Stratos Multi E401

HART Command Specification

Device Revision 1

HART Protocol Revision 7.6

Document Revision 1.1

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Content

1 General Information

This documentation describes the functionality of the Stratos Multi E401. The HART functionality based on the HART Protocol Revision 7.6 and supports all mandatory and some optional features.

2 Common Tables

2.1 Device Variable Codes

Some Device Variables (e.g. Temperature) can be used with different units. The unit code to be used can be changed at the device only.

Sensor Channel	Category	Device Variable Code	PV	Measuring Value	Units Code	Variable Class
IA	Temperature	0	x	Temperature	32 °C 33 °F	64 - Temperature
	pH	1	x	pH value	59 pH	81 - Analytical
		2	x	Redox Voltage	36 mV	83 - Electronic Potential
		3	x	pH Voltage	36 mV	83 - Electronic Potential
		4	x	rH Value	242 rH	81 - Analytical
		5	x	Glass Impedance	170 MΩ	85 - Resistance
		6	-	Reference Impedance	163 kΩ	85 - Resistance
		7	-	pH Zero Point	59 pH	81 - Analytical
		8	-	pH Slope	243 mV/pH	0 - Not classified
		9	-	ISFET Operating Point	36 mV	83 - Electronic Potential
		10	-	ORP Offset	36 mV	83 - Electronic Potential
	Oxy	11	x	Sat. %Air	57 %	111 - Miscellaneous
		12	x	Sat. %O2	57 %	111 - Miscellaneous
		13	x	Conc. (Liquid)	146 µg/l 169 ppb	73 - Mass per Volume
		14	x	Conc. (Gas)	57 %	88 - Volume per Volume
		15	-	Sensor Current	170 nA	84 - Current
		16	x	Partial Pressure	8 mbar 5 mmHg	65 - Pressure
		17	-	Sensor Current (25 °C)	170 nA	84 - Current
		18	-	Process Pressure	8 mbar 12 kPa 6 psi	65 - Pressure
		19	-	Impedance	163 kΩ	85 - Resistance
		20	-	Oxy Zero	170 nA	84 - Current
		21	-	Oxy Slope	170 nA	84 - Current
		22	-	Stern Volmer C.	251 none	0 - Not classified
		23	-	Phase Angle	143 °	86 - Angle
	Cond	24	x	Conductivity	67 µS/cm	87 - Conductance
		25	x	Salinity	244 g/kg	90 - Concentration
		26	x	Concentration	57 %	90 - Concentration
		27	x	Resistivity	173 MΩcm	85 - Resistance
		28	x	USP Value	57 %	87 - Conductance
		29	x	TDS	170 mg/l	73 - Mass per Volume
		30	-	Conductance	56 µS	87 - Conductance
		31	-	Cell Constant	245 1/cm	0 - Not classified
		32	-	Zero Point	56 µS	87 - Conductance
	Diagnostic	33	-	Sensoface	251 none	0 - Not classified
		34	-	Cal Timer	52 h	70 - Time
		35	-	Remaining Lifetime	52 h	70 - Time
		36	-	Wear	57 %	0 - Not classified
		37	-	Operating Time	53 d	70 - Time
		38	-	SIP Counter	251 none	0 - Not classified
		39	-	CIP Counter	251 none	0 - Not classified
		40	-	Autoclaving Counter	251 none	0 - Not classified

Sensor Channel	Category	Device Variable Code	PV	Measuring Value	Units Code	Variable Class
IIA	Temperature	44	x	Temperature	32 °C 33 °F	64 - Temperature
	pH	45	x	pH value	59 pH	81 - Analytical
		46	x	Redox Voltage	36 mV	83 - Electronic Potential
		47	x	pH Voltage	36 mV	83 - Electronic Potential
		48	x	rH Value	242 rH	81 - Analytical
		49	x	Glass Impedance	170 MΩ	85 - Resistance
		50	-	Reference Impedance	163 kΩ	85 - Resistance
		51	-	pH Zero Point	59 pH	81 - Analytical
		52	-	pH Slope	243 mV/pH	0 - Not classified
		53	-	ISFET Operating Point	36 mV	83 - Electronic Potential
		54	-	ORP Offset	36 mV	83 - Electronic Potential
	Oxy	55	x	Sat. %Air	57 %	111 - Miscellaneous
		56	x	Sat. %O2	57 %	111 - Miscellaneous
		57	x	Conc. (Liquid)	146 µg/l 169 ppb	73 - Mass per Volume
		58	x	Conc. (Gas)	57 %	88 - Volume per Volume
		59	-	Sensor Current	170 nA	84 - Current
		60	x	Partial Pressure	8 mbar 5 mmHg	65 - Pressure
		61	-	Sensor Current (25 °C)	170 nA	84 - Current
		62	-	Process Pressure	8 mbar 12 kPa 6 psi	65 - Pressure
		63	-	Impedance	163 kΩ	85 - Resistance
		64	-	Oxy Zero	170 nA	84 - Current
		65	-	Oxy Slope	170 nA	84 - Current
		66	-	Stern Volmer C.	251 none	0 - Not classified
		67	-	Phase Angle	143 °	86 - Angle
	Cond	68	x	Conductivity	67 µS/cm	87 - Conductance
		69	x	Salinity	244 g/kg	90 - Concentration
		70	x	Concentration	57 %	90 - Concentration
		71	x	Resistivity	173 MΩcm	85 - Resistance
		72	x	USP Value	57 %	87 - Conductance
		73	x	TDS	170 mg/l	73 - Mass per Volume
		74	-	Conductance	56 µS	87 - Conductance
		75	-	Cell Constant	245 1/cm	0 - Not classified
		76	-	Zero Point	56 µS	87 - Conductance
	Diagnostic	77	-	Sensoface	251 none	0 - Not classified
		78	-	Cal Timer	52 h	70 - Time
		79	-	Remaining Lifetime	52 h	70 - Time
		80	-	Wear	57 %	0 - Not classified
		81	-	Operating Time	53 d	70 - Time
		82	-	SIP Counter	251 none	0 - Not classified
		83	-	CIP Counter	251 none	0 - Not classified
		84	-	Autoclaving Counter	251 none	0 - Not classified

Sensor Channel	Category	Device Variable Code	PV	Measuring Value	Units Code	Variable Class
IIB	Temperature	88	x	Temperature	32 °C 33 °F	64 - Temperature
	Cond	89	x	Conductivity	67 µS/cm	87 - Conductance
		90	x	Salinity	244 g/kg	90 - Concentration
		91	x	Concentration	57 %	90 - Concentration
		92	x	Resistivity	173 MΩcm	85 - Resistance
		93	x	USP Value	57 %	87 - Conductance
		94	x	TDS	170 mg/l	73 - Mass per Volume
		95	-	Conductance	56 µS	87 - Conductance
		96	-	Cell Constant	245 1/cm	0 - Not classified
		97	-	Zero Point	56 µS	87 - Conductance
	Diagnostic	98	-	Sensoface	251 none	0 - Not classified
		99	-	Cal Timer	52 h	70 - Time
		100	-	Remaining Lifetime	52 h	70 - Time
		101	-	Wear	57 %	0 - Not classified
		102	-	Operating Time	53 d	70 - Time
		103	-	SIP Counter	251 none	0 - Not classified
		104	-	CIP Counter	251 none	0 - Not classified
		105	-	Autoclaving Counter	251 none	0 - Not classified
CI	Temperature	109	x	Temp.-Diff.	32 °C 33 °F	64 - Temperature
	pH	110	x	pH Diff.	59 pH	81 - Analytical
		111	x	pH Volt. Diff.	36 mV	83 - Electronic Potential
		112	x	ORP Diff.	36 mV	81 - Analytical
	Oxy	113	x	Sat. %Air Diff.	57 %	111 - Miscellaneous
		114	x	Sat. %O2 Diff.	57 %	111 - Miscellaneous
		115	x	Conc. (Liq.) Diff.	146 µg/l 169 ppb	73 - Mass per Volume
		116	x	Conc. (Gas) Diff.	57 %	88 - Volume per Volume
	Cond	117	x	Cond Diff.	67 µS/cm	87 - Conductance
		118	x	Resistivity Diff.	173 MΩcm	85 - Resistance
		119	x	Ratio	251 none	0 - Not classified
		120	x	Passage	57 %	0 - Not classified
		121	x	Rejection	57 %	0 - Not classified
		122	x	Deviation	57 %	0 - Not classified
		123	x	Conc. Alkal. [ppm]	139 ppm	90 - Concentration
		124	x	pH Value	59 pH	81 - Analytical
		125	x	Degassed Cond	67 µS/cm	87 - Conductance
		126	-	Remaining Capacity	57 %	111 - Miscellaneous
		127	-	Remaining Time	51 s	70 - Time

Sensor Channel	Category	Device Variable Code	PV	Measuring Value	Units Code	Variable Class
CII	Temperature	128	x	Temp.-Diff.	32 °C 33 °F	64 - Temperature
	pH	129	x	pH Diff.	59 pH	81 - Analytical
		130	x	pH Volt. Diff.	36 mV	83 - Electronic Potential
		131	x	ORP Diff.	36 mV	81 - Analytical
	Oxy	132	x	Sat. %Air Diff.	57 %	111 - Miscellaneous
		133	x	Sat. %O2 Diff.	57 %	111 - Miscellaneous
		134	x	Conc. (Liq.) Diff.	146 µg/l 169 ppb	73 - Mass per Volume
		135	x	Conc. (Gas) Diff.	57 %	88 - Volume per Volume
	Cond	136	x	Cond Diff.	67 µS/cm	87 - Conductance
		137	x	Resistivity Diff.	173 MΩcm	85 - Resistance
		138	x	Ratio	251 none	0 - Not classified
		139	x	Passage	57 %	0 - Not classified
		140	x	Rejection	57 %	0 - Not classified
		141	x	Deviation	57 %	0 - Not classified
		142	x	Conc. Alkal. [ppm]	139 ppm	90 - Concentration
		143	x	pH Value	59 pH	81 - Analytical
		144	x	Degassed Cond	67 µS/cm	87 - Conductance
		145	-	Remaining Capacity	57 %	111 - Miscellaneous
		146	-	Remaining Time	51 s	70 - Time
Misc	Misc	147	-	Flow	138 l/h	66 - Volumetric Flow
		148	-	Current Input	39 mA	84 - Current
		244	-	Percent of Range	57 %	0 - Not classified
		245	-	Loop Current	39 mA	0 - Not classified
		246	-	PV	- -	depends on selection
		247	-	SV	- -	depends on selection
		248	-	TV	- -	depends on selection
		249	-	QV	- -	depends on selection

2.2 Analog Channel Codes

Analog Channel Code	Description
0	Current Loop – I1
1	Current Loop – I2
2	Current Loop – I3 - (TAN Option)
3	Current Loop – I4 – (TAN Option)

2.3 Transfer Function Codes

Transfer Function Code	Description
0	Linear
234	Logarithmic
235	Table – (TAN Option)
236	Function

2.4 Alarm Selection Codes

Alarm Selection Code	Description
0	High – (22 mA)

1	Low – (3,8 mA)
239	Hold Last Value
240	Costum – (Defined by GUI)
251	None – (Off)

2.5 Unit Codes

Unit Code	Description
240	[PPT] – Parts per Trillion
242	[rH]
243	[mV/pH] – Milli Volt per pH
244	[g/kg] – Gramms per Kilogramms
245	[1/cm] – One per Centimeter

3 Commands

3.1 Universal Commands

Command 0 Read: Unique Identifier

Return identity information about the field device including: the Device Type, Revision Levels, and Device ID. This command is implemented by a field device in both Short and Long Frame Formats. Command 0 is the only command that may respond to a short frame address.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0	Unsigned-8	Reserved. Constant value "254"
1-2	Enum	Device Type Code - [0x61CD]
3	Unsigned-8	Minimum Number of Preambles required (Master to Slave)
4	Unsigned-8	HART Protocol Major Revision
5	Unsigned-8	Device Revision Level
6	Unsigned-8	Software Revision Level
7	Unsigned-8	Hardware Revision/Physical Signaling Code [U5/U3]
8	Bits	HART Signal Flags
9-11	Unsigned-24	Device ID
12	Unsigned-8	Minimum Number of preambles (Slave to Master)
13	Unsigned-8	Maximum Number of Device Variables
14-15	Unsigned-16	Configuration Change Counter
16	Bits	Extended Field Device Status
17-18	Enum	Manufacturer - Identification Code - [0x0061]
19-20	Enum	Private Label Distributor - Identification Code - [0x0061]
21	Enum	Device Profile Code

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error

Command 1 Read: Primary Variable

Read the Primary Variable. The Primary Variable value is returned along with its Units Code.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0	Enum	Primary Variable - Unit Code
1-4	Float	Primary Variable - Value

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
6	Error	Device-Specific Error
8	Warning	Update Failure
16	Error	Access Restricted

Command 2 Read: Current Loop, Percent of Range

Reads the Loop Current and its associated Percent of Range. The Loop Current always matches the current that can be measured by a milliampere in series with the field device; this includes the loop current under alarm conditions.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0-3	Float	Primary Variable - Loop Current [mA]
4-7	Float	Primary Variable - Percent Of Range [%]

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
6	Error	Device-Specific Error
8	Warning	Update Failure
16	Error	Access Restricted

Command 3 Read: Dynamic Variable, Loop Current

Reads the Loop Current and up to four predefined Dynamic Variables. The Loop Current always matches the current that can be measured by a milliampere in series with the field device; this includes alarm condition and set values.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0-3	Float	Primary Variable - Loop Current [mA]
4	Enum	Primary Variable - Unit Code
5-8	Float	Primary Variable - Value
9	Enum	Secondary Variable - Unit Code
10-13	Float	Secondary Variable - Value
14	Enum	Tertiary Variable - Unit Code
15-18	Float	Tertiary Variable - Value
19	Enum	Quaternary Variable - Unit Code
20-23	Float	Quaternary Variable - Value

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
6	Error	Device-Specific Error
8	Warning	Update Failure
16	Error	Access Restricted

Command 6 Write: Polling Address

Writes the Polling Address and the Loop Current mode to the field device. The Polling Address is used for automatic master identification of the field devices. The Loop Current Mode determines whether current signaling is being used by the field device.

Request Bytes

Index	Type	Description
0	Unsigned-8	Polling Address
1	Enum	Loop Current Mode

Response Bytes

Index	Type	Description
0	Unsigned-8	Polling Address
1	Enum	Loop Current Mode

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
2	Error	Invalid Poll Address Selection
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
12	Error	Invalid Mode Selection
16	Error	Access Restricted
32	Error	Busy

Command 7 Read Loop Configuration

Read Polling Address and the Loop Current Mode.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0	Unsigned-8	Polling Address
1	Enum	Loop Current Mode

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
16	Error	Access Restricted

Command 8 Read: Dynamic Variable Classification

Reads the Classification associated with the Dynamic Variables. The Classification determines the Unit Code Expansion Table that must be used by a Host.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0	Enum	Primary Variable Classification
1	Enum	Secondary Variable Classification
2	Enum	Tertiary Variable Classification
3	Enum	Quaternary Variable Classification

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
16	Error	Access Restricted

Command 9 Read: Device Variable with Status

This command allows a master to request the value and status of up to eight Device or Dynamic Variables. A master may request any number of Device Variables between Slot 1 and Slot 8.

Request Bytes

Index	Type	Description
0	Unsigned-8	Read Device Variable - Slot 1
1	Unsigned-8	Read Device Variable - Slot 2
2	Unsigned-8	Read Device Variable - Slot 3
3	Unsigned-8	Read Device Variable - Slot 4
4	Unsigned-8	Read Device Variable (optional) - Slot 5
5	Unsigned-8	Read Device Variable (optional) - Slot 6
6	Unsigned-8	Read Device Variable (optional) - Slot 7
7	Unsigned-8	Read Device Variable (optional) - Slot 8

Response Bytes

Index	Type	Description
0	Bits	Extended Field Device Status
1	Unsigned-8	Device Variable Code - Slot 1
2	Enum	Device Variable Classification - Slot 1
3	Enum	Device Variable Unit Code - Slot 1
4-7	Float	Device Variable Value - Slot 1
8	Bits	Device Variable Status - Slot 1
9	Unsigned-8	Device Variable Code - Slot 2
10	Enum	Device Variable Classification - Slot 2
11	Enum	Device Variable Unit Code - Slot 2
12-15	Float	Device Variable Value - Slot 2
16	Bits	Device Variable Status - Slot 2
17	Unsigned-8	Device Variable Code - Slot 3
18	Enum	Device Variable Classification - Slot 3
19	Enum	Device Variable Unit Code - Slot 3
20-23	Float	Device Variable Value - Slot 3
24	Bits	Device Variable Status - Slot 3
25	Unsigned-8	Device Variable Code - Slot 4
26	Enum	Device Variable Classification - Slot 4
27	Enum	Device Variable Unit Code - Slot 4
28-31	Float	Device Variable Value - Slot 4
32	Bits	Device Variable Status - Slot 4
33	Unsigned-8	Device Variable Code - Slot 5
34	Enum	Device Variable Classification - Slot 5
35	Enum	Device Variable Unit Code - Slot 5
36-39	Float	Device Variable Value - Slot 5
40	Bits	Device Variable Status - Slot 5
41	Unsigned-8	Device Variable Code - Slot 6
42	Enum	Device Variable Classification - Slot 6
43	Enum	Device Variable Unit Code - Slot 6
44-47	Float	Device Variable Value - Slot 6
48	Bits	Device Variable Status - Slot 6
49	Unsigned-8	Device Variable Code - Slot 7
50	Enum	Device Variable Classification - Slot 7
51	Enum	Device Variable Unit Code - Slot 7
52-55	Float	Device Variable Value - Slot 7
56	Bits	Device Variable Status - Slot 7
57	Unsigned-8	Device Variable Code - Slot 8
58	Enum	Device Variable Classification - Slot 8
59	Enum	Device Variable Unit Code - Slot 8
60-63	Float	Device Variable Value - Slot 8
64	Bits	Device Variable Status - Slot 8
65-68	Time	Device Time Stamp (Counter of seconds)

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
2	Error	Invalid Poll Address Selection
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
8	Warning	Update Failure
14	Warning	Dynamic Variables Returned For Device Variables
16	Error	Access Restricted
30	Warning	Command Response Truncated

Command 11 Read: Unique Identifier Associated With Tag

This command may be issued using either the device's long frame address or the Broadcast Address. No response is made unless the Tag matches that of the device. When the device's long frame address is used, no response is made unless the address and Tag matches that of the device.

Request Bytes

Index	Type	Description
0-5	Packed	Device Tag (6 Byte as 8 character Packed ASCII)

Response Bytes

Index	Type	Description
0	Unsigned-8	Reserved. Constant value "254"
1-2	Enum	Device Type Code - [0x61CD]
3	Unsigned-8	Minimum Number of Preambles required (Master to Slave)
4	Unsigned-8	HART Protocol Major Revision
5	Unsigned-8	Device Revision Level
6	Unsigned-8	Software Revision Level
7	Unsigned-8	Hardware Revision/Physical Signaling Code [U5/U3]
8	Bits	HART Signal Flags
9-11	Unsigned-24	Device ID
12	Unsigned-8	Minimum Number of preambles (Slave to Master)
13	Unsigned-8	Maximum Number of Device Variables
14-15	Unsigned-16	Configuration Change Counter
16	Bits	Extended Field Device Status
17-18	Enum	Manufacturer - Identification Code - [0x0061]
19-20	Enum	Private Label Distributor - Identification Code - [0x0061]
21	Enum	Device Profile Code

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error

Command 12 Read: Message

Reads the Message contained within the device.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0-23	Packed	Device Message (24 Byte as 32 character Packed ASCII)

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
16	Error	Access Restricted
32	Error	Busy

Command 13 Read: Device Tag, Descriptor, Date

Read the Tag, Descriptor and Date contained within the device. Only the Tag (6 Bytes or 8 Packed ASCII characters) is read here. To use the Long Tag used command 20.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0-5	Packed	Device Tag (6 Byte as 8 character Packed ASCII)
6-17	Packed	Descriptor (12 Byte as 16 character Packed ASCII)
18-20	Date	Date of next/last device action

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
16	Error	Access Restricted
32	Error	Busy

Command 14 Read: Primary Variable Transducer Information

Reads the Transducer Serial Number, Limits/Minimum Span Units Code, Upper/Lower Transducer Limit, and Minimum Span for the Primary Variable transducer.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0-2	Unsigned-24	Transducer Serial Number
3	Enum	Transducer Limits and Minimum Span Unit Code
4-7	Float	Upper Transducer Limit
8-11	Float	Lower Transducer Limit
12-15	Float	Minimum Span

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
16	Error	Access Restricted
32	Error	Busy

Command 15 Read: Device Information

Reads the Alarm Selection Code, Transfer Function Code, Range Values Unit Codes, Upper/Lower Range Values, Damping Value and Write Protect Code.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0	Enum	Primary Variable - Alarm Selection Code
1	Enum	Primary Variable - Transfer Function Code
2	Enum	Primary Variable - Upper/Lower Range Unit Code
3-6	Float	Primary Variable - Upper Range Value
7-10	Float	Primary Variable - Lower Range Value
11-14	Float	Primary Variable - Damping Value [s]
15	Enum	Write Protection Code
16	Enum	Reserved
17	Bits	Primary Variable - Analog Channel Flag

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
16	Error	Access Restricted
32	Error	Busy

Command 16 Read: Final Assembly Number

Reads the Final Assembly Number associated with the device. The Final Assembly Number is used for identifying the materials and electronics that comprise the field device.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0-2	Unsigned-24	Final Assembly Number

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
16	Error	Access Restricted
32	Error	Busy

Command 17 Write: Device Message

Write the Message into the device.

Request Bytes

Index	Type	Description
0-23	Packed	Device Message (24 Byte as 32 character Packed ASCII)

Response Bytes

Index	Type	Description
0-23	Packed	Device Message (24 Byte as 32 character Packed ASCII)

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
16	Error	Access Restricted
32	Error	Busy

Command 18 Write: Device Tag, Descriptor, Date

Write the Tag, Descriptor and Date into the device. Only the Tag (6 Bytes or 8 Packed ASCII characters) is written here.

Request Bytes

Index	Type	Description
0-5	Packed	Device Tag (6 Byte as 8 character Packed ASCII)
6-17	Packed	Descriptor (12 Byte as 16 character Packed ASCII)
18-20	Date	Date of next/last device action

Response Bytes

Index	Type	Description
0-5	Packed	Device Tag (6 Byte as 8 character Packed ASCII)
6-17	Packed	Descriptor (12 Byte as 16 character Packed ASCII)
18-20	Date	Date of next/last Device Action

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
9	Error	Invalid Date Code
16	Error	Access Restricted
32	Error	Busy

Command 19 Write: Final Assembly Number

Write Final Assembly Number into the device. The Final Assembly Number is used for identifying the materials and electronics that comprise the field device.

Request Bytes

Index	Type	Description
0-2	Unsigned-24	Final Assembly Number

Response Bytes

Index	Type	Description
0-2	Unsigned-24	Final Assembly Number

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
16	Error	Access Restricted
32	Error	Busy

Command 20 Read: Device Long Tag

Reads the 32 Byte Long Tag. Only the Long Tag (32 ISO Latin-1 characters) is read here.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0-31	Latin-1	Long Tag (32 Byte - Latin-1)

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
16	Error	Access Restricted
32	Error	Busy

Command 21 Read: Unique Identifier Associated With Long Tag

This command may be issued using either the device's Long Frame Address or the Broadcast Address. No response is made unless the Long Tag matches that of the device. This comparison is sensitive to character case. When the Long Frame Address is used no response is made unless the Address and Long Tag matches that of the device.

Request Bytes

Index	Type	Description
0-31	Latin-1	Long Tag (32 Byte - Latin-1)

Response Bytes

Index	Type	Description
0	Unsigned-8	Reserved. Constant value "254"
1-2	Enum	Device Type Code - [0x61CD]
3	Unsigned-8	Minimum Number of Preambles required (Master to Slave)
4	Unsigned-8	HART Protocol Major Revision
5	Unsigned-8	Device Revision Level
6	Unsigned-8	Software Revision Level
7	Unsigned-8	Hardware Revision/Physical Signaling Code [U5/U3]
8	Bits	HART Signal Flags
9-11	Unsigned-24	Device ID
12	Unsigned-8	Minimum Number of preambles (Slave to Master)
13	Unsigned-8	Maximum Number of Device Variables
14-15	Unsigned-16	Configuration Change Counter
16	Bits	Extended Field Device Status
17-18	Enum	Manufacturer - Identification Code - [0x0061]
19-20	Enum	Private Label Distributor - Identification Code - [0x0061]
21	Enum	Device Profile Code

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error

Command 22 Write: Device Long Tag

Writes the 32 Byte Long Tag. Only the Long Tag (32 ISO Latin-1 characters) is written here.

Request Bytes

Index	Type	Description
0-31	Latin-1	Long Tag (32 Byte - Latin-1)

Response Bytes

Index	Type	Description
0-31	Latin-1	Long Tag (32 Byte - Latin-1)

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
16	Error	Access Restricted
32	Error	Busy

Command 38 Reset: Configuration Changed Flag

Upon receiving this command, the device shall compare the Configuration Change Counter received in this command with the device's current value. If they do not match, the device returns "Configuration Change Counter Mismatch" and does not reset the Configuration Changed Bit.

Request Bytes

Index	Type	Description
0-1	Unsigned-16	Configuration Change Counter

Response Bytes

Index	Type	Description
0-1	Unsigned-16	Configuration Change Counter

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
9	Error	Configuration Change Counter Mismatch
16	Error	Access Restricted

Command 48 Read: Additional Device Status

Returns device status information not included in the Response Code or Device Status Byte. Response Bytes 0-5 and 14-24 may contain Device Specific Status information (see: Section 5)

Request Bytes

Index	Type	Description
0-5	Bits	Device Specific Status (6 Byte) - See section 4
6	Bits	Extended Device Status
7	Bits	Device Operating Mode
8	Bits	Standardized Status 0
9	Bits	Standardized Status 1
10	Bits	Analog Channel Saturated
11	Bits	Standardized Status 2
12	Bits	Standardized Status 3
13	Bits	Analog Channel Fixed
14-21	Bits	Device Specific Status (8 Byte - Bit) - See section 4

Response Bytes

Index	Type	Description
0-5	Bits	Device Specific Status (6 Byte) - See section 4
6	Bits	Extended Device Status
7	Bits	Device Operating Mode
8	Bits	Standardized Status 0
9	Bits	Standardized Status 1
10	Bits	Analog Channel Saturated
11	Bits	Standardized Status 2
12	Bits	Standardized Status 3
13	Bits	Analog Channel Fixed
14-21	Bits	Device Specific Status (8 Byte - Bit) - See section 4

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
6	Error	Device-Specific Error
8	Warning	Update In Progress
16	Error	Access Restricted

3.2 Common Practice Commands

Command 33 Read: Device Variables

This command allows a master to request the value of up to four Device Variables. Each Slot will accept any Device Variable supported by the device.

Request Bytes

Index	Type	Description
0	Unsigned-8	Device Variable Code - Slot 0
1	Unsigned-8	Device Variable Code - Slot 1
2	Unsigned-8	Device Variable Code - Slot 2
3	Unsigned-8	Device Variable Code - Slot 3

Response Bytes

Index	Type	Description
0	Unsigned-8	Device Variable Code - Slot 0
1	Enum	Device Variable Unit Code - Slot 0
2-5	Float	Device Variable Value - Slot 0
6	Unsigned-8	Device Variable Code - Slot 1
7	Enum	Device Variable Unit Code - Slot 1
8-11	Float	Device Variable Value - Slot 1
12	Unsigned-8	Device Variable Code - Slot 2
13	Enum	Device Variable Unit Code - Slot 2
14-17	Float	Device Variable Value - Slot 2
18	Unsigned-8	Device Variable Code - Slot 3
19	Enum	Device Variable Unit Code - Slot 3
20-23	Float	Device Variable Value - Slot 3

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
2	Error	Invalid Selection
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
8	Warning	Update Failure
16	Error	Access Restricted

Command 34 Write: Primary Variable Damping Value

The Primary Variable Damping Value represents one time constant. The output response to a step input reaches 63% of final steady-state value, after this time has elapsed.

Request Bytes

Index	Type	Description
0-3	Float	Primary Variable Damping Value [s]

Response Bytes

Index	Type	Description
0-3	Float	Primary Variable Damping Value [s]

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
3	Error	Passed Parameter Too Large
4	Error	Passed Parameter Too Small
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
8	Warning	Set To Nearest Possible Value
16	Error	Access Restricted
32	Error	Busy

Command 35 Write: Primary Variable Range Values

Defines the relationship between the Loop Current 4.00 mA and 20.0 mA points and the Primary Variable Value.

Request Bytes

Index	Type	Description
0	Unsigned-8	Primary Variable - Upper/Lower Range Unit Code
1-4	Float	Primary Variable - Upper Range Value
5-8	Float	Primary Variable - Lower Range Value

Response Bytes

Index	Type	Description
0	Unsigned-8	Primary Variable - Upper/Lower Range Unit Code
1-4	Float	Primary Variable - Upper Range Value
5-8	Float	Primary Variable - Lower Range Value

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
2	Error	Invalid Selection
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
8	Warning	Set To Nearest Possible Value
9	Error	Lower Range Value Too High
10	Error	Lower Range Value Too Low
11	Error	Upper Range Value Too High
12	Error	Upper Range Value Too Low
13	Error	Upper and Lower Range Values Out Of Limits
14	Warning	Span Too Small (Device Accuracy may be Impaired)
16	Error	Access Restricted
18	Error	Invalid Units Code
29	Error	Invalid Span
32	Error	Busy

Command 47 Write: Primary Variable Transfer Function

Selects the transfer function to be used between the Loop Current and the Primary Variable digital value.

Request Bytes

Index	Type	Description
0	Enum	Primary Variable - Transfer Function Code

Response Bytes

Index	Type	Description
0	Enum	Primary Variable - Transfer Function Code

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
2	Error	Invalid Selection
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
16	Error	Access Restricted
32	Error	Busy

Command 50 Read: Dynamic Variable Assignmnets

Responds with the Device Variable Numbers that are assigned to the Primary, Secondary, Tertiary and Quaternary Variables. Unsupported Dynamic Variables return "250" (Not Used) as the Device Variable assigned.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0	Unsigned-8	Device Variable Code assigned to Primary Variable
1	Unsigned-8	Device Variable Code assigned to Secondary Variable
2	Unsigned-8	Device Variable Code assigned to Tertiary Variable
3	Unsigned-8	Device Variable Code assigned to Quaternary Variable

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
6	Error	Device-Specific Error
16	Error	Access Restricted

Command 51 Write: Dynamic Variable Assignments

Assigns Device Variables to the Primary, Secondary, Tertiary and Quaternary Variables.

Request Bytes

Index	Type	Description
0	Unsigned-8	Device Variable Code assigned to Primary Variable
1	Unsigned-8	Device Variable Code assigned to Secondary Variable
2	Unsigned-8	Device Variable Code assigned to Tertiary Variable
3	Unsigned-8	Device Variable Code assigned to Quaternary Variable

Response Bytes

Index	Type	Description
0	Unsigned-8	Device Variable Code assigned to Primary Variable
1	Unsigned-8	Device Variable Code assigned to Secondary Variable
2	Unsigned-8	Device Variable Code assigned to Tertiary Variable
3	Unsigned-8	Device Variable Code assigned to Quaternary Variable

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
2	Error	Invalid Selection
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
16	Error	Access Restricted
32	Error	Busy

Command 54 Read: Device Variable Information

Responds with the Transducer Serial Number, the Limits, Damping Value and Minimum Span of the selected Device Variable along with the corresponding engineering units.

Request Bytes

Index	Type	Description
0	Unsigned-8	Device Variable Code

Response Bytes

Index	Type	Description
0	Unsigned-8	Device Variable Code
1-3	Unsigned-24	Device Variable Transducer Serial Number
4	Enum	Device Variable Limits and Minimum Span Unit Code
5-8	Float	Device Variable Upper Transducer Limit
9-12	Float	Device Variable Lower Transducer Limit
13-16	Float	Device Variable Damping Value
17-20	Float	Device Variable Minimum Span
21	Enum	Device Variable Classification
22	Enum	Device Variable Family
23-26	Time	Acquisition Period
27	Bits	Device Variable Properties

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
2	Error	Invalid Selection
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
16	Error	Access Restricted
32	Error	Busy

Command 59 Write: Number Of Response Preambles

This command sets the number of asynchronous 0xFF Preambles Bytes to be sent by a device before the start of a response message. Values between 5-20 are supported.

Request Bytes

Index	Type	Description
0	Unsigned-8	Number of Preambles send from Slave to Master [5-20]

Response Bytes

Index	Type	Description
0	Unsigned-8	Number of Preambles send from Slave to Master [5-20]

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
3	Error	Passed Parameter Too Large
4	Error	Passed Parameter Too Small
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
8	Warning	Set To Nearest Possible Value
16	Error	Access Restricted
32	Error	Busy

Command 76 Read: Device Lock State

This command reads the current state of the Lock Device.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0	Bits	Locking State Bits

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
6	Error	Device-Specific Error
16	Error	Access Restricted
32	Error	Busy

Command 520 Read: Process Unit Tag

Reads the 32 Byte Process unit Tag. Often within a plant there are multiple identical process units. Consequently the Long Tag for the devices maybe the same unit to unit. The Process Unit Tag indicates the process unit this device is associated with and can used to differentiate this unit from other devices with the same Long Tag but installed on a different process unit.

Request Bytes

Index	Type	Description
		None

Response Bytes

Index	Type	Description
0-31	Latin-1	Process Unit Tag

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
16	Error	Access Restricted
32	Error	Busy

Command 521 Write: Process Unit Tag

Writes the 32 Byte Process Unit Tag. The Process Unit Tag indicates the process unit this device is associated with.

Request Bytes

Index	Type	Description
0-31	Latin-1	Process Unit Tag

Response Bytes

Index	Type	Description
0-31	Latin-1	Process Unit Tag

Return Codes

Code	Class	Description
0	Success	No Command-Specific Error
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Error
7	Error	In Write Protect Mode
16	Error	Access Restricted
32	Error	Busy

4 Device Specific Status of Command 48

Byte	Bit	Message No	Message Text	Comment
0	0	F009	Firmware Error	additionally as C, D, P, T
	1	F202	System Failure	
	2	F201	KBUS Error	
	3	F230	Factory Setting	
	4	F200	Data Loss FRONT Param.	additionally as A, B, D, E, H, I, N, P, R, T, U, V, W, X-001, F204, F205
	5	F203	Inconsistent Parameter Setting	
	6	F212	Time/Date	
	7	-	-	Not used
1	0	F190	Meas. Recorder Full	
	1	F215	Memory Card Full	
	2	F211	Memory Card	
	3	F226	Power Supply OFF	
	4	-	-	Not used
	5	-	-	Not used
	6	-	-	Not used
	7	-	-	Not used
2	0	B074	Current I1 Parameter	
	1	B079	Current I2 Parameter	
	2	B084	Current I3 Parameter	
	3	B089	Current I4 Parameter	
	4	B070	Current I1 Span	
	5	B075	Current I2 Span	
	6	B080	Current I3 Span	
	7	B085	Current I4 Span	
3	0	-	-	Byte not used
4	0	F029	No Sensor Connected	Sensor 1
	1	F030	Wrong Sensor Connected	Sensor 1
	2	F036	Sensor Devaluated	Sensor 1
	3	C121	Sensor Error (Factory Settings)	Sensor 1; additionally as D, P, T
	4	-	-	Not used
	5	F029	No Sensor Connected	Sensor 2
	6	F030	Wrong Sensor Connected	Sensor 2
	7	F036	Sensor Devaluated	Sensor 2
5	0	C121	Sensor Error (Factory Settings)	Sensor 2; additionally as D, P, T
	1	-	-	Not used
	2	F029	No Sensor Connected	Sensor 3
	3	F030	Wrong Sensor Connected	Sensor 3
	4	F036	Sensor Devaluated	Sensor 3
	5	C121	Sensor Error (Factory Settings)	Sensor 3; additionally as D, P, T
	6	-	-	Not used
	7	-	-	Not used
6	0	-	-	Maintenance required
	1	-	-	Device variable alert
	2	-	-	Critical power failure
	3	-	-	Failure
	4	-	-	Out of specification
	5	-	-	Function check
	6	-	-	Not used
	7	-	-	Not used
7	0	-	-	Device Operation Mode - Not in use

Byte	Bit	Message No	Message Text	Comment
8	0	-	-	Device variable simulation active
	1	-	-	Non volatile memory defect
	2	-	-	Volatile memory defect
	3	-	-	Watchdog reset executed
	4	-	-	Power supply condition out of range
	5	-	-	Environment condition out of spec
	6	-	-	Electronic defect
	7	-	-	Device configuration locked
9	0	-	-	Status simulation active
	1	-	-	Discrete variable simulation active
	2	-	-	Event notification overflow
	3	-	-	Power supply need maintenance
10	0	-	-	SV - Analog channel saturated
	1	-	-	TV - Analog channel saturated
	2	-	-	QV - Analog channel saturated
11	0	-	-	Byte: IO-Devices - Not used
12	0	-	-	Byte: Wireless HART - Not used
13	0	-	-	SV - Analog channel fixed
	1	-	-	TV - Analog channel fixed
	2	-	-	QV - Analog channel fixed
14	0	F008	Adjustment Data	Sensor 1; additionally as C, D, P, T
	1	F240	Cal Mode is Active	Sensor 1
	2	C122	Sensor Memory (Cal Data)	Sensor 1; additionally as D, P, T
	3	C123	New Sensor – Adjustment Required	Sensor 1; additionally as D, P, T
	4	C124	Sensor Date	Sensor 1; additionally as D, P, T
	5	C110	CIP Counter	Sensor 1; additionally as D, P, T
	6	C111	SIP Counter	Sensor 1; additionally as D, P, T
	7	D112	Autoclaving Counter	Sensor 1; additionally as P, T
15	0	P073	TTM Maintenance Timer	Sensor 1 - [pH]
	1	P090	Error in Buffer Table	Sensor 1 - [pH]
	2	-	-	Not used
	3	D080	Sensor Current Range	Sensor 1 - [Oxy]
	4	D081	O2 Measurement OFF (Temp)	Sensor 1 - [Oxy]
	5	C045	Conductance Range	Sensor 1 - [Cond/CondI]
	6	-	-	Not used
	7	-	-	Not used
16	0	F008	Adjustment Data	Sensor 2; additionally as C, D, P, T
	1	F240	Cal Mode is Active	Sensor 2
	2	C122	Sensor Memory (Cal Data)	Sensor 2; additionally as D, P, T
	3	C123	New Sensor – Adjustment Required	Sensor 2; additionally as D, P, T
	4	C124	Sensor Date	Sensor 2; additionally as D, P, T
	5	C110	CIP Counter	Sensor 2; additionally as D, P, T
	6	C111	SIP Counter	Sensor 2; additionally as D, P, T
	7	D112	Autoclaving Counter	Sensor 2; additionally as P, T
17	0	P073	TTM Maintenance Timer	Sensor 2 - [pH]
	1	P090	Error in Buffer Table	Sensor 2 - [pH]
	2	-	-	Not used
	3	D080	Sensor Current Range	Sensor 2 - [Oxy]
	4	D081	O2 Measurement OFF (Temp)	Sensor 2 - [Oxy]
	5	C045	Conductance Range	Sensor 2 - [Cond/CondI]
	6	-	-	Not used
	7	-	-	Not used
18	0	F008	Adjustment Data	Sensor 3; additionally as C, D, P, T
	1	F240	Cal Mode is Active	Sensor 3

Byte	Bit	Message No	Message Text	Comment
	2	C122	Sensor Memory (Cal Data)	Sensor 3; additionally as D, P, T
	3	C123	New Sensor – Adjustment Required	Sensor 3; additionally as D, P, T
	4	C124	Sensor Date	Sensor 3; additionally as D, P, T
	5	C110	CIP Counter	Sensor 3; additionally as D, P, T
	6	C111	SIP Counter	Sensor 3; additionally as D, P, T
	7	D112	Autoclaving Counter	Sensor 3; additionally as P, T
19	0	P073	TTM Maintenance Timer	Sensor 3 - [pH]
	1	P090	Error in Buffer Table	Sensor 3 - [pH]
	2	-	-	Not used
	3	D080	Sensor Current Range	Sensor 3 - [Oxy]
	4	D081	O2 Measurement OFF (Temp)	Sensor 3 - [Oxy]
	5	C045	Conductance Range	Sensor 3 - [Cond/Condl]
	6	-	-	Not used
	7	-	-	Not used
20	0	-	-	Byte not used
21	0	-	-	Byte not used
22	0	-	-	Byte not used
23	0	-	-	Byte not used
24	0	-	-	Byte not used

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