HART® Field Device Specification:
CiDRA SONARtrac

Document 21479, rev. 0

Initial release: 10 February 2014
Current release: 10 February 2014

Cidra Corporate Services

50 Barnes Park North

Wallingford, Ct 06492

USA

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Scope

The CiDRA Corporate Services, SONARtrac flowmeter 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.

1.2 Purpose

This specification is designed to complement other documentation (e.g., the *20822 Installation Manual*) by providing a complete, unambiguous description of this Field Device from a HART Communication perspective

1.3 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.

1.4 Abbreviations and definitions

GVF	Gas Volume Fraction
TLF	True Liquid Flow
PV	Primary Variable
SV	Secondary Variable
TV	Tertiary Variable
QV	Quaternary Variable

1.5 References

HART Smart Communications Protocol Specification. HCF_SPEC-12. Available from the HCF.

SONARtrac Installation Manual, Document 20822. Available from the CiDRA Corporate Services Web-site, (www.cidra.com).

2. DEVICE IDENTIFICATION

Manufacturer Name:	CiDRA Corporate Services	**Model Name(s):**	SONARtrac
Manufacture ID Code:	(76 Hex)	**Device Type Code:**	(EF Hex)
HART Protocol Revision	7.0	**Device Revision:**	0
Number of Device Variables	VFGVF-100 (4)		
Physical Layers Supported	FSK		
Physical Device Category	2 Wire Transmitter		

The SONARtrac is a designed to mount on a pipe. The name plate is located on the exterior of Transmitter Box and indicates the model name and revision.

3. PRODUCT OVERVIEW

SONARtrac® passive sonar process monitoring systems utilize patented sonar array processing techniques to listen to and interpret flow turbulence generated by fluid flow and sound generated by process piping and instrumentation. The clamp-on design eliminates the need for cutting pipe or interrupting process flow during installation.

The Model VF/GVF 100 (Volumetric Flow / Gas Volume Fraction) Combined monitoring system measures the volumetric flow and gas volume / void fraction in process pipes. This is also available as with the High Dispersion option as an HP VF/GVF-100 Process Monitoring System.

4. PRODUCT INTERFACES

4.1 Process Interface

4.1.1 RS485/ RS232 Interface

The outputs of the transmitter are connected to provide communication between the transmitter and other equipment. COMM denotes the connection point for serial digital communications. Either RS232 or RS485 communications is supported with baud rates settable between 2400 and 115200 baud (8 bits, no parity, 1 stop bit). The communications type (RS232/485) as well as the baud rate can be set by the front panel keypad. Host interface

4.1.2 Analog 4-20 Outputs CUR1 and CUR2

The CUR1 (HART accessible) and CUR2 terminals are used for connection to the primary 4-20mA output from the transmitter. The transmitter can be configured such that an external supply can be used for power (i.e. the 4-20mA loop current is driven externally) or such that the transmitter itself will power the loop (internal power). A combination of power wiring and internal software settings will ensure that the 4-20mA output will function properly. The following figures show proper wiring for internal and external power. The software configuration must be set to match the external wire connections for proper operation of this output. The primary 4-20mA output is the only 4-20mA output that supports

HART communication. This is the only output from this transmitter, representing the process temperature measurement, linearized and scaled according to the configured range of the instrument. This output corresponds to the Primary Variable. HART Communication is supported on this loop. This device has a CN number of 1.

4.1.3 Internally Powered 4-20mA Loop Configuration

The connections for a 4-20mA interface configured as "Internally Powered" are shown below. The maximum value of RL is 500 Ohms. The voltage across RL must be measured differentially. The V-INT connection is tied to a −10V reference internal to the transmitter and must not be connected to ground in the plant control system.
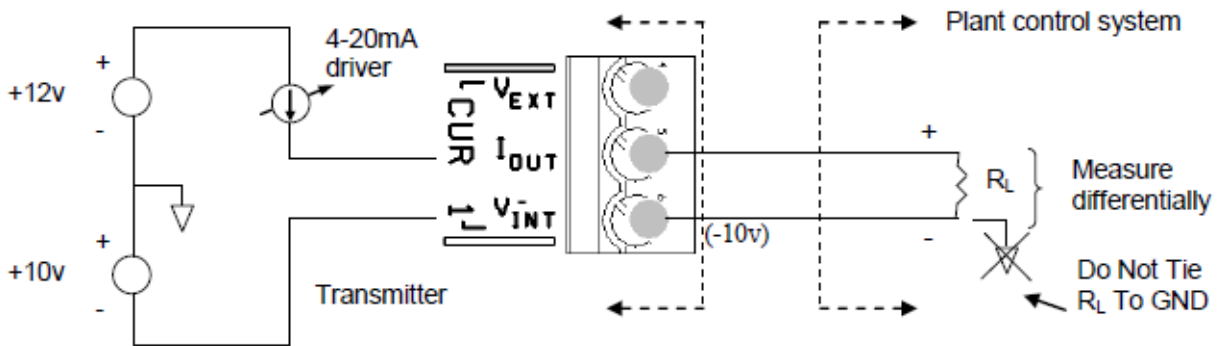
4.1.4 Externally Powered 4-20mA Loop Configuration

The connections for a 4-20mA interface configured as "Externally Powered" are shown below. The maximum value of VEXT should be chosen such that the maximum applied voltage between VEXT and local ground and IOUT and local ground shall be within the range of +30V / -10V and current limited to 100mA. The maximum value of RL is determined by the following equation:

$$L\ Max = (VEXT - 8.35) / (0.022)$$

For example, with VEXT = 24VDC: RL Max = (24-8.35) / (0.022) = 711 Ohms

In the externally powered configuration the 4-20mA interface is capacitively isolated from the rest of the transmitter electronics provided that the applied voltages are within +30V / -30V.
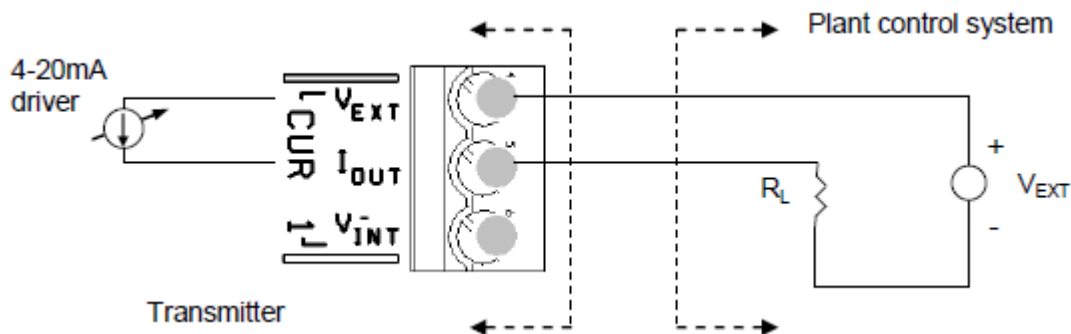
4.2 Local Interfaces, Display

4.2.1 Local Controls And Displays
This device has external local controls with a display.

4.2.2 Menu Control and Display
Write Protect option

Write Protection
Menu Command provides a write-protect function. When the command is absent, "write" commands are disabled. Refer to the Installation Manual for details.

5. DEVICE VARIABLES

- PV – Flow Rate

- SV – Total

- TV – TLF

- QV – GVF

6. DYNAMIC VARIABLES
Dynamic Variables are not implemented.

7. STATUS INFORMATION

7.1 Device Status
Bit 0 ("Primary Variable out of Limits") indicates the Flow Rate is outside the Flow Cutoff Range or below minimum Quality.

Bit 1 ("Non-Primary Variable Out Of Limits") refers to GVF or TLF. (This event does *not* set bit 7 ("Field Device Malfunction").)

Bit 2 ("PV Analog Channel Saturated") indicates the 4-20mA is set to an error state.

Bit 3 ("PV Analog Channel Fixed") Indicates the Flow Rate is not changing.

Bit 4 ("More Status Available") is set whenever an Alarm Status is detected. Command #48 gives further detail. (See Section 7.2.)

7.2 Extended Device Status
The Extended Device Status bits are used to indicate Alarm Status, either Warning or Critical level.

7.3 Additional Device Status (Command #48)

Additional Status Bytes returned by Command #48 are used by Sensor Test and are not useful for the user.

8. UNIVERSAL COMMANDS

Command #3 returns PV, SV, TV and QV for a total of 24 bytes of response data).

9. COMMON-PRACTICE COMMANDS

9.1 Supported Commands

The following common-practice commands are implemented:

33 Read Device Variables

34 Write Damping Value

35 Write Range Values

38 Reset "Configuration Changed" Flag

40 Enter/Exit Fixed Current Mode

41 Perform Device Self-Test

42 Perform Master Reset

43 Set (Trim) PV Zero

44 Write PV Units

45 Trim DAC Zero

46 Trim DAC Gain

49 Write PV Transducer Serial Number

53 Write Device Variable Units

59 Write Number Of Response Preambles

72 Squawk

73 Find Device

76 Read Lock Device State

89 Set Real-time Clock

90 Read Real-time Clock

9.2 Burst Mode
This Field Device does not support Burst Mode.

9.3 Catch Device Variable
This Field Device does not support Catch Device Variable.

10. DEVICE-SPECIFIC COMMANDS

The following device-specific commands are implemented:

160 Write CiDRA Control Record

161 Read CiDRA Control Record

163 Read CiDRA Device Information

164 Write CiDRA Pipe Information

165 Read CiDRA Pipe Information

166 Write CiDRA Fluid Properties

167 Read CiDRA Fluid Properties

168 Write CiDRA Environment Settings

169 Read CiDRA Environment Settings

170 Write CiDRA Display Settings

171 Read CiDRA Display Settings

172 Write CiDRA System Settings

173 Read CiDRA System Settings

175 Read CiDRA System Dynamic

176 Write CiDRA Preamp Settings

177 Read CiDRA Preamp Settings

178 Write CiDRA Flow Algorithm

179 Read CiDRA Flow Algorithm

181 Read CiDRA Flow Algorithm Dynamic

182 Write CiDRA Flow Calibration

183 Read CiDRA Flow Calibration Settings

184 Write CiDRA SOS Algorithm

185 Read CiDRA SOS Algorithm

187 Read CiDRA SOS Algo Dynamic

190 Write CiDRA Analog Section

191 Read CiDRA Analog Section

192 Write CiDRA Input Units

193 Read CiDRA Input Units

194 Write CiDRA Flow NR Filter

195 Read CiDRA Flow NR Filter

196 Write CiDRA Flow Damping

197 Read CiDRA Flow Damping

198 Write CiDRA Flow Spike Filter

199 Read CiDRA Flow Spike Filter

200 Write CiDRA GVF NR Filter

201 Read CiDRA GVF NR Filter

202 Write CiDRA GVF Damping

203 Read CiDRA GVF Damping

204 Write CiDRA GVF Spike Filter

205 Read CiDRA GVF Spike Filter

206 Write CiDRA Sensor

207 Read CiDRA Sensor

208 Write CiDRA Sensor Spacing

209 Read CiDRA Sensor Spacing

213 Read CiDRA Measured Values

215 Read CiDRA Sensor Max Min

217 Read CiDRA Sensor Alpha

10.1 Command 160 Write CiDRA Control Record

Sets the CiDRA Control Record Variables.

Request Data Bytes

Byte	Format	Description
0	Enum	Write Control code (see Section 11.1)
1	Enum	Reset Totalizer code (see Section 11.2)
2	Enum	Clear Alarm code (see Section 11.2)
3	Enum	Clear History code (see Section 11.2)

Response Data Bytes

Byte	Format	Description
0	Enum	Write Control code (see Section 11.1)
1	Enum	Reset Totalizer code (see Section 11.2)
2	Enum	Clear Alarm code (see Section 11.2)
3	Enum	Clear History code (see Section 11.2)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.2 Command 161 Read CiDRA Control Record

Gets the CiDRA Control Record Variables.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	Write Control code (see Section 11.1)
1	Enum	Reset Totalizer code (see Section 11.2)
2	Enum	Clear Alarm code (see Section 11.2)
3	Enum	Clear History code (see Section 11.2)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.3 Command 163 Read CiDRA Device Information
Gets the CiDRA Device Information.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-15	Latin-1	Serial Number
16-31	Latin-1	Model Number
32-47	Latin-1	Software Revision
48-63	Latin-1	Sensorhead Serial Number
64-79	Latin-1	Preamp Software Revision
80-95	Latin-1	Preamp Serial Number

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.4 Command 164 Write CiDRA Pipe Information
Sets the CiDRA Pipe Information.

Request Data Bytes

Byte	Format	Description
0	Enum	Pipe Diameter Select code (see Section 11.3)
1	Enum	Pipe Diameter Units code (see Section 11.4)
2-5	Float	Display Pipe Diameter
6-9	Float	Pipe Outside Diameter
10	Enum	Pipe OD Wall Units code (see Section 11.4)
11-14	Float	Wall Thickness
15	Enum	Pipe Size/Schedule Size code (see Section 11.5)
16	Enum	Pipe Size/Schedule Schedule code (see Section 11.6)
17	Enum	SOS Pipe Wall Thickness Units code (see Section 11.4)
18-21	Float	SOS Pipe Wall Thickness
22	Enum	SOS Pipe Modulus Select code (see Section 11.7)
23-26	Float	SOS Pipe Modulus

Response Data Bytes

Byte	Format	Description
0	Enum	Pipe Diameter Select code (see Section 11.3)
1	Enum	Pipe Diameter Units code (see Section 11.4)
2-5	Float	Display Pipe Diameter
6-9	Float	Pipe Outside Diameter
10	Enum	Pipe OD Wall Units code (see Section 11.4)
11-14	Float	Wall Thickness
15	Enum	Pipe Size/Schedule Size code (see Section 11.5)
16	Enum	Pipe Size/Schedule Schedule code (see Section 11.6)
17	Enum	SOS Pipe Wall Thickness Units code (see Section 11.4)
18-21	Float	SOS Pipe Wall Thickness
22	Enum	SOS Pipe Modulus Select code (see Section 11.7)
23-26	Float	SOS Pipe Modulus

10.5 Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.6 Command 165 Read CiDRA Pipe Information

Gets the CiDRA Pipe Information.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	Pipe Diameter Select code (see Section 11.3)
1	Enum	Pipe Diameter Units code (see Section 11.4)
2-5	Float	Display Pipe Diameter
6-9	Float	Pipe Outside Diameter
10	Enum	Pipe OD Wall Units code (see Section 11.4)
11-14	Float	Wall Thickness
15	Enum	Pipe Size/Schedule Size code (see Section 11.5)
16	Enum	Pipe Size/Schedule Schedule code (see Section 11.6)
17	Enum	SOS Pipe Wall Thickness Units code (see Section 11.4)
18-21	Float	SOS Pipe Wall Thickness
22	Enum	SOS Pipe Modulus Select code (see Section 11.7)
23-26	Float	SOS Pipe Modulus

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.7 Command 166 Write CiDRA Fluid Properties

Sets the CiDRA Fluid Properties

Request Data Bytes

Byte	Format	Description
0-3	Float	Viscosity
4	Enum	SOS Gas Constant Selection code (see Section 11.8)
5	Enum	SOS Specific Gravity Select code (see Section 11.9)
6	Enum	Liquid Sound Speed Select code (see Section 11.9)
7-10	Float	SOS Gas Constant
11-14	Float	Specific Gravity
15-18	Float	Liquid SOS
19-22	Float	Specific Heat Ratio
23-26	Float	Liquid Density

Response Data Bytes

Byte	Format	Description
0-3	Float	Viscosity
4	Enum	SOS Gas Constant Selection code (see Section 11.8)
5	Enum	SOS Specific Gravity Select code (see Section 11.9)
6	Enum	Liquid Sound Speed Select code (see Section 11.9)
7-10	Float	SOS Gas Constant
11-14	Float	Specific Gravity
15-18	Float	Liquid SOS
19-22	Float	Specific Heat Ratio
23-26	Float	Liquid Density

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined

Code	Class	Description
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.8 Command 167 Read CiDRA Fluid Properties

Gets the CiDRA Fluid Properties.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	Viscosity
4	Enum	SOS Gas Constant Selection code (see Section 11.8)
5	Enum	SOS Specific Gravity Select code (see Section 11.9)
6	Enum	Liquid Sound Speed Select code (see Section 11.9)
7-10	Float	SOS Gas Constant
11-14	Float	Specific Gravity
15-18	Float	Liquid SOS
19-22	Float	Specific Heat Ratio
23-26	Float	Liquid Density

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.9 Command 168 Write CiDRA Environment Settings

Sets the CiDRA Environment Settings

Request Data Bytes

Byte	Format	Description
0	Enum	Temperature Input Select code (see Section 11.10)
1	Enum	Pressure Input Select code (see Section 11.10)
2	Enum	SOS Temperature Units code (see Section 11.11)
3	Enum	SOS Pressure Units code (see Section 11.12)
4-7	Float	SOS Temperature
8-11	Float	SOS Pressure
12	Enum	Altitude Units code (see Section 11.13)
13-16	Float	Altitude

Response Data Bytes

Byte	Format	Description
0	Enum	Temperature Input Select code (see Section 11.10)
1	Enum	Pressure Input Select code (see Section 11.10)
2	Enum	SOS Temperature Units code (see Section 11.11)
3	Enum	SOS Pressure Units code (see Section 11.12)
4-7	Float	SOS Temperature
8-11	Float	SOS Pressure
12	Enum	Altitude Units code (see Section 11.13)
13-16	Float	Altitude

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.10 Command 169 Read CiDRA Environment Settings

Gets the CiDRA Environment Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	Temperature Input Select code (see Section 11.10)
1	Enum	Pressure Input Select code (see Section 11.10)
2	Enum	SOS Temperature Units code (see Section 11.11)
3	Enum	SOS Pressure Units code (see Section 11.12)
4-7	Float	SOS Temperature
8-11	Float	SOS Pressure
12	Enum	Altitude Units code (see Section 11.13)
13-16	Float	Altitude

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.11 Command 170 Write CiDRA Display Settings
Sets the CiDRA Display Settings

Request Data Bytes

Byte	Format	Description
0	Enum	Volume Units code (see Section 11.14)
1	Enum	Time Units code (see Section 11.15)
2-5	Float	Low Flow Cutoff %
6-9	Float	High Flow Cutoff %
10	Enum	Custom Volume Units code (see Section 11.16)
11	Enum	Custom Time Units code (see Tabl1 11.17)
12-14	Latin-1	Custom Volume Label
15-16	Latin-1	Custom Time Label
17-20	Float	Custom Volume Scale
21-24	Float	Custom Time Scale
25-28	Float	VF Quality Delta
29	Unsigned-8	GVF Decimal Places
30	Enum	SOS Volume Units code (see Section 11.13)
31-34	Float	SOS Quality Delta

Response Data Bytes

Byte	Format	Description
0	Enum	Volume Units code (see Section 11.14)
1	Enum	Time Units code (see Section 11.15)
2-5	Float	Low Flow Cutoff %
6-9	Float	High Flow Cutoff %
10	Enum	Custom Volume Units code (see Section 11.16)
11	Enum	Custom Time Units code (see Tabl1 11.17)
12-14	Latin-1	Custom Volume Label
15-16	Latin-1	Custom Time Label
17-20	Float	Custom Volume Scale
21-24	Float	Custom Time Scale
25-28	Float	VF Quality Delta

29	Unsigned-8	GVF Decimal Places
30	Enum	SOS Volume Units code (see Section 11.13)
31-34	Float	SOS Quality Delta

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.12 Command 171 Read CiDRA Display Settings

Gets the CiDRA Display Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	Volume Units code (see Section 11.14)
1	Enum	Time Units code (see Section 11.15)
2-5	Float	Low Flow Cutoff %
6-9	Float	High Flow Cutoff %
10	Enum	Custom Volume Units code (see Section 11.16)
11	Enum	Custom Time Units code (see Tabl1 11.17)
12-14	Latin-1	Custom Volume Label
15-16	Latin-1	Custom Time Label
17-20	Float	Custom Volume Scale
21-24	Float	Custom Time Scale
25-28	Float	VF Quality Delta
29	Unsigned-8	GVF Decimal Places
30	Enum	SOS Volume Units code (see Section 11.13)
31-34	Float	SOS Quality Delta

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.13 Command 172 Write CiDRA System Settings

Sets the CiDRA System Settings

Request Data Bytes

Byte	Format	Description
0-3	Enum	Operating Mode code (see Section 11.18)
4-7	Unsigned-32	Update Rate
8-11	Unsigned-32	Channels
12-15	Float	Gain
16-19	Float	SPL Threshold
20	Enum	Write Protect code (see Section 11.1)
21-22	Unsigned-16	Idle Timeout
23-24	Unsigned-16	Ethernet Idle Timeout

Response Data Bytes

Byte	Format	Description
0-3	Enum	Operating Mode code (see Section 11.18)
4-7	Unsigned-32	Update Rate
8-11	Unsigned-32	Channels
12-15	Float	Gain
16-19	Float	SPL Threshold
20	Enum	Write Protect code (see Section 11.1)
21-22	Unsigned-16	Idle Timeout
23-24	Unsigned-16	Ethernet Idle Timeout

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.14 Command 173 Read CiDRA System Settings

Gets the CiDRA System Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Enum	Operating Mode code (see Section 11.18)
4-7	Unsigned-32	Update Rate
8-11	Unsigned-32	Channels
12-15	Float	Gain
16-19	Float	SPL Threshold
20	Enum	Write Protect code (see Section 11.1)
21-22	Unsigned-16	Idle Timeout
23-24	Unsigned-16	Ethernet Idle Timeout

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.15 Command 175 Read CiDRA System Dynamic

Sets the CiDRA Dynamic System Variables

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	SPL Average
4-7	Float	SPL Standard Deviation

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.16 Command 176 Write CiDRA Preamp Settings

Sets the CiDRA Preamp Settings

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Preamp Gain
1-4	Unsigned-32	AGC Run Mode
5-8	Float	Charge Gain
9-12	Float	Gain0
13-16	Float	Gain1
17-20	Float	Gain2
21-24	Float	Gain3

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Preamp Gain
1-4	Unsigned-32	AGC Run Mode
5-8	Float	Charge Gain
9-12	Float	Gain0
13-16	Float	Gain1
17-20	Float	Gain2
21-24	Float	Gain3

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.17 Command 177 Read CiDRA Preamp Settings

Gets the CiDRA Preamp Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Preamp Gain
1-4	Unsigned-32	AGC Run Mode
5-8	Float	Charge Gain
9-12	Float	Gain0
13-16	Float	Gain1
17-20	Float	Gain2
21-24	Float	Gain3

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.18 Command 178 Write CiDRA Flow Algorithm

Sets the CiDRA Flow Algorithm Settings

Request Data Bytes

Byte	Format	Description
0-3	Float	Sample Frequency
4-7	Float	Channel Skew
8-11	Float	Frequency Min
12-15	Float	Frequency Max
16-19	Float	Flow Min
20-23	Float	Flow Max
24-27	Float	Min Quality
28-31	Float	VF Nyquist High
32-35	Float	VF Nyquist Low
36-39	Float	VF Centroid Width
40-43	Float	VF Search Limit Low
44-47	Float	VF Search Limit High
48-51	Float	VF Nyquist Init Value
52-55	Unsigned-32	Decimation
56-59	Unsigned-32	Window Type
60-63	Unsigned-32	Detrend Flag
64-67	Unsigned-32	Velocity Normalization Flag
68-71	Unsigned-32	Velocity Differencing Flag
72-75	Unsigned-32	Flow Direction
76-79	Unsigned-32	Transit Time Multiplier
80-83	Unsigned-32	VF Peak Search Mode
84-87	Unsigned-32	VF Op Mode Settings
88-92	Unsigned-32	VF Quality Mode

Response Data Bytes

Byte	Format	Description
0-3	Float	Sample Frequency
4-7	Float	Channel Skew

8-11	Float	Frequency Min
12-15	Float	Frequency Max
16-19	Float	Flow Min
20-23	Float	Flow Max
24-27	Float	Min Quality
28-31	Float	VF Nyquist High
32-35	Float	VF Nyquist Low
36-39	Float	VF Centroid Width
40-43	Float	VF Search Limit Low
44-47	Float	VF Search Limit High
48-51	Float	VF Nyquist Init Value
52-55	Unsigned-32	Decimation
56-59	Unsigned-32	Window Type
60-63	Unsigned-32	Detrend Flag
64-67	Unsigned-32	Velocity Normalization Flag
68-71	Unsigned-32	Velocity Differencing Flag
72-75	Unsigned-32	Flow Direction
76-79	Unsigned-32	Transit Time Multiplier
80-83	Unsigned-32	VF Peak Search Mode
84-87	Unsigned-32	VF Op Mode Settings
88-92	Unsigned-32	VF Quality Mode

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.19 Command 179 Read CiDRA Flow Algorithm

Gets the CiDRA Flow Algorithm Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	Sample Frequency
4-7	Float	Channel Skew
8-11	Float	Frequency Min
12-15	Float	Frequency Max
16-19	Float	Flow Min
20-23	Float	Flow Max
24-27	Float	Min Quality
28-31	Float	VF Nyquist High
32-35	Float	VF Nyquist Low
36-39	Float	VF Centroid Width
40-43	Float	VF Search Limit Low
44-47	Float	VF Search Limit High
48-51	Float	VF Nyquist Init Value
52-55	Unsigned-32	Decimation
56-59	Unsigned-32	Window Type
60-63	Unsigned-32	Detrend Flag
64-67	Unsigned-32	Velocity Normalization Flag
68-71	Unsigned-32	Velocity Differencing Flag
72-75	Unsigned-32	Flow Direction
76-79	Unsigned-32	Transit Time Multiplier
80-83	Unsigned-32	VF Peak Search Mode
84-87	Unsigned-32	VF Op Mode Settings
88-92	Unsigned-32	VF Quality Mode

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.20 Command 181 Read CiDRA Flow Algorithm Dynamic

Sets the CiDRA Dynamic Flow Algorithm Variables

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Unsigned-32	Blocks
4-7	Unsigned-32	FFT Points
8-11	Unsigned-32	Window Overlap
12-15	Unsigned-32	FFT Averages

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.21 Command 182 Write CiDRA Flow Calibration
Sets the CiDRA Flow Calibration Settings

Request Data Bytes

Byte	Format	Description
0-3	Float	Reynolds Calibration 0
4-7	Float	Reynolds Calibration 1
8-11	Float	Reynolds Calibration 2

Response Data Bytes

Byte	Format	Description
0-3	Float	Reynolds Calibration 0
4-7	Float	Reynolds Calibration 1
8-11	Float	Reynolds Calibration 2

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.22 Command 183 Read CiDRA Flow Calibration Settings

Gets the CiDRA Flow Calibration Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	Reynolds Calibration 0
4-7	Float	Reynolds Calibration 1
8-11	Float	Reynolds Calibration 2

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.23 Command 184 Write CiDRA SOS Algorithm
Sets the CiDRA Flow Algorithm Settings

Request Data Bytes

Byte	Format	Description
0-3	Float	SOS Sample Frequency
4-7	Float	SOS Frequency Min
8-11	Float	SOS Frequency Max
12-15	Float	SOS Min
16-19	Float	SOS Max
20-23	Float	SOS Min Quality
24-27	Float	SOS Centroid Width
28-31	Float	SOS Frequency Threshold
32-35	Float	SOS k Min
36-39	Float	SOS k Max
40-43	Float	SOS Search Limit
44-47	Float	SOS Lambda Diameter
48-51	Unsigned-32	SOS Blocks
52-55	Unsigned-32	SOS FFT Points
56-59	Unsigned-32	SOS Window Overlap
60-63	Unsigned-32	SOS Sub Arrays
64-67	Unsigned-32	SOS Normalization Flal
68-71	Unsigned-32	SOS Differencing Flag
72-75	Unsigned-32	SOS Op Mode Settings
76-79	Unsigned-32	SOS Select Num
80-83	Unsigned-32	SOS Min Frequency Points

Response Data Bytes

Byte	Format	Description
0-3	Float	SOS Sample Frequency
4-7	Float	SOS Frequency Min
8-11	Float	SOS Frequency Max

12-15	Float	SOS Min
16-19	Float	SOS Max
20-23	Float	SOS Min Quality
24-27	Float	SOS Centroid Width
28-31	Float	SOS Frequency Threshold
32-35	Float	SOS k Min
36-39	Float	SOS k Max
40-43	Float	SOS Search Limit
44-47	Float	SOS Lambda Diameter
48-51	Unsigned-32	SOS Blocks
52-55	Unsigned-32	SOS FFT Points
56-59	Unsigned-32	SOS Window Overlap
60-63	Unsigned-32	SOS Sub Arrays
64-67	Unsigned-32	SOS Normalization Flal
68-71	Unsigned-32	SOS Differencing Flag
72-75	Unsigned-32	SOS Op Mode Settings
76-79	Unsigned-32	SOS Select Num
80-83	Unsigned-32	SOS Min Frequency Points

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.24 Command 185 Read CiDRA SOS Algorithm

Gets the CiDRA SOS Algorithm Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	SOS Sample Frequency
4-7	Float	SOS Frequency Min
8-11	Float	SOS Frequency Max
12-15	Float	SOS Min
16-19	Float	SOS Max
20-23	Float	SOS Min Quality
24-27	Float	SOS Centroid Width
28-31	Float	SOS Frequency Threshold
32-35	Float	SOS k Min
36-39	Float	SOS k Max
40-43	Float	SOS Search Limit
44-47	Float	SOS Lambda Diameter
48-51	Unsigned-32	SOS Blocks
52-55	Unsigned-32	SOS FFT Points
56-59	Unsigned-32	SOS Window Overlap
60-63	Unsigned-32	SOS Sub Arrays
64-67	Unsigned-32	SOS Normalization Flal
68-71	Unsigned-32	SOS Differencing Flag
72-75	Unsigned-32	SOS Op Mode Settings
76-79	Unsigned-32	SOS Select Num
80-83	Unsigned-32	SOS Min Frequency Points

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

Code	Class	Description
1-127		Undefined

10.25 Command 187 Read CiDRA SOS Algo Dynamic

Gets the CiDRA SOS Algorithm Dynamic Variables

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Unsigned-32	SOS Num Pts Right
4-7	Unsigned-32	SOS Num Pts Left

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.26 Command 190 Write CiDRA Analog Section
Sets the CiDRA Analog Section Settings

Request Data Bytes

Byte	Format	Description
0	Enum	Sensor Input Units 0 (see Section 11.19)
1	Enum	Sensor Input Units 1 (see Section 11.19)
2-5	Float	Sensor Input Scale 0
6-9	Float	Sensor Input Scale 1
10-13	Float	Sensor Input Offset 0
14-17	Float	Sensor Input Offset 1
18	Enum	First Order Damping Filter Enable 0 (see Section 11.1)
19	Enum	First Order Damping Filter Enable 1 (see Section 11.1)
20-23	Float	Sensor 1 Damping Tau
24-27	Float	Sensor 2 Damping Tau

Response Data Bytes

Byte	Format	Description
0	Enum	Sensor Input Units 0 (see Section 11.19)
1	Enum	Sensor Input Units 1 (see Section 11.19)
2-5	Float	Sensor Input Scale 0
6-9	Float	Sensor Input Scale 1
10-13	Float	Sensor Input Offset 0
14-17	Float	Sensor Input Offset 1
18	Enum	First Order Damping Filter Enable 0 (see Section 11.1)
19	Enum	First Order Damping Filter Enable 1 (see Section 11.1)
20-23	Float	Sensor 1 Damping Tau
24-27	Float	Sensor 2 Damping Tau

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined

Code	Class	Description
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.27 Command 191 Read CiDRA Analog Section

Gets the CiDRA Analog Section Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	Sensor Input Units 0 (see Section 11.19)
1	Enum	Sensor Input Units 1 (see Section 11.19)
2-5	Float	Sensor Input Scale 0
6-9	Float	Sensor Input Scale 1
10-13	Float	Sensor Input Offset 0
14-17	Float	Sensor Input Offset 1
18	Enum	First Order Damping Filter Enable 0 (see Section 11.1)
19	Enum	First Order Damping Filter Enable 1 (see Section 11.1)
20-23	Float	Sensor 1 Damping Tau
24-27	Float	Sensor 2 Damping Tau

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.28 Command 192 Write CiDRA Input Units

Sets the CiDRA Input Units Settings

Request Data Bytes

Byte	Format	Description
0	Enum	Pressure Input Units (see Section 11.19)
1	Enum	Temperature Input Units (see Section 11.19)
2	Enum	External Input Units 0 (see Section 11.19)
3	Enum	External Input Units 1 (see Section 11.19)
4	Enum	External Input Units 2 (see Section 11.19)

Response Data Bytes

Byte	Format	Description
0	Enum	Pressure Input Units (see Section 11.19)
1	Enum	Temperature Input Units (see Section 11.19)
2	Enum	External Input Units 0 (see Section 11.19)
3	Enum	External Input Units 1 (see Section 11.19)
4	Enum	External Input Units 2 (see Section 11.19)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.29 Command 193 Read CiDRA Input Units

Gets the CiDRA Inout Units Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	Pressure Input Units (see Section 11.19)
1	Enum	Temperature Input Units (see Section 11.19)
2	Enum	External Input Units 0 (see Section 11.19)
3	Enum	External Input Units 1 (see Section 11.19)
4	Enum	External Input Units 2 (see Section 11.19)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.30 Command 194 Write CiDRA Flow NR Filter
Sets the CiDRA Flow Noise Reduction Filter Settings

Request Data Bytes

Byte	Format	Description
0	Enum	VF NR Filter Enable (see Section 11.1)
1	Enum	VF NR Filter Magnitude Select (see Section 11.20)

Response Data Bytes

Byte	Format	Description
0	Enum	VF NR Filter Enable (see Section 11.1)
1	Enum	VF NR Filter Magnitude Select (see Section 11.20)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.31 Command 195 Read CiDRA Flow NR Filter

Gets the CiDRA Flow Noise Reduction Filter Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	VF NR Filter Enable (see Section 11.1)
1	Enum	VF NR Filter Magnitude Select (see Section 11.20)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.32 Command 196 Write CiDRA Flow Damping Filter
Sets the CiDRA Flow Damping FIlter

Request Data Bytes

Byte	Format	Description
0	Enum	VF Damping Filter Enable (see Section 11.1)
1-4	Float	VF Damping Tau

Response Data Bytes

Byte	Format	Description
0	Enum	VF Damping Filter Enable (see Section 11.1)
1-4	Float	VF Damping Tau

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.33 Command 197 Read CiDRA Flow Damping Filter

Gets the CiDRA Flow Damping Filter Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	VF Damping Filter Enable (see Section 11.1)
1-4	Float	VF Damping Tau

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.34 Command 198 Write CiDRA Flow Spike Filter

Sets the CiDRA Flow Spike Filter Settings

Request Data Bytes

Byte	Format	Description
0	Enum	VF Spike Filter Enable (see Section 11.1)
1	Unsigned-8	VF Spike No Flow Length
2	Unsigned-8	Spike Filter Length
3	Unsigned-8	Spike Up Count
4	Unsigned-8	Spike Down Count
5-8	Float	Spike Percent
9	Unsigned-8	Spike Percent Window Length

Response Data Bytes

Byte	Format	Description
0	Enum	VF Spike Filter Enable (see Section 11.1)
1	Unsigned-8	VF Spike No Flow Length
2	Unsigned-8	Spike Filter Length
3	Unsigned-8	Spike Up Count
4	Unsigned-8	Spike Down Count
5-8	Float	Spike Percent
9	Unsigned-8	Spike Percent Window Length

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.35 Command 199 Read CiDRA Flow Spike Filter

Gets the CiDRA Flow Spike Filter Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	VF Spike Filter Enable (see Section 11.1)
1	Unsigned-8	VF Spike No Flow Length
2	Unsigned-8	Spike Filter Length
3	Unsigned-8	Spike Up Count
4	Unsigned-8	Spike Down Count
5-8	Float	Spike Percent
9	Unsigned-8	Spike Percent Window Length

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.36 Command 200 Write CiDRA GVF NR Filter

Sets the CiDRA GVF Noise Reduction Filter Settings

Request Data Bytes

Byte	Format	Description
0	Enum	GVF NR Filter Enable (see Section 11.1)
1	Enum	GVF NR Filter Magnitude Select (see 11.20)

Response Data Bytes

Byte	Format	Description
0	Enum	GVF NR Filter Enable (see Section 11.1)
1	Enum	GVF NR Filter Magnitude Select (see 11.20)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.37 Command 201 Read CiDRA GVF NR Filter

Gets the CiDRA GVF Noise Reduction Filter Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	GVF NR Filter Enable (see Section 11.1)
1	Enum	GVF NR Filter Magnitude Select (see Section 11.20)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.38 Command 202 Write CiDRA GVF Damping Filter
Sets the CiDRA GVF Damping Filter

Request Data Bytes

Byte	Format	Description
0	Enum	GVF Damping Filter Enable (see Section 11.1)
1-4	Float	GVF Damping Tau

Response Data Bytes

Byte	Format	Description
0	Enum	GVF Damping Filter Enable (see Section 11.1)
1-4	Float	GVF Damping Tau

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.39 Command 203 Read CiDRA GVF Damping Filter

Gets the CiDRA GVF Damping Filter Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	GVF Damping Filter Enable (see Section 11.1)
1-4	Float	GVF Damping Tau

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.40 Command 204 Write CiDRA GVF Spike Filter

Sets the CiDRA GVF Spike Filter Settings

Request Data Bytes

Byte	Format	Description
0	Enum	GVF Spike Filter Enable (see Section 11.1)
1	Unsigned-8	GVF Spike No Flow Length
2	Unsigned-8	Spike Filter Length
3	Unsigned-8	Spike Up Count
4	Unsigned-8	Spike Down Count
5-8	Float	Spike Percent
9	Unsigned-8	Spike Percent Window Length

Response Data Bytes

Byte	Format	Description
0	Enum	GVF Spike Filter Enable (see Section 11.1)
1	Unsigned-8	GVF Spike No Flow Length
2	Unsigned-8	Spike Filter Length
3	Unsigned-8	Spike Up Count
4	Unsigned-8	Spike Down Count
5-8	Float	Spike Percent
9	Unsigned-8	Spike Percent Window Length

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.41 Command 205 Read CiDRA GVF Spike Filter

Gets the CiDRA GVF Spike Filter Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	GVF Spike Filter Enable (see Section 11.1)
1	Unsigned-8	GVF Spike No Flow Length
2	Unsigned-8	Spike Filter Length
3	Unsigned-8	Spike Up Count
4	Unsigned-8	Spike Down Count
5-8	Float	Spike Percent
9	Unsigned-8	Spike Percent Window Length

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.42 Command 206 Write CiDRA Sensor

Sets the CiDRA Sensor Settings

Request Data Bytes

Byte	Format	Description
0-15	Latin-1	Sensorhead Serial Number
16-19	Signed-32	Max Sensor Threshold
20-23	Signed-32	Min Sensor Threshold

Response Data Bytes

Byte	Format	Description
0-15	Latin-1	Sensorhead Serial Number
16-19	Signed-32	Max Sensor Threshold
20-23	Signed-32	Min Sensor Threshold

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.43 Command 207 Read CiDRA Sensor

Gets the CiDRA Sensor Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-15	Latin-1	Sensorhead Serial Number
16-19	Signed-32	Max Sensor Threshold
20-23	Signed-32	Min Sensor Threshold

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.44 Command 208 Write CiDRA Sensor Spacing

Sets the CiDRA Sensor Spacing Settings

Request Data Bytes

Byte	Format	Description
0-3	Float	Sensor Spacing 0
4-7	Float	Sensor Spacing 1
8-11	Float	Sensor Spacing 2
12-15	Float	Sensor Spacing 3
16-19	Float	Sensor Spacing 4
20-23	Float	Sensor Spacing 5
24-27	Float	Sensor Spacing 6
28-31	Float	Sensor Spacing 7

Response Data Bytes

Byte	Format	Description
0-3	Float	Sensor Spacing 0
4-7	Float	Sensor Spacing 1
8-11	Float	Sensor Spacing 2
12-15	Float	Sensor Spacing 3
16-19	Float	Sensor Spacing 4
20-23	Float	Sensor Spacing 5
24-27	Float	Sensor Spacing 6
28-31	Float	Sensor Spacing 7

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5		Too few data bytes received
6		Undefined
7		In Write Protect Mode
8		Parameter Invalid
9-127		Undefined

10.45 Command 209 Read CiDRA Sensor Spacing

Gets the CiDRA Sensor Spacing Settings

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	Sensor Spacing 0
4-7	Float	Sensor Spacing 1
8-11	Float	Sensor Spacing 2
12-15	Float	Sensor Spacing 3
16-19	Float	Sensor Spacing 4
20-23	Float	Sensor Spacing 5
24-27	Float	Sensor Spacing 6
28-31	Float	Sensor Spacing 7

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.46 Command 213 Read CiDRA Measured Values

Gets the CiDRA Measured Values

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	Quality
4-7	Float	Flow Rate
8-11	Float	Display Pressure
12-15	Float	Display Temperature
16-19	Float	SOS Quality
20-23	Float	SOS
24-27	Float	Display SOS Flow Rate
28-31	Float	Display TLF
32-35	Float	Total TLF
36-39	Float	TLF
40-43	Float	Filtered Sensor In 0
44-47	Float	Filtered Sensor In 1
48-51	Float	Total Fractional Part
52-55	Float	Total TLF Fractional Part
56-59	Unsigned-32	Total Carry Part
60-63	Unsigned-32	Total TLF Carry Part
64-67	Unsigned-32	System Status

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.47 Command 215 Read CiDRA Sensor Max Min

Gets the CiDRA Sensor Max Min Values

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Signed-32	Channel Max 0
4-7	Signed-32	Channel Max 1
8-11	Signed-32	Channel Max 2
12-15	Signed-32	Channel Max 3
16-19	Signed-32	Channel Max 4
20-23	Signed-32	Channel Max 5
24-27	Signed-32	Channel Max 6
28-31	Signed-32	Channel Max 7
32-35	Signed-32	Channel Min 0
36-39	Signed-32	Channel Min 1
40-43	Signed-32	Channel Min 2
44-47	Signed-32	Channel Min 3
48-51	Signed-32	Channel Min 4
52-55	Signed-32	Channel Min 5
56-59	Signed-32	Channel Min 6
60-63	Signed-32	Channel Min 7

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.48 Command 217 Read CiDRA Sensor Alpha

Gets the CiDRA Sensor Alpha Values

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	Channel 0
4-7	Float	Channel 1
8-11	Float	Channel 2
12-15	Float	Channel 3
16-19	Float	Channel 4
20-23	Float	Channel 5
24-27	Float	Channel 6
28-31	Float	Channel 7

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

11. TABLES

11.1 Disable / Enable Codes

Code	Description	Note
0	Disable	
1	Enable	

11.2 Running / Clear Codes

Code	Description	Note
0	Running	
1	Clear	

11.3 Pipe Diameter Select Codes

Code	Description	Note
0	Inside Diameter	
1	[not used]	
2	Size / Schedule	
3	OD / Wall	

11.4 Length Units Select Codes

Code	Description	Note
0	in	
1	mm	

11.5 Size/Schedule Size Select Codes

Code	Description	Note
0	3"	
1	3.5"	
2	4"	
3	5"	
4	6"	
5	8"	

Code	Description	Note
6	10"	
7	12"	
8	14"	
9	16"	
10	18"	
11	20"	
12	22"	
13	28"	
14	30"	
15	36"	
16	2"	
17	2.5"	
18	24"	
19	26"	
20	32"	
21	34"	

11.6 Size/Schedule Schedule Select Codes

Code	Description	Note
0	5S	
1	10	
2	10S	
3	20	
4	30	
5	40	
6	40S	
7	60	
8	80	
9	80S	
10	STD	
11	XS	

11.7 Pipe Modulus Select Codes

Code	Description	Note
0	SS	

Code	Description	Note
1	Steel	
2	PVC	
3	Custom	

11.8 Gas Constant Select Codes

Code	Description	Note
0	Air Const	
1	Custom	

11.9 Water Constant Select Codes

Code	Description	Note
0	Water Const	
1	Custom	

11.10 Sensor Input Select Codes

Code	Description	Note
0	Fixed	
1	Sensor #1	
2	Sensor #2	

11.11 Temperature Units Select Codes

Code	Description	Note
0	C	
1	F	

11.12 Pressure Units Select Codes

Code	Description	Note
0	PSig	
1	kPAg	
2	BARg	

11.13 Length Units 2 Select Codes

Code	Description	Note
0	ft	
1	m	

11.14   Volume Units Select Codes

Code	Description	Note
0	CuMtr	Cubic Meters
1	liter	liters
2	Gal	Gallons
3	M	Meters
4	Ft	Feet
5	Igal	Imperial Gallons
6	Cuft	Cubic Feet
7	User	User

11.15   Time Units Select Codes

Code	Description	Note
0	day	
1	hr	
2	min	
3	sec	
4	User	

11.16   Custom Volume Units Select Codes

Code	Description	Note
0	CuMtr	Cubic Meters
1	liter	liters
2	Gal	Gallons
3	M	Meters
4	Ft	Feet
5	Igal	Imperial Gallons
6	Cuft	Cubic Feet

11.17   Custom Time Units Select Codes

Code	Description	Note
0	day	
1	hr	
2	min	
3	sec	

11.18 Operating Mode Codes

Code	Description	Note
0	VF	
1	SOS	
2	VF/SOS	

11.19 Sensor Input Unit Codes

Code	Description	Note
0	None	
1	PSIg	
2	kPAg	
3	BARg	
4	C	
5	F	

11.20 Magnitude Select Codes

Code	Description	Note
0	Low	
1	High	

12. PERFORMANCE

12.1 Sampling Rates

Sample rates are configurable from 1 second up.

12.2 Power-Up

On power up, the transmitter goes through a power-up test procedure (see section 12.4), which takes approximately 30 seconds. During this period, the device will not respond to HART commands, and the analog output is set at 4.0mA.

When the self-test is satisfactorily completed, and the first measurement has been made, the PV, SV, TV and QV values are set, and the analog output moves to a value representing the measurement. The slew rate of this movement is limited by the configured "damping time".

Fixed-current mode is cancelled by power loss.

12.3 Reset

Command 42 ("Device Reset") causes the device to reset its microprocessor. The resulting restart is identical to the normal power up sequence. (See Section 12.2.)

12.4 Power-Up Test

Power-up Test includes the following. This procedure is executed at power up, or following Command 42 ("Device Reset"),

- Memory tests

- Microcontroller tests

- Preamp test

- System initialization

12.5 Self-Test

The self-test or following Command 41 ("self-test"). The self-test includes:

- Sensor Test

During self-test following a self-test command, the analog output is held at its last value; the device may respond normally to HART commands, or may return "busy" status.

12.6 Command Response Times

Minimum	20ms
Typical	50ms
Maximum	100ms *

*Response time may increase if the command interrupts other system processes.

12.7 Busy and Delayed-Response

The transmitter may respond with "busy" status if a further command is received while self-test is underway.

Delayed-response is not used.

12.8 Long Messages

The largest data field used is in the response to Command 178: 96 bytes including the two status bytes.

12.9 Non-Volatile Memory

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

12.10 Modes

Fixed current mode is implemented, using Command 40. This mode is cleared by power loss or reset.

12.11 Write Protection

Write-protection is selected by a write protect command or menu option. When the option is disabled, all commands are available. When the option is enabled no "write" commands are accepted.

12.12 Damping

Damping is standard, affecting only the PV and the loop current signal.

ANNEX A.   CAPABILITY CHECKLIST

Manufacturer, model and revision	CiDRA Corporate Services VF-100, rev. 0
Device type	Transmitter
HART revision	7.0
Device Description available	Yes
Number and type of sensors	1 (one external)
Number and type of actuators	0
Number and type of host side signals	2: 4 - 20mA analog
Number of Device Variables	4
Number of Dynamic Variables	0
Mappable Dynamic Variables?	No
Number of common-practice commands	18
Number of device-specific commands	47
Bits of additional device status	8
Alternative operating modes?	No
Burst mode?	No
Write-protection?	Yes

ANNEX B.   DEFAULT CONFIGURATION

Parameter	Default value
Lower Range Value	513.575 gal/min
Upper Range Value	5135.75 gal/min
PV Units	Gal/min
Damping time constant	6 seconds
Write-protect	Disabled
Number of response preambles	5

ANNEX C.   REVISION HISTORY

A1.   Initial Release

Initial release of HART 7.0 for SONARtrac.