HART® Field Device Specification:

Rhosonics 9D-series analyser

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0. Product descriptions

This FDS describes the Rhosonics 9D-series Analyser. It is a system developed by Rhosonics for measuring concentrations in liquids, emulsions and slurries by use of ultrasonic techniques and temperature.

0.1 Document approval & history

Authors & approvals			
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0.2 Table of contents

1. Introduction:

1.1 About the product:

This FDS describes the specifications for the Rhosonics 9D-series Analyser.
The Rhosonics 9D-series Analyser can be used for a wide range of industries and applications.
Depending on the type of probes and measurement principles there are several analyser models.
For all these models this FDS describes the commando's even if the resulting data has no relevance for the specific model.
In the DD this problem is solved by making certain items invalid for the specific model.

1.2 Purpose of this document:

The FDS specifies the capabilities, features and operation of the Rhosonics 9D-series Analyser as viewed from a HART perspective. This document is complementary to other manuals, such as the model dependent manual, quick start guides etc..

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:

EEPROM	Electrically-Erasable Read-Only Memory
Pt100	100-ohm Platinum (temperature sensor)
SG	Specific Gravity
ZL	Acoustic impedance of the liquid
N.A.	Not applicable

1.5 References:

- Model dependent manual
- HCF_SPEC-127 Universal Command Specification Revision 7.1
- HCF_SPEC-151 Common Practice Command Specification Revision 10.0
- HCF_SPEC-183 Common Tables Specification Revision 22.0
- HCF_SPEC-307 Command Response Codes Revision 6.0

2. Device identification:

Manufacturer name	Rhosonics Analytical BV
Manufacturer ID Code	0x60C2
Model Name	9D-series Analyzer
Device Type code	0xE35D
Device Revision	2
HART Protocol Revision	7.0
Number of device variables	8
Physical Layers supported	FSK
Physical Device Category	Current Output

3. Product Overview:

This device is an inline ultrasonic analyser suitable for inline measuring density of slurries.
This is the first device of Rhosonics analysers which support the HART-protocol.

The analogue output is a 2-wire loop-powered 4-20mA signal.
The analogue output is assigned to one of the nine Device Variables the value is linear with this reading.

4. Product Interfaces:

4.1 Process Interface

Sensor Input Channels

Depending on the model there is a conductivity, temperature or external ultrasonic sensor input. The primary Ultrasonic sensor is integrated. Since mechanical appearance differs per model please refer to the model dependent manual chapter 2.

Analog Output 1:

The two-wire 4-to-20mA current loop is connected on two terminals marked "HART+" and "HART-". As is shown in the installation chapter 2 of the model dependent manual.
This is output from the measurement is 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.
A guaranteed linear over-range is provided. Device malfunction can be indicated by down-scale or up-scale current. This is selectable by common practice command 100 Write primary Variable Alarm Code. Current values are shown in the table below.

	Direction	Values (percent of range)	Values (mA or V)
Linear over-range	Down	-1.250% ± 0.1%	3.784 to 3.816 mA
	Up	+103.125% ± 0.1%	20.448 to 20.512 mA
Device malfunction indication	Down: less than	-2.500%	3.6 mA
	Up: greater than	+106.250%	21.0 mA
Maximum current		N.A.	N.A
Multi-Drop current draw			4.0 mA
Lift-off voltage			N.A.
Maximum acceptable load resistance (cable resistance included)			1000 Ω
Capacitance Number (terminal to terminal)			10000 pF

4.2 Local Interfaces, Jumpers And Switches

Local Controls And Displays

This device has a local RGB backlight.
Via USB there are factory and distributor calibrations and diagnostics possible.
(See: operation chapter 3 of the model dependent manual)

5. Device Variables:

The Rhosonics 9D-series Analyser supports a total of 9 Device Variables.
Depending on the model and use the Device Variable will contain relevant information.
All device variables will have Device Family set to not used[250].

5.1 Device Variable 0

Device Variable 0 gives the result of concentration 1.
The units in which the concentration is calculated is sometimes non conform the standard units for concentration this is why no units are chosen.

Number	0
Name	Concentration 1
Classification	Device Variable Not Classified [0]
Unit codes	manufacturer specific (241 Table 11.1)
Limits	-10, 9999.999
Minimum span	0.1

5.2 Device variable 1

Device Variable 1 gives the result of concentration 2.
The units in which the concentration is calculated is sometimes non conform the standard units for concentration this is why no units are chosen.

Number	1
Name	Concentration 2
Classification	Device Variable Not Classified [0]
Unit codes	manufacturer specific (241 Table 11.1)
Limits	-10, 9999.999
Minimum span	0.1

5.3 Device variable 2

Device Variable 2 gives the result of sound speed (c[m/s]).

Number	2
Name	Sound Speed
Classification	velocity [67]
Unit codes	m/s [21]
Limits	400 <=sound speed< =3000
Minimum span	100

5.4 Device variable 3

Device Variable 3 gives the result of Temperature [°C].
This can be ultrasonic temperature or temperature of the Pt100.

Number	3
Name	Temperature
Classification	Temperature [64]
Unit codes	°C [32]
Limits	-100 <= Temperature <= 200
Minimum span	10

5.5 Device variable 4

Device Variable 4 gives the result of Specific Gravity(SG) x1000 and has no unit.
As rule of thumb SG x1000 ~ Density (ρ[g/l]) .

Number	4
Name	SGx1000
Classification	Device Variable Not Classified [0]
Unit codes	manufacturer specific (242 Table 11.1)
Limits	200 <= SGx1000 <= 6500
Minimum span	100

5.6 Device variable 5

Device Variable 5 gives the result of Acoustic Impedance (ZL[kRayl]).

Number	5
Name	Acoustic Impedance
Classification	Device Variable Not Classified [0]
Unit codes	manufacturer specific (240 Table 11.1)
Limits	300 <= ZL <= 30000
Minimum span	100

5.7 Device Variable 6

Device Variable 6 gives the result of Solids [g/l)]

Number	6
Name	Solids
Classification	Mass per volume[73]
Unit codes	g/l [97]
Limits	0 <= Solids <= 3000
Minimum span	1

5.8 Device Variable 7

Device Variable 7 gives the result for power of the liquid echo (P_{LE}[dB]).

Number	7
Name	P_{LE}
Classification	Miscellaneous [111]
Unit codes	dB[156]
Limits	-150 <= P_{LE} <= 20
Minimum span	1

5.9 Device Variable 8

Device Variable 8 gives the filtered conductivity measurement in mS/cm

Number	8
Name	Conductivity
Classification	Conductance[87]
Unit codes	milli Siemens per centimetre [66]
Limits	-1 <= mS/cm <= 1000
Minimum span	1

5.10 Engineering units

Device variable 0 and 1 (concentration) have the engineering units set to none. This is because in some cases the concentration is in units not supported by HART. This is depended on the liquid polynomial, which is updated separately from the DD.

5.11 Damping Values

The Rhosonics 9D-series Analyser supports the Common Practice Command 34 ”Write PV Damping Value”, 55 “Write Device Variable Damping Value.”
All device variables share the same damping variable value. Setting the damping value for one variable will change them for all device variables.

6. Dynamic Variables

The Rhosonics 9D-series Analyser supports 4 dynamic variables being: PV, SV, TV en QV.

7. Status information

7.1 Field device status

Bit 4 (“More Status Available”) is set whenever any failure is detected.
Status-mapping is shown in §9.2 Command #523- Read Condensed Status Mapping Array.

7.2 Extended device status

Extended device status status-mapping is shown in §9.2 Command #523- Read Condensed Status Mapping Array.

7.3 Standardized Status 0

Standardized Status 0 status-mapping is shown in §9.2 Command #523- Read Condensed Status Mapping Array.

7.4 Standardized Status 1

Standardized Status 1 status-mapping is shown in §9.2 Command #523- Read Condensed Status Mapping Array.

7.5 Command #48-Additional device status

The Additional Device Status as returned by command 48 is listed in the table below.

Byte	Bit	Meaning	Class	
0		Device Specific		See table below
1		Device Specific		See table below
2		Device Specific		See table below
3		Device Specific		See table below
4		Device Specific		See table below
5		Device Specific		Always 0
6		Extended Device Status		Spec.183 table 17
7		Device Operating Mode		Always 0
8		Standardized Status 0		Spec.183 table 29
9		Standardized Status 1		Spec.183 table 30
10		Analog Channel Saturated		Always 0
11		Standardized Status 2		Always 0
12		Standardized Status 3		Always 0
13		Analog Channel Fixed		Always 0
14-..		Device Specific		Always 0

Device Specific Status 0

General Device Specific Status

Bit	Description
0	Maintenance Required
1	Failure
2	Out of Specification
3	Function Check
4-7	Always 0

Device Specific Status 1

Measurement Status

Bit	Description
0	Time measurement out of limits
1	Sensor measurement out of limits
2	Calculation out of limits
3-7	Always 0

Device Specific Status 2

Calibration Status

Bit	Description
0	Factory calibration out of range
1	mA-trimming out of range
2	Supervisor calibration out of range
3-7	Always 0

Device Specific Status 3

Setting Status

Bit	Description
0	Always 0
1	Loaded setting out of range
2	Loaded liquid out of specification
3	Manual setting out of range
4-7	Always 0

Device Specific Status 4

Diagnostic Status

Bit	Description
0	Show echo problem
1	Logdata problem
2-7	Always 0

8. Universal Commands

The Rhosonics 9D-series Analyser supports all universal commands.

9. Common-Practice Commands

9.1 Supported Common Practice commands

Table -9 Supported Common Practice Commands

33	Read Device Variables
34	Write PV Damping Value
35	Write PV Ranges
36	Set PV Upper Range
37	Set PV Lower Range
40	Enter/Exit Fixed Current Mode
42	Perform Device Reset
44	Write PV Units
45	Trim Loop Current Zero
46	Trim Loop Current Gain
49	Write Primary Variable Transducer Serial Number
50	Read Dynamic Variable Assignment
51	Write Dynamic Variable Assignment
53	Write Device Variable Units
54	Read Device Variable Information
55	Write Device Variable Damping Value
56	Write Device Variable Transducer Serial Number
59	Write Number of Response Preambles
71	Lock Device
76	Read Lock Device State
89	Set Real Time Clock
90	Read Real Time Clock
100	Write Primary Variable Alarm Code
512	Read Country Code
513	Write Country Code
516	Read Device Location
517	Write Device Location
518	Read Location Description
519	Write Location Description
520	Read Process Unit Tag
521	Write Process Unit Tag

9.2 Burst mode

Not supported

9.3 Catch Device Variable

Not supported

9.4 Trim points

Device variable trim points are not supported.

10. Device-specific Commands

Description:	Format:
INTEGER (Signed Integer 16 bits)	s16
UNSIGNED INTEGER (Unsigned Integer 8 bits)	u8
UNSIGNED INTEGER (Unsigned Integer 16 bits)	u16
UNSIGNED INTEGER (Unsigned Integer 32 bits)	u32
FLOAT	float
DOUBLE	double
ENUMERATION	Enum
ALPHANUMERIC (ISO 8859-1 Latin-1)	Latin1

These Response Codes are applicable for each Command

#0 – NO_COMMAND_ERRORS (success)
#5 – TOO_FEW_DATA_BYTES (error) (only applicable when having request bytes)

These Response Codes are applicable for each Write Command

#7 – IN_WRITE_PROTECT_MODE (error)
#16 – ACCESS_RESTRICTED (error)

10.1 Command 150 Read factory configuration model

Read factory configuration model. Used for creating DD menu and for diagnostics.
Read version numbers for diagnostic purposes.
This data is relevant for all models.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-1	Latin 1	Factory Configuration Model
2	u8	softw_b_day (1= 1st of the month)
3	u8	softw_b_month (1= January)
4	u8	softw_b_year year-2000
5	u8	service version
6	u8	Model Short Code

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.2 Command 151 Read liquid calibration selected

Read liquid number selected. Displays the number of the current liquid calibration.
If the value is 1 the liquid calibration is selected. If the value is 0 the water calibration is selected
The water calibration has no effect for the models which don't measure the sound velocity such as density meters and acoustic impedance meters.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0	u8	Liquid calibration selected

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.3 Command 152 Write liquid calibration selected

Write liquid calibration selected changes whether or not the liquid calibration is selected. If not the water calibration is selected.

Request Data Bytes

Byte	Format	Description
0	u8	Liquid calibration selected

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.4 Command 153 Read liquid calibration name

Read the liquid calibration name.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-15	Latin1	Liquid calibration name

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.5 Command 154 Read polynomial 1 name

Read polynomial 1 name and unit. Used for diagnostic purposes and as an aid for field / sample calibration editing liquids selecting liquids etc.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-7	Latin1	Name concentration 1
8-14	Latin1	Unit concentration 1

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.6 Command 155 Read polynomial 2 name

Read polynomial 2 name and unit. Used for diagnostic purposes and as an aid for field / sample calibration editing liquids selecting liquids etc.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-7	Latin1	Name concentration 2
8-14	Latin1	Unit concentration 2

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.7 Command 156 Read liquid echo time of flight

Read time of flight of the liquid echo and the probe attenuation for diagnostic purposes.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	float	time of flight liquid echo

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.8 Command 157 Set sample calibration mode

Applicable for ternary liquid models.
For successful sample calibration this must be called before command 159 write sample calibration laboratory values

Request Data Bytes

Byte	Format	Description
0	Enum	Sample calibration mode (Table 11.2)

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.9 Command 158 Read values for sample calibration

Applicable for ternary liquid models.
Values read 0 if not in sample calibration mode (see command 157).
Else they read the values stored at entering sample calibration mode

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	Stored concentration1
4-7	Float	Stored concentration2
8-11	Float	Stored assign1
12-15	Float	Stored assign2
16-19	Float	Stored temperature
20-23	Float	Stored concentration3

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.10 **Command 159 write sample calibration laboratory values**

Applicable for ternary liquid models.
Command returns device specific error if not in sample calibration mode.
Command returns passed parameter too large if the sample calibration is out of range.
If device is in sample calibration mode it will go out of Sample Calibration mode after handling this command.

Request Data Bytes

Byte	Format	Description
0-3	Float	Laboratory value Concentration 1
4-7	Float	Laboratory value Concentration 2

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#5	TOO_FEW_DATA_BYTES (error)
#6	DEVICE_SPECIFIC_COMMAND_ERROR
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.11 **Command 160 Read concentration 3**

Applicable for quaternary liquid models.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	Concentration 3

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.12 **Command 201 Write acoustic impedance offset**

Read the variables necessary for correcting the offset for ZL.
Temperature must be OK.
ZL of the process liquid must be known accurate and process must be stable.

Request Data Bytes

Byte	Format	Description
0-3	Float	Acoustic Impedance offset

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.13 **Command 202 Read acoustic impedance (ZL) span**

Read the variable necessary for correcting the span of ZL
Process must be stable. ZL of the process liquid must be known accurate.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	ZL span factor

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.14 **Command 203 Read customer conductivity reference**

Read the customer conductivity reference value

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	Conductivity reference value

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.15 **Command 204 Write acoustic impedance (ZL) span**

Write the variable necessary for correcting the span of ZL
Process must be stable. ZL of the process liquid must be known accurate.

Request Data Bytes

Byte	Format	Description
0-3	Float	ZL span factor

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.16 **Command 205 Read solids offset**

Read the variable necessary for correcting the offset of the Solids
Process must be stable. The suspended Solids of the process liquid must be known accurate.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	Solids offset

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.17 **Command 206 Write solids offset**

Write the variable necessary for calibrating the measured solids.
Process must be stable. The suspended Solids of the process liquid must be known accurate.

Request Data Bytes

Byte	Format	Description
0-3	Float	Solids offset

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.18 **Command 207 Read solids span**

Read the span of the Solids
Process must be stable. The suspended Solids of the process liquid must be known accurate.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	Solids span factor

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.19 **Command 208 Read unfiltered temperature**

Read the value of the raw, unfiltered temperature.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	Unfiltered temperature

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.20 **Command 209 Write solids span**

Write solids calibration variables.
Process must be stable. The suspended Solids of the process liquid must be known accurate.

Request Data Bytes

Byte	Format	Description
0-3	Float	Solids span factor

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.21 **Command 211 Read offset field calibration**

Read variable for field offset calibration.
Function applies an offset on the result of the concentration calculation.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	float	Concentration offset

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.22 **Command 212 Write offset field calibration**

Write offset field calibration polynomial 1.
This function applies an offset on the result of the concentration calculation.

Request Data Bytes

Byte	Format	Description
0-3	float	Concentration offset

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)

#16	ACCESS_RESTRICTED (error)

10.23 **Command 213 Read span factor for field calibration**

Read span factor for field calibration polynomial 1. This function applies a span factor on the result of the concentration calculation.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	float	Concentration span factor

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.24 **Command 214 Write span factor for field calibration**

Write span factor for field calibration polynomial 1. This function applies a span factor on the result of the concentration calculation.

Request Data Bytes

Byte	Format	Description
0-3	float	Concentration span factor

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.25 **Command 215 Read interface measurements**

Read the time of flight and power of the interface echo for diagnostic purposes.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	float	time of flight interface echo
4-7	float	Power interface echo

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.26 **Command 216 Read reference measurements**

Read the time of flight and power of the reference echo (when available) for diagnostic purposes.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	float	time of flight reference echo
4-7	float	Power reference echo

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.27 **Command 217 Read temperature offset**

Read temperature offset.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	float	Temperature Offset

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.28 **Command 218 Write temperature offset**

Write temperature offset.

Request Data Bytes

Byte	Format	Description
0-3	float	Temperature Offset

Response Data Bytes
Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.29 **Command 219 Read SGx1000 offset**
Read SGx1000 offset.

Request Data Bytes
None

Response Data Bytes

Byte	Format	Description
0-3	Float	SGx1000 offset

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.30 **Command 220 Write SGx1000 offset**

Write SGx1000 offset.
Process must be stable. SGx1000 of the process liquid must be known accurate.

Request Data Bytes

Byte	Format	Description
0-3	Float	SGx1000 offset

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.31 **Command 221 Read SG span**

Read the span of SGx1000.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	SG span factor

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.32 **Command 222 Write SG span**

Write the span of SGx1000
Process must be stable. SGx1000 of the process liquid must be known accurate.

Request Data Bytes

Byte	Format	Description
0-3	Float	SG span factor

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.33 **Command 223 Read supporting variables for acoustic impedance (ZL) offset calibration**

Read the variables necessary for correcting the offset for ZL
Temperature must be OK.
ZL of the process liquid must be known accurate and process must be stable. Gives the model specific measured values for diagnostic purposes.
Polynomial Input is the delayed input for the concentration calculation.
Values are all filtered with the damping factor.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	Acoustic Impedance of pure water ZL(H2O)
4-7	float	Acoustic Impedance offset

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.34 **Command 224 Undo Customer Calibrations**

Undo all calibrations. The factory calibrations remain

Request Data Bytes

Byte	Format	Description
0	Enum	Undo Customer Calibrations (Table 11.2)

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.35 **Command 225 Read measurement types**

Read Booleans indicating measuring properties of the analyser. A value greater than 0 indicates the property is available.

Request Data Bytes

None

Response Data Bytes

byte	Format	Description
0	u8	ZL Calibration
1	u8	Beer analyzer
2	u8	Binary liquid
3	u8	Ternary liquid
4	u8	Wort liquid
5	u8	Hybrid sensor
6	u8	Conductivity sensor
7	u8	Measures SG
8	u8	Measures speed
9	u8	Transmissive
10	u8	Has 1 buffer
11	u8	Fixed temperature

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.36 **Command 226 Read liquid number**

Read the liquid number.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	Liquid number

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.37 **Command 227 Write liquid number**

Write liquid number.

Request Data Bytes

Byte	Format	Description
0-3	Float	Liquid number

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.38 **Command 228 Read conductivity offset**

Read the conductivity offset.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	Conductivity offset

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.39 **Command 229 Write conductivity offset**

Write conductivity offset.

Request Data Bytes

Byte	Format	Description
0-3	Float	Conductivity offset

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.40 **Command 230 Read conductivity span**

Read the span factor for conductivity.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	Conductivity span factor

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.41 **Command 231 Write conductivity span**

Write the span factor for conductivity.

Request Data Bytes

Byte	Format	Description
0-3	Float	Conductivity span factor

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.42 **Command 232 Read sound path**

Read the sound path.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	Sound path

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.43 **Command 233 Write sound path**

Write the sound path.

Request Data Bytes

Byte	Format	Description
0-3	Float	Sound path

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#3	PASSED_PARAMETER_TOO_LARGE
#4	PASSED_PARAMETER_TOO_SMALL
#5	TOO_FEW_DATA_BYTES (error)
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.44 **Command 234 Read external input**

Read the value of the external input register.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	Float	External input value

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.45 **Command 235 Write external input**

Write the external input register.

Request Data Bytes

Byte	Format	Description
0-3	Float	External input value

Response Data Bytes

Idem

Response Codes

#0	NO_COMMAND_ERRORS (success)
#5	TOO_FEW_DATA_BYTES (error)
#6	DEVICE_SPECIFIC_COMMAND_ERROR
#7	IN_WRITE_PROTECT_MODE (error)
#16	ACCESS_RESTRICTED (error)

10.46 **Command 236 Read density**

Read density. Density is used for diagnostic purposes and as polynomial input.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	float	Density (Rho[g/l])

Response Codes

#0	NO_COMMAND_ERRORS (success)

10.47 **Command 237 Read highest liquid number**

Read highest liquid number.
Highest liquid number is used for diagnostic purposes.

Request Data Bytes

None

Response Data Bytes

Byte	Format	Description
0-3	float	Highest liquid number

Response Codes

#0	NO_COMMAND_ERRORS (success)

11. Tables:

11.1 Manufacturer supporting engineering units:

Value	Meaning
240	kRayl
241	Concentration unit is depending on the specific liquid calibration
242	SG x1000

11.2 Enumerations

Undo Customer Calibrations:

Value	Meaning
0	Undo inactive
1	Undo active

Sample calibration mode:

Value	Meaning
0	Sample calibration mode inactive
1	Sample calibration mode active

12. Performance:

12.1 Sampling rates:

All device variables will have an acquisition period of 0.1s or faster.

12.2 Power up

Powering-up takes approximately 10 seconds. During this period, the device will not respond to HART commands, and the analog output will also be down.

12.3 Device reset:

The Reset cycle of the Rhosonics 9D-series Analyser is shorter than the power-up cycle.

12.4 Self test

Self test is not supported in this version.

12.5 Command response delay

Command response delay is not supported.

12.6 Busy and Delayed_Response

Delayed response and busy are not supported.

12.7 Long messages

Long messages are not supported.

12.8 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.

12.9 Operating Modes

Default variable mA signal. "Fixed Current" is optional.

12.10 Write Protection

The Rhosonics 9D-series Analyser supports write protection.

12.11 Damping

Damping values are synchronized.
Changing one of the Damping values of Device Variables, PV, or the loop current will cause all Damping values to become this value.