TABLE OF CONTENTS

1. HOST INTERFACE DESCRIPTIONS

1.1. CONFORMANCE CLASS DEFINITIONS

Conformance Classes are groups of commands indicating the level of HART functionality implemented in a Host. Each Conformance Class includes the functions of all the lower classes except for a choice between Class 1 or 1A. Class 1 is the lowest and Class 5 is the highest.

A Host may choose to implement any of the functions regardless of their class. However, it can only claim conformance to a specific class if it implements all of the functions in that class and all classes below.

CLASS	DESCRIPTION
1	A read-only class to obtain the Primary Variable from the device.
1A	An optional read-only class to obtain the Primary Variable as a percent of range and current.
2	A read-only class to obtain information that is common to all devices.
3	A read-only class to obtain the information that is specific to each individual device. All information about a device is accessible.
4	A write-only class to send the information to each device that is necessary for routine operations.
5	A write-only class to send information to each device that is necessary for initial setup.
Unclassified	Read and write functions that are not part of the above numeric classes. These commands will not be implemented by a host of another manufacturer.

CONFORMANCE CLASS COMMAND GROUPS

Universal and Common-Practice Commands Only

COMMAND NUMBER	DESCRIPTION
CONFORMANCE CLASS # 1	
	- UNIVERSAL
0	Read Unique Identifier
1	Read Primary Variable
CONFORMANCE CLASS # 1A	
	- UNIVERSAL
0	Read Unique Identifier
2	Read P. V. Current and Percent of Range
CONFORMANCE CLASS # 2	
	- UNIVERSAL
4	Reserved
11	Read Unique Identifier Associated with Tag
12	Read Message
13	Read Tag, Descriptor, Date
14	Read Primary Variable Sensor Information
15	Read Primary Variable Output Information
16	Read Final Assembly Number
CONFORMANCE CLASS # 2	
	- UNIVERSAL
3	Read All Dynamic Variables and Current
	- COMMON PRACTICE
33	Read Transmitter Variables
48	Read Additional Transmitter Status
50	Read Dynamic Variable Assignments
54	Read Transmitter Variable Information
57	Read Unit Tag, Descriptor, Date
60	Read Analog Output and Percent of Range
61	Read Dynamic Variables and P. V. Analog Output
62	Read Analog Outputs
63	Read Analog Output Information
70	Read Analog Output Endpoints
110	Read All Dynamic Variables

COMMAND NUMBER		DESCRIPTION
CONFORMANCE CLASS # 4		
		- COMMON PRACTICE
34	*	Write Primary Variable Damping Value
35	*	Write Primary Variable Range Values
36	*	Set Primary Variable Upper Range Value
37	*	Set Primary Variable Lower Range Value
38	*	Reset Configuration Changed Flag
39	*	EEPROM Control
40	*	Enter/Exit Fixed Primary Variable Current Mode
41	*	Perform Transmitter Self Test
42	*	Perform Master Reset
47	*	Write Primary Variable Transfer Function
55	*	Write Transmitter Variable Damping Value
64	*	Write Analog Output Additional Damping Value
65	*	Write Analog Output Range Values
66	*	Enter/Exit Fixed Analog Output Mode
69	*	Write Analog Output Transfer Function

* When implemented by a device, these commands will always be a member of the indicated Conformance Class

COMMAND NUMBER	DESCRIPTION
CONFORMANCE CLASS # 5	
	- UNIVERSAL
5	Reserved
6	Write Polling Address
17	Write Message
18	Write Tag, Descriptor, Date
19	Write Final Assembly Number
	- COMMON PRACTICE
43	Set Primary Variable Zero
44	Write Primary Variable Units
45	Trim Primary Variable Current DAC Zero
46	Trim Primary Variable Current DAC Gain
49	Write Primary Variable Sensor Serial Number
51	Write Dynamic Variable Assignments
52	Set Transmitter Variable Zero
53	Write Transmitter Variable Units
56	Write Transmitter Variable Sensor Serial Number
58	Write Unit Tag, Descriptor, Date
59	Write Number of Response Preambles
67	Trim Analog Output Zero
68	Trim Analog Output Gain
107	Write Burst Transmitter Variables
108	Write Burst Mode Command Number
109	Burst Mode Control
111	Transfer Service Control
112	Transfer Service

2. TRANSMITTER INTERFACE DESCRIPTIONS

2.1. TRANSMITTER COMMAND CLASS DEFINITIONS

CLASS	DESCRIPTION
Universal	All devices implement these commands. The functions performed by these commands are performed by all devices.
Common-Practice	Many devices implement these commands. The functions performed by these commands may not be possible for all devices.
Transmitter-Specific	Only one or at most a few devices implement these functions. The functions performed by these commands allow each device type to implement their own commands for special functions, calibration, and special data handling.

2.2. TRANSMITTER COMMAND CLASS PARTITIONS

COMMAND NUMBER	COMMAND CLASS
0	Universal
•	•
•	•
•	•
30	Universal
31	Reserved
32	Common-Practice
•	•
•	•
•	•
127	Reserved
128	Transmitter-Specific
•	•
•	•
•	•
253	Transmitter-Specific
254	Reserved
255	Reserved

3. RESPONSE CODE INFORMATION

FIRST BYTE

Bit #7	When set, the First Response Byte contains Communication Error Summary information. When reset, the first Response Byte contains Command Response Summary information. Write Tag, Descriptor, Date Write Final Assembly Number

3.1. COMMUNICATIONS ERROR SUMMARY

Bit #7 = 1
This byte contains information pertaining to the reception of a message by a device. These flags indicate that an error was detected and the message was not accepted. The Response Data Bytes are not returned when errors are being reported.

Bit #6	Vertical Parity Error—The parity of one or more of the bytes received by the device was incorrect.
Bit #5	Overrun Error—At least one byte of data in the receive buffer of the UART was overwritten before it was read.
Bit#4	Framing Error—The Stop Bit of one or more bytes received by the device was not detected by the UART.
Bit #3	Longitudinal Parity Error—The Longitudinal Parity calculated by the device did not match the Longitudinal Parity byte at the end of the message.
Bit #2	Reserved, set to zero.
Bit #1	Buffer Overflow—The message was too long for the receive buffer of the device.
Bit #0	Undefined—Not defined at this time.

3.2. COMMAND RESPONSE SUMMARY

This byte contains information relative to the execution of a command. The Command-Specific Response Codes contain a completion report as documented for each command.

Command-Specific Response Codes are encoded in bits #6 - #0 of the first byte of the Response Codes. These codes are 7-bit unsigned integers, have values ranging from 0 to 127, and are not bit-mapped.

Response Codes #32, Busy, or #64, Command Not Implemented, may be returned in response to any command. Their definitions follow.

Response Code #32	Busy—The device is performing a function that cannot be interrupted by this command.
Response Code #64	Command Not Implemented—The command was not defined for this device.

Definitions for other Command-Specific Response Codes are contained in Appendix 1 - Command-Specific Response Code Definitions.

The Command-Specific Response Codes have symbolic meanings which fall into the following classes:

Notification	Command executed properly. Response Data Bytes are returned.
Warning	Command executed with deviation as described in response. Response Data Bytes are returned.
Error	Command execution was not properly completed and Response Code indicates reason. Response Data Bytes are NOT returned.

Error and Warning definitions are assigned to specific Response Codes. Error definitions are assigned to Response Codes 0 through 7, 9 through 13, 15 through 23, 28, 29, and 32 through 95. Warning definitions are assigned to Response Codes 8, 14, 24 through 27, 30, 31, 96 through 127. These assignments must be observed whenever new Response Codes are defined and added to existing commands so that the Host can respond properly to the new code. These assignments must also be observed when defining Response Codes for new commands.

The ability to have Single and Multiple definitions is also assigned to specific Response Codes. Only a Single definition is allowed for Response Codes 0 through 7, 16 through 27, 32 through 64, and 96 through 111. These codes and will have the same meaning when used in any command. Multiple definitions are allowed for Response Codes 8 through 15, 28 through 31, 65 through 95, and 112 through 127. These codes may have different meanings when used in different commands. These assignments must be observed at all times.

The following summarizes the above information.

RESPONSE CODES	DEFINITION TYPE	NUMBER OF DEFINITIONS
0 - 7, 16 - 23, 32 - 64	Error	Single
9 - 13, 15, 28, 29, 65 - 95	Error	Multiple
24 - 27, 96 - 111	Warning	Single
8, 14, 30, 31, 112 - 127	Warning	Multiple

Some previously assigned codes may not match these groupings. These groupings must be followed from this time on.

3.3. FIELD DEVICE STATUS

SECOND BYTE

The information in this byte pertains to the operating status of the device as a whole and is not associated with the completion of any command. Byte is not meaningful whenever a Communications Error is reported in the first byte.

Bit #7	Field Device Malfunction—A hardware error or failure has been detected by the device. Further information may be available through the Read Additional Transmitter Status Command, #48.
Bit #6	Configuration Changed—A write or set command has been executed.
Bit #5	Cold Start—Power has been removed and reapplied resulting in the reinstallations of the setup information. The first command to recognize this condition will automatically reset this flag. This flag may also be set following a Master Reset or a Self Test.
Bit #4	More Status Available—More status information is available than can be returned in the Field Device Status.Command #48, Read Additional Status Information, will provide this additional status information.
Bit #3	Primary Variable Analog Output Fixed—The analog and digital analog outputs for the Primary Variable are held at the requested value. They will not respond to the applied process.
Bit #2	Primary Variable Analog Output Saturated—The analog and digital analog outputs for the Primary Variable are beyond their limits and no longer represent the true applied process.
Bit #1	Non-Primary Variable Out of Limits—The process applied to a sensor, other than that of the Primary Variable, is beyond the operating limits of the device. The Read Additional Transmitter Status Command, #48, may be required to identify the variable.
Bit #0	Primary Variable Out of Limits—The process applied to the sensor for the Primary Variable is beyond the operating limits of the device.

4. DATA FORMATS

The most significant byte is transmitted first in each of the following data formats.

4.1. UNSIGNED INTEGER FORMAT

Some numeric data passed by the protocol is transmitted to and from the device in unsigned integers ranging from 1 to 24 bits in length. This format is used to pass table indexes and as well as raw numbers. The various lengths are combined or null bits added so that data is always passed in multiples of eight bits.

The 8-bit unsigned integers that do not apply to a device and are used as a table index will be filled with "250", Not Used. Other unsigned integer fields may be set to "0" or another number when they do not apply. Each document describes these special cases when they occur.

4.2. IEEE 754 FLOATING POINT FORMAT

The following summarizes the IEEE 754 and recommends that standards are referred to for implementation.

The floating point values passed by the protocol are based on the IEEE 754 single precision floating point standard.

Data Bvte	#0	#1	#2	#3
	S EEEEEEE	E MMMMMMM	MMMMMMMM	MMMMMMMM

S - Sign of the mantissa; 1 = negative

E - Exponent; Biased by 127 decimal in two's complement format

M- Mantissa; 23 least significant bits, fractional portion

The value of the floating point number described above is obtained by multiplying 2, raised to the power of the unbiased exponent, by the 24-bit mantissa. The 24-bit mantissa is composed of an assumed most significant bit of 1, a decimal point following the 1, and the 23 bits of the mantissa.

$$S1.M \times 2^{E-127}$$

The floating point parameters not used by a device will be filled with 7F A0 00 00; Not-a-Number.

4.3. ASCII DATA FORMAT

Some of the alpha-numeric data passed by the protocol is transmitted to and from the devices in the ASCII format. Refer to any ASCII Code table for the alpha-numeric character code assignments.

4.4. PACKED-ASCII (6-BIT ASCII) DATA FORMAT

Some of the alpha-numeric data passed by the protocol is transmitted to and from the devices in the Packed-ASCII format. Packed-ASCII is a subset of ASCII produced by removing the two most significant bits of each ASCII character. This allows four Packed-ASCII characters to be placed in the space of three ASCII characters. Typically, Packed-ASCII strings are defined in even multiples of three bytes, four ASCII characters.

Packed-ASCII Data Byte	#0		#1		#2		…
ASCII Data Byte	#0	#1	# 1	#2	#2	#3	…
ASCII Data Bit	543210	54	3210	5432	10	543210	…

Construction of Packed-ASCII characters:

a) Truncate Bit #6 and #7 of each ASCII character.
b) Pack four, 6 bit-ASCII characters into three bytes.

Reconstruction of ASCII characters:

a) Unpack the four, 6-bit ASCII characters.
b) Place the complement of Bit #5 of each unpacked, 6-bit ASCII character into Bit #6.
c) Set Bit #7 of each of the unpacked ASCII characters to zero.

PACKED-ASCII CODES
(in Hexadecimal)

CHAR	CODE	CHAR	CODE	CHAR	CODE	CHAR	CODE
@	00	P	10	Space	20	0	30
A	01	Q	11	!	21	1	31
B	02	R	12	“	22	2	32
C	03	S	13	#	23	3	33
D	04	T	14	$	24	4	34
E	05	U	15	%	25	5	35
F	06	V	16	&	26	6	36
G	07	W	17	’	27	7	37
H	08	X	18	(	28	8	38
I	09	Y	19	)	29	9	39
J	0A	Z	1A	*	2A	:	3A
K	0B	[	1B	+	2B	;	3B
L	0C	\	1C	’	2C	<	3C
M	0D	]	1D	-	2D	=	3D
N	0E	^	1E	.	2E	>	3E
O	0F	_	1F	/	2F	?	3F

5. VARIABLE DESCRIPTIONS

This section contains definitions for each variable type within a device.

Dynamic Variables is the term given to the collective set of Primary, Secondary, Tertiary, and 4th Variables.

The Primary Variable is the first Dynamic Variable returned in Command #3, Read All Dynamic Variables. In most cases, this variable will contain the process information. The Primary Variable is always associated with Analog Output #1. All commands that configure Analog Output #1 are related to the Primary Variable and all commands that affect the Primary Variable will also affect Analog Output #1.

The Secondary, Tertiary, and 4th Variables are the second, third and fourth Dynamic Variables returned in Command #3. In most cases, these variables contain information associated with the process being measured in the Primary Variable. When more than one Analog Output exists in a field device, the Secondary, Tertiary, and 4th Variables are always associated with Analog Output #2, #3, and #4, respectively.

Transmitter Variables have been defined for those devices that require more flexibility. A Transmitter Variable is a uniquely defined variable within a device and is typically associated with process information. A code number is assigned for each and this assignment will never change. These Transmitter Variable Codes are then used to assign Transmitter Variables to Dynamic Variables and their respective Analog Outputs, to change the order in which the Dynamic Variables are returned, and to perform functions on the Transmitter Variables that are similar to the Dynamic Variables. Transmitter Variables also enable a device to accommodate more than four variables. In this case, a user can setup the device one time and then access the Dynamic Variables as if only dedicated Primary through 4th Variables existed. Command #33 and #50 through #56 provide the ability to perform these functions.

6. IMPLEMENTATION NOTES

6.1. COMPATIBILITY RULES

Forward Compatibility allows HART field device implementations to be enhanced or modified in specific ways without requiring HART master software upgrades. This rather straightforward statement is complicated by the need to determine when a HART master needs to upgrade its software.

A master must upgrade its software when it is unable to access required data or services. This only happens when a device cannot or decides not to follow the Forward Compatibility Rules, changes its Device Type Code, and becomes unknown to the master.

Another aspect of Forward Compatibility is identifying which devices use a particular frame format, since the released versions of the HART Protocol utilize two different frame formats. The original version is referred to as the Short Frame and the more recent version is referred to as the Extended Frame.

Forward Compatibility applies to HART Devices beginning at Revision 5. These rules are not followed in the transition from HART Revision 3 and 4 to Revision 5.

Forward Compatibility Rules

1) The contents of the Identification Service, Command #O and #11, must retain their present meanings. This includes Device Type Code Expansion.

2) The Short Frame Format is used in HART devices containing Universal Revision 3 and 4. The Extended Frame Format is used in HART devices containing Universal Revision 5 and higher. Command 0 will be implemented in both Short and Extended Frame Formats for Universal Revision 5 and higher.

3) No command may be changed in such a way as to alter any member of its data field so that the use of the command will produce different results than a previous version.

4) Bytes may be added to any command up to the maximum number of data bytes.

5) Universal and Common-Practice Commands may not be deleted from any device.

6) Specially marked Transmitter Specific Commands cannot be deleted.

7) Universal Command definitions are based on the Universal revision level of the device. (most recent <= that of device)

8) A complete list of commands, Transmitter-Specific Command Definitions, and Common-Practice Command Definitions are based on the Transmitter-Specific Revision Level.

9) Extensions to any command and the addition of any command must be accompanied by a change in the appropriate document revision level and approved by everyone on the ECO approval list for the document.

10) Common-Practice Commands should be used whenever possible.

11) Current entries may not be deleted from enumerated tables or Response Codes. Only additions can be made.

12) When a device does not satisfy the above Forward Compatibility requirements, it must be assigned and use a different Device Type Code. It is recommended that a change in Type Code effects the product in visible ways to avoid customer confusion, especially among control system users. For instance, the product name should change, packaging should reflect the new product name, and it should be understood that there is no inference of similarity between the old and new products.

13) Field Devices may upgrade to Revision 5 at some later time without changing the Type Code, by following these rules.

a) Command #4 and #5 must be deleted.
b) Command #11 through #19 must be added to replace Command #4 and #5.
c) Transmitter Type Code must be removed from all Transmitter-Specific Commands.
d) All commands, except command #0, must only be implemented in the Extended Frame Format.
e) Command #0 must be implemented in both Short and Extended Frame Formats.
f) The number of Command-Specific Response Codes must be expanded from 15 to 127.

6.2. RESPONSE DATA BYTES

The Data Bytes of the response message following a write command will reflect the data held in the device's data memory.

The data returned with a valid write command will be in the same units as the data that was sent.

The Response Data Bytes are not returned if a Communications or Command Error is being reported. Refer to Section 3, Response Code Information, for further information.

6.3. TABLES

A device may develop tables for specific purposes. An 8-bit unsigned integer based table shall use the following standard format.

0	Transmitter Specified Function
•	•
•	•
•	•
249	Transmitter Specified Function
250	"Not Used"
251	"None"
252	"Unknown"
253	"Special"
254	“Expansion”
255	Reserved

Any dedicated codes, 250 - 255, not used in a table shall be defined as Reserved in each Transmitter-Specific document.

6.4. EXAMPLE PRIMARY VARIABLE CURRENT DAC TRIM SEQUENCE

Enter Fixed Primary Variable Current Mode at 4 ma with Command #40. Perform Primary Variable Current DAC Zero Trim with Command #45.Enter Fixed Pirmary Variable Current Mode at 20 ma with Command #40. Perform Primary Variable Current DAC Gain Trim with Command #46. Exit Fixed Primary Variable Current Mode with Command #40.

6.5. WRITE PROTECT MODE

The Write Protect Mode provides a method of preventing changes to the device's setup information and other stored data. This mode is enabled and disabled with a hardware jumper inside the device or some other technique.

When Write Protected is enabled, the local Zero and Span buttons on the device are disabled and most of the commands that change information within the device will not be executed. The Self Test, Master Reset, and all read commands will operate normally in this mode. Those commands not executed for this reason will return Command-Specific Response Code #7, In Write Protect Mode.

Not all devices implement Write Protect. Refer to the User's Manual for the specific device to determine if it has been implemented. When this feature has not been implemented, the Write Protect Code returned with Command #15, Read Output Information, defaults to “251”, None.

6.6. PRIVATE LABEL DISTRIBUTOR

The Private Label Distributor Code contains the code for the name of the manufacturer that will appear on a Host display. It provides the ability for one manufacturer to sell devices manufactured by another manufacturer without the name of the primary manufacturer appearing.

The Private Label Distributor Code is returned with Command #15, Read Output Information. This code is set to the primary manufacturer of the device whenever the device is not private labeled.

6.7 EXPANDED DEVICE TYPE CODE

The 16-bit Expanded Device Type Code is composed of the Manufacturer Identification Code and the Manufacturer's Device Type Code.

The Manufacturer Identification Codes are unique to each manufacturer of HART devices and are defined in Table VIII of the Common Tables Document.

The Manufacturer's Device Type Codes are unique to each type of HART device made by the manufacturer and are assigned by the manufacturer of the product. The codes for Rosemount's devices are defined in Table I, Rosemount Device Type Codes, of the Common Tables Document. The Manufacturer's Device Type Code definitions for the other manufacturers should be available directly from the manufacturer of the device.

The Device Type Code of "254", Expansion, will always be returned in Byte #0 of Command #0 and #11. Expansion indicates that the following byte contains the Manufacturer Identification Code and the byte following this contains the Manufacturer's Device Type Code.

6.8. UNIQUE IDENTIFIER

The Unique Identifier is a 38-bit number which uniquely identifies each individual HART device. It is composed of the 14 least significant bits of the Expanded Device Type Code and a 24-bit Device Identification Number.

The 14-bit Expanded Device Type Code is composed of the 6 least significant bits of the Manufacturers Identification Code and the 8-bit Manufacturer's Device Type Code. Rosemount Group companies should use the Manufacturer Identification Code for the group and not the code for Rosemount.

One method of obtaining the Unique Identifier from a specific device is to issue Command #0 using the Short Frame Format. The Command #0 response includes the Manufacturers Identification Code, the Manufacturer's Device Type Code, and the Device Identification Number. These three parameters are combined to create the Unique Identifier of the specific device.

Command #11, Read Unique Identifier Associated with Tag, can also be used to obtain the Unique Identifier when the Tag of the specific device is known and this Command is sent with the Broadcast Address. Command #11 also responds with the three parameters required to construct the Unique Identifier.

A Broadcast Address is defined as 38 bits of zeros. Details for usage of these commands may be found in Data Link Layer Specification.

6.9. POLLING ADDRESS

The Polling Address is an address ranging from 0 through 15 that can be assigned by a customer to a field device. This address is used to control Analog Output #1 and provide a means of device identification. The device will retain this address through a Master Reset, Self Test, and the power being removed. Assigning a Polling Address to a device is compatible with Multidrop and Burst Mode operations.

The Polling Address can be used to activate and deactivate Analog Output #1. Analog Output #1 responds to the applied process only when the Polling Address of the device is set to 0. When the address assigned to a device is in the range from 1 through 15, Analog Output #1 is Not Active and does not respond to the applied process. While Analog Output #1 is Not Active, this Analog Output is set to its minimum; the Transmitter Status Bit #3, Primary Variable Analog Output Fixed, is set; and the Upscale/Downscale Alarm is disabled. If the Polling Address is changed back to 0, Analog Output #1 will again become Active and respond to the applied process. The operation of Analog Outputs other than #1 is not affected by the Polling Address.

The Polling Address can also be used to identify devices on Multidrop networks of up to 15 field devices. At installation, the customer assigns different Polling Addresses to each device on the network. Later, whenever the Host needs to obtain the Unique Identifier of a device, it sends Command #0, Read Unique Identifier, containing the Polling Address of the desired device.

In Burst Mode operation, the Polling Address can be assigned to the one field device present. Only one field device should be connected to a common transmission medium while operating in Burst Mode.

Certain commands that affect Analog Output #1 will not be executed while the Polling Address is set in the range from 1 through 15. For example, the Enter/Exit Fixed Primary Variable Current Mode, #40; Trim Primary Variable Current DAC Zero, #45; and Trim

Primary Variable Current DAC Gain, #46; will not be accepted and will return Command-Specific Response Code #11, in Multidrop Mode, when the device is operating in this mode. In addition, Command #66, Enter/Exit Fixed Analog Output Mode; Command #67, Trim Analog Output Zero; and Command #68, Trim Analog Output Gain will return In Multidrop Mode when Analog Output #1 is selected and the Polling Address is other than 0. Refer to the Data Link Layer Specification for further information.

7. UNIQUE TRANSMITTER CHARACTERISTICS

Each device may utilize different hardware components. This results in certain functions being performed differently in the various types of devices.

7.1 UPDATING DEVICE MEMORY

The devices typically use EEPROM or NVRAM to permanently store data. Depending on the specific type of EEPROM/NVRAM and its implementation in a device, the EEPROM Control Command, #39, may be required after a write command to permanently record the data. Refer to the Transmitter-Specific document for the specific requirements of each type of device.

If a device does not require and has not implemented the EEPROM Control Command, Response Code #64 of the Command Response Summary, Command Not Implemented, will be returned.

7.2 BUSY RESPONSE CODE

A few types of devices do not implement the Command Response Summary Response Code #32, Busy. These device types are not able to process incoming messages while performing certain functions and under these circumstances the device will not respond. Refer to the Transmitter-Specific documents for the specific implementation of each type of device.

8. MULTIDROP MODE OPERATION

Multidrop is a network of one or two Master devices connecting to multiple field devices across a common pair of wires or other medium. The Unique Identifier within the message must match that of the field device before commands received by a field device will be executed. bLikewise, a Host can determine from the Unique Identifier which field device sent the response.

Two mechanisms are available to obtain the Unique Identifier of a device. The Polling Address of the device can be used in networks containing up to 15 field devices by issuing Command #0, Read Unique Identifier, in the Short Frame Format. The user entered Tag of the device can be used in networks of almost any size by issuing Command #11, Read Unique Identifier Associated with Tag. Both of these approaches return the Unique Identifier required for further communications with the device.

Independent of the protocol, the interconnecting medium may place additional constraints on the number of field devices allowed on one network.

Sending Command #6, Write Polling Address, with the Polling Address ranging from 1 to 15 places the device into the Multidrop Mode. While in Multidrop Mode, Analog Output #l of the field device will be set to its minimum.

9. BURST MODE

Burst Mode is an extension to the HART Protocol that provides the continuous transmission of standard HART command responses by a field device. This mode provides digital communications for those Host devices that choose not to issue commands to request information. Only one field device should be connected to a common transmission medium while operating in Burst Mode.

Command #109, Burst Mode Control, is used to enter and exit the Burst Mode. The device will remain in Burst Mode through a Master Reset, a Self Test, and the power being removed. The tracking of the Primary Variable by Analog Output #1 is controlled by the Polling Address assigned with Command #6.

Command #108, Write Burst Mode Command Number, selects the response message that the device is to send. The user chooses between Command #1, #2, or #3 of the Universal Commands with Command #l being the default. Refer to the Transmitter-Specific document for additional commands that may have been implemented in each device type. The device will remember the Burst Command Number through an exit of Burst Mode, a Master Reset, a Self Test, and the power being removed.

10. RELEASE NOTES

10.1. MAJOR MODIFICATIONS FROM INITIAL REV 3 TO REV 4

- Added Command #49, Write Sensor Serial Number.
  (Refer to document Revision 3, D8700038, and Revision 4, D8900067, for detailed information.)

10.2. MAJOR MODIFICATIONS FROM REV 4 TO REV 5

- This revision incorporates Write Protect Mode and adds Transmitter Variable Commands.
- Added sections on variable descriptions, Write Protect Mode, Private Label Distributor, and Transmitter Type Code Expansion.
- Added Command #50, Read Dynamic Variable Assignments.
- Added Command #51, Write Dynamic Variable Assignments.
- Added Command #52, Set Transmitter Variable Zero.
- Added Command #53, Write Transmitter Variable Units.
- Added Command #54, Read Transmitter Variable Damping Value.
- Added Command #55, Write Transmitter Variable Damping Value.
- Added Command #56, Write Transmitter Variable Sensor Serial Number.

10.3. MAJOR MODIFICATIONS FROM REV 5 TO REV 6.0 - FINAL

- This revision incorporates Unique Identifier, Burst Mode Operation, Polling Address, and other changes pertaining to the Extended Frame Format.
- A decimal point and integer has been added to the HART document revision numbering system.
- Rearranged document and renamed several sections.
- Changed most occurrences of "transmitter" to "field device".
- Deleted all references to the Transmitter Type Code being returned in the Transmitter-Specific Commands.
- Deleted Command #4, Read Common Static Data.
- Deleted Command #5, Write Common Static Data.
- Removed Expansion from each of the Transmitter Command Class Partitions.
- Changed the titles of several commands.
- Added Command #11, Read Unique Identifier Associated with Tag.
- Added Command #12, Read Message.
- Added Command #13, Read Tag, Descriptor, Date.

- Added Command #14, Read Primary Sensor Information.
- Added Command #15, Read Output Information.
- Added Command #16, Read Final Assembly Number.
- Added Command #17, Write Message.
- Added Command #18, Write Tag, Descriptor, Date.
- Added Command #19, Write Final Assembly Number.
- Added Command #57, Read Unit Tag, Descriptor, Date.
- Added Command #58, Write Unit Tag, Descriptor, Date.
- Added Command #59, Write Number of Response Preambles.
- Added Command #108, Write Burst Mode Command Number.
- Added Command #109, Burst Mode Control.
- Added Command #110, Read All Dynamic Variables.
- Added Command #111, Transfer Service Control.
- Added Command #112, Transfer Service.
- Changed Communications Error Summary Bit #2 from Message Time-out Reserved.
- Changed the Command-Specific Response Code bit assignments from #0 - #3 to #0 - #6 and expanded the number of codes to 127.
- Moved Command Response Summary, Bit #4, Transmitter Fault to Command-Specific Response Code #16 and renamed it Access Restricted.
- Changed Command Response Summary Bit #5 to Response Code #32.
- Changed Command Response Summary Bit #6 to Response Code #64.
- Changed Field Device Status Bit #4 from In Burst Mode to Reserved.
- Added section on IEEE 754 Floating Point Format.
- Added section on ASCII Data Format.
- Added section on Compatibility.
- Removed section on Model 268 Compatibility.
- Added section on DAC Trim Sequence.
- Added section on Unique Identifier.

- Added section on Polling Address.
- Added section on Burst Mode.
  (Refer to document Revision 6, D8900069, for detailed information.)

10.4. CHANGES FROM REV 6.0 - FINAL TO REV 7.0 - FINAL

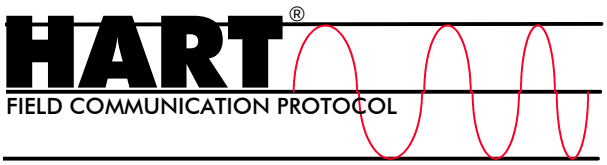
- This revision adds commands for devices with Multiple Analog Outputs and Analog Outputs other than Current.
- This revision adds More Status Available to the Field Device Status Byte of the Response Codes.
- Summarized Release Notes from Rev 5 to Rev 6.0 - Final

Page	Line	Change	Text
T P	4	Replace	"6.0" by "7.0"
T P	5	Replace	"14 February 1990" by "11 October 1990"
T P	6	Replace	"14 February 1990" by "11 October 1990"
T P	7	Replace	"14 February 1990" by "11 October 1990"
T P	8	Replace	"D8900069;" by "D9000035;"
2	19	Insert	"P. V."
2	31	Insert	"Primary Variable"
2	44	Insert	"60 * Read Analog Output and Percent of Range..."
2	49	Replace	"110" by “110*”
3	8	Insert	"Primary Variable"
3	9	Insert	"Primary Variable"
3	9	Delete	"(Push SPAN Button)"
3	10	Insert	"Primary Variable"
3	10	Delete	"(Push ZERO Button)"
3	13	Insert	"Primary Variable"
3	16	Insert	"Primary Variable"
3	18	Insert	"64 * Write Analog Output Additional Damping..."
3	36	Insert	"Primary Variable Current"
3	37	Insert	"Primary Variable Current"
3	45	Insert	"67 Trim Analog Output Zero 68 Trim Analog..."
7	5	Replace	"Command Specific" by "Command-Specific"
7	10	Delete	"they"
7	12	Replace	"#32 and #64" by "#32, Busy, or #64, Command..”
7	24	Insert	"Command-Specific"
7	34	Replace	"Reponse" by "Response"
9	24	Replace	"Reserved, set to zero." by "More Status..."
9	29	Replace	"Bit #3 Output..." by "Bit #3 Primary Variable. -."
9	34	Insert	"Primary Variable"
9	35	Replace	"current" by "analog outputs for the Primary..."
9	36	Replace	"cannot respond to..." by "no Longer represent..."
12	13	Replace	"the analog output." by "Analog Output #1."
12	14	Replace	"the analog output..." by "Analog Output #1..."
12	16	Replace	"the analog output." by "Analog Output #1."
12	21	Insert	"When more than one Analog Output exists in a…"
12	31	Replace	"Variables," by "Variables and their..."
12	33	Delete	"to select the variable for the analog output,"
14	27	Replace	"type code," by "Type Code,"
15	22	Insert	"EXAMPLE PRIMARY VARIABLE CURRENT"
15	24	Insert	"Primary Variable"
15	24	Replace	"4rnA" by "4 ma"
15	25	Insert	"Primary Variable Current"
15	26	Insert	"Primary Variable"

Page	Line	Change	Text
15	26	Replace	"2OmA" by "20 ma"
15	27	Insert	"Primary Variable Current"
15	28	Insert	"Primary Variable"
16	32	Replace	"Rosemount Devices" by "Rosemount's devices"
18	6	Delete	"the"
18	6	Insert	"#1"
18	12	Replace	"the Analog Output...." by "Analog Output #1...."
18	16	Delete	"the"
18	16	Insert	"#1"
18	17	Delete	"the"
18	17	Insert	"#1"
18	17	Replace	"the current" by "this Analog Output"
18	18	Replace	"4 milliamperes;" by "its minimum;"
18	18	Replace	"#4," by "#3, Primary Variable Analog"
18	19	Delete	"Current"
18	20	Delete	"the"
18	21	Insert	"#1"
18	22	Insert	"The operation of Analog Outputs other than #1..."
18	36	Delete	"the"
18	36	Insert	"#1"
18	38	Insert	"Primary Variable"
18	39	Insert	"Primary Variable Current"
18	39	Insert	"Primary Variable Current"
18	40	Replace	"#46" by "#46;"
18	42	Insert	"In addition, Command #66, Enter/Exit Fixed..."
18	47	Replace	"information ." by "information."
20	26	Delete	"the"
20	26	Insert	"#1"
20	27	Replace	"4 milliamperes." by "its minimum."
21	14	Delete	"the"
21	14	Insert	"#1"

10.5. CHANGES FROM REV 7.0 TO REV 7.1

The document was translated from a Multimate document to Microsoft Word. As a result of this translation the document format was altered. No other modifications were made to the document.



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HART® Communication Foundation / HCF Staff	Keith Kleinschmidt	On File	22Jan97