AWT210

2-wire conductivity/pH/ORP/pIon transmitter HART field device specification

HART® field device specification

Measurement made easy

—
AWT210
2-Wire conductivity/pH/ORP/pIon transmitter

Introduction

This Communications supplement provides HART® field device specifications for the AWT210 transmitter.

For more information

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Data Sheet AWT210 2-Wire conductivity/pH/ORP/pIon transmitter	DS/AWT210-EN
Operating Instruction AWT210 2-Wire conductivity/pH/ORP/pIon transmitter	OI/AWT210-EN
Commissioning Instruction AWT210 2-Wire conductivity/pH/ORP/pIon transmitter	CI/AWT210-EN
Communications Supplement AWT210 transmitter – HART communications supplement	COM/AWT210/HART-EN

Contents

2. Introduction

2.1. Scope

ABB AWT210 complies with HART Protocol Revision 7.0. This document specifies all the device specific features and documents HART Protocol implementation details (e.g., the Engineering Unit Codes supported). The functionality of this Field Device is described sufficiently to allow its proper application in a process and its complete support in HART capable host applications.

2.2. Purpose

This specification is designed to complement the AWT210 Operating instruction (OI/AWT210-EN), Commissioning instruction (CI/AWT210-EN) and HART Communications supplement (COM/AWT210/HART-EN) by providing a complete, unambiguous description of this Field Device from a HART Communication perspective

2.3. Who should use this document?

The specification is designed to be a technical reference for HART capable Host Application Developers, System Integrators and knowledgeable End Users. It also provides functional specifications (e.g., commands, enumerations and performance requirements) used during Field Device development, maintenance and testing. This document assumes the reader is familiar with HART Protocol requirements and terminology.

2.4. Abbreviations and Definitions

ADC	Analog to Digital Converter
CPU	Central Processing Unit (of microprocessor)
DAC	Digital to Analog Converter
TE Module	Two Electrode Conductivity Module
EC Module	Four Electrode Conductivity Module
TC Module	Toroidal Conductivity Module
TC	Temperature Compensation
Pt100	100Ω Platinum temperature sensor
Pt1000	1000Ω Platinum temperature sensor
3k Balco	3000Ω Balco Alloy temperature sensor
ORP	Oxidation-Reduction Potential

2.5. References

AWT 210 Operating instruction (OI/AWT210-EN).

AWT 210 HART Communication supplement (COM/AWT210/HART-EN).

3. Device Identification

Manufacturer Name:	ABB Ltd	Model Name(s):	AWT 210
Manufacture ID Code:	1A (Hex)	Device Type Code:	22 (Hex)
HART Protocol Revision	7	Device Revision:	1
Number of Device Variables	None		
Physical Layers Supported	FSK		
Physical Device Category	Water Analyzer Transmitter		

4. Product Overview

The AWT210 is a multipurpose loop powered transmitter with a 4-to-20mA output. It can be configured with a choice of 4 interchangeable sensor modules to work with a range of pH or Conductivity sensors.

The AWT210 replaces the TB82 range of products, improving functionality and user friendliness.

The device has four dynamic variables.

The Analogue output of this device corresponds to the primary variable (pH, ORP, pIon, Ion Concentration, Conductivity, or Concentration), outputting 4mA at the lower range value and 20mA at the upper range value.

Supported Sensors:

- pH
- Two electrode conductivity
- Four electrode conductivity
- Toroidal conductivity

Supported RTD Temperature Sensors:

- Pt100 (2/3 Wire)
- Pt1000 (2/3 Wire)
- 3k Balco (2/3 Wire)
- None – manually set temperature

5. Product Interfaces

5.1. Process Interface

5.1.1. Sensor Input Channels

The sensor module provides 8 terminals marked 1-8, 1-4 for Process Variable (detailed in commissioning instructions) and 5-8 for the temperature sensor (up to 3 wire RTD + Shield). Operating ranges correspond to the capabilities of each sensor type.

Different types of sensor modules can be connected to this device. Please refer user manual for details about different input signal types and ranges.

5.2. Host Interface

The two-wire 4 to 20 mA current loop is connected via terminals 1 and 2 on the HART communications module and can be tested via terminals 4 and 5.

5.2.1. Analog Output

The output from the transmitter representing the PV measurement linearized and scaled according to the engineering range set on the instrument. PV% is displayed on the Signals View page.

	Values (mA or V)
Below Lower Range	3.8 mA
Above Upper Range	20.5 mA
Device malfunction indication	User Configurable High (20.5mA) or Low (3.6mA)
Maximum current	22.0 mA
Multi-Drop current draw	3.6 mA
Lift-off voltage	12V

5.3. Local Interfaces, Jumpers and Switches

5.3.1. Local Controls and Displays

The Device has a 75mm x 65mm (3.00 x 2.55 in.) monochromatic dot matrix LCD display and 4 capacitive push buttons.

5.3.2. Internal Jumpers and Switches

The device has 2 internal DIP switches, situated on the top right-hand side of the HART Communication Module.

DIP1: Reset to Defaults

If the device is powered up with DIP1 in the ON position it will return device setup to default factory settings. If powered up with DIP1 in the OFF position the device will retain previously saved user settings.

DIP2: Write Protection

If DIP2 is in the ON position HW write protect will show as enabled and the user will be unable to make changes to setup or send Write commands via HART. With DIP2 in OFF position, the user will be able to make changes/send commands providing they are in a sufficient access level and Software Write Protect has not been enabled.

6. Device Variables

This Field Device does not expose any Device Variables

7. Dynamic Variables

Four Dynamic Variables are implemented:

	pH (pH)		Conductivity (TE, EC, TC)	
	Measurement	Units	Measurement	Units
PV	pH ORP, pION Ion Conc.	pH mV %, ppb, ppm, µg/l, mg/l	Conductivity Concentration	µS/cm, mS/cm %, ppb, ppm, µg/l, mg/l
SV	Temperature	°C, °F	Temperature	°C, °F
TV	Reference Impedance	KΩ	Compensated Conductivity	µS/cm
QV	Input Voltage	mV	Uncompensated Conductivity	µS/cm

8. Status Information

8.1. Device Status

Device status is sent as part of every HART response, the first two bytes of the data field.

Bit 4 indicates more status available – Additional Device Status
Bit 7 indicated Field device malfunction

8.2. Extended Device Status

Extended Device Status is a byte returned to commands 0, 9, 11, 21, and 48 (detailed in section 10) and contains an enumeration value corresponding to the following states:
0 – Default Extended Device Status
1 – Maintenance Required
2 – Device Variable Alert
4 – Critical Power Failure

8.3. Additional Device Status

Command 48 returns 24 bytes of data with the following status information:

Byte	Bit	Meaning	Class	Device Status Bits Set
0	0	Primary Variable Input Read Error	Failure	4, 7
	1	Temperature Input Read Error	Off Spec	4, 7
	2	Reference Impedance Read Error	Maintenance	4, 7
	3	Second Primary Variable Read Error	Failure	4, 7
	4	Primary Variable Outside Limits	Off Spec	4, 7
	5	Sensor is Dirty	Maintenance	4, 7
	6	Diagnostic Input Read Error	Maintenance	4, 7
	7	Sensor Polarization	Maintenance	4, 7
1	0	Not Used	-	-
	1	Not Used	-	-
	2	Primary Variable Outside Range Limits	Off Spec	4, 7
	3	Sensor Temperature Outside Limits	Off Spec	4, 7
	4	High Reference Impedance	Maintenance	4, 7
	5	Not Used	-	-
	6	Not Used	-	-
	7	Not Used	-	-
2	0	Sensor Module Failure	Failure	4, 7
	1	Sensor Module Memory Corrupted	Failure	4, 7
	2	Sensor Calibration Data Corrupted	Maintenance	4, 7
	3	Not Used	-	-
	4	Not Used	-	-
	5	Not Used	-	-
	6	Not Used	-	-
	7	Electronic Memory Corrupted	Failure	4, 7
3	0	Not Used	-	
	1	Not Used	-	-
	2	Not Used	-	-
	3	Not Used	-	-
	4	Not Used	-	-
	5	Not Used	-	-
	6	Current Output Fixed	Warning	4, 7

	7	Current Output Saturated	Off Spec	4, 7
4	0	Current Output Not Calibrated	Failure	4, 7
	1	Power Supply Outside Limits	Maintenance	4, 7
	2	Not Used	-	-
	3	Current Output Read back Failure	Failure	4, 7
	4	Sensor Module Voltage Warning	Maintenance	4, 7
	5	Diagnostic Input Read Error	Maintenance	4, 7
	6	Shorted Cable or Ground Loops Present	Maintenance	4, 7
	7	Low Electrode Impedance	Maintenance	4, 7
5	0	Open Cable or Sensor Out of Solution	Maintenance	4, 7
	1	Data Simulation	Off Spec	4, 7
	2	Not Used	-	-
	3	High Sensor Efficiency	Off Spec	4, 7
	4	Low Sensor Efficiency	Off Spec	4, 7
	5	High Sensor Offset	Off Spec	4, 7
	6	Low Sensor Offset	Off Spec	4, 7
	7	Manual Temperature Compensation Mode	Off Spec	4, 7

'Not Used' bits are always set to 0.

All bits that indicate device or sensor failure also set bit 7 and 4 of the Device Status byte.

9. Universal Commands

It is recommended to use the DTM or EDD provided for AWT210 to communicate with the device.

Command #3 returns PV, SV, TV and QV for a total of 26 bytes of response data.

Command #14: Units for Sensor Limits and Minimum Span are taken from PV units for the following sensors and measurement types they are:

pH (pH)	- pH
ORP (pH)	- mV
pIon (pH)	- mV
Ion Concentration (pH)	- ppm
Conductivity (EC/TE/TC)	- µS/cm
Concentration (EC/TE/TC)	- %

10. Common-Practice Commands

10.1. Supported Commands

The following Common-Practice Commands are implemented:

- #34 Write PV Damping Value
- #35 Write PV Range Values
- #36 Set PV Upper Range Value
- #37 Set PV Lower Range Value
- #40 Enter/Exit Fixed Current Mode
- #41 Perform Self-Test
- #42 Perform Device Reset
- #44 Write PV Units
- #45 Trim Loop Current Zero
- #46 Trim Loop Current Gain
- #48 Read Additional Device Status
- #59 Write Number of Response Preambles
- #71 Lock Device
- #76 Read Lock Device State

10.2. Burst Mode

This Field Device does not support Burst Mode.

10.3. Catch Device Variable

This Field Device does not support Catch Device Variable.

11. Device Specific Commands

The Following Device Specific Commands are implemented:

11.1. General Commands

#122 Login to Service Level

#123 Read Board Object*

#124 Write Object*

#125 Read Memory*

#126 Write Memory*

#128 Reset Software Write Protection

#129 Read Revision

#130 Write Current Alarm Selection

#131 Read Write Protection

#132 Write Software Write Protection

#134 Recognize Temperature Compensation Type

#135 Reset to Factory Default

#136 Write Temperature Compensation Type

#137 Read Front End Board Data

#138 Write Manual Temperature Set Point

#139 Write Reference Temperature

#140 Read PV and Temperature Calibration Slope and Offset

#141 Write PV Calibration Slope and Offset

#142 Write Temperature Calibration Slope and Offset

#143 Log Out HART Service Code

#168 HART Login with Password

#200 Read Diagnosis Masking

#201 Write Diagnosis Masking

#202 Read Diagnosis Simulation

#203 Write Diagnosis Simulation

#210 Write HART Version

#243 Write Sensor Diagnostic Option

#249 Write Temperature Unit

#250 Read Conductivity Units Mode

#251 Write Conductivity Units Mode

#523 Read Condensed Status Mapping Array

* Requires HART login to Service level (Command 122).

11.1.1. Command #122: Write HART Service Code

Logs into HART Service level.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Service code character 1 (ASCII)
1	Unsigned-8	Service code character 2 (ASCII)
2	Unsigned-8	Service code character 3 (ASCII)
3	Unsigned-8	Service code character 4 (ASCII)
4	Unsigned-8	Service code character 5 (ASCII)
5	Unsigned-8	Service code character 6 (ASCII)
6	Unsigned-8	Service code character 7 (ASCII)
7	Unsigned-8	Service code character 8 (ASCII)
8	Unsigned-8	Service code character 9 (ASCII)
9	Unsigned-8	Service code character 10 (ASCII)
10	Unsigned-8	Service code character 11 (ASCII)
11	Unsigned-8	Service code character 12 (ASCII)
12	Unsigned-8	Service code character 13 (ASCII)
13	Unsigned-8	Service code character 14 (ASCII)
14	Unsigned-8	Service code character 15 (ASCII)
15	Unsigned-8	Service code character 16 (ASCII)
16	Unsigned-8	Service code character 17 (ASCII)
17	Unsigned-8	Service code character 18 (ASCII)
18	Unsigned-8	Service code character 19 (ASCII)
19	Unsigned-8	Service code character 20 (ASCII)

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Service code character 1 (ASCII)
1	Unsigned-8	Service code character 2 (ASCII)
2	Unsigned-8	Service code character 3 (ASCII)
3	Unsigned-8	Service code character 4 (ASCII)
4	Unsigned-8	Service code character 5 (ASCII)
5	Unsigned-8	Service code character 6 (ASCII)
6	Unsigned-8	Service code character 7 (ASCII)
7	Unsigned-8	Service code character 8 (ASCII)
8	Unsigned-8	Service code character 9 (ASCII)
9	Unsigned-8	Service code character 10 (ASCII)
10	Unsigned-8	Service code character 11 (ASCII)
11	Unsigned-8	Service code character 12 (ASCII)
12	Unsigned-8	Service code character 13 (ASCII)
13	Unsigned-8	Service code character 14 (ASCII)
14	Unsigned-8	Service code character 15 (ASCII)
15	Unsigned-8	Service code character 16 (ASCII)
16	Unsigned-8	Service code character 17 (ASCII)
17	Unsigned-8	Service code character 18 (ASCII)
18	Unsigned-8	Service code character 19 (ASCII)
19	Unsigned-8	Service code character 20 (ASCII)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8	Error	Update Failure
9-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.2. Command #123: Read Board Object

Reads board object parameters.

- This command is available when the user is logged-in as Service.

Request Data Bytes

Byte	Format	Description
0	Usigned-8	Board Code
1	Usigned-8	Address
2-3	Usigned-16	Subsystem Index
4-5	Usigned-16	Object Index
6-7	Usigned-16	Attribute Index

Response Data Bytes

Byte	Format	Description
0	Usigned-8	Board Code
1	Usigned-8	Address
2-3	Usigned-16	Subsystem Index
4-5	Usigned-16	Object Index
6-7	Usigned-16	Attribute Index
8	Usigned-8	Object Data Length
9-40	Usigned-8	Object Data

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.3. Command #124: Write Board Object

Writes board object parameters.

- This command is available when the user is logged-in as Service.

Request Data Bytes

Byte	Format	Description
0	Usigned-8	Board Code
1	Usigned-8	Address
2-3	Usigned-16	Subsystem Index
4-5	Usigned-16	Object Index
6-7	Usigned-16	Attribute Index
8	Usigned-8	Object Data Length
9-40	Usigned-8	Object Data

Response Data Bytes

Byte	Format	Description
0	Usigned-8	Board Code
1	Usigned-8	Address
2-3	Usigned-16	Subsystem Index
4-5	Usigned-16	Object Index
6-7	Usigned-16	Attribute Index
8	Usigned-8	Object Data Length
9-40	Usigned-8	Object Data

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.4. Command #125: Read Board Memory

Reads board memory parameters.

- This command is only available when the user is logged-in as Service.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Usigned-8	Board Code
1	Usigned-8	Address
2-3	Usigned-16	Memory Address
4	Usigned-8	Memory Length
5-36	Usigned-8	Memory Data

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.5. Command #126: Write Board Memory

Writes board memory parameters.

- This command is only available when the user is logged-in as Service.

Request Data Bytes

Byte	Format	Description
0	Usigned-8	Board Code
1	Usigned-8	Address
2-3	Usigned-16	Memory Address
4	Usigned-8	Memory Length
5-36	Usigned-8	Memory Data

Response Data Bytes

Byte	Format	Description
0	Usigned-8	Board Code
1	Usigned-8	Address
2-3	Usigned-16	Memory Address
4	Usigned-8	Memory Length
5-36	Usigned-8	Memory Data

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6		Undefined
7	Error	In Write Protect Mode
8-31		Undefined
32	Error	Busy
33-127		Undefined

11.1.6. Command #128: Write Software Write Protection

Enables/disables write protection with the following enums:
0 – Disable
1 – Enable

Request Data Bytes

Byte	Format	Description
0	Enum	Software write protection action

Response Data Bytes

Byte	Format	Description
0	Enum	Software write protection action

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

11.1.7. Command #129: Read Revision

Reads device information.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-2	Unsigned-8	Hardware Revision
3-5	Unsigned-8	Software Revision
6-19	Unsigned-8	Device Serial Number

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.8. Command #130: Write Current Alarm Selection

Sets fault current option via the following enums:

0 – High

1 – Low

Request Data Bytes

Byte	Format	Description
0	Enum	Alarm State Selection

Response Data Bytes

Byte	Format	Description
0	Enum	Alarm State Selection

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

11.1.9. Command #131: Read Write Protection Status

Reads hardware and software write protection status via the following enums:

0 – Disabled

1 – Enabled

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	SW Write Protection
1	Enum	HW Write Protection

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.10. Command #132: Write Software Write Protection

Enables/disables software write protection with the following enums:
0 – Disabled
1 – Enabled

Request Data Bytes

Byte	Format	Description
0	Enum	SW Write Protection State

Response Data Bytes

Byte	Format	Description
0	Enum	SW Write Protection State

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4	Error	Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

11.1.11. Command #134: Detect Temperature Sensor

Initiates temperature sensor detection process.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.12. Command #135: Reset to Default

Initiates reset to default process.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.13. Command #136: Write Temperature Compensation Type

Set temperature compensation type via the following enums:

0 – Manual

1 – Auto

2 – Auto Solution

Request Data Bytes

Byte	Format	Description
0	Enum	Temperature Compensation Type

Response Data Bytes

Byte	Format	Description
0	Enum	Temperature Compensation Type

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

11.1.14. Command #137: Read Front End Board Data

Reads sensor module information, including using the following bit masked values:

0 – Unknown

1 – pH

2 – EC

4 – TE

8 – TC

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Unsigned-32	Total Valid Frames
4-7	Unsigned-32	Total Lost Frames
8	Unsigned-8	ADC Identification Number
9	Enum	Front End Board Type
10-12	Unsigned-8	Sensor Type
13-16	Float	ADC Vdd
17-19	Float	ADC Temperature

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.15. Command #138: Write Manual Temperature Value

Sets manual temperature value. Units remain as set by user (default: °C).

Request Data Bytes

Byte	Format	Description
0-3	Float	Manual Temperature set point

Response Data Bytes

Byte	Format	Description
0-3	Float	Manual Temperature set point

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed Parameter Too Large
4	Error	Passed Parameter Too Small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

11.1.16. Command #139: Write Reference Temperature

Sets reference temperature value. Units remain as set by user (default: °C).

Request Data Bytes

Byte	Format	Description
0-3	Float	Reference Temperature set point

Response Data Bytes

Byte	Format	Description
0-3	Float	Reference Temperature set point

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed Parameter Too Large
4	Error	Passed Parameter Too Small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

11.1.17. Command #140: Read PV and Temperature Calibration Slope and Offset

Reads user calibration information. PV offset units are the same as PV units.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	PV Slope
4-7	Float	PV Offset
8-11	Float	Temperature Slope
12	Unsigned-8	Temperature Unit Object
13-16	Float	Temperature Offset

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.18. Command #141: Write PV Slope and Offset

Sets user calibration information for PV. PV offset units are the same as PV units.

Request Data Bytes

Byte	Format	Description
0-3	Float	PV Slope
4-7	Float	PV Offset

Response Data Bytes

Byte	Format	Description
0-3	Float	PV Slope
4-7	Float	PV Offset

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed Parameter Too Large
4	Error	Passed Parameter Too Small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

11.1.19. Command #142: Write Temperature Calibration Slope and Offset

Sets Temperature calibration information.

Request Data Bytes

Byte	Format	Description
0-3	Float	Temperature Slope
4-7	Float	Temperature Offset

Response Data Bytes

Byte	Format	Description
0-3	Float	Temperature Slope
4-7	Float	Temperature Offset

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed Parameter Too Large
4	Error	Passed Parameter Too Small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

11.1.20. Command #143: Logout from HART Service Login

Resets HART access level to restrict user access.

Request Data Bytes

	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33 - 127		Undefined

11.1.21. Command #168: HART Login with Password

Changes HART access level with the following enums:

0 – No User

1 – Standard

2 – Advanced

3 – Service

4 – Custody

Request Data Bytes

Byte	Format	Description
0	Enum	Access Level
1-20	Char	Password

Response Data Bytes

Byte	Format	Description
0	Enum	Access Level
1-20	Char	Password

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

11.1.22.Command #200: Read Diagnosis Masking

Reads masked diagnostics.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-5	Unsigned-8	Diagnosis Masking

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.23.Command #201: Write Diagnosis Masking

Masks requested diagnostics.

Request Data Bytes

Byte	Format	Description
0-5	Unsigned-8	Diagnosis Masking

Response Data Bytes

Byte	Format	Description
0-5	Unsigned-8	Diagnosis Masking

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.24.Command #202: Read Diagnosis Simulation

Reads whether diagnosis simulation is enabled/disabled and reads 16 simulated diagnosis status bits.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Simulation Status
1-16	Unsigned-8	Diagnosis Simulation

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.25.Command #203: Write Diagnosis Simulation

Enables/disables diagnosis simulation and simulated diagnostic.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Simulation Status
1-16	Unsigned-8	Diagnosis Simulation

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Simulation Status
1-16	Unsigned-8	Diagnosis Simulation

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.26.Command #210: Write HART Version

Switches between HART 5 and HART 7 command revision with the following enums:
5 – HART Revision 5
7 – HART Revision 7

(The change takes effect only after a power cycle)

Request Data Bytes

Byte	Format	Description
0	Enum	HART Revision

Response Data Bytes

Byte	Format	Description
0	Enum	HART Revision

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.27.Command #243: Write Sensor Diagnostic Option

Enables/disables sensor diagnostics with the following enums:
0 – Disable
1 – Enable

Request Data Bytes

Byte	Format	Description
0	Enum	Sensor Diagnostics Option

Response Data Bytes

Byte	Format	Description
0	Enum	Sensor Diagnostics Option

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.28.Command #249: Write Temperature Unit

Sets temperature unit with the following enums:
0 – °C
1 – °F

Request Data Bytes

Byte	Format	Description
0	Enum	Temperature Unit (Object)

Response Data Bytes

Byte	Format	Description
0	Enum	Temperate Unit (Object)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.29.Command #250: Read Conductivity Units Mode

Read conductivity unit:
0 – Auto
1 – µS/cm
2 – mS/cm

(Not present on pH devices)

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Conductivity Unit

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.30.Command #251: Write Conductivity Units Mode

Sets conductivity unit with the one of the following enum values:
0 – Auto
1 – µS/cm
2 – mS/cm

(Not present on pH devices)

Request Data Bytes

Byte	Format	Description
0	Enum	Conductivity Unit

Response Data Bytes

Byte	Format	Description
0	Enum	Conductivity Unit

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.1.31.Command #523: Read Condensed Status Mapping Array

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Starting Index
1	Unsigned-8	Number of Entries

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Starting Index
1	Unsigned-8	Number of Entries
2-35	Unsigned-8	Mapping Array

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.2. Two Electrode Conductivity (TE)

#144 Write Measurement Type

#145 Write Cell Constant (TE)

#146 Read Concentration Configuration

#147 Write Concentration Display Text

#148 Read Temperature Sensor and Compensation Configuration

#149 Write Automatic Temperature Compensation Option

#150 Write Temperature Compensation Coefficient

#151 Write Temperature Compensation Pure H2O Option

#152 Read Temperature Compensation Curve

#153 Write Temperature Compensation Curve

#154 Read Concentration Curve

#155 Write Concentration Curve

#156 Reset PV and Temperature Calibration

#157 Read Stable PV Value to be displayed for edit during 1 point PV Calibration

#158 Read Calibration Mode and Status

#159 Write Calibration Mode and Status

#160 Write Calibration Value

#161 Read Calibration Progress and Error Status

#162 Read Factory Calibration Parameters

#163 Write Factory Calibration Parameters

#164 Read Factory Calibration Slope and Offset

#252 Read PV Sensor Configuration

11.2.1. Command #144: Write Measurement Type

Set measurement type using the following enums:
113 – Conductivity
117 - Concentration

Request Data Bytes

Byte	Format	Description
0	Enum	PV Configuration (Conductivity/Concentration)

Response Data Bytes

Byte	Format	Description
0	Enum	PV Configuration (Conductivity/Concentration)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.2. Command #145: Write Cell Constant

Set cell constant value (0.003 to 1.999).

Request Data Bytes

Byte	Format	Description
0	Float	Cell Constant

Response Data Bytes

Byte	Format	Description
0	Float	Cell Constant

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.3. Command #146: Read Concentration Configuration

Read concentration curve name, values and units.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Concentration Curve Name Character 1 (ASCII)
1	Unsigned-8	Concentration Curve Name Character 2 (ASCII)
2	Unsigned-8	Concentration Curve Name Character 3 (ASCII)
3	Unsigned-8	Concentration Curve Name Character 4 (ASCII)
4	Unsigned-8	Concentration Curve Name Character 5 (ASCII)
5	Unsigned-8	Concentration Curve Name Character 6 (ASCII)
6	Unsigned-8	Object combining DV0 and DV0 Unit

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.4. Command #147: Write Concentration Display Text

Write concentration curve name.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Concentration Curve Name Character 1 (ASCII)
1	Unsigned-8	Concentration Curve Name Character 2 (ASCII)
2	Unsigned-8	Concentration Curve Name Character 3 (ASCII)
3	Unsigned-8	Concentration Curve Name Character 4 (ASCII)
4	Unsigned-8	Concentration Curve Name Character 5 (ASCII)
5	Unsigned-8	Concentration Curve Name Character 6 (ASCII)

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Concentration Curve Name Character 1 (ASCII)
1	Unsigned-8	Concentration Curve Name Character 2 (ASCII)
2	Unsigned-8	Concentration Curve Name Character 3 (ASCII)
3	Unsigned-8	Concentration Curve Name Character 4 (ASCII)
4	Unsigned-8	Concentration Curve Name Character 5 (ASCII)
5	Unsigned-8	Concentration Curve Name Character 6 (ASCII)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.5. Command #148: Read Temperature Sensor and Compensation Configuration

Reads temperature sensor configuration with the following enums:

Temperature Sensor Type:

0 – Balko 3K 2 Wire
1 – Balko 3K 3 Wire
2 – PT100 2 Wire
3 – PT100 3 Wire
4 – PT1000 2 Wire
5 – PT1000 3 Wire
6 – Not Connected

Temperature Compensation Type:

0 – Manual
1 – Automatic
2 – Automatic Solution

Automatic Temperature Compensation Option:

0 – Standard KCl
1 – Temperature Compensation Coefficient
2 – Pure H2O
3 – User Defined

Temperature Sensor Recognition Status:

0 – Not Recognized
1 – Recognized

Automatic Temperature Compensation Pure H20 Option:

0 – Neutral
1 – Acid
2 – Base

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Temperature Sensor Type
1	Enum	Temperature Compensation Type
2	Enum	Automatic Temperature Compensation Option
3-6	Float	Automatic Temperature Compensation Coefficient
7	Unsigned-8	Units
8-11	Float	Reference Temperature
12	Unsigned-8	Units
13-16	Float	Manual Temperature Value
17	Enum	Temperature Sensor Recognized Status
18	Enum	Pure H2O Options

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.6. Command #149: Write Automatic Temperature Compensation Option

Sets automatic temperature compensation option with the following enums:

0 – Standard KCl
1 – Temperature Compensation Coefficient
2 – Pure H2O
3 – User Defined

Requires a recognized temperature sensor

Request Data Bytes

Byte	Format	Description
0	Enum	Automatic Compensation Type

Response Data Bytes

Byte	Format	Description
0	Enum	Automatic Compensation Type

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.7. Command #150: Write Temperature Compensation Coefficient

Sets the value of the temperature compensation coefficient if selected as temperature compensation type.

Request Data Bytes

Byte	Format	Description
0	Float	Temperature Compensation Coefficient

Response Data Bytes

Byte	Format	Description
0	Float	Temperature Compensation Coefficient

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.8. Command #151: Write Temperature Compensation Pure H2O Option

Automatic Temperature Compensation Pure H20 option:

0 – Neutral
1 – Acid
2 – Base

Request Data Bytes

Byte	Format	Description
0	Enum	Pure H20 Temperature Compensation Option

Response Data Bytes

Byte	Format	Description
0	Enum	Pure H20 Temperature Compensation Option

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.9. Command #154: Read Concentration Curve

Reads concentration table values.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Concentration Curve: X1
4-7	Float	Concentration Curve: X2
8-11	Float	Concentration Curve: X3
12-15	Float	Concentration Curve: X4
16-19	Float	Concentration Curve: X5
20-13	Float	Concentration Curve: X6
24-27	Float	Concentration Curve: Y1
28-31	Float	Concentration Curve: Y2
32-35	Float	Concentration Curve: Y3
36-39	Float	Concentration Curve: Y4
40-43	Float	Concentration Curve: Y5
44-47	Float	Concentration Curve: Y6

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.10.Command #155: Write Concentration Curve

Writes concentration table values.

Request Data Bytes

Byte	Format	Description
0-3	Float	Concentration Curve: X1
4-7	Float	Concentration Curve: X2
8-11	Float	Concentration Curve: X3
12-15	Float	Concentration Curve: X4
16-19	Float	Concentration Curve: X5
20-13	Float	Concentration Curve: X6
24-27	Float	Concentration Curve: Y1
28-31	Float	Concentration Curve: Y2
32-35	Float	Concentration Curve: Y3
36-39	Float	Concentration Curve: Y4
40-43	Float	Concentration Curve: Y5
44-47	Float	Concentration Curve: Y6

Response Data Bytes

Byte	Format	Description
0-3	Float	Concentration Curve: X1
4-7	Float	Concentration Curve: X2
8-11	Float	Concentration Curve: X3
12-15	Float	Concentration Curve: X4
16-19	Float	Concentration Curve: X5
20-13	Float	Concentration Curve: X6
24-27	Float	Concentration Curve: Y1
28-31	Float	Concentration Curve: Y2
32-35	Float	Concentration Curve: Y3
36-39	Float	Concentration Curve: Y4
40-43	Float	Concentration Curve: Y5
44-47	Float	Concentration Curve: Y6

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.11.Command #156: Reset PV and Temperature Calibration

Reset PV and temperature spans to 100% and offsets to 0.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.12.Command #157: Read Stable PV Value for 1 point PV Calibration

Reads PV value to be adjusted by calibration.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration: PV Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.13.Command #158: Read Calibration Mode and Status

Reads calibration mode and status.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Overall Calibration Mode
1	Unsigned-8	Calibration Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.14.Command #160: Write Calibration Mode and Status

Sets calibration mode and changes status.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Overall Calibration Mode
1	Unsigned-8	Calibration Status

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Overall Calibration Mode
1	Unsigned-8	Calibration Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.15.Command #160: Write Calibration Value

Sets value for manual calibration.

Request Data Bytes

Byte	Format	Description
0-3	Float	Calibration New Value

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration New Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.16.Command #161: Read Calibration Progress and Error Status

Reads calibration progress and error status if calibration has failed.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration Progress Timer
4	Unsigned-8	Calibration Error Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.17.Command #162: Read Factory Calibration Parameters

Reads status of factory calibration using the following enums:

Factory Calibration Status:

0 – Not Active
1 – R0 High 50Ω
2 – R0 Low 50Ω
3 – G0 High 50Ω
4 – G0 Low 50Ω
5 – R1 High 100Ω
6 – R1 Low 50Ω
7 – G1 High 100Ω
8 – G1 Low 50Ω
9 – R2 High 1000Ω
10 – R2 Low 100Ω
11 – G2 High 1000Ω
12 – G2 Low 100Ω
13 – R3 High 10KΩ
14 – R3 Low 1000Ω
15 – G3 High 10KΩ
16 – G3 Low 1000Ω
17 – R4 High 100KΩ
18 – R4 Low 10KΩ
19 – G4 High 100KΩ
20 – G4 Low 10KΩ
21 – Calibration Error
22 – Complete

Factory Calibration Action:

0 – None
1 – Start
2 – 100KΩ Applied
3 – 10KΩ Applied
4 – 1000Ω Applied
5 – 100Ω Applied
6 – 50Ω Applied
7 – 5Ω Applied
8 – Abort

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Conductivity Factory Calibration Status
1	Enum	Conductivity Factory Calibration Action

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.18.Command #163: Write Factory Calibration Parameters

Sets action for factory calibration with the following enums:

Factory Calibration Action:

0 – None
1 – Start
2 – 100KΩ Applied
3 – 10KΩ Applied
4 – 1000Ω Applied
5 – 100Ω Applied
6 – 50Ω Applied
7 – 5Ω Applied
8 – Abort

Request Data Bytes

Byte	Format	Description
0	Enum	Factory Calibration Action

Response Data Bytes

Byte	Format	Description
0	Enum	Factory Calibration Action

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.19.Command #164: Read Factory Calibration Slope and Offset

Returns the factory calibration data based on following enums:

Slot 0: PV Factory Calibration Slope
Slot 1: PV Factory Calibration Offset
Slot 2: Secondary PV Factory Calibration Slope
Slot 3: Secondary PV Factory Calibration Offset

Request Data Bytes

Byte	Format	Description
0	Enum	Slot

Response Data Bytes

Byte	Format	Description
0	Enum	Slot
1-4	Float	<Slot> for Auto Range 0
5-8	Float	<Slot> for Auto Range 1
9-12	Float	<Slot> for Auto Range 2
13-16	Float	<Slot> for Auto Range 3
17-20	Float	<Slot> for Auto Range 4

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.2.20.Command #252: Read PV Sensor Configuration

Reads sensor configuration with the following enums:

Measurement Type:

113 – Conductivity

117 – Concentration

Sensor Diagnostics:

0 – Disabled

1 – Enabled

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Measurement Type
1-4	Float	Cell Constant
5	Enum	Sensor Diagnostics

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.3. Toroidal Conductivity (TC)

#165 Read PV Sensor Configuration

#166 Write Measurement Type

#167 Read Concentration Configuration

#169 Write Concentration Display Text

#170 Read Temperature Sensor and Compensation Configuration

#171 Write Automatic Temperature Compensation Option

#172 Write Temperature Compensation Coefficient

#173 Read Temperature Compensation Curve Part1

#174 Read Temperature Compensation Curve Part 2

#175 Read Temperature Compensation Curve Part 3

#176 Read Temperature Compensation Curve Part 4

#177 Reset PV and Temperature Calibration

#178 Read Stable PV Value for 1 point PV Calibration

#179 Read Calibration Mode and Status

#180 Write Calibration Mode and Status

#181 Write Calibration Value

#182 Read Calibration Progress and Error

#183 Read Factory Calibration Parameters

#184 Write Factory Calibration Parameters

#185 Read Factory Calibration Slope and Offset

#253 Write Concentration Solution

11.3.1. Command #165: Read PV Sensor Configuration

Reads sensor measurement type with the following enums.

Measurement Type:
113 – Conductivity
117 – Concentration

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Measurement Type

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.2. Command #165: Write Measurement Type

Sets sensor measurement type with the following enums:

Measurement Type:
113 – Conductivity
117 – Concentration

Request Data Bytes

Byte	Format	Description
0	Enum	Measurement Type

Response Data Bytes

Byte	Format	Description
0	Enum	Measurement Type

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.3. Command #167: Read Concentration Configuration

Reads concentration name, solution, and units.

Concentration Solution:
0 – NaOH
1 – NaCl
2 – HCl
3 – H2SO4
4 – User Defined

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Concentration Solution
1	Unsigned-8	Concentration Curve Name – Char 1 (ASCII)
2	Unsigned-8	Concentration Curve Name – Char 2 (ASCII)
3	Unsigned-8	Concentration Curve Name – Char 3 (ASCII)
4	Unsigned-8	Concentration Curve Name – Char 4 (ASCII)
5	Unsigned-8	Concentration Curve Name – Char 5 (ASCII)
6	Unsigned-8	Concentration Curve Name – Char 6 (ASCII)
7	Unsigned-8	Object Combining DV0 and DV0Unit

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.4. Command #169: Write Concentration Curve Name

Write the concentration curve name provided in ASCII format.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Concentration Curve Name – Char 1 (ASCII)
1	Unsigned-8	Concentration Curve Name – Char 2 (ASCII)
2	Unsigned-8	Concentration Curve Name – Char 3 (ASCII)
3	Unsigned-8	Concentration Curve Name – Char 4 (ASCII)
4	Unsigned-8	Concentration Curve Name – Char 5 (ASCII)
5	Unsigned-8	Concentration Curve Name – Char 6 (ASCII)

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Concentration Curve Name – Char 1 (ASCII)
1	Unsigned-8	Concentration Curve Name – Char 2 (ASCII)
2	Unsigned-8	Concentration Curve Name – Char 3 (ASCII)
3	Unsigned-8	Concentration Curve Name – Char 4 (ASCII)
4	Unsigned-8	Concentration Curve Name – Char 5 (ASCII)
5	Unsigned-8	Concentration Curve Name – Char 6 (ASCII)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.6. Command #170: Read Temperature Configuration

Read temperature sensor and compensation configurations.

Temperature Sensor Type:

0 – Balko 3K 2 Wire
1 – Balko 3K 3 Wire
2 – PT100 2 Wire
3 – PT100 3 Wire
4 – PT1000 2 Wire
5 – PT1000 3 Wire
6 – Not Connected

Temperature Compensation Type:

0 – Manual
1 – Automatic
2 – Automatic Solution

Automatic Temperature Compensation Option:

0 – Standard KCl
1 – Temperature Compensation Coefficient
2 – NaOH
3 – NaCl
4 – HCl
5 – H2SO4
6 – User Defined

Temperature Sensor Recognition Status:

0 – Not Recognized
1 – Recognized

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Temperature Sensor Type
1	Enum	Temperature Compensation Type
2	Enum	Automatic Temperature Compensation Option
3-6	Float	Automatic Temperature Compensation Coefficient
7	Unsigned-8	Units
8-11	Float	Reference Temperature
12	Unsigned-8	Units
13-16	Float	Manual Temperature Value
17	Enum	Temperature Sensor Recognized Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.7. Command #171: Write Automatic Temperature Compensation Option

Automatic Temperature Compensation Option:

0 – Standard KCl
1 – Temperature Compensation Coefficient
2 – NaOH
3 – NaCl
4 – HCl
5 – H2SO4
6 – User Defined

Request Data Bytes

Byte	Format	Description
0	Enum	Automatic Compensation Type

Response Data Bytes

Byte	Format	Description
0	Enum	Automatic Compensation Type

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.8. Command #172: Write Temperature Compensation Coefficient

Writes the provided temperature coefficient value.

Request Data Bytes

Byte	Format	Description
0	Float	Temperature Compensation Coefficient

Response Data Bytes

Byte	Format	Description
0	Float	Temperature Compensation Coefficient

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.9. Command #173: Read Temperature Compensation Curve

Read X and Y coordinate values from temperature compensation curve table.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	User Defined Automatic Temperature Compensation Table: X1
4-7	Float	User Defined Automatic Temperature Compensation Table: X2
8-11	Float	User Defined Automatic Temperature Compensation Table: X3
12-15	Float	User Defined Automatic Temperature Compensation Table: X4
16-19	Float	User Defined Automatic Temperature Compensation Table: X5
20-13	Float	User Defined Automatic Temperature Compensation Table: X6
24-27	Float	User Defined Automatic Temperature Compensation Table: Y1
28-31	Float	User Defined Automatic Temperature Compensation Table: Y2
32-35	Float	User Defined Automatic Temperature Compensation Table: Y3
36-39	Float	User Defined Automatic Temperature Compensation Table: Y4
40-43	Float	User Defined Automatic Temperature Compensation Table: Y5
44-47	Float	User Defined Automatic Temperature Compensation Table: Y6

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.10.Command #174: Write Temperature Compensation Curve

Write X and Y coordinate values to temperature compensation curve table.

Request Data Bytes

Byte	Format	Description
0-3	Float	User Defined Automatic Temperature Compensation Table: X1
4-7	Float	User Defined Automatic Temperature Compensation Table: X2
8-11	Float	User Defined Automatic Temperature Compensation Table: X3
12-15	Float	User Defined Automatic Temperature Compensation Table: X4
16-19	Float	User Defined Automatic Temperature Compensation Table: X5
20-13	Float	User Defined Automatic Temperature Compensation Table: X6
24-27	Float	User Defined Automatic Temperature Compensation Table: Y1
28-31	Float	User Defined Automatic Temperature Compensation Table: Y2
32-35	Float	User Defined Automatic Temperature Compensation Table: Y3
36-39	Float	User Defined Automatic Temperature Compensation Table: Y4
40-43	Float	User Defined Automatic Temperature Compensation Table: Y5
44-47	Float	User Defined Automatic Temperature Compensation Table: Y6

Response Data Bytes

Byte	Format	Description
0-3	Float	User Defined Automatic Temperature Compensation Table: X1
4-7	Float	User Defined Automatic Temperature Compensation Table: X2
8-11	Float	User Defined Automatic Temperature Compensation Table: X3
12-15	Float	User Defined Automatic Temperature Compensation Table: X4
16-19	Float	User Defined Automatic Temperature Compensation Table: X5
20-13	Float	User Defined Automatic Temperature Compensation Table: X6
24-27	Float	User Defined Automatic Temperature Compensation Table: Y1
28-31	Float	User Defined Automatic Temperature Compensation Table: Y2
32-35	Float	User Defined Automatic Temperature Compensation Table: Y3
36-39	Float	User Defined Automatic Temperature Compensation Table: Y4
40-43	Float	User Defined Automatic Temperature Compensation Table: Y5
44-47	Float	User Defined Automatic Temperature Compensation Table: Y6

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.11.Command #175 Read Concentration Curve

Read X and Y coordinate values from concentration curve table.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Concentration Curve: X1
4-7	Float	Concentration Curve: X2
8-11	Float	Concentration Curve: X3
12-15	Float	Concentration Curve: X4
16-19	Float	Concentration Curve: X5
20-13	Float	Concentration Curve: X6
24-27	Float	Concentration Curve: Y1
28-31	Float	Concentration Curve: Y2
32-35	Float	Concentration Curve: Y3
36-39	Float	Concentration Curve: Y4
40-43	Float	Concentration Curve: Y5
44-47	Float	Concentration Curve: Y6

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.12.Command #176: Write Concentration Curve

Write X and Y coordinate values to concentration curve table.

Request Data Bytes

Byte	Format	Description
0-3	Float	Concentration Curve: X1
4-7	Float	Concentration Curve: X2
8-11	Float	Concentration Curve: X3
12-15	Float	Concentration Curve: X4
16-19	Float	Concentration Curve: X5
20-13	Float	Concentration Curve: X6
24-27	Float	Concentration Curve: Y1
28-31	Float	Concentration Curve: Y2
32-35	Float	Concentration Curve: Y3
36-39	Float	Concentration Curve: Y4
40-43	Float	Concentration Curve: Y5
44-47	Float	Concentration Curve: Y6

Response Data Bytes

Byte	Format	Description
0-3	Float	Concentration Curve: X1
4-7	Float	Concentration Curve: X2
8-11	Float	Concentration Curve: X3
12-15	Float	Concentration Curve: X4
16-19	Float	Concentration Curve: X5
20-13	Float	Concentration Curve: X6
24-27	Float	Concentration Curve: Y1
28-31	Float	Concentration Curve: Y2
32-35	Float	Concentration Curve: Y3
36-39	Float	Concentration Curve: Y4
40-43	Float	Concentration Curve: Y5
44-47	Float	Concentration Curve: Y6

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.13.Command #177: Reset Calibration

Reset PV and Temperature Spans to 100% and Offsets to 0.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.14.Command #178 Read Stable PV for 1 Point Calibration

Conductivity measurement type only.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration: PV Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.15.Command #179 Read Calibration Mode and Status

Reads calibration mode and status values.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Overall Calibration Mode
1	Unsigned-8	Calibration Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.16.Command #180: Write Calibration Mode Status

Writes calibration mode and status values provided.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Overall Calibration Mode
1	Unsigned-8	Calibration Status

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Overall Calibration Mode
1	Unsigned-8	Calibration Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.17.Command #181: Write Calibration Value

Writes new value during calibration.

Request Data Bytes

Byte	Format	Description
0-3	Float	Calibration New Value

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration New Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.18.Command #182: Read Calibration Progress and Error

Read calibration progress value and error status.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration Progress Timer
4	Unsigned-8	Calibration Error Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.19.Command #183: Read Factory Calibration Parameters

Reads status of factory calibration using the following enums:

Factory Calibration Status:

0 – Not Active
1 – R0 High 100Ω
2 – R0 Low 10Ω
3 – R1 High 1000Ω
4 – R1 Low 100Ω
5 – R2 High 10KΩ
6 – R2 Low 100Ω
7 – R3 High 100KΩ
8 – R3 Low 10K Ω
9 – Calibration Error
10 – Complete

Factory Calibration Action:

0 – None
1 – Start
2 – 100KΩ Applied
3 – 10KΩ Applied
4 – 1000Ω Applied
5 – 100Ω Applied
6 – 10Ω Applied
7 – Abort

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Conductivity Factory Calibration Status
1	Enum	Conductivity Factory Calibration Action

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.20.Command #184: Write Factory Calibration Parameters

Sets action for factory calibration with the following enums:

Factory Calibration Action:

0 – None	1 – Start
2 – 100KΩ Applied	3 – 10KΩ Applied
4 – 1000Ω Applied	5 – 100Ω Applied
6 – 10Ω Applied	7 – Abort

Request Data Bytes

Byte	Format	Description
0	Enum	Factory Calibration Action

Response Data Bytes

Byte	Format	Description
0	Enum	Factory Calibration Action

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.21.Command #185: Read Factory Calibration Slope and Offset

Reads calibration slope and offset values.

Slot 0: PV Factory Calibration Slope
Slot 1: PV Factory Calibration Offset
Slot 2: Secondary PV Factory Calibration Slope
Slot 3: Secondary PV Factory Calibration Offset

Request Data Bytes

Byte	Format	Description
0	Enum	Slot

Response Data Bytes

Byte	Format	Description
0	Enum	Slot
1-4	Float	<Slot> for Auto Range 0
5-8	Float	<Slot> for Auto Range 1
9-12	Float	<Slot> for Auto Range 2
13-16	Float	<Slot> for Auto Range 3
17-20	Float	<Slot> for Auto Range 4

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.3.22.Command #253 Write Concentration Solution

Write concentration solution type.

0 – NaOH
1 – NaCl
2 – HCl
3 – H2SO4
4 – User Defined

Request Data Bytes

Byte	Format	Description
0	Enum	Solution

Response Data Bytes

Byte	Format	Description
0	Enum	Solution

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4. Four Electrode Conductivity (EC)

#186 Read PV Sensor Configuration

#187 Write Measurement Type

#188 Write Sensor Group

#189 Read Concentration Configuration

#190 Write Concentration Solution

#191 Write Concentration Text Display

#192 Read Temperature Sensor and Compensation Configuration

#193 Write Automatic Temperature Compensation Option

#194 Write Temperature Compensation Coefficient

#195 Read Temperature Compensation Curve Part1

#196 Read Temperature Compensation Curve Part 2

#197 Read Temperature Compensation Curve Part 3

#198 Read Temperature Compensation Curve Part 4

#199 Reset PV and Temperature Calibration

#204 Read Stable PV Value for 1 point PV Calibration

#205 Read Calibration Mode and Status

#206 Write Calibration Mode and Status

#207 Write Calibration Value

#208 Read Calibration Progress and Error

#209 Read Factory Calibration Parameters

#211 Write Factory Calibration Parameters

#212 Read Factory Calibration Slope and Offset

11.4.1. Command #186: Read PV Sensor Configuration

PV Type:

113 – Conductivity 117 – Concentration

Sensor Group:

0 – A 1 – B

Sensor Diagnostics:

0 – Disabled 1 – Enabled

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	PV Type
1	Enum	Conductivity Sensor Group
2	Enum	Sensor Diagnostics Enable

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.2. Command #187: Write Measurement Type

Measurement Type:

113 – Conductivity 117 – Concentration

Request Data Bytes

Byte	Format	Description
0	Enum	PV Type

Response Data Bytes

Byte	Format	Description
0	Enum	PV Type

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.3. Command #188: Write Sensor Group

Sensor Group:

0 – A 1 – B

Request Data Bytes

Byte	Format	Description
0	Enum	Sensor Group

Response Data Bytes

Byte	Format	Description
0	Enum	Sensor Group

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.4. Command #189: Read Concentration Configuration

Concentration Solution:

0 – NaOH
1 – NaCl
2 – HCl
3 – H2SO4
4 – User Defined

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Solution
1	Unsigned-8	Concentration Curve Name – Char 1 (ASCII)
2	Unsigned-8	Concentration Curve Name – Char 2 (ASCII)
3	Unsigned-8	Concentration Curve Name – Char 3 (ASCII)
4	Unsigned-8	Concentration Curve Name – Char 4 (ASCII)
5	Unsigned-8	Concentration Curve Name – Char 5 (ASCII)
6	Unsigned-8	Concentration Curve Name – Char 6 (ASCII)
7	Unsigned-8	Object Combining DV0 and DV0 Unit

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.5. Command #190: Write Concentration Solution

Concentration Solution:

0 – NaOH
1 – NaCl
2 – HCl
3 – H2SO4
4 – User Defined

Request Data Bytes

Byte	Format	Description
0	Enum	Solution

Response Data Bytes

Byte	Format	Description
0	Enum	Solution

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.6. Command #191: Write Concentration Text Display

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Concentration Curve Name – Char 1 (ASCII)
1	Unsigned-8	Concentration Curve Name – Char 2 (ASCII)
2	Unsigned-8	Concentration Curve Name – Char 3 (ASCII)
3	Unsigned-8	Concentration Curve Name – Char 4 (ASCII)
4	Unsigned-8	Concentration Curve Name – Char 5 (ASCII)
5	Unsigned-8	Concentration Curve Name – Char 6 (ASCII)

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Concentration Curve Name – Char 1 (ASCII)
1	Unsigned-8	Concentration Curve Name – Char 2 (ASCII)
2	Unsigned-8	Concentration Curve Name – Char 3 (ASCII)
3	Unsigned-8	Concentration Curve Name – Char 4 (ASCII)
4	Unsigned-8	Concentration Curve Name – Char 5 (ASCII)
5	Unsigned-8	Concentration Curve Name – Char 6 (ASCII)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.7. Command #192: Read Temperature Sensor and Compensation Configuration

Temperature Sensor Type:

0 – Balko 3K 2 Wire
1 – Balko 3K 3 Wire
2 – PT100 2 Wire
3 – PT100 3 Wire
4 – PT1000 2 Wire
5 – PT1000 3 Wire
6 – Not Connected

Temperature Compensation Type:

0 – Manual
1 – Automatic
2 – Automatic Solution

Automatic Temperature Compensation Option:

0 – Standard KCl
1 – Temperature Compensation Coefficient
2 – NaOH
3 – NaCl
4 – HCl
5 – H2SO4
6 – User Defined

Temperature Sensor Recognition Status:

0 – Not Recognized
1 – Recognized

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Temperature Sensor Type
1	Enum	Temperature Compensation Type
2	Enum	Automatic Temperature Compensation Option
3-6	Float	Automatic Temperature Compensation Coefficient
7	Unsigned-8	Units
8-11	Float	Reference Temperature
12	Unsigned-8	Units
13-16	Float	Manual Temperature Value
17	Enum	Temperature Sensor Recognized Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.8. Command #193: Write Automatic Temperature Compensation Option

Automatic Temperature Compensation Option:

0 – Standard KCl
1 – Temperature Compensation Coefficient
2 – NaOH
3 – NaCl
4 – HCl
5 – H2SO4
6 – User Defined

Request Data Bytes

Byte	Format	Description
0	Enum	Automatic Compensation Type

Response Data Bytes

Byte	Format	Description
0	Enum	Automatic Compensation Type

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.9. Command #194: Write Temperature Compensation Coefficient

Concentration Solution:

0 – NaOH
1 – NaCl
2 – HCl
3 – H2SO4
4 – User Defined

Request Data Bytes

Byte	Format	Description
0	Float	Temperature Compensation Coefficient

Response Data Bytes

Byte	Format	Description
0	Float	Temperature Compensation Coefficient

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.10.Command #195: Read Temperature Compensation Curve

Read X and Y coordinate values of temperature compensation curve table.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	User Defined Automatic Temperature Compensation Table: X1
4-7	Float	User Defined Automatic Temperature Compensation Table: X2
8-11	Float	User Defined Automatic Temperature Compensation Table: X3
12-15	Float	User Defined Automatic Temperature Compensation Table: X4
16-19	Float	User Defined Automatic Temperature Compensation Table: X5
20-13	Float	User Defined Automatic Temperature Compensation Table: X6
24-27	Float	User Defined Automatic Temperature Compensation Table: Y1
28-31	Float	User Defined Automatic Temperature Compensation Table: Y2
32-35	Float	User Defined Automatic Temperature Compensation Table: Y3
36-39	Float	User Defined Automatic Temperature Compensation Table: Y4
40-43	Float	User Defined Automatic Temperature Compensation Table: Y5
44-47	Float	User Defined Automatic Temperature Compensation Table: Y6

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.11.Command #196: Write Temperature Compensation Curve

Write X and Y coordinate values to temperature compensation curve table.

Request Data Bytes

Byte	Format	Description
0-3	Float	User Defined Automatic Temperature Compensation Table: X1
4-7	Float	User Defined Automatic Temperature Compensation Table: X2
8-11	Float	User Defined Automatic Temperature Compensation Table: X3
12-15	Float	User Defined Automatic Temperature Compensation Table: X4
16-19	Float	User Defined Automatic Temperature Compensation Table: X5
20-13	Float	User Defined Automatic Temperature Compensation Table: X6
24-27	Float	User Defined Automatic Temperature Compensation Table: Y1
28-31	Float	User Defined Automatic Temperature Compensation Table: Y2
32-35	Float	User Defined Automatic Temperature Compensation Table: Y3
36-39	Float	User Defined Automatic Temperature Compensation Table: Y4
40-43	Float	User Defined Automatic Temperature Compensation Table: Y5
44-47	Float	User Defined Automatic Temperature Compensation Table: Y6

Response Data Bytes

Byte	Format	Description
0-3	Float	User Defined Automatic Temperature Compensation Table: X1
4-7	Float	User Defined Automatic Temperature Compensation Table: X2
8-11	Float	User Defined Automatic Temperature Compensation Table: X3
12-15	Float	User Defined Automatic Temperature Compensation Table: X4
16-19	Float	User Defined Automatic Temperature Compensation Table: X5
20-13	Float	User Defined Automatic Temperature Compensation Table: X6
24-27	Float	User Defined Automatic Temperature Compensation Table: Y1
28-31	Float	User Defined Automatic Temperature Compensation Table: Y2
32-35	Float	User Defined Automatic Temperature Compensation Table: Y3
36-39	Float	User Defined Automatic Temperature Compensation Table: Y4
40-43	Float	User Defined Automatic Temperature Compensation Table: Y5
44-47	Float	User Defined Automatic Temperature Compensation Table: Y6

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.12.Command #197: Read Concentration Curve

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Concentration Curve: X1
4-7	Float	Concentration Curve: X2
8-11	Float	Concentration Curve: X3
12-15	Float	Concentration Curve: X4
16-19	Float	Concentration Curve: X5
20-13	Float	Concentration Curve: X6
24-27	Float	Concentration Curve: Y1
28-31	Float	Concentration Curve: Y2
32-35	Float	Concentration Curve: Y3
36-39	Float	Concentration Curve: Y4
40-43	Float	Concentration Curve: Y5
44-47	Float	Concentration Curve: Y6

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.13.Command #198: Write Concentration Curve

Request Data Bytes

Byte	Format	Description
0-3	Float	Concentration Curve: X1
4-7	Float	Concentration Curve: X2
8-11	Float	Concentration Curve: X3
12-15	Float	Concentration Curve: X4
16-19	Float	Concentration Curve: X5
20-13	Float	Concentration Curve: X6
24-27	Float	Concentration Curve: Y1
28-31	Float	Concentration Curve: Y2
32-35	Float	Concentration Curve: Y3
36-39	Float	Concentration Curve: Y4
40-43	Float	Concentration Curve: Y5
44-47	Float	Concentration Curve: Y6

Response Data Bytes

Byte	Format	Description
0-3	Float	Concentration Curve: X1
4-7	Float	Concentration Curve: X2
8-11	Float	Concentration Curve: X3
12-15	Float	Concentration Curve: X4
16-19	Float	Concentration Curve: X5
20-13	Float	Concentration Curve: X6
24-27	Float	Concentration Curve: Y1
28-31	Float	Concentration Curve: Y2
32-35	Float	Concentration Curve: Y3
36-39	Float	Concentration Curve: Y4
40-43	Float	Concentration Curve: Y5
44-47	Float	Concentration Curve: Y6

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.14.Command #199: Reset PV and Temperature Calibration

Reset PV and temperature spans to 100% and offsets to 0.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.15.Command #204: Read Stable PV Value for 1 point PV Calibration

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration: PV Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.16.Command #205: Read Calibration Mode and Status

Reads calibration mode and status.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Overall Calibration Mode
1	Unsigned-8	Calibration Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.17.Command #206: Write Calibration Mode and Status

Writes calibration mode and status.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Overall Calibration Mode
1	Unsigned-8	Calibration Status

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Overall Calibration Mode
1	Unsigned-8	Calibration Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.18.Command #207: Write Calibration Value

Writes new value during calibration.

Request Data Bytes

Byte	Format	Description
0-3	Float	Calibration New Value

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration New Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.19.Command #208: Read Calibration Progress and Error

Read calibration progress value and error status.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration Progress Timer
4	Unsigned-8	Calibration Error Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.20.Command #209: Read Factory Calibration Parameters

Reads status of factory calibration using the following enums:

Factory Calibration Status:

0 – Not Active
1 – R0 High
2 – R0 Low
3 – G0 High
4 – G0 Low
5 – R1 High
6 – R1 Low
7 – G1 High
8 – G1 Low
9 – R2 High
10 – R2 Low
11 – G2 High
12 – G2 Low
13 – R3 High
14 – R3 Low
15 – G3 High
16 – G3 Low
17 – R4 High
18 – R4 Low
19 – G4 High
20 – G4 Low
21 – Calibration Error
22 – Complete

Factory Calibration Action:

0 – None
1 – Start
2 – 25KΩ Applied
3 – 2.5KΩ Applied
4 – 250Ω Applied
5 – 25Ω Applied
6 – 2.5Ω Applied
7 – 0.5Ω Applied
8 – Abort

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Conductivity Factory Calibration Status
1	Enum	Conductivity Factory Calibration Action

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.21.Command #211: Write Factory Calibration Parameters

Sets action for factory calibration with the following enums:

Factory Calibration Action:

0 – None
1 – Start
2 – 25KΩ Applied
3 – 2.5KΩ Applied
4 – 250Ω Applied
5 – 25Ω Applied
6 – 2.5Ω Applied
7 – 0.5Ω Applied
8 – Abort

Request Data Bytes

Byte	Format	Description
0	Enum	Factory Calibration Action

Response Data Bytes

Byte	Format	Description
0	Enum	Factory Calibration Action

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.4.22.Command #212: Read Factory Calibration Slope and Offset

Returns the factory calibration data based on following enums:

Slot 0: PV Factory Calibration Slope
Slot 1: PV Factory Calibration Offset
Slot 2: Secondary PV Factory Calibration Slope
Slot 3: Secondary PV Factory Calibration Offset

Request Data Bytes

Byte	Format	Description
0	Enum	Slot

Response Data Bytes

Byte	Format	Description
0	Enum	Slot
1-4	Float	<Slot> for Auto Range 0
5-8	Float	<Slot> for Auto Range 1
9-12	Float	<Slot> for Auto Range 2
13-16	Float	<Slot> for Auto Range 3
17-20	Float	<Slot> for Auto Range 4

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5. pH (pH)

#213 Read PV Sensor Configuration

#214 Write Measurement Type

#215 Write pH Sensor Type

#216 Write Reference Impedance Limit

#217 Write Isopotential pH and Asymmetric Potential

#218 Read ION Concentration Configuration

#219 Write ION Concentration Configuration

#220 Read Temperature Sensor and Compensation Configuration

#221 Write pH Solution Coefficient Value

#222 Write millivolt Solution Coefficient Value

#223 Read Primary Variable Transfer Function Curve Part 1

#224 Write Primary Variable Transfer Function Curve Part 1

#225 Read Two Point Manual Calibration Parameters

#226 Write Two Point Manual Calibration Parameters

#227 Reset PV and Temperature Calibration

#228 Read the Stable PV value for 1 point PV Calibration

#229 Read PV Calibration Slope and Offset Alarm Limits

#230 Write PV Calibration Slope and Offset Alarm Limits

#231 Read Auto-Buffer Calibration Parameters

#232 Write Standard Buffer Type

#233 Write Buffer 1 and Buffer 2 Values

#234 Read Calibration Mode and Status

#235 Write Calibration Mode and Status

#236 Read Temperature Compensated Buffer Value

#237 Write Calibration Value

#238 Read Calibration Progress and Error

#239 Read User Defined Buffer Table 1 Temperature and pH

#240 Write User Defined Buffer Table 1 Temperature and pH

#241 Read User Defined Buffer Table 2 Temperature and pH

#242 Write User Defined Buffer Table 2 Temperature and pH

#244 Read Factory Calibration Parameters

#245 Write Factory Calibration Parameters

#246 Read Factory Calibration Slope and Offset

#247 Write Linearity/Function Generator

#248 Read Linearity/Function Generator

11.5.1. Command #213: Read PV Sensor Configuration

11.5.2.

11.5.3. Reads pH sensor configuration with the following enums:

PV Type:

111 – pH
114 – ORP
117 – Ion Concentration:
118 – PION

pH Sensor Type

0 – Glass
1 – Antimony
2 – Custom

Sensor Diagnostics:

0 – Disable
1 – Enable

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Analyzer Type
1	Enum	pH Sensor Type
2-5	Float	Reference Impedance
6-9	Float	Isopotential Point (pH)
10-13	Float	Asymmetric Potential (mV)
14	Enum	Sensor Diagnostics Enable

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.4. Command #214: Write Measurement Type

Sets primary variable for pH module with the following enums:

PV Type:

111 – pH
114 – ORP
117 – Ion Concentration:
118 – PION

Request Data Bytes

Byte	Format	Description
0	Enum	PV Type

Response Data Bytes

Byte	Format	Description
0	Enum	PV Type

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.5. Command#215: Write pH Sensor Type

Sets pH sensor type with the following enums:

pH Sensor Type
0 – Glass
1 – Antimony
2 – Custom

Request Data Bytes

Byte	Format	Description
0	Enum	pH Sensor Type

Response Data Bytes

Byte	Format	Description
0	Enum	pH Sensor Type

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.6. Command #216: Write Reference Impedance Limit

Sets point at which reference impedance diagnostics are displayed.

Request Data Bytes

Byte	Format	Description
0-3	Float	Reference Impedance Limit

Response Data Bytes

Byte	Format	Description
0-3	Float	Reference Impedance Limit

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.7. Command #217: Write Isopotential pH and Asymmetric Potential

Sets Isopotential pH and Asymmetric potential values for user defined pH sensor.

Request Data Bytes

Byte	Format	Description
0-3	Float	Isopotential Point (pH)
4-7	Float	Asymmetric Potential (mV)

Response Data Bytes

Byte	Format	Description
0-3	Float	Isopotential Point (pH)
4-7	Float	Asymmetric Potential (mV)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.8. Command #218: Read ION Concentration Configuration

Reads ION concentration configuration with the following enums:

Valence:

0 – Valence = -3
1 – Valence = -2
2 – Valence = -1
3 – Valence = 1
4 – Valence = 2
5 – Valence = 3

Magnitudes:

1 – 1
2 – 2
3 – 3

End Point Magnitude:

1 – 10
2 – 100
3 – 1000

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Valence
1	Enum	Magnitudes
2	Enum	End Point Magnitude
3-4	Integer-16	End mV Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.9. Command #219: Write ION Concentration Configuration

Sets ION concentration configuration with the following enums:

Valence:

0 – Valence = -3
1 – Valence = -2
2 – Valence = -1
3 – Valence = 1
4 – Valence = 2
5 – Valence = 3

Magnitudes:

1 – 1
2 – 2
3 – 3

End Point Magnitude:

1 – 10
2 – 100
3 – 1000

Request Data Bytes

Byte	Format	Description
0	Enum	Valence
1	Enum	Magnitudes
2	Enum	End Point Magnitude
3-4	Integer-16	End mV Value

Response Data Bytes

Byte	Format	Description
0	Enum	Valence
1	Enum	Magnitudes
2	Enum	End Point Magnitude
3-4	Integer-16	End mV Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.10.Command #220: Read Temperature Sensor and Compensation Configuration

Reads temperature sensor setup.

Temperature Sensor Type:

0 – Balko 3K 2 Wire
1 – Balko 3K 3 Wire
2 – PT100 2 Wire
3 – PT100 3 Wire
4 – PT1000 2 Wire
5 – PT1000 3 Wire
6 – Not Connected

Temperature Compensation Type:

0 – Manual
1 – Automatic
2 – Automatic Solution

Temperature Sensor Recognition Status:

0 – Not Recognized
1 – Recognized

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Temperature Sensor Type
1	Enum	Temperature Compensation Type
2-5	Float	pH Solution Coefficient
6-9	Float	mV Solution Coefficient
10	Unsigned-8	Object Device Variable and Unit
11-14	Float	Manual Temperature
15	Enum	Temperature Sensor Recognition Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.11.Command #221: Write pH Solution Coefficient Value

Sets solution calibration in pH.

Request Data Bytes

Byte	Format	Description
0-3	Float	pH Solution Coefficient

Response Data Bytes

Byte	Format	Description
0-3	Float	pH Solution Coefficient

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.12.Command #222: Write millivolt Solution Coefficient Value

Sets solution coefficient value in mV.

Request Data Bytes

Byte	Format	Description
0-3	Float	mV Solution Coefficient

Response Data Bytes

Byte	Format	Description
0-3	Float	mV Solution Coefficient

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.13.Command #223: Read Primary Variable Transfer Function Curve Part 1

Reads output curve for nonlinear current output.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	PV Transfer Function - X1 (%)
4-7	Float	PV Transfer Function - X2 (%)
8-11	Float	PV Transfer Function - X3 (%)
12-15	Float	PV Transfer Function - X4 (%)
16-19	Float	PV Transfer Function - X5 (%)
20-23	Float	PV Transfer Function - Y1
24-27	Float	PV Transfer Function - Y2
28-31	Float	PV Transfer Function - Y3
32-35	Float	PV Transfer Function - Y4
36-39	Float	PV Transfer Function - Y5

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.14.Command #224: Write Primary Variable Transfer Function Curve Part 1

Sets output curve for nonlinear current output.

Request Data Bytes

Byte	Format	Description
0-3	Float	PV Transfer Function - X1 (%)
4-7	Float	PV Transfer Function - X2 (%)
8-11	Float	PV Transfer Function - X3 (%)
12-15	Float	PV Transfer Function - X4 (%)
16-19	Float	PV Transfer Function - X5 (%)
20-23	Float	PV Transfer Function - Y1
24-27	Float	PV Transfer Function - Y2
28-31	Float	PV Transfer Function - Y3
32-35	Float	PV Transfer Function - Y4
36-39	Float	PV Transfer Function - Y5

Response Data Bytes

Byte	Format	Description
0-3	Float	PV Transfer Function - X1 (%)
4-7	Float	PV Transfer Function - X2 (%)
8-11	Float	PV Transfer Function - X3 (%)
12-15	Float	PV Transfer Function - X4 (%)
16-19	Float	PV Transfer Function - X5 (%)
20-23	Float	PV Transfer Function - Y1
24-27	Float	PV Transfer Function - Y2
28-31	Float	PV Transfer Function - Y3
32-35	Float	PV Transfer Function - Y4
36-39	Float	PV Transfer Function - Y5

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.15.Command #225: Read Two Point Manual Calibration Parameters

Reads 2 point calibration configuration.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Buffer Value 1 for Manual 2pt Calibration
4-7	Float	Buffer Value 2 for Manual 2pt Calibration
8	Unsigned-8	DV1 and Unit
9-12	Float	Buffer Temperature for Manual 2pt Calibration

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.16.Command #226: Write Two Point Manual Calibration Parameters

Configures 2 point calibration.

Request Data Bytes

Byte	Format	Description
0-3	Float	Buffer Value 1 for Manual 2pt Calibration
4-7	Float	Buffer Value 2 for Manual 2pt Calibration
8-11	Float	Buffer Temperature for Manual 2pt Calibration

Response Data Bytes

Byte	Format	Description
0-3	Float	Buffer Value 1 for Manual 2pt Calibration
4-7	Float	Buffer Value 2 for Manual 2pt Calibration
8-11	Float	Buffer Temperature for Manual 2pt Calibration

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.17.Command #227: Reset PV and Temperature Calibration

Resets PV and Temperature calibrations to 100% slope, 0.0 offset.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.18.Command #228: Read the Stable PV Value for 1 point PV Calibration

Reads PV value for adjustment within calibration.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration New Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.19.Command #229: Read PV Calibration Slope and Offset Alarm Limits

Reads calibration slope and offset alarm limits.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	PV Slope High Alarm Limit %
4-7	Float	PV Slope Low Alarm Limit %
8-11	Float	PV Offset Alarm Limit (+/-) %

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.20.Command #230: Write PV Calibration Slope and Offset Alarm Limits

Writes limits for pH PV slope and offset, to set levels at which calibration diagnostics are triggered.

Request Data Bytes

Byte	Format	Description
0-3	Float	PV Slope High Alarm Limit %
4-7	Float	PV Slope Low Alarm Limit %
8-11	Float	PV Offset Alarm Limit (+/-) %

Response Data Bytes

Byte	Format	Description
0-3	Float	PV Slope High Alarm Limit %
4-7	Float	PV Slope Low Alarm Limit %
8-11	Float	PV Offset Alarm Limit (+/-) %

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.21.Command #231: Read Auto-Buffer Calibration Parameters

Reads auto-buffer calibration configuration with the following enums:

Standard Calibration Buffer Selection:

0 – User Defined
1 – Standard ABB
2 – NIST
3 – DIN 19266
4 – MERCK
5 – US Tech

Buffer Values:

0 – ABB 4
1 – ABB 7
2 – ABB 9
3 – MERCK 4
4 – MERCK 7
5 – MERCK 9
6 – MERCK 10
7 – DIN 1.6
8 – DIN 4
9 – DIN 6.8
10 – DIN 9.1
11 – US TECH 4
12 – US TECH 7
13 – US TECH 10
14 – NIST 4
15 – NIST 6.8
16 – NIST 9

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Standard Calibration Buffer Selection
1	Enum	Buffer Value 1
2	Enum	Buffer Value 2

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.22.Command #232: Write Standard Buffer Type

Sets buffer type with the following enums:

Standard Calibration Buffer Selection:

0 – User Defined
1 – Standard ABB
2 – NIST
3 – DIN 19266
4 – MERCK
5 – US Tech

Request Data Bytes

Byte	Format	Description
0	Enum	Standard Calibration Buffer Selection

Response Data Bytes

Byte	Format	Description
0	Enum	Standard Calibration Buffer Selection

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.23.Command #233: Write Buffer 1 and Buffer 2 Values

Sets values for pH calibration buffers 1 and 2 with the following enums:

Buffer Values:

0 – ABB 4
1 – ABB 7
2 – ABB 9
3 – MERCK 4
4 – MERCK 7
5 – MERCK 9
6 – MERCK 10
7 – DIN 1.6
8 – DIN 4
9 – DIN 6.8
10 – DIN 9.1
11 – US TECH 4
12 – US TECH 7
13 – US TECH 10
14 – NIST 4
15 – NIST 6.8
16 – NIST 9

Request Data Bytes

Byte	Format	Description
0	Enum	Buffer Value 1
1	Enum	Buffer Value 2

Response Data Bytes

Byte	Format	Description
0	Enum	Buffer Value 1
1	Enum	Buffer Value 2

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.24.Command #234: Read Calibration Mode and Status

Reads calibration mode and status.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Overall Calibration Mode
1	Unsigned-8	Calibration Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.25.Command #235: Write Calibration Mode and Status

Sets calibration mode, returning status.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Calibration Mode
1	Unsigned-8	Calibration Status

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Calibration Mode
1	Unsigned-8	Calibration Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.26.Command #236: Read Temperature Compensated Buffer Value

Reads compensated value from calibration buffer.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration PV Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.27.Command #237: Write Calibration Value

Sets pH calibration value for PV manual calibration.

Request Data Bytes

Byte	Format	Description
0-3	Float	Calibration Value

Response Data Bytes

Byte	Format	Description
0-3	Float	Calibration Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.28.Command #238: Read Calibration Progress and Error

Reads pH calibration progress, returning an error code if calibration fails.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Progress Timer
4	Unsigned-8	Calibration Error State

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.29.Command #239: Read User Defined Buffer Table 1 Temperature and pH

Writes user defined buffer table 1 values for pH calibration.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Buffer 1 - Temperature 1
4-7	Float	Buffer 1 - Temperature 2
8-11	Float	Buffer 1 - Temperature 3
12-15	Float	Buffer 1 - Temperature 4
16-19	Float	Buffer 1 - Temperature 5
20-23	Float	Buffer 1 - pH 1
24-27	Float	Buffer 1 - pH 2
28-31	Float	Buffer 1 - pH 3
32-35	Float	Buffer 1 - pH 4
36-39	Float	Buffer 1 - pH 5

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.30.Command #240: Write User Defined Buffer Table 1 Temperature and pH

Writes values to user defined buffer table 1 for pH calibration.

Request Data Bytes

Byte	Format	Description
0-3	Float	Buffer 1 - Temperature 1
4-7	Float	Buffer 1 - Temperature 2
8-11	Float	Buffer 1 - Temperature 3
12-15	Float	Buffer 1 - Temperature 4
16-19	Float	Buffer 1 - Temperature 5
20-23	Float	Buffer 1 - pH 1
24-27	Float	Buffer 1 - pH 2
28-31	Float	Buffer 1 - pH 3
32-35	Float	Buffer 1 - pH 4
36-39	Float	Buffer 1 - pH 5

Response Data Bytes

Byte	Format	Description
0-3	Float	Buffer 1 - Temperature 1
4-7	Float	Buffer 1 - Temperature 2
8-11	Float	Buffer 1 - Temperature 3
12-15	Float	Buffer 1 - Temperature 4
16-19	Float	Buffer 1 - Temperature 5
20-23	Float	Buffer 1 - pH 1
24-27	Float	Buffer 1 - pH 2
28-31	Float	Buffer 1 - pH 3
32-35	Float	Buffer 1 - pH 4
36-39	Float	Buffer 1 - pH 5

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.31.Command #241: Read User Defined Buffer Table 2 Temperature and pH

Reads user defined buffer table 2 values for pH calibration.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Buffer 2 - Temperature 1
4-7	Float	Buffer 2 - Temperature 2
8-11	Float	Buffer 2 - Temperature 3
12-15	Float	Buffer 2 - Temperature 4
16-19	Float	Buffer 2 - Temperature 5
20-23	Float	Buffer 2 - pH 1
24-27	Float	Buffer 2 - pH 2
28-31	Float	Buffer 2 - pH 3
32-35	Float	Buffer 2 - pH 4
36-39	Float	Buffer 2 - pH 5

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.32.Command #242: Write User Defined Buffer Table 2 Temperature and pH

Writes values to user defined buffer table 2 for pH calibration.

Request Data Bytes

Byte	Format	Description
0-3	Float	Buffer 2 - Temperature 1
4-7	Float	Buffer 2 - Temperature 2
8-11	Float	Buffer 2 - Temperature 3
12-15	Float	Buffer 2 - Temperature 4
16-19	Float	Buffer 2 - Temperature 5
20-23	Float	Buffer 2 - pH 1
24-27	Float	Buffer 2 - pH 2
28-31	Float	Buffer 2 - pH 3
32-35	Float	Buffer 2 - pH 4
36-39	Float	Buffer 2 - pH 5

Response Data Bytes

Byte	Format	Description
0-3	Float	Buffer 2 - Temperature 1
4-7	Float	Buffer 2 - Temperature 2
8-11	Float	Buffer 2 - Temperature 3
12-15	Float	Buffer 2 - Temperature 4
16-19	Float	Buffer 2 - Temperature 5
20-23	Float	Buffer 2 - pH 1
24-27	Float	Buffer 2 - pH 2
28-31	Float	Buffer 2 - pH 3
32-35	Float	Buffer 2 - pH 4
36-39	Float	Buffer 2 - pH 5

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.33.Command #244: Read Factory Calibration Parameters

Reads state of factory calibration via the following enums:

0 – No (Calibration inactive)
1 – Yes (Calibration started)
2 – Active (Calibration in progress)
3 – Error (Calibration failed)

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	PV Factory -1000mV Calibration State
1	Enum	PV Factory +1000mV Calibration State
2	Enum	Ref. Impedance Factory 1KΩ State
3	Enum	Ref. Impedance Factory 100KΩ State

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.34.Command #245: Write Factory Calibration Parameters

Sets state of factory calibration via the following enums:

0 – No (Calibration inactive)
1 – Yes (Start calibration)
2 – Active (Calibration in progress)
3 – Error (Calibration failed)

Requires service level login

Request Data Bytes

Byte	Format	Description
0	Enum	PV Factory -1000mV Calibration State
1	Enum	PV Factory +1000mV Calibration State
2	Enum	Ref. Impedance Factory 1KΩ State
3	Enum	Ref. Impedance Factory 100KΩ State

Response Data Bytes

Byte	Format	Description
0	Enum	PV Factory -1000mV Calibration State
1	Enum	PV Factory +1000mV Calibration State
2	Enum	Ref. Impedance Factory 1KΩ State
3	Enum	Ref. Impedance Factory 100KΩ State

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.35.Command #246: Read Factory Calibration Slope and Offset

Reads calibration data from electrical calibration.

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	PV Factory Cal Slope
4-7	Float	PV Factory Cal Offset
8-11	Float	Ref. Impedance Cal Slope
12-15	Float	Ref. Impedance Cal Offset

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.36.Command #247: Write Linearity/Function Generator

Writes current output configuration with the following enums:

0 – Linear
4 – Function Generator Curve

Request Data Bytes

Byte	Format	Description
0	Enum	Linearity Mode

Response Data Bytes

Byte	Format	Description
0	Enum	Linearity Mode

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid Selection
3-4		Undefined
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-255		Undefined

11.5.37.Command #248: Read Linearity/Function Generator

Reads current output configuration with the following enums:

0 – Linear
4 – Function Generator Curve

Request Data Bytes

Byte	Format	Description
N/A	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Enum	Linearity Mode

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-31		Undefined
32	Error	Busy
33-255		Undefined

Tables

11.6. Unit Codes

11.6.1. pH

Unit Code	Description	Dynamic Variable(s)
59	pH	pH (PV)
36	mV	ORP/pION (PV) Input mV (QV)
57	%	Ion Concentration (PV)
139	ppm	Ion Concentration (PV)
169	ppb	Ion Concentration (PV)
170	mg/l	Ion Concentration (PV)
146	µg/l	Ion Concentration (PV)
163	KΩ	Reference Impedance (TV)
32	°C	Temperature (SV)
33	°F	Temperature (SV)

11.6.2. Conductivity

Unit Code	Description	Dynamic Variable(s)
66	mS/cm	Conductivity (PV)
67	µS/cm	Conductivity (PV/TV/QV)
57	%	Concentration (PV)
139	ppm	Concentration (PV)
169	ppb	Concentration (PV)
170	mg/l	Concentration (PV)
146	µg/l	Concentration (PV)
32	°C	Temperature (SV)
33	°F	Temperature (SV)

11.7. Unit Conversion

11.7.1. pH

Internally the transmitter uses millivolts. Conversions to pH are made using internal functions of Iso-potential Pt. and Asymmetric Pot., dependent on sensor type.

If Ionic Concentration is selected measurement type mV input is converted into concentration units (%, ppm, ppb, mg/l, µg/l) using a function of Valence, Magnitude, End Magnitude and End mV.

11.7.2. Conductivity

Internally the transmitter uses microsiemens per centimeter, which are converted to millisiemens per centimeter if conductivity unit is mS/cm, or if conductivity unit is Auto and the value of PV exceeds 1999 µS/cm.

If Concentration is selected the micro siemens per centimeter is converted into concentration units (%, ppm, ppb, mg/l µg/l) using either predefined or user defined functions, dependent on the solution used.

11.7.3. Temperature

Internally, the transmitter uses degrees Celsius. Conversion to and from degrees Fahrenheit is made using the equation:

$$C = (F - 32) \times 5/9.$$

Performance

11.8. Sampling Rates

11.8.1. Four Electrode Conductivity

Measurement	Typical Sampling Rate
Primary Variable	165ms
Secondary Variable	600/1000ms (2Wire/3Wire)
Output Current	125ms

*depending on temperature sensor type

11.8.2. Two Electrode Conductivity

Measurement	Typical Sampling Rate
Primary Variable	155ms
Secondary Variable	600/1000ms (2Wire/3Wire)
Output Current	125ms

*depending on temperature sensor type

11.8.3. Toroidal Conductivity

Measurement	Typical Sampling Rate
Primary Variable	150ms
Secondary Variable	600/1000ms (2Wire/3Wire)
Output Current	125ms

*depending on temperature sensor type

11.8.4. pH

Measurement	Typical Sampling Rate
Primary Variable	150ms
Secondary Variable	600/1000ms (2Wire/3Wire)
Output Current	125ms

*depending on temperature sensor type

11.9. Power-Up

Power-Up time can be affected by various factors, including the state of Reset to Defaults DIP switch and the sensor type connected, typical times for different stages of startup are given below, but these may vary.

Stage	Time(Typical)
HART Response	~17s
Operator Page Displayed	~25s
Steady Reading	~40s

11.10. Reset

11.10.1. Device Reset

Command 42 causes the device to reset its microprocessor, mimicking a power cycle and so initiating the normal power up sequence

11.10.2. Reset to Defaults

Command 135 causes the device to reset, loading default values to advanced level parameters. This reset can also be triggered by the Reset to Defaults option in the Device setup menu of the HMI.

Switch 1 on the HART communications module causes default values to be loaded on power up when the switch in the On position.

11.11. Self-Test

Self-Test (Command 41) is not implemented on this device.

Error checking is performed on start-up and throughout device operation.

11.12. Command Response Times

Minimum	20 ms
Typical	100 ms
Maximum	200 ms

11.13. Busy and Delayed-Response

The Transmitter does not return a “Busy” status because it does not perform a self-test function.

Delayed response is also not supported.

11.14. Long Messages

Command 21 returns the full 32byte Long Message field with two status bytes – 34 bytes in total.

11.15. Non-Volatile Memory

EEPROM is used to hold the device’s configuration parameters. New data is written to this memory immediately on execution of a write command.

11.16. Modes

Fixed current mode is implemented by sending command 40 with the desired current output (mA) as a floating point value (4.00 to 20.0).
Fixed Current Mode is cleared by sending 0.0, returning the device to its normal operation.

11.17. Write Protection

Write protection is provided by an internal DIP switch, and also in software via the HMI and via HART Commands (132 to set, 128 to reset)

11.18. Damping

Damping is configurable by the user and affects only the PV and thus also the loop current signal.

Appendix A. Capability Check List

Manufacturer, model and revision	ABB AWT210
Device type	Water Analyzer Transmitter
HART revision	7.0
Device Description available	Yes
Number and type of sensors	4 Sensor Options – EC, TE, TC and pH (Only one can be connected) with Temperature
Number and type of actuators	0
Number and type of host side signals	1: 4 - 20mA analog
Number of Device Variables	0
Number of Dynamic Variables	4
Mappable Dynamic Variables	No
Number of common-practice commands	14
Number of device-specific commands	130
Bits of additional device status	16 (Command 48)
Alternative operating modes?	HART rev 5.0
Burst mode?	No
Write-protection?	Yes

Appendix B. Default Configuration

11.19. pH

Parameter	Default Value
PV Lower Range Value	0.00 pH
PV Upper Range Value	14.00 pH
PV Units	pH
Measurement Type	pH
Sensor Type	Glass
SV Units	°C
Reference Temperature	25.0°C
Damping Time Constant	0.5 Sec
Write Protection	Disabled
HART Device Address	0
Response Preambles	5
Loop Current Mode	Enabled
Fault Condition Current	Low (3.6mA)

11.20. Two Electrode Conductivity

Parameter	Default Value
PV Lower Range Value	0.0 µS/cm
PV Upper Range Value	200.0 µS/cm
PV Units	µS/cm
Measurement Type	Conductivity
Cell Constant	0.010
SV Units	°C
Reference Temperature	25.0°C
Damping Time Constant	0.5 Sec
Write Protection	Disabled
HART Device Address	0
Response Preambles	5
Loop Current Mode	Enabled
Fault Condition Current	Low (3.6mA)

11.21. Four Electrode Conductivity

Parameter	Default Value
PV Lower Range Value	0 µS/cm
PV Upper Range Value	200,000 µS/cm
PV Units	µS/cm
Measurement Type	Conductivity
Sensor Group	A
SV Units	°C
Reference Temperature	25.0°C
Damping Time Constant	0.5 Sec
Write Protection	Disabled
HART Device Address	0
Response Preambles	5
Loop Current Mode	Enabled
Fault Condition Current	Low (3.6mA)

11.22. Toroidal Conductivity

Parameter	Default Value
PV Lower Range Value	0 µS/cm
PV Upper Range Value	200,000 µS/cm
PV Units	µS/cm
Measurement Type	Conductivity
SV Units	°C
Reference Temperature	25.0°C
Damping Time Constant	0.5 Sec
Write Protection	Disabled
HART Device Address	0
Response Preambles	5
Loop Current Mode	Enabled
Fault Condition Current	Low (3.6mA)

12. Annex C. Revision History

Author	Change	Version	Date
James Philp	First Version	1.0	16th November 2016

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