Interface Description COM/FCB300/FCH300/HART-EN

CoriolisMaster FCB330, FCB350, FCH330, FCH350
Coriolis Mass Flowmeter

HART protocol 5.1
Valid from software version 00.03.xx

Measurement made easy

Power and productivity
for a better world™

Short product description

For the measurement of mass and volume flow, the density and the temperature of liquid and gaseous measuring media.

Further information

Additional documentation on CoriolisMaster FCB330, FCB350, FCH330, FCH350 is available for download free of charge at www.abb.com.
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Contents

1 Revision history

Revision	Software Version	Date	Changes	Name
0	00.01.00	03/01/2013	Document created on the basis of FCM2000	H. Seebode
1	00.02.00	06/26/2013	Min. density parameter (Error 9b) supplemented	H. Seebode
2	00.03.00	06/02/2014	Damping density parameter supplemented; pulse value limits changed	H. Seebode

2 HART commands overview

This overview lists all HART commands which can be used by customers. It includes universal and common practice commands, as well as special ones such as slot commands, among others.
Previously, the only way to find out what changes had been made to earlier command overviews was to thoroughly check every single command to see if it had been modified. This is no longer necessary, as any changes made to individual commands can be easily seen under the "Revision" item.

This documentation is valid for the following software revisions: 3KXF002358U0100 00.03.xx

2.1 Universal commands

2.1.1 Command 0: Read Transmitter Unique Identifier

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	#0	Device Type Code for Expansion	= 254
	#1	Manufacturer Identification Code	= 18 = ABB
	#2	Manufacturer Device Type	= 19 = FCM2000 / FCB3
	#3	Number of Request Preambles	= 8
	#4	Revision Level of Universal Command	= 5
	#5	Revision Level of Transmitter Document	= 0
	#6	Software Revision Level	= 2
	#7	Hardware Revision Level	= 0
	#8	Flags, none defined at this time	= 0
	#9	Device Identification Number, 24 Bit, MSB	= Device number byte 3
	#10	Device Identification Number, 24 Bit	= Device number byte 2
	#11	Device Identification Number, 24 Bit, LSB	= Device number byte 1
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	

2.1.2 Command 1: Read Primary Variable

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	#0	Primary Variable Unit Code (Table 2)	
	#1..#4	Primary Variable, IEEE 754	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
Comments		Primary Variable => Dependent on the setting of current output 1	

2.1.3 Command 2: Read Current and Percent of Range

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	#0..#3	Analog Output Current mA, IEEE 754	
	#4..#7	Percent of Range, IEEE 754	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	

2.1.4 Command 3: Read all dynamic Variables and Current

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	#0..#3	Analog Output Current mA, IEEE 754	
	#4	Primary Variable Unit Code (Table 2)	
	#5..#8	Primary Variable, IEEE 754	
	#9	Secondary Variable Unit Code (Table 2)	
	#10..#13	Secondary Variable, IEEE 754	
	#14	Tertiary Variable Unit Code (Table 2)	
	#15..#18	Tertiary Variable, IEEE 754	
	#19	4th Variable Unit Code (Table 2)	
	#20..#23	4th Variable, IEEE 754	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
Comments		Primary Variable = Dependent on the setting of current output 1	
		Secondary Variable = Dependent on the setting of current output 2	
		Tertiary Variable = Dependent on the setting of the pulse output	
		Fourth Variable = Dependent on the setting of the second display line	

2.1.5 Command 6: Write Polling Address

Command	Description		Revision
Request Data Bytes	#0	Polling Address of Device	
Response Data Bytes	#0	Polling Address of Device	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.1.6 Command 11: Read Unique Identifier Associated With Tag

Command	Description		Revision
Request Data Bytes	#0..#5	Tag, Packed ASCII	
Response Data Bytes	#0	Device Type Code for Expansion	= 254
	#1	Manufacturer Identification Code	= 18 = ABB
	#2	Manufacturer Device Type	= 19 = FCM2000 / FCB3
	#3	Number of Request Preambles	= 8
	#4	Revision Level of Universal Command	= 5
	#5	Revision Level of Transmitter Document	= 0
	#6	Software Revision Level	= 2
	#7	Hardware Revision Level	= 0
	#8	Flags, none defined at this time	= 0
	#9	Device Identification Number, 24 Bit, MSB	= Device number byte 3
	#10	Device Identification Number, 24 Bit	= Device number byte 2
	#11	Device Identification Number, 24 Bit, LSB	= Device number byte 1
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	

2.1.7 Command 12: Read Message

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	#0..#23	Message, Packed ASCII	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	

2.1.8 Command 13: Read Tag, Descriptor, Date

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	#0..#5	Tag, Packed ASCII	
	#6..#17	Descriptor, Packed ASCII	
	#18..#20	Date: Day, Month, Year	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	

2.1.9 Command 14: Read Primary Variable Sensor Information

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	#0..#2	Sensor Serial Number MSB, 24 bit unsigned integer	
	#3	Sensor Limits/Min Span Units, Table II Unit Codes	
	#4..#7	Upper Sensor Limit, IEEE754	
	#8..#11	Lower Sensor Limit, IEEE754	
	#12..#15	Minimum Span, IEEE754	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
Comments		Sensor Serial Number	= 0
		Upper Sensor Limit	= Dependent on the setting of current output 1
		Lower Sensor Limit	= Dependent on the setting of current output 1
		Minimum Span	= Dependent on the setting of current output 1

2.1.10 Command 15: Read Primary Variable Output Information

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	#0	Alarm Select Code, Table VI	
	#1	Primary Variable Transfer Function Code, Table III	
	#2	Primary Variable Range Values Units Code, Table II	
	#3..#6	Primary Variable Upper Range Value, IEEE754	
	#7..#10	Primary Variable Lower Range Value, IEEE754, always Zero	
	#11..#14	Primary Variable Damping Value, IEEE754, Units of Seconds	
	#15	Write Protect Code, Table VII	
	#16	Private Label Distributor Code, Table VIII	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
Comments		Alarm Selection Code	= 0 = High, 1 = Low
		PV Transfer Function Code	= 0 = Linear
		PV Upper Range Value	= Dependent on the setting of current output 1
		PV Lower Range Value	= Dependent on the setting of current output 1
		PV Damping Value	= Damping
		Write Protect Code	= 251 = Not Implemented
		Private Label Distributor	= 18 = ABB

2.1.11 Command 16: Read Final Assembly Number

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	#0..#2	Final Assembly Number	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	

2.1.12 Command 17: Write Message

Command	Description		Revision
Request Data Bytes	#0..#23	Message, Packed ASCII	
Response Data Bytes	#0..#23	Message, Packed ASCII	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.1.13 Command 18: Write Tag, Descriptor, Date

Command	Description		Revision
Request Data Bytes	#0..#5	Tag, Packed ASCII	
	#6..#17	Descriptor, Packed ASCII	
	#18..#20	Date: Day, Month, Year	
Response Data Bytes	#0..#5	Tag, Packed ASCII	
	#6..#17	Descriptor, Packed ASCII	
	#18..#20	Date: Day, Month, Year	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.1.14 Command 19: Write Final Assembly Number

Command	Description		Revision
Request Data Bytes	#0..#2	Final Assembly Number	
Response Data Bytes	#0..#2	Final Assembly Number	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.2 Common Practice Commands

2.2.1 Command 33: Read Transmitter Variables

Command	Description		Revision
Request Data Bytes	#0	Transmitter Variable assigned to Slot #0	
	#1	Transmitter Variable assigned to Slot #1	
	#2	Transmitter Variable assigned to Slot #2	
	#3	Transmitter Variable assigned to Slot #3	
Response Data Bytes	#0	Transmitter Variable assigned to Slot #0	
	#1	Slot #0 Unit Code	
	#2..#5	Slot #0 Variable, IEEE 754	
	#6	Transmitter Variable assigned to Slot #1	
	#7	Slot #1 Unit Code	
	#8..#11	Slot #1 Variable, IEEE 754	
	#12	Transmitter Variable assigned to Slot #2	
	#13	Slot #2 Unit Code	
	#14..#17	Slot #2 Variable, IEEE 754	
	#18	Transmitter Variable assigned to Slot #3	
	#19	Slot #3 Unit Code	
	#20..#23	Slot #3 Variable, IEEE 754	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection	
	5	Incorrect Byte Count	
Comments		Transmitter Variables: Four variables can be read out via the implemented slot commands (see „Table of "float" variables“ on page 21)	

2.2.2 Command 34: Write Primary Variable Damping Value

Command	Description		Revision
Request Data Bytes	#0..#3	Damping Value, IEEE 754	
Response Data Bytes	#0..#3	Actual Damping Value, IEEE 754	
Response Codes	0	No Command Specific Error	
	3	Passed Parameter to Large	
	4	Passed Parameter to Small	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.2.3 Command 35: Write Primary Variable Range Values

Command	Description		Revision
Request Data Bytes	#0	PV Upper and Lower Range Values Units Code, Table II	
	#1..#4	Primary Variable Upper Range Value, IEEE 754	
	#5..#8	Primary Variable Lower Range Value, IEEE 754	
Response Data Bytes	#0	PV Upper and Lower Range Values Units Code, Table II	
	#1..#4	Primary Variable Upper Range Value, IEEE 754	
	#5..#8	Primary Variable Lower Range Value, IEEE 754	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection	
	5	Incorrect Byte Count	
	11	Upper Range Value too High	
	12	Upper Range Value too Low	
	13	Upper and Lower Range Values Out of Limits	
	14	Span too small	
	16	Access Restrict	
Comments		PV Upper Range Value = Dependent on the setting of current output 1	
		PV lower Range Value = Dependent on the setting of current output 1	

2.2.4 Command 38: Reset Configuration Changed Flag

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	none		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	

2.2.5 Command 40: Enter/Exit Primary Variable Current Mode

Command	Description		Revision
Request Data Bytes	#0..#3	Fixed Primary Variable Current Level, IEEE 754, mA	
Response Data Bytes	#0..#3	Actual Fixed Primary Variable Current Level, IEEE 754, mA	
Response Codes	0	No Command Specific Error	
	3	Passed Parameter to Large (> 20.0 mA)	
	4	Passed Parameter to Small (< 4.00 mA)	
	5	Incorrect Byte Count	
	11	In Multidrop Mode	
	16	Access Restrict	

2.2.6 Command 44: Write Primary Variable Units

Command	Description		Revision
Request Data Bytes	#0	Primary Variable Unit Code	
Response Data Bytes	#0	Primary Variable Unit Code	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection	
	5	Incorrect Byte Count	
	16	Access Restrict	
Comments		Primary Variable Unit Code = Dependent on the setting of current output 1	

2.2.7 Command 45: Trim Primary Variable Current DAC Zero

Command	Description		Revision
Request Data Bytes	#0..#3	Externally Measured Primary Variable Current Level, IEEE 754, Units of mA	
Response Data Bytes	#0..#3	Actual Measured Primary Variable Current Level, IEEE 754, mA	
Response Codes	0	No Command Specific Error	
	3	Passed Parameter to Large (> 6mA)	
	4	Passed Parameter to Small (< 2mA)	
	5	Incorrect Byte Count	
	9	Not in Proper Current Mode	
	11	In Multidrop Mode	
	16	Access Restrict	

2.2.8 Command 46: Trim Primary Variable Current DAC Gain

Command	Description		Revision
Request Data Bytes	#0..#3	Externally Measured Primary Variable Current Level, IEEE 754, Units of mA	
Response Data Bytes	#0..#3	Actual Measured Primary Variable Current Level, IEEE 754, mA	
Response Codes	0	No Command Specific Error	
	3	Passed Parameter to Large (> 22mA)	
	4	Passed Parameter to Small (< 18mA)	
	5	Incorrect Byte Count	
	9	Not in Proper Current Mode	
	11	In Multidrop Mode	
	16	Access Restrict	

2.2.9 Command 48: Read Additional Transmitter Status

Command	Description					Revision
Request Data Bytes	none					
Response Data Bytes	#0..#3	Additional transmitter status (errors)				
	#4..#5	Additional transmitter status (errors – not defined)				
	#6	Operating Mode #1 (not used (= 250))				
	#7	Operating Mode #2 (not used (= 250))				
	#8..#10	Analog Output Saturated (not defined)				
	#11..#13	Analog Output Fixed (not defined)				
	#14..#15	Additional transmitter status (transmitter status)				
	#16..#18	Additional transmitter status (warnings)				
	Error bytes			**Status bytes**		
	#0, Bit 0	Error 5a:	Internal database	#14, Bit 0		Function test
	#0, Bit 1	Error 5b:	External database	#14, Bit 1		Simulation
	#0, Bit 2	Error 10:	DSP communication	#14, Bit 2		Auto. adjustment
	#0, Bit 3	Error 1:	A/D converter	#14, Bit 3		running
	#0, Bit 4	Error 11d:	Sensor	#14, Bit 4		Auto. adjustment error
	#0, Bit 5	Error 0:	Sensor amplitude	up to		Unused
	#0, Bit 6	Error 2a:	Driver	#15, Bit 7		up to
	#0, Bit 7	Error 2b:	Driver current			Unused
	#1, Bit 0	Error 9a:	Density measurement	**Warning bytes**		
	#1, Bit 1	Error 9b:	Unused	#16, Bit 0	Warning. 2:	
	#1, Bit 2	Error 7:	Temperature	#16, Bit 1	Warning. 6a:	Totalizer reset
	#1, Bit 3	Error 3:	measurement	#16, Bit 2	Warning. 5a:	MAX alarm Qm
	#1, Bit 4	Error 4:	Flow rate > 103 %	#16, Bit 3	Warning. 6b:	MIN alarm Qm
	#1, Bit 5	Error 8a:	Ext. cut-off	#16, Bit 4	Warning. 5b:	MAX alarm density
	#1, Bit 6	Error 8b:	Iout 1 too large	#16, Bit 5	Warning. 6c:	MIN alarm density
	#1, Bit 7	Error 8c:	Iout1 too small	#16, Bit 6	Warning. 5c:	MAX alarm temperature
	#2, Bit 0	Error 8d:	Iout2 too large	#16, Bit 7	Warning. 10:	MIN alarm temperature
	#2, Bit 1	Error 6a:	Iout2 too small	#17, Bit 0	Warning. 7:	Reverse Q
	#2, Bit 2	Error 6b:	Totalizer mass > F	#17, Bit 1	Warning. 8a:	Ext. data loaded
	#2, Bit 3	Error 6c:	Totalizer mass < R	#17, Bit 2	Warning. 8b:	Update int. data
	#2, Bit 4	Error 6d:	Totalizer volume > F	#17, Bit 3	Warning. 1:	Update ext. data
	#2, Bit 5	Error 11a:	Totalizer volume < R	#17, Bit 4	Warning. 9a:	Simulation
	#2, Bit 6	Error 11b:	Sensor A	#17, Bit 5	Warning. 9b:	Overflow > F mass
	#2, Bit 7	Error 11c:	Sensor B	#17, Bit 6	Warning. 9c:	Overflow < R mass
	#3, Bit 0	Error 7b:	Unused	#17, Bit 7	Warning. 9d:	Overflow < F vol.
	#3, Bit 1	Error 12:	Housing temperature	#18, Bit 0	Warning. 9e:	Overflow < R vol.
	#3, Bit 2	Error 6e:	Concentration	#18, Bit 1	Warning. 9f:	Overflow > F %M.
	#3, Bit 3	Error 6f:	Totalizer net mass > F	#18, Bit 2	Warning. 6d:	Overflow < R %M.
	#3, Bit 4		Totalizer net mass < R	#18, Bit 3	Warning. 5d:	MAX alarm conc.
	#3, Bit 5		Unused	#18, Bit 4		MIN alarm conc.
	#3, Bit 6		Unused	up to		Unused
	#3, Bit 7		Unused	#18, Bit		up to
			Unused			Unused
Response Codes	0	No Command Specific Error				
	5	Incorrect Byte Count				

2.3 Slot commands

The transmitter parameters can be divided into five groups:

Unsigned char variables
Parameters of menus with selection lists are saved as "unsigned char", e. g. language:
German = 0
English = 1

Unsigned int variables
Certain numbers, which only appear as integers, are saved as "unsigned int", e. g. device number.

Float variables
The other numbers are saved as "float" (IEEE 754), e. g. damping.

Programmable unit
Write / read text (3 bytes) from programmable unit Qm and Qv.

String variables
E. g., read the unit software version.

The relevant read and write command and a table containing the associated parameters are shown below for each of the five groups.

2.3.1 Unsigned char variables

Command 128: Read unsigned char variable

Command	Description		Revision
Request Data Bytes	#0	Slot-Index	
Response Data Bytes	#0	Slot-Index	
	#1	Content of Slot	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	6	Transmitter Specific Command Error -> Invalid slot number	
	16	Access Restrict	

Command 129: Write unsigned char variable

Command	Description		Revision
Request Data Bytes	#0	Slot-Index	
	#1	Content of Slot	
Response Data Bytes	#0	Slot-Index	
	#1	Content of Slot	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection	
	3	Parameter to large	
	5	Incorrect Byte Count	
	6	Transmitter Specific Command Error -> Invalid slot number	
	16	Access Restrict	

Table of "unsigned char" variables

Slot number	Parameter	Number	Meaning	Revision
0	Display line 1	0	Q [Bar graph, %]	
1	Display line 2	1	Qm [Unit]	
		2	Qv [Unit]	
		3	Qm [%]	
		11	Temperature	
		13	Blank line	
		12	TAG number	
		4	Totalizer mass	
		5	Totalizer mass > F	
		6	Totalizer mass < R	
		7	Totalizer volumes	
		8	Totalizer volume > F	
		9	Totalizer volume < R	
		26	Totalizer net mass	
		27	Totalizer net mass > F	
		28	Totalizer net mass < R	
		10	Density	
		23	Concentration [unit]	
		24	Concentration [percentage]	
		25	Qm concentration	
2	Display line 1 multiplex	0	Q [Bar graph, %]	
3	Display line 2 multiplex	1	Qm [Unit]	
		2	Qv [Unit]	
		3	Qm [%]	
		11	Temperature	
		13	Blank line	
		12	TAG number	
		4	Totalizer mass	
		5	Totalizer mass > F	
		6	Totalizer mass < R	
		7	Totalizer volumes	
		8	Totalizer volume > F	
		9	Totalizer volume < R	
		26	Totalizer net mass	
		27	Totalizer net mass > F	
		28	Totalizer net mass < R	
		10	Density	
		23	Concentration [unit]	
		24	Concentration [percentage]	
		25	Qm concentration	
		20	Off	
10	Unit of density	95	g/ml	
		97	g/l	
		91	g/cm^3	
		96	kg/l	
		92	kg/m^3	
		94	lb/ft^3	
		93	lb/ugl	

Slot number	Parameter	Number	Meaning	Revision
11	Unit Qm (mass)	70	g/s	
		71	g/min	
		72	g/h	
		73	kg/s	
		74	kg/min	
		75	kg/h	
		76	kg/d	
		77	t/min	
		78	t/h	
		79	t/d	
		80	lb/s	
		81	lb/min	
		82	lb/h	
		83	lb/d	
		240	Programmable unit / s	
		241	Programmable unit / min	
		242	Programmable unit / h	
		243	Programmable unit / d	
12	Unit Qv (volume)	24	l/s	
		17	l/min	
		138	l/h	
		28	m3/s	
		131	m3/min	
		19	m3/h	
		29	m3/d	
		26	ft/s	
		15	ft/min	
		130	ft/h	
		27	ft/d	
		22	ugl/s	
		16	ugl/min	
		136	ugl/h	
		23	mgl/d	
		137	igps	
		18	igpm	
		30	igph	
		31	igpd	
		132	bbl/s	
		133	bbl/min	
		134	bbl/h	
		135	bbl/d	
		245	Programmable unit / s	
		246	Programmable unit / min	
		247	Programmable unit / h	
		248	Programmable unit / d	
13	Temperature	32	°C	
		33	K	
		35	°F	

Slot number	Parameter	Number	Meaning	Revision
14	Unit totalizer Qm	60	g	
		61	kg	
		62	t	
		63	lb	
		244	Programmable unit	
15	Unit totalizer Qv	41	l	
		43	m^3	
		112	ft^3	
		40	ugl	
		42	igl	
		46	bbl	
		249	Programmable unit	
20	Flow direction	0	Forward	
		1	Supply/Return	
21	Directional display	0	Normal	
		1	Inverse	
25	Output of pulse output	0	Mass	
		1	Volume	
		2	Net mass	
30	Meter tube	8	FCB DN 15	
		10	FCB DN 25	
		12	FCB DN 50	
31	Signal level	0	Automatic	
		1	High	
		2	Low	
35	Language	0	German	
		1	English	
40	Current output 1: Alarm	0	High	
		1	Low	
41	Current output 2: Alarm	0	High	
		1	Low	
42	Current output 1: Output	0	Qm	
		1	Qv	
		2	Density	
		3	Temperature	
		4	Concentration	
		5	Qm concentration	
43	Current output 2: Output	0	Qm	
		1	Qv	
		2	Density	
		3	Temperature	
		4	Concentration	
		5	Qm concentration	
48	Contact input	0	No function	
		1	external switch-off	
		2	Totalizer reset	
		3	Concentration table	

Slot number	Parameter	Number	Meaning		Revision
49	Switch output	0 1 2 3 4 5 6 7 8 9 10	No function VR signal open VR signal closed General alarm open General alarm closed Max. / min. alarm open Max. / min. alarm closed Min. alarm open Min. alarm closed Max. alarm open Max. alarm closed		
95	Operating protection switch	0 1	Not set Set Read only		
140	Concentration measurement	0 1 255	Off On Code invalid		
141	Medium (concentration)	 0 1 2 3 4 5	 Variable matrix Sodium hydroxide Alcohol Wheat starch Corn starch Sugar solution	Selectable units Var Percent, Baumé Percent Percent, Baumé Percent, Baumé Brix (percent), Baumé	
142	Unit concentration	57 101 240 241	Percent Brix degrees Unit of the variable matrix Baumé degrees Note: The selectable units depend on the medium (see "Medium")		
143	Submatrix for calculating concentrations	1 2	Submatrix 1 Submatrix 2		
144	Submatrix used for calculating concentrations (taking the contact input into account)	1 2	Submatrix 1 Submatrix 2 Read only!		

2.3.2 Unsigned int variables

Command 130: Read unsigned int variable

Command	Description		Revision
Request Data Bytes	#0	Slot-Index	
Response Data Bytes	#0	Slot index	
	#1	Unit code	
	#2..#3	Content of slot	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	6	Transmitter Specific Command Error -> Invalid slot number	
	16	Access Restrict	

Command 131: Write unsigned int variable

Command	Description		Revision
Request Data Bytes	#0	Slot-Index	
	#1	Unit code	
		Content of slot	
	#2	MSB	
	#3	LSB	
Response Data Bytes	#0	Slot-Index	
	#1	Unit code	
		Content of slot	
	#2	MSB	
	#3	LSB	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection -> Invalid unit code	
	3	Parameter Too Large	
	4	Parameter Too Small	
	5	Incorrect Byte Count -> Number of Data Bytes Not Equal to 4	
	6	Transmitter Specific Command Error -> Invalid slot number	
	16	Access Restrict	
Comments		The unit code received by the master is ignored when processing commands and the valid, set unit code is returned with the response	

Table of "unsigned int" variables

Slot number	Parameter	Meaning	Revision
0	Device address	Unit None = 250 Minimum = 0 Maximum = 15	
10	Totalizer Qm overflow > F	Unit None = 250 Read only	
11	Totalizer Qm overflow < R	Unit None = 250 Read only	
12	Totalizer Qv overflow > F	Unit None = 250 Read only	
13	Totalizer Qv overflow < R	Unit None = 250 Read only	
14	Totalizer Qm net overflow > F	Unit None = 250 Read only	
15	Totalizer Qm net overflow < R	Unit None = 250 Read only	
68	Error memory: Number	Unit None = 250 Read only	
69	Warning memory: Number	Unit None = 250 Read only	
70	Power outage	Unit None = 250 Read only	

2.3.3 Float variables

Command 132: Read float variable

Command	Description		Revision
Request Data Bytes	#0	Slot-Index	
Response Data Bytes	#0	Slot-Index	
	#1	Unit code	
	#2..#5	Content of Slot	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	6	Transmitter Specific Command Error -> Invalid slot number	
	16	Access Restrict	

Command 133: Write float variable

Command	Description		Revision
Request Data Bytes	#0	Slot-Index	
	#1	Unit code	
	#2..#5	Content of Slot	
Response Data Bytes	#0	Slot-Index	
	#1	Unit code	
	#2..#5	Content of Slot	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection -> Invalid unit code	
	3	Parameter Too Large	
	4	Parameter Too Small	
	5	Incorrect Byte Count -> Number of Data Bytes Not Equal to 4	
	6	Transmitter Specific Command Error -> Invalid slot number	
	16	Access Restrict	
Comments		The unit code received by the master is ignored when processing commands and the valid, set unit code is returned with the response	

Table of "float" variables

Slot number	Parameter	Meaning				Revision
0	Mass flow in unit	Process value	(cannot be changed)			
1	Volume flow in unit	Process value	(cannot be changed)			
2	Mass flow in percent	Process value	(cannot be changed)			
3	Density in unit	Process value	(cannot be changed)			
4	Temperature in unit	Process value	(cannot be changed)			
5	Concentration in unit	Process value	(cannot be changed)			
6	Concentration in percent	Process value	(cannot be changed)			
7	Net mass flow in unit	Process value	(cannot be changed)			
8	Current output 1 in unit	Process value	(cannot be changed)			
9	Current output 2 in unit	Process value	(cannot be changed)			
10	Damping Qm	Unit s = 51 Minimum = Maximum =		1 s 100 s		
11	Damping density	Unit s = 51 Minimum = Maximum =		1 s 100 s		00.03.xx
20	Unit factor Qm	Unit Liter = 61 Minimum = Maximum =		0.00001 kilograms 5000000 kilograms		
21	Unit factor Qv	Unit Liter = 41 Minimum = Maximum =		0.00001 liter 5000000 liter		
25	Pulse output: Qv max.	Unit				
		l/s	24	ugl/h	136	
		l/min	17	mgl/d	23	
		l/h	138	igps	137	
		m3/s	28	igpm	18	
		m3/min	131	igph	30	
		m3/h	19	igpd	31	
		m3/d	29	bbl/s	132	
		ft/s	26	bbl/min	133	
		ft/min	15	bbl/h	134	
		ft/h	130	bbl/d	135	
		ft/d	27	Prog. unit / s	245	
		ugl/s	22	Prog. unit / min	246	
		ugl/min	16	Prog. unit / h	247	
				Prog. unit / d	248	
		Minimum =	(0.01 * Qmax meter tube) / (max. density (3.5 kg/l))			
		Maximum =	(Qmax meter tube) / (min. density (0.5 kg/l))			

Slot number	Parameter	Meaning				Revision
26	Pulse width	Unit				
		Milliseconds =	253 (Special)			
		Minimum =	0.1 ms			
		Maximum =	2000.0 ms			
27	Pulse factor Qm	Unit				00.03.xx
		/g	60	/lb	63	
		/kg	61	/Prog. Einheit	244	
		/t	62			
		Minimum =	0.00001 / totalizer unit Qm			
		Maximum =	100.000 / totalizer unit Qm			
28	Pulse factor Qv	Unit				00.03.xx
		/l	41	/igl	42	
		/m3	43	/bbl	46	
		/ft^3	112	/Prog. Einheit	249	
		/ugl	40			
		Minimum =	0.00001 / totalizer unit Qv			
		Maximum =	100.000 / totalizer unit Qv			
35	Qm maximum	Unit				
		g/s	70	t/d	79	
		g/min	71	lb/s	80	
		g/h	72	lb/min	81	
		kg/s	73	lb/h	82	
		kg/min	74	lb/d	83	
		kg/h	75	Prog. unit / s	240	
		kg/d	76	Prog. unit / min	241	
		t/min	77	Prog. unit / h	242	
		t/h	78	Prog. unit / d	243	
		Minimum =	0.01 * Qmax meter tube			
		Maximum =	Qmax meter tube			
40	Qmax meter tube	Unit				
		g/s	70	t/d	79	
		g/min	71	lb/s	80	
		g/h	72	lb/min	81	
		kg/s	73	lb/h	82	
		kg/min	74	lb/d	83	
		kg/h	75	Prog. unit / s	240	
		kg/d	76	Prog. unit / min	241	
		t/min	77	Prog. unit / h	242	
		t/h	78	Prog. unit / d	243	
		Note:	Qmax meter tube is read only!			
45	Low flow	Unit				
		% = 57				
		Minimum =	0 %			
		Maximum =	10 %			

Slot number	Parameter	Meaning		Revision
46	Min. density (Error 9b)	Unit		00.02.xx
		g/ml	95	
		g/l	97	
		g/cm3	91	
		kg/l	96	
		kg/m^3	92	
		lb/ft^3	94	
		lb/ugl	93	
		Minimum =	0.0 g/cm^3	
		Maximum =	3.5 g/cm^3	
50	Current output 1:	Unit		
	Lower alarm limit	mA = 39		
60	Current output 2:	Minimum =	21.0 mA	
	Lower alarm limit	Maximum =	26.0 mA	
51	Current output 1:	Unit		
	Lower alarm limit	mA = 39		
61	Current output 2:	Minimum =	21.0 mA	
	Lower alarm limit	Maximum =	26.0 mA	
52	Current output 1:	Unit		
	Lower density limit	g/ml	95	
	at I = 0 %	g/l	97	
		g/cm3	91	
62	Current output 2:	kg/l	96	
	Lower density limit	kg/m^3	92	
	at I = 0 %	lb/ft^3	94	
		lb/ugl	93	
		Minimum =	Min density	
			(*** 0.00001 g/cm^3...0.5 g/cm^3)	
		Maximum =	3.5 g/cm^3 (basic unit)	
52	Current output 1:	Unit		
	Lower density limit	g/ml	95	
	at I = 100 %	g/l	97	
		g/cm3	91	
63	Current output 2:	kg/l	96	
	Lower density limit	kg/m^3	92	
	at I = 100 %	lb/ft^3	94	
		lb/ugl	93	
		Minimum =	Min density	
			(*** 0.00001 g/cm^3...0.5 g/cm^3)	
		Maximum =	3.5 g/cm^3 (basic unit)	

Slot number	Parameter	Meaning				Revision
54	Current output 1:	Unit				
	Qv max. at I = 100 %	l/s	24	ugl/h	136	
		l/min	17	mgl/d	23	
64	Current output 2:	l/h	138	igps	137	
	Qv max. at I = 100 %	m3/s	28	igpm	18	
		m3/min	131	igph	30	
		m3/h	19	igpd	31	
		m3/d	29	bbl/s	132	
		ft/s	26	bbl/min	133	
		ft/min	15	bbl/h	134	
		ft/h	130	bbl/d	135	
		ft/d	27	Prog. unit / s	245	
		ugl/s	22	Prog. unit / min	246	
		ugl/min	16	Prog. unit / h	247	
				Prog. unit / d	248	
		Minimum =	(0.01 * Qmax meter tube) / (max. density (3.5 kg/l))			
		Maximum =	(Qmax meter tube) / (min. density (0.5 kg/l))			
55	Current output 1:	Unit				
	Lower temperature limit	32	°C			
	at I = 0 %	35	K			
		33	°F			
65	Current output 2:					
	Lower temperature limit	Minimum =	-50 °C (basic unit)			
	at I = 0 %	Maximum =	+180 °C (basic unit)			
56	Current output 1:	Unit				
	Upper temperature limit	32	°C			
	at I = 100 %	35	K			
		33	°F			
66	Current output 2:					
	Upper temperature limit	Minimum =	-50 °C (basic unit)			
	at I = 100 %	Maximum =	+180 °C (basic unit)			
73	Set totalizer net mass > F	Unit				
		g	60	Prog. unit	244	
74	Set totalizer net mass < R	kg	61			
		t	62			
		lb	63			
		Minimum =	0 (basic unit)			
		Maximum =	9999999 (basic unit)			
75	Set totalizer Qm > F	Unit				
		g	60	Prog. unit	244	
76	Set totalizer Qm < R	kg	61			
		t	62			
		lb	63			
		Minimum =	0 (basic unit)			
		Maximum =	9999999 (basic unit)			

Slot number	Parameter	Meaning				Revision
77	Set totalizer Qv > F	Unit				
		l	41	igl	42	
78	Set totalizer Qv < R	m^3	43	bbl	46	
		ft^3	112	Prog. unit	249	
		ugl	40			
		Minimum =	0 (basic unit)			
		Maximum =	9999999 (basic unit)			
79	Unit factor prog. Unit Qm (mass)	Unit				
		Prog. unit / s	240			
		Prog. unit / min	241			
		Prog. unit / h	242			
		Prog. unit / d	243			
		Minimum =	0,00001 kg			
		Maximum =	5000000 kg			
80	Unit factor prog. Unit Qv (volume)	Unit				
		Prog. unit / s	245			
		Prog. unit / min	246			
		Prog. unit / h	247			
		Prog. unit / d	248			
		Minimum =	0,00001 l			
		Maximum =	5000000 l			
81	D correction	Unit				
		g/ml	95			
		g/l	97			
		g/cm3	91			
		kg/l	96			
		kg/m^3	92			
		lb/ft^3	94			
		lb/ugl	93			
		Minimum =	-50 g/l			
		Maximum =	+50 g/l			
82	Qm correction	Unit				
		%	57			
		Minimum =	-5%			
		Maximum =	+5%			
83	System Zero adj.	Unit				
		%	57			
		Minimum =	-10%			
		Maximum =	+10%			
84	Min Alarm Qm	Unit				
		%	57			
		Minimum =	0 %			
		Maximum =	103,125 %			
85	Max Alarm Qm	Unit				
		%	57			
		Minimum =	0 %			
		Maximum =	103,125 %			

Slot number	Parameter	Meaning		Revision
86	Min Alarm	Unit		
		g/ml	95	
		g/l	97	
		g/cm3	91	
		kg/l	96	
		kg/m^3	92	
		lb/ft^3	94	
		lb/ugl	93	
		Minimum =	Min density	
			(*** 0.00001 g/cm^3...0.5 g/cm^3)	
		Maximum =	3,5 g/cm^3	
87	Max Alarm	Unit		
		g/ml	95	
		g/l	97	
		g/cm3	91	
		kg/l	96	
		kg/m^3	92	
		lb/ft^3	94	
		lb/ugl	93	
		Minimum =	Min density	
			(*** 0.00001 g/cm^3...0.5 g/cm^3)	
		Maximum =	3,5 g/cm^3	
88	Min alarm temp	Unit		
		°C	32	
		K	33	
		°F	35	
		Minimum =	-50°C	
		Maximum =	+2000°C	
89	Max alarm temp	Unit		
		°C	32	
		K	33	
		°F	35	
		Minimum =	-50°C	
		Maximum =	+200°C	
170	Field optimization concentration submatrix 1	Minimum =	-1000	
		Maximum =	1000	
			Each in selected concentration unit	
171	Field optimization concentration submatrix 2	Minimum =	-1000	
		Maximum =	1000	
			Each in selected concentration unit	
172	Min alarm concentration	Variable matrix	Can be set up to -99,999	
		Sodium hydroxide	-5 %, -5 Baumé	
		Alcohol	-5 %	
		Wheat starch	-5 %, -5 Baumé	
		Corn starch	-5 %, -5 Baumé	
		Sugar solution	-5 %, -5 Baumé	
173	Max alarm concentration	Variable matrix	Can be set up to 99,999	
		Sodium hydroxide	105 %, 105 Baumé	
		Alcohol	105 %	
		Wheat starch	105 %, 60 Baumé	
		Corn starch	105 %, 60 Baumé	
		Sugar solution	105 %, 60 Baumé	

Slot number	Parameter	Meaning		Revision
174	Flow range end value of the net mass flow for the pulse output	Minimum = Maximum =	0.01 * Qmax meter tube Qmax meter tube	
175	Pulse factor net mass flow	Minimum = Maximum =	0.00001 / totalizer unit Qm 100000 / totalizer unit Qm	00.03.xx
176 179	Current output 1: Lower concentration limit at I = 0 % Current output 2: Lower concentration limit at I = 0 %	Variable matrix Sodium hydroxide Alcohol Wheat starch Corn starch Sugar solution	Can be set up to -99,999 -5 %, -5 Baumé -5 % -5 %, -5 Baumé -5 %, -5 Baumé -5 %, -5 Baumé	
177 180	Current output 1: Upper concentration limit at I = 100 % Current output 2: Upper concentration limit at I = 100 %	Variable matrix Sodium hydroxide Alcohol Wheat starch Corn starch Sugar solution	Can be set up to 99,999 105 %, 105 Baumé 105 % 105 %, 60 Baumé 105 %, 60 Baumé 105 %, 60 Baumé	
   178 181	Flow range end value net mass flow Current output 1: at I = 100 % Current output 2: at I = 100 %	Minimum = Maximum =	0.01 * Qmax meter tube Qmax meter tube	
182	Minimum concentration of the copy of the variable matrix	Minimum = Maximum =	-99999 Maximum concentration of the variable matrix	
183	Maximum concentration of the copy of the variable matrix	Minimum = Maximum =	Min. concentration of the variable matrix 99999	

***: Min. density depends on the manufacturer's value

2.3.4 Programmable unit

Command 150: Read programmable unit

Command	Description		Revision
Request Data Bytes	#0	Slot-Index	
Response Data Bytes	#0	Slot-Index	
	#1..#3	Content of Slot	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection → Slot Not Found	
	5	Incorrect Byte Count	
	6	Transmitter Specific Command Error → Invalid Slot Number	
	16	Access Restrict	

Command 151: Write programmable unit

Command	Description		Revision
Request Data Bytes	#0	Slot-Index	
	#1..#3	Content of Slot	
Response Data Bytes	#0	Slot-Index	
	#1..#3	Content of Slot	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection → Invalid unit code	
	5	Incorrect Byte Count → Number of Data Bytes Not Equal to 4	
	6	Transmitter Specific Command Error → Invalid Slot Number	
	16	Access Restrict	
Comments		The unit code received by the master is ignored when processing commands and the valid, set unit code is returned with the response	

Table of "programmable units"

Slot number	Parameter	Number	Meaning	Revision
0	Prog. Unit Qm	0	Write / read text from programmable unit for Qm	
1	Prog. Unit Qv	0	Write / read text from programmable unit for Qv	

2.3.5 String variables

Command 230: Read string variable

Command	Description		Revision
Request Data Bytes	#0	Slot-Index	
Response Data Bytes	#0	Slot-Index	
	#Var.	Content of Slot	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection → Slot Not Found	
	5	Incorrect Byte Count	
	6	Transmitter Specific Command Error → Invalid Slot Number	
	16	Access Restrict	

Table of "string" variables

Slot number	Parameter	Byte number	Meaning	Revision
4	Order no.	16	Read order number	
5	Software Version	16	Read unit software version	
6	Unit name of the variable matrix	6	Unit name of the variable matrix. Parameter is read only.	
7	Unit name of the copy of the variable matrix	6	Unit name of the copy of the variable matrix.	
8	Medium name of the variable matrix	16	Medium name of the variable matrix	
9	Medium name of the copy of the variable matrix	16	Medium name of the copy of the variable matrix	

2.3.6 Short overview of slot commands

Menu title	Variable type	Command		Slot	Revision
		Read	Write		
Display line 1	unsigned char	128	129	0	
Display line 2	unsigned char	128	129	1	
Display line 1 multiplex	unsigned char	128	129	2	
Display line 2 multiplex	unsigned char	128	129	3	
Unit of density	unsigned char	128	129	10	
Unit Qm (mass)	unsigned char	128	129	11	
Unit Qm (volume)	unsigned char	128	129	12	
Temperature	unsigned char	128	129	13	
Unit totalizer Qm	unsigned char	128	129	14	
Unit totalizer Qv	unsigned char	128	129	15	
Flow direction	unsigned char	128	129	20	
Directional display	unsigned char	128	129	21	
Output of pulse output	unsigned char	128	129	25	
Meter tube (2.)	unsigned char	128		30	
Signal level	unsigned char	128	129	31	
Language	unsigned char	128	129	35	
Current output 1: Alarm	unsigned char	128	129	40	
Current output 2: Alarm	unsigned char	128	129	41	
Current output 1: Output	unsigned char	128	129	42	
Current output 2: Output	unsigned char	128	129	43	
Contact input	unsigned char	128	129	48	
Switch output	unsigned char	128	129	49	
Operating protection switch	unsigned char	128		95	
Concentration measurement	unsigned char	128	129	140	
Medium	unsigned char	128	129	141	
Unit concentration	unsigned char	128	129	142	
Submatrix for calculating concentrations	unsigned char	128	129	143	
Submatrix used for calculating concentrations	unsigned char	128		144	
Device address	unsigned int	130	131	0	
Totalizer Qm overflow > F	unsigned int	130		10	
Totalizer Qm overflow < R	unsigned int	130		11	
Totalizer Qv overflow > F	unsigned int	130		12	
Totalizer Qv overflow < R	unsigned int	130		13	
Error memory: Number	unsigned int.	130		68	
Warning memory: Number	unsigned int.	130		69	
Power outage	unsigned int.	130		70	

Menu title	Variable type	Command		Slot	Revision
		Read	Write		
Mass flow in unit	float	132		0	
Volume flow in unit	float	132		1	
Mass flow in percent	float	132		2	
Density in unit	float	132		3	
Temperature in unit	float	132		4	
Concentration in unit	float	132		5	
Concentration in percent	float	132		6	
Net mass flow in unit	float	132		7	
Current output 1 in unit	float	132		8	
Current output 2 in unit	float	132		9	
Damping	float	132	133	10	
Unit factor Qm	float	132	133	20	
Unit factor Qv	float	132	133	21	
Pulse output: Qv max. (1.)	float	132	133	25	
Pulse width (1.)	float	132	133	26	
Pulse value Qm (1.)	float	132	133	27	
Pulse value Qv (1.)	float	132	133	28	
Qm max.	float	132	133	35	
Qmax meter tube	float	132	133	40	
Low flow	float	132	133	45	
Min. density (Error 9b)	float	132	133	48	
Current output 1: Lower alarm limit	float	132	133	50	
Current output 2: Lower alarm limit	float	132	133	60	
Current output 1: Upper alarm limit	float	132	133	51	
Current output 2: Upper alarm limit	float	132	133	61	
Current output 1: Lower density limit at I = 0 %	float	132	133	52	
Current output 2: Lower density limit at I = 0 %	float	132	133	62	
Current output 1: Upper density limit at I = 100 %	float	132	133	53	
Current output 2: Upper density limit at I = 100 %	float	132	133	63	
Current output 1: Qv max. at I = 100 %	float	132	133	54	
Current output 2: Qv max. at I = 100 %	float	132	133	64	

Menu title	Variable type	Command		Slot	Revision
		Read	Write		
Current output 1: Lower temperature limit at I = 0 %	float	132	133	55	
Current output 2: Lower temperature limit at I = 0 %	float	132	133	65	
Current output 1: Upper temperature limit at I = 100 %	float	132	133	56	
Current output 2: Upper temperature limit at I = 100 %	float	132	133	66	
Set totalizer net mass > F	float	132	133	73	
Set totalizer net mass < R	float	132	133	74	
Set totalizer Qm > F	float	132	133	75	
Set totalizer Qm < R	float	132	133	76	
Set totalizer Qv > F	float	132	133	77	
Set totalizer Qv < R	float	132	133	78	
Field optimization concentration submatrix 1	float	132	133	170	
Field optimization concentration submatrix 2	float	132	133	171	
Min alarm concentration	float	132	133	172	
Max alarm concentration	float	132	133	173	
Flow range end value of the net mass flow for the pulse output	float	132	133	174	
Pulse factor net mass flow	float	132	133	175	
Lower concentration limit Current output 1 at I = 0 %	float	132	133	176	
Upper concentration limit Current output 1 at I = 100 %	float	132	133	177	
Flow range end value net mass flow Current output 1 at I = 100 %	float	132	133	178	
Lower concentration limit Current output 2 at I = 0 %	float	132	133	179	
Upper concentration limit Current output 2 at I = 100 %	float	132	133	180	

Menu title	Variable type	Command		Slot	Revision
		Read	Write		
Flow range end value net mass flow Current output 2: at I = 100 %	float	132	133	181	
Minimum concentration of the copy of the variable matrix	float	132	133	182	
Maximum concentration of the copy of the variable matrix	float	132	133	183	

NOTE

- In addition to the "standard" dependencies (meter tube -> Qmax meter tube etc.), if changes are made to the pulse width, pulse values, Qm max., or pulse output Qv max (depending on the selection), the two first parameters must be read again in order to obtain any newly calculated values in the transmitter.
- To change the parameters, the service code number must be entered.

2.4 Other commands which can be used by customers

This section lists all other commands that are not Universal, Common Practice, or Slot commands.

2.4.1 Command 140: Delete Qm totalizer > F and overflow > F

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	none		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.2 Command 141: Delete Qm totalizer < R and overflow < R

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	none		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.3 Command 142: Delete Qm overflow > F

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	none		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.4 Command 143: Delete Qm overflow < R

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	none		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.5 Command 144: Delete Qv totalizer > F and overflow > F

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	none		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.6 Command 145: Delete Qv totalizer < R and overflow < R

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	none		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.7 Command 146: Delete Qv overflow > F

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	none		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.8 Command 147: Delete Qv overflow < R

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	none		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.9 Command 148: Reset Qm + Qv and, if necessary, Qnm totalizers

Command	Description		Revision
Request Data Bytes	none		
Response Data Bytes	none		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.10 Command 170: Start adjustment of system zero point

Command	Description		Revision
Request Data Bytes	#0	Slot-Index	
Response Data Bytes	#0	Slot-Index	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection → Slot Not Found	
	5	Incorrect Byte Count	
	6	Transmitter Specific Command Error → Invalid Slot Number	
	16	Access Restrict	

2.4.11 Table for automatic system zero point adjustment

Slot number	Meaning	Revision
0	Start slow automatic system zero point adjustment	
1	Start fast automatic system zero point adjustment	

2.4.12 Matrix configuration

Command 190: Read matrix configuration

Command	Description		Revision
Request Data Bytes	#0	Slot-Index	
Response Data Bytes	#0	Slot Index	
	#1	Number of Matrices (1 or 2)	
	#2..#3	Number of Temperatures (Columns)	
	#4..#5	Number of Concentrations (Rows)	
	#6	Concentration available in percent (2 => NO / 3 => YES)	
	#7	Number of Concentration Units (Without Concentration in Percent)	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

Command 191: Write matrix configuration

Command	Description		Revision
Request Data Bytes	#0	Slot Index	
	#1	Number of Matrices (1 or 2)	
	#2..#3	Number of Temperatures (Columns)	
	#4..#5	Number of Concentrations (Rows)	
	#6	Concentration available in percent (2 => NO / 3 => YES)	
	#7	Number of Concentration Units (Without Concentration in Percent)	
Response Data Bytes	#0	Slot Index	
	#1	Number of Matrices (1 or 2)	
	#2..#3	Number of Temperatures (Columns)	
	#4..#5	Number of Concentrations (Rows)	
	#6	Concentration available in percent (2 => NO / 3 => YES)	
	#7	Number of Concentration Units (Without Concentration in Percent)	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection → Slot Not Found	
	3	One or More Parameters Too Large	
	4	One or More Parameters Too Small	
	5	Incorrect Byte Count	
	13	At Least One Parameter Too Small and One Parameter Too Large	
	16	Access Restrict → Configuration Cannot Be Changed (Fixed Matrix)	

Table of slot indices for the matrix configuration

Slot number	Meaning	Access	Revision
0	Variable matrix	Read	
4	Copy of the variable matrix	Read and write	
8	Sodium hydroxide	Read	
12	Alcohol in water	Read	
16	Wheat starch	Read	
20	Corn starch	Read	
24	Sugar in water	Read	

2.4.13 Float array

Command 192: Read elements of a float array

Command	Description		Revision
Request Data Bytes	#0	Slot Index	
	#1	Offset	
	#2	Number of Floats to Be Read	
Response Data Bytes	#0	Slot Index	
	#1	Offset	
	#2	Number of Floats to Be Read	
	#3-#6	1st float	
	#7-#10	2nd float	
	#11-#14	3rd float	
	#15-#18	4th float	
	#19-#22	5th float	
		Note: If fewer than five floats are requested, the frame is filled to five floats with the "zero" value (constant frame length).	
Response Codes	0	No Command Specific Error	
	3	Parameter too large (Number of floats too large and / or offset plus number greater than overall length)	
	5	Incorrect Byte Count	
	16	Access Restrict	

Command 193: Write elements of a float array

Command	Description		Revision
Request Data Bytes	#0	Slot Index	
	#1	Offset	
	#2	Number of floats to be written	
	#3-#6	1st float	
	#7-#10	2nd float	
	#11-#14	3rd float	
	#15-#18	4th float	
	#19-#22	5th float	
		Note: Up to five floats can be written. However, the frame must always contain five floats, even if not all five floats are written (constant frame length).	
Response Data Bytes	#0	Slot Index	
	#1	Offset	
	#2	Number of floats to be written	
	#3-#6	1st float	
	#7-#10	2nd float	
	#11-#14	3rd float	
	#15-#18	4th float	
	#19-#22	5th float	
		Note: If fewer than five floats are to be written, the frame is filled to five floats with the "zero" value (constant frame length).	
Response Codes	0	No Command Specific Error	
	3	Parameter too large (Number of floats too large and / or offset plus number greater than overall length)	
	5	Incorrect Byte Count	
	16	Access Restrict	

Table of slot indices for reading and writing float arrays

Slot number	Meaning		Access	Revision
0	Variable matrix	Temperature and concentration values	Read	
1		Density values	Read	
2		Minimum concentrations	Read	
3		Maximum concentrations	Read	
4	Copy of the variable matrix	Temperature and concentration values	Read and write	
5		Density values	Read and write	
6		Minimum concentrations	Read and write	
7		Maximum concentrations	Read and write	
8	Sodium hydroxide	Temperature and concentration values	Read	
9		Density values	Read	
10		Minimum concentrations	Read	
11		Maximum concentrations	Read	
12	Alcohol in water	Temperature and concentration values	Read	
13		Density values	Read	
14		Minimum concentrations	Read	
15		Maximum concentrations	Read	
16	Wheat starch	Temperature and concentration values	Read	
17		Density values	Read	
18		Minimum concentrations	Read	
19		Maximum concentrations	Read	
20	Corn starch	Temperature and concentration values	Read	
21		Density values	Read	
22		Minimum concentrations	Read	
23		Maximum concentrations	Read	
24	Sugar in water	Temperature and concentration values	Read	
25		Density values	Read	
26		Minimum concentrations	Read	
27		Maximum concentrations	Read	

The number of values present in a slot depends on the corresponding configuration of the matrix.

2.4.14 Status arrays

The status represents the state of the associated density value, which is contained in the density array. The state is saved in a byte and can assume three values. These are:

State	Value
Density value has been entered	0
Density value is to be calculated	1
Density value has been calculated	2

Command 194: Read elements of a status array

Command	Description		Revision
Request Data Bytes	#0	Slot Index	
	#1	Offset	
	#2	Number of Statuses to Be Read	
Response Data Bytes	#0	Slot Index	
	#1	Offset	
	#2	Number of Statuses to Be Read	
	#3-#22	Statuses 1 to 20	
		Note: If fewer than 20 statuses are requested, the frame is filled to 20 statuses with the "255" value (constant frame length).	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection → Slot Not Found	
	3	Parameter too large (Number of bytes too large and / or offset plus number greater than overall length)	
	5	Incorrect Byte Count	
	16	Access Restrict	

Command 195: Write elements of a status array

Command	Description		Revision
Request Data Bytes	#0	Slot Index	
	#1	Offset	
	#2	Number of Statuses to Be Written	
	#3-#22	Statuses 1 to 20	
		Note: Up to 20 statuses can be written. However, the frame must always contain 20 statuses, even if not all 20 statuses are written (constant frame length).	
Response Data Bytes	#0	Slot Index	
	#1	Offset	
	#2	Number of Statuses to Be Written	
	#3-#22	Statuses 1 to 20	
		Note: If fewer than 20 statuses are to be written, the frame is filled to 20 statuses with the "255" value (constant frame length).	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection → Slot Not Found or Status Is Not 0, 1, or 2	
	3	Parameter too large (Number of statuses too large and / or offset plus number greater than overall length)	
	5	Incorrect Byte Count	
	16	Access Restrict	

Table of slot indices for reading and writing status arrays

Slot number	Meaning	Access	Revision
0	Variable matrix	Read	
4	Copy of the variable matrix	Read and write	

2.4.15 Command 196: Calculate density values in the copy of the variable matrix

Command	Description		Revision
Request Data Bytes	#0	Submatrix to Be Calculated (1 or 2)	
Response Data Bytes	#0	Calculated Submatrix (1 or 2)	
	#1	Number of Density Values Which Cannot Be Calculated	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection → Submatrix Not Available	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.16 Command 197: Matrix input end

Command	Description		Revision
Request Data Bytes	#0	Action	
		1: Check and, if Required, Save Matrix Data	
		Other value: Reject changes.	
		A copy of the variable matrix is overwritten with the data from the variable matrix	
Response Data Bytes	#0	Action	
	#1	Error code	
		: Action OK	
		: Temperature not increasing	
		: Concentration in unit neither increasing nor decreasing	
		: Concentration in percent neither increasing nor decreasing	
		: Density not increasing	
		: Non-calculated density values are present	
		An error is assigned to a submatrix by adding 0x50 for submatrix 1 and 0x60 for submatrix 2.	
		Example: Error Code 0x64 show that the density values in submatrix 2 are not increasing.	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.17 Command 200: Delete totalizer net mass > F and overflow > F

Command	Description		Revision
Request Data Bytes	None		
Response Data Bytes	None		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.18 Command 201: Delete totalizer net < R and overflow < R

Command	Description		Revision
Request Data Bytes	None		
Response Data Bytes	None		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.19 Command 202: Delete net mass overflow > F

Command	Description		Revision
Request Data Bytes	None		
Response Data Bytes	None		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.20 Command 203: Delete net mass overflow < R

Command	Description		Revision
Request Data Bytes	None		
Response Data Bytes	None		
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
	16	Access Restrict	

2.4.21 Command 208: Read DensiMass code

Command	Description		Revision
Request Data Bytes	None		
Response Data Bytes	#0-#3	DensiMass code	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	

2.4.22 Command 209: Write DensiMass code

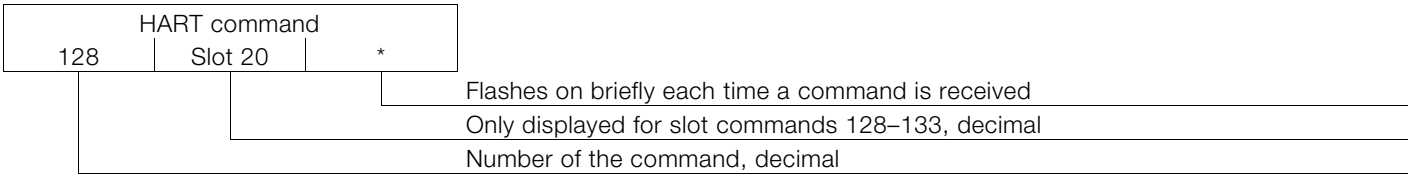
Command	Description		Revision
Request Data Bytes	#0-#3	DensiMass code Minimum value: 0 Maximum value: 9999999	
Response Data Bytes	#0-#3	DensiMass code	
Response Codes	0	No Command Specific Error	
	3	Parameter Too Large	
	4	Parameter Too Small	
	5	Incorrect Byte Count	
	16	Access Restrict	

3 Troubleshooting HART

If HART communication is not functioning, check the following items:

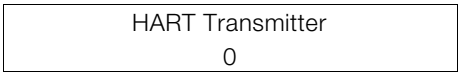
1. The transmitter must be equipped with a HART-enabled current output module
2. The load at the current output must be between 250 and 500 Ω
3. The device address in the "Interface" menu must be correct

If all of these points are correct but HART communication is still not functioning, the next item to check is the reception. The "Functional test" submenu contains the "HART command" function:



If nothing appears here, the reception is not working properly. In this case, use an oscilloscope to check whether a HART signal is even arriving at the transmitter. The signal level is typically 1 mApp, which means, for example, that a load of 500 Ω will result in a signal of 1 mApp * 500 Ω = 500 mVpp.
If a signal arrives and the transmitter does not detect it, this can probably be put down to poor signal quality. In this case, the test should be repeated under better conditions.

If the transmitter receives the HART commands and its counterpart (a handheld communicator, for example) still reports errors, the sending procedure transmitter must be checked using an oscilloscope. This can be done using the functional test of the "HART Transmitter":



The transmitter sends a logical 0 (= 2200 Hz) when this function is called up, and a logical 1 (= 1200 Hz) when a button is pressed.

The oscilloscope should also be used to check whether the transmitter responds to the command.

4 Concentration matrix

The following section provides a brief description of how the concentration matrix is structured and how data is stored in the memory.
The concentration matrix looks like this:

			Temp. 1		Temp. N
Concentr. percent 1	Concentr.	Concentr. percent 1	Density		
…	…		1.1	…	Density
Concentr. percent M	Concentr. unit B M	Concentr.	N,1		

The matrix data is stored in two float arrays. The variable matrix also features a status array, which indicates whether the density data

- is to be entered
- is to be calculated
- has been calculated

The first array contains the temperature data from left to right, followed by the concentration data from right to left (column by column). Within a column, the data is stored from top to bottom.

The above matrix is stored in the memory as follows:

Temperature / concentration of array:

Temp1 … TempN, concentr. unit A 1… concentr. unit A M, concentr. unit B 1… concentr. unit B M, concentr. percent 1… concentr. percent M

The number of different concentrations in units is variable for matrices which are permanently stored and depends on the number of units for a medium. Only one "concentration in unit" exists for the variable matrix. The values in the column entitled "Concentr. percent" are used to calculate the net mass flow and to calculate the concentration in percent. Space is always reserved for the column entitled "Concentr. percent", even if no values are stored here.

The second array contains the density data. Here the data is stored in rows from top to bottom and, within a row, from left to right.

Density array:

Density 1,1 … Density N,1 … Density 1,M … Density N,M

The variable matrix also features a status array, where the status of every density value is stored. Data is stored here in the same way as in the density array.

Two submatrices of the same size can be created, which can be toggled by means of a HART command, a menu, or a contact input.

If two submatrices do exist, the data of the second matrix is appended to the corresponding array in the order shown.

The data is also communicated with the corresponding array commands (float array, status array) in the same order in which it is stored in the memory.

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