 2 was modified to include the HART Protocol and Specification revision criteria.

In paragraph 3 the document abbreviations for Rosemount documents were deleted as no longer necessary. The Rosemount document numbers are provided in the listing for historical cross-reference only.

Formatting changes were made to the Table 1 - HART Protocol Specifications to delete the column titled 'Document Version' which is not used in the current document numbering system. For reference no document version other than A was ever published.

Formatting changes were made to the Table 2 - HART Revision Implementation Matrix to delete unused columns indicating Appendix 2 and Appendix 3 which are not used.

Formatting changes were made to the Tables 3 through 12 - to delete the column titled 'Document Version' which is not used in the current document numbering system. For reference no document version other than A was ever published.

A14.Changes from Revision 5.6 to 5.7

This document was updated with Revision 5.7 to reflect changes to the documents which define the protocol.

Certain documents required reformatting as a result of translating them from ASCII text or Multimate file formats to Microsoft Word. The revisions have been made to mark this translation only and in no way did this process change document content. These documents include:

The document titled: 'Command Summary Specification', Document Revision: 7.0, HCF_SPEC-99, was modified and a new revision created. The file required translation from ASCII text file format to Microsoft Word.

The document titled: 'Universal Command Specification', Document Revision: 5.2, HCF_SPEC-127, was modified and a new revision created. The file required translation from Multimate file format to Microsoft Word.

The document titled: 'Common Practice Command Specification', Document Revision: 7.0, HCF_SPEC-151, was modified and a new revision created. The file required translation from ASCII text file format to Microsoft Word.

The document titled: 'Command Specific Response Code Definitions', Document Revision: 4.0, HCF_SPEC-307, was modified and a new revision created. The file required translation from ASCII text file format to Microsoft Word.