Interface Description

D184B108U08

Mass Flowmeter
CoriolisMaster FCM2000

HART protocol 5.1

Valid for software levels from B.30 and C.1x

HART COMMUNICATION PROTOCOL

Mass Flowmeter
CoriolisMaster FCM2000

Interface Description

D184B108U08

09.2009

Rev. 05

Manufacturer:

ABB Automation Products GmbH
Dransfelder Straße 2
D-37079 Göttingen
Germany
Tel.: +49 551 905-534
Fax: +49 551 905-555
CCC-support.deapr@de.abb.com

Customer service center
Phone: +49 180 5 222 580
Fax: +49 621 381 931-29031
automation.service@de.abb.com

1 Revision overview

Revision		Date	New page	Modified page	Name
No.	Soft.				
0	A.00	09/15/1998	Created	-	AP
1	A.10	01/17/2000	-	HCMD 48 (Reg. expanded) HCMD 0 (SW-Rev. 1)	AP
2	A.10	02/10/2000	-	Float slot cmd; error in doc. → slot 15 removed	AP
3	A.10	07/17/2000	-	Uns. char slot cmd; error in doc. → text for unit 23 changed in mgl / d	AP
4	B.20	01/08/2008	-	1. All write CMDs have been assigned the additional Response Code 16 (Access Restrict). 2. Additional slot no. for HART slot CMD 128 ... 133 3. HART CMD 150 / 151 programmable unit 4. HART CMD 230 read string variable 5. HART CMD 148 reset Qm + Qv totalizer 6. HART CMD 170 start adjustment of system zero point 7. Qmmax > 103 %	A. Brust
5	B.30	06/12/2009	-	Additional commands for concentration measurement created / existing commands expanded	See-bode

2 HART Commando 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.

2.1 UNIVERSAL COMMANDS (HCF_SPEC-127, Rev. 6.0)

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
	#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	= Byte 3 Device number
	#10	Device Identification Number, 24 Bit	= Byte 2 Device number
	#11	Device Identification Number, 24 Bit, LSB	= Byte 1 Device number
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	
Remark		Primary Variable => Depends on configuration 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	
Remark	Primary Variable = Depends on configuration of current output 1 Secondary Variable = Depends on configuration of current output 2 Tertiary Variable = Depends on configuration of pulse output Fourth Variable = Depends on configuration of second display line	

2.1.5 COMMAND 6

WRITE POLLING ADDRESS

COMMAND	Description	Revision 4
Request Data Bytes	#0 Polling Adress of Device	
Response Data Bytes	#0 Polling Adress 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
	#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	= Byte 3 Device number
	#10	Device Identification Number, 24 Bit	= Byte 2 Device number
	#11	Device Identification Number, 24 Bit, LSB	= Byte 1 Device number
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

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	
Remark		Sensor Serial Number =	0
		Upper Sensor Limit =	Depends on configuration of current output 1
		Lower Sensor Limit =	Depends on configuration of current output 1
		Minimum Span =	Depends on configuration 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	
Remark		Alarm Selection Code =	0 = High, 1 = Low
		PV Transfer Function Code =	0 = Linear
		PV Upper Range Value =	Depends on configuration of current output 1
		PV Lower Range Value =	Depends on configuration of current output 1
		PV Damping Value =	Damping
		Write Protect Code =	251 = Not Implemented
		Private Label Distributor =	18 =B-F&P

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 4
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

COMMAND	Description	Revision 4
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 4
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 (HCF_SPEC-151, Rev. 8.0)

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	
Remark	Transmitter Variables: Four variables can be read out via the implemented slot commands	

2.2.2 COMMAND 34

WRITE PRIMARY VARIABLE DAMPING VALUE

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

2.2.5 COMMAND 40

ENTER / EXIT PRIMARY VARIABLE CURRENT MODE

COMMAND	Description	Revision 4
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 3 4 5 11 16	No Command Specific Error Passed Parameter to Large (> 20.0 mA) Passed Parameter to Small (< 4.00 mA) Incorrect Byte Count In Multidrop Mode Access Restrict

2.2.6 COMMAND 44

WRITE PRIMARY VARIABLE UNITS

COMMAND	Description	Revision 4
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	
Remark	Primary Variable Unit Code =	Depends on the setting of current output 1

2.2.7 COMMAND 45

TRIM PRIMARY VARIABLE CURRENT DAC ZERO

COMMAND	Description	Revision 4
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 (> 6 mA) 4 Passed Parameter to Small (< 2 mA) 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 4
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 (> 22 mA) 4 Passed Parameter to Small (< 18 mA) 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 5
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

#0, Bit 0	Error 5a:	Internal database
#0, Bit 1	Error 5b:	External database
#0, Bit 2	Error 10:	DSP communication
#0, Bit 3	Error 1:	A/D converter
#0, Bit 4	Error 11d:	Sensor
#0, Bit 5	Error 0:	Sensor amplitude
#0, Bit 6	Error 2a:	Driver
#0, Bit 7	Error 2b:	Driver current
#1, Bit 0	Error 9a:	Density measurement
#1, Bit 1	Error 9b:	Density <0.5 kg/l
#1, Bit 2	Error 7:	Temp. measurement
#1, Bit 3	Error 3	Flowrate > 103 %
#1, Bit 4	Error 4:	Ext. contact
#1, Bit 5	Error 8a:	Iout 1 too high
#1, Bit 6	Error 8b:	Iout1 too low
#1, Bit 7	Error 8c:	Iout 2 too high

Status bytes

#14, Bit 0	Function test
#14, Bit 1	Simulation
#14, Bit 2	Auto. adjustment is running
#14, Bit 3	Auto. adjustment error
#14, Bit 4	unused
up to	up to
#15, Bit 7	unused

Warning bytes

#16, Bit 0	Warning 2:	Totalizer reset
#16, Bit 1	Warning 6a:	MAX alarm Qm
#16, Bit 2	Warning 5a:	MIN alarm Qm
#16, Bit 3	Warning 6b:	MAX alarm density
#16, Bit 4	Warning 5b:	MIN alarm density
#16, Bit 5	Warning 6c:	MAX alarm temp

	Error bytes			**Warning bytes**		
	#2, Bit 0	Error 8d:	Iout2 too low	#16, Bit 6	Warning 5c:	MIN alarm temp.
	#2, Bit 1	Error 6a:	Totalizer mass >V	#16, Bit 7	Warning 10:	Reverse flow Q
	#2, Bit 2	Error 6b:	Totalizer mass <R	#17, Bit 0	Warning 7:	Ext. Data loaded
	#2, Bit 3	Error 6c	Totalizer volume > F	#17, Bit 1	Warning 8a:	Update int. data
	#2, Bit 4	Error 6d:	Totalizer volume < R	#17, Bit 2	Warning 8b:	Update ext. data
	#2, Bit 5	Error 11a:	Sensor A	#17, Bit 3	Warning 1:	Simulation
	#2, Bit 6	Error 11b:	Sensor B	#17, Bit 4	Warning 9a:	Overflow > F mass
	#2, Bit 7	Error 11c:	Sensor C	#17, Bit 5	Warning 9b:	Overflow < R mass
	#3, Bit 0	Error 7b:	Housing temperature	#17, Bit 6	Warning 9c:	Overflow < F volume
	#3, Bit 1	Error 12:	Concentration	#17, Bit 7	Warning 9d:	Overflow < R volume
	#3, Bit 2	Error 6e:	Totalizer net mass > F	#18, Bit 0	Warning 9e:	Overflow > F % mass
	#3, Bit 3	Error 6f:	Totalizer net mass< R	#18, Bit 1	Warning 9f:	Overflow < R % mass
	#3, Bit 4		Unused	#18, Bit 2	Warning 6d:	MAX alarm concentra-tion
	#3, Bit 5		Unused	#18, Bit 3	Warning 5d:	MIN alarm concentratio n
	#3, Bit 6		Unused	#18, Bit 4		unused
	#3, Bit 7		Unused	up to		up to
				#18, Bit 7		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., unit number.

float-variables

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

programmable unit

Write / read text (3 bytes) of 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.

Unsigned-char-variables

2.3.1 COMMAND 128

READ UNSIGNED CHAR VARIABLE

COMMAND	Description	Revision
Request Data Bytes	#0 Slot-Index	
Response Data Bytes	#0 Slot-Index #1 Slot-Data	
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count 6 Transmitter Specific Command Error → Invalid Slot Number 16 Access Restrict	

2.3.2 COMMAND 129

WRITE UNSIGNED CHAR VARIABLE

COMMAND	Description	Revision 4
Request Data Bytes	#0 Slot-Index #1 Slot-Data	
Response Data Bytes	#0 Slot-Index #1 Slot-Data	
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	

2.3.3 Table of "unsigned char" variables

Slot number	Parameter	Number	Meaning	Revision
0 1	Display 1st line Display 2nd line	0 1 2 3 11 13 12 4 5 6 7 8 9 26 27 28 10 23 24 25	Q [Bar graph, %] Qm [Unit] Qv [Unit] Qm [%] Temperature Blank line TAG number Totalizer mass Totalizer mass >V Totalizer mass <R Totalizer volumes Totalizer volume > F Totalizer volume < R Totalizer net mass Totalizer net mass > F Totalizer net mass< R Density Conc. unit Conc. percent Qm concentration	5

Slot number	Parameter	Number	Meaning	Revision
2 3	Display 1st line multiplex Display 2nd line multiplex	0 1 2 3 11 13 12 4 5 6 7 8 9 26 27 28 10 23 24 25 20	Q [Bar graph, %] Qm [Unit] Qv [Unit] Qm [%] Temperature Blank line TAG number Totalizer mass Totalizer mass >V Totalizer mass <R Totalizer volumes Totalizer volume > F Totalizer volume < R Totalizer net mass Totalizer net mass > F Totalizer net mass< R Density Concentration unit Concentration percent Qm concentration Off	5
10	Unit density	95 97 91 96 92 94 93	g/ml g/l g/cm³ kg/l kg/m³ lb/ft³ lb/ugl	
11	Unit Qm (mass)	70 71 72 73 74 75 76 77 78 79 80 81 82 83 240 241 242 243	g/s g/min g/h kg/s kg/min kg/h kg/d t/min t/h t/d lb/s lb/min lb/h lb/d Programmable unit / s Programmable unit / min Programmable unit / h Programmable unit / d	

Slot number	Parameter	Number	Meaning	Revision
12	Unit Qv (volume)	24 17 138 28 131 19 29 26 15 130 27 22 16 136 23 137 18 30 31 132 133 134 135 245 246 247 248	l/s l/min l/h m3/s m3/min m3/h m3/d ft/s ft/min ft/h ft/d ugl/s ugl/min ugl/h mgl/d igps igpm igph igpd bbl/s bbl/min bbl/h bbl/d Programmable unit / s Programmable unit / min Programmable unit / h Programmable unit / d	
13	Temperature	32 33 35	°C K only °F	
14	Unit Counter Qm	60 61 62 63 244	g kg t lb Programmable unit	
15	Unit Counter Qv	41 43 112 40 42 46 249	l m³ ft³ ugl igl bbl Programmable unit	
20	Flow direction	0 1	Forward Forward//Reverse	
21	Directional display	0 1	Normal Inverse	4

Slot number	Parameter	Number	Meaning	Revision
25	Pulse output	0 1 2	Mass Volume Net mass	5
30	Primary	7 8 9 10 11 12 13 14 15 16 17	Trio 10 C Trio 15 D Trio 20 E Trio 25 F Trio 40 G Trio 50 H Trio 65 I Trio 80 J Trio 100 K Trio 150 L_O Trio 150 L	4
31	EEx protection	0 1	Off On	
35	Language	0 1	German English	
40	Current output 1: Alarm	0 1	High Low	
41	Current output 2: Alarm	0 1	High Low	
42	Current output 1: Output	0 1 2 3 4 5	Qm Qv Density Temperature Concentration Qm concentration	5
43	Current output 2: Output	0 1 2 3 4 5	Qm Qv Density Temperature Concentration Qm concentration	5
48	Contact input	0 1 2 3	No function ext. Zero Return Totalizer reset Concentration table	5

Slot number	Parameter	Number	Meaning		Revision
49	Contact 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		4
95	Operating protection switch	0 1	Not set Set Read only		4
140	Concentration measurement	0 1 255	Off On Code invalid		5
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	5
142	Unit concentration	57 101 240 241	Percent Brix degrees Unit of the variable matrix Baumé degrees Comment: The selectable units depend on the medium (see "Medium")		5
143	Submatrix for calculating concentrations	1 2	Submatrix 1 Submatrix 2		5
144	Submatrix used for calculating concentrations (taking the contact input into account)	1 2	Submatrix 1 Submatrix 2 Read only!		5

Unsigned int variables

2.3.4 COMMAND 130

READ UNSIGNED INT VARIABLE

COMMAND	Description	Revision 4
Request Data Bytes	#0 Slot-Index	
Response Data Bytes	#0 Slot-Index #1 Unit Code #2 … 3 Slot-Data	
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count 6 Transmitter Specific Command Error → Invalid Slot Number 16 Access Restrict	

2.3.5 COMMAND 131

WRITE UNSIGNED INT VARIABLE

COMMAND	Description	Revision 4
Request Data Bytes	#0 Slot-Index #1 Unit Code Slot-Data #2 MSB #3 LSB	
Response Data Bytes	#0 Slot Index #1 Unit Code Slot-Data #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	
Remark	The unit code received by the master is ignored when processing commands and the valid, set unit code is returned with the response.	

2.3.6 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	5
15	Totalizer Qm net overflow > R	Unit None = 250 Read only	5
68	Error log: Number	Unit None = 250 Read only	4
69	Warning register: Number	Unit None = 250 Read only	4
70	Power outage	Unit None = 250 Read only	4

Float variables

2.3.7 COMMAND 132

READ FLOAT VARIABLE

COMMAND	Description	Revision 4
Request Data Bytes	#0 Slot Index	
Response Data Bytes	#0 Slot Index #1 Unit Code #2 … 5 Slot-Data	
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count 6 Transmitter Specific Command Error → Invalid Slot Number 16 Access Restrict	

2.3.8 COMMAND 133

WRITE FLOAT VARIABLE

COMMAND	Description	Revision 4
Request Data Bytes	#0 Slot Index #1 Unit Code #2 … 5 Slot-Data	
Response Data Bytes	#0 Slot Index #1 Unit Code #2 … 5 Slot-Data	
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	
Remark	The unit code received by the master is ignored when processing commands and the valid, set unit code is returned with the response.	

2.3.9 Table of "float"-variables

Slot number	Parameter	Meaning	Revision
0	Mass flow in unit	Process data (cannot be changed)	5
1	Volume flow in unit	Process data (cannot be changed)	5
2	Mass flow in percent	Process data (cannot be changed)	5
3	Density in unit	Process data (cannot be changed)	5
4	Temperature in unit	Process data (cannot be changed)	5
5	Concentration in unit	Process data (cannot be changed)	5
6	Concentration in percent	Process data (cannot be changed)	5
7	Net mass flow in unit	Process data (cannot be changed)	5
8	Current output 1 in unit	Process data (cannot be changed)	5
9	Current output 2 in unit	Process data (cannot be changed)	5
10	Damping	Unit s = 51 Minimum = 1 sec. Maximum = 100 sec.	
20	Factor Unit Qm	Unit Liter = 61 Minimum = 0.00001 kilograms Maximum = 5000000 kilograms	
21	Factor Unit Qv	Unit Liter = 41 Minimum = 0.00001 liter Maximum = 5000000 liter	
25	Pulse output: Qv max.	Unit l/min 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 /g 60 /lb 63 /kg 61 /Prog. Unit 244 /t 62 Minimum = 0.001 / totalizer unit Qm Maximum = 1000 / totalizer unit Qm	
28	Pulse factor Qv	Unit /l 41 /igl 42 /m3 43 /bbl 46 /ft³ 112 /Prog. Unit 249 /ugl 40 Minimum = 0.001 / totalizer unit Qv Maximum = 1000 / totalizer unit Qv	
35	Qm maximal	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 Primary	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 Comment: Qmax meter tube is read only!	
45	Low flow cut off	Unit % = 57 Minimum = 0 % Maximum = 10 %	

Slot number	Parameter	Meaning	Revision
50 60	Current output 1: Low alarm Current output 2: Low alarm	Unit mA = 39 Minimum = 21,0 mA Maximum = 26,0 mA	
51 61	Current output 1: high alarm Current output 2: high alarm	Unit mA = 39 Minimum = 21,0 mA Maximum = 26,0 mA	
52 62	Current output 1: density value at I = 0 % Current output 2: density value at I = 0 %	Unit g/ml 95 g/l 97 g/cm3 91 kg/l 96 kg/m³ 92 lb/ft³ 94 lb/ugl 93 Minimum = Min density (*** 0.00001 g / cm³ … 0.5 g/cm³) Maximum = 3.5 g/cm³ (basic unit)	4
53 63	Current output 1: density value at I = 100 % Current output 2: density value at I = 100 %	Unit g/ml 95 g/l 97 g/cm3 91 kg/l 96 kg/m³ 92 lb/ft³ 94 lb/ugl 93 Minimum = Min density (*** 0.00001 g / cm³ … 0.5 g/cm³) Maximum = 3.5 g/cm³ (basic unit)	

Slot number	Parameter	Meaning				Revision
54 64	Current output 1: Qv max. at I = 100 % Current output 2: Qv max. at I = 100 %	Unit l/min l/min l/h m3/s m3/min m3/h m3/d ft/s ft/min ft/h ft/d ugl/s ugl/min	24 17 138 28 131 19 29 26 15 130 27 22 16	ugl/h mgl/d igps igpm igph igpd bbl/s bbl/min bbl/h bbl/d Prog. unit / s Prog. unit / min Prog. unit / h Prog. unit / d	136 23 137 18 30 31 132 133 134 135 245 246 247 248	
		Minimum = Maximum =		(0.01 * Qmax meter tube) / (max. density (3.5 kg/l)) (Qmax meter tube) / (min. density (0.5 kg/l))		
55 65	Current output 1: temperature value at I = 0 % Current output 2: temperature value at I = 0 %	Unit 32 35 33 Minimum = Maximum =		°C K only °F -50 °C (basic unit) +180 °C (basic unit)		
56 66	Current output 1: temperature value at I = 100 % Current output 2: temperature value at I = 100 %	Unit 32 35 33 Minimum = Maximum =		°C K only °F -50 °C (basic unit) +180 °C (basic unit)		
73 74	Set totalizer net mass > F Set totalizer net mass< R	Unit g kg t lb Minimum = Maximum =	60 61 62 63	Prog. unit 0 (basic unit) 9999999 (basic unit)	244	5
75 76	Set totalizer Qm > V Set totalizer Qm < R	Unit g kg t lb	60 61 62 63	Prog. unit	244	

Slot number	Parameter	Meaning	Revision
77 78	Set totalizer Qv > V Set totalizer Qv < R	Unit l 41 igl 42 m³ 43 bbl 46 ft³ 112 Prog. unit 249 ugl 40 Minimum = 0 (basic unit) Maximum = 9999999 (basic unit)	
79	Unit factor prog. unit Qm (mass)	Unit Progr. unit/s 240 Progr. unit/min 241 Progr. unit/h 242 Progr. unit/d 243 Minimum = 0.00001 kg Maximum = 5,000,000 kg	4
80	Unit factor prog. unit Qv (volume)	Unit Progr. unit/s 245 Progr. unit/min 246 Progr. unit/h 247 Progr. unit/d 248 Minimum = 0,00001 l Maximum = 5000000 l	4
81	D correction	Unit g/ml 95 g/l 97 g/cm3 91 kg/l 96 kg/m³ 92 lb/ft³ 94 lb/ugl 93 Minimum = -50 g/l Maximum = +50 g/l	4
82	Qm correction	Unit % 57 Minimum = -5 % Maximum = +5 %	4
83	System Zero adj.	Unit % 57 Minimum = -10 % Maximum = +10 %	4
84	Min Alarm Qm	Unit % 57 Minimum = 0 % Maximum = 103,125 %	4
85	Max Alarm Qm	Unit % 57 Minimum = 0 % Maximum = 103,125 %	4

Slot number	Parameter	Meaning	Revision
86	Min Alarm	Unit g/ml 95 g/l 97 g/cm3 91 kg/l 96 kg/m³ 92 lb/ft³ 94 lb/ugl 93 Minimum = Min density (*** 0.00001 g / cm³ … Maximum = 0.5 g/cm³) 3.5 g/cm³	4
87	Max Alarm	Unit g/ml 95 g/l 97 g/cm3 91 kg/l 96 kg/m³ 92 lb/ft³ 94 lb/ugl 93 Minimum = Min density (***0.00001 g/ cm³ ... 0.5 g/cm³) Maximum = 3.5 g/cm³	4
88	Min alarm temp	Unit °C 32 K only 33 °F 35 Minimum = -50 °C Maximum = +2000 °C	4
89	Max alarm temp	Unit °C 32 K only 33 °F 35 Minimum = -50 °C Maximum = +200 °C	4
170	Field optimization concentration submatrix 1	Minimum = -1000 Maximum = 1000 Each in selected concentration unit	5
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	5

Slot number	Parameter	Meaning		Revision
173	Max alarm concentration	Variable matrix Sodium hydroxide Alcohol Wheat starch Corn starch Sugar solution	Can be set up to 99999 105 %, 105 Baumé 105 % 105 %, 60 Baumé 105 %, 60 Baumé 105 %, 60 Baumé	5
174	Flow range end value of the net mass flow for the pulse output	Minimum = Maximum =	0.01 * Qmax meter tube Qmax meter tube	5
175	Pulse factor net mass flow	Minimum = Maximum =	0.001 / totalizer unit Qm 1000 / totalizer unit Qm	5
176 179	Current output 1: concentration value at I = 0 % Current output 2: concentration value 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	5
177 180	Current output 1: concentration value at I = 100 % Current output 2: concentration value at I = 100 %	Variable matrix Sodium hydroxide Alcohol Wheat starch Corn starch Sugar solution	Can be set up to 99999 105 %, 105 Baumé 105 % 105 %, 60 Baumé 105 %, 60 Baumé 105 %, 60 Baumé	5
   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	5
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 =	Minimum concentration of the variable matrix 99999	

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

Programmable unit

2.3.10 COMMAND 150

READ PROGRAMMABLE UNIT

COMMAND	Description	Revision 4
Request Data Bytes	#0 Slot Index	
Response Data Bytes	#0 Slot Index #1 … 3 Slot-Data	
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	

2.3.11 COMMAND 151

WRITE PROGRAMMABLE UNIT

COMMAND	Description	Revision 4
Request Data Bytes	#0 Slot Index #1 … 3 Slot-Data	
Response Data Bytes	#0 Slot Index #1 … 3 Slot-Data	
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	
Remark	The unit code received by the master is ignored when processing commands and the valid, set unit code is returned with the response.	

2.3.12 Table of "programmable units"

Slot number	Parameter	Number	Meaning	Revision
0	Prog. Unit Qm	0	Write / read text of programmable unit for Qm	4
1	Prog. Unit Qv	0	Write / read text of programmable unit for Qv	4

String variables

2.3.13 COMMAND 230

READ STRING VARIABLE

COMMAND	Description	Revision 4
Request Data Bytes	#0	Slot Index
Response Data Bytes	#0 #Var.	Slot Index Slot-Data
Response Codes	0 2 5 6 16	No Command Specific Error Invalid Selection → Slot Not Found Incorrect Byte Count Transmitter Specific Command Error → Invalid Slot Number Access Restrict

2.3.14 Table of "string"-variables

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

2.3.15 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	4
Output of pulse output	unsigned char	128	129	25	
Meter tube (2)	unsigned char	128		30	
EEx protection (2)	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: Shown as	unsigned char	128	129	42	
Current output 2: Shown as	unsigned char	128	129	43	
Contact input	unsigned char	128		48	4
Contact output	unsigned char	128	129	49	4
Operating protection switch	unsigned char	128		95	4
Concentration measurement	unsigned char	128	129	140	5
Medium	unsigned char	128	129	141	5
Unit concentration	unsigned char	128	129	142	5
Submatrix for calculating concentrations	unsigned char	128	129	143	5
Submatrix used for calculating concentrations	unsigned char	128		144	5
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 log: Number	unsigned int.	130		68	4
Warning register: Number	unsigned int.	130		69	4
Power outage	unsigned int.	130		70	4
Mass flow in unit	float	132		0	5
Volume flow in unit	float	132		1	5
Mass flow in percent	float	132		2	5
Density in unit	float	132		3	5
Temperature in unit	float	132		4	5
Concentration in unit	float	132		5	5
Concentration in percent	float	132		6	5
Net mass flow in unit	float	132		7	5

Menu title	Variable type	Command		Slot	Revision
		Read	Write		
Current output 1 in unit	float	132		8	5
Current output 2 in unit	float	132		9	5
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 factor Qm (1)	float	132	133	27	
Pulse factor 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	
Current output 1: Low alarm	float	132	133	50	
Current output 2: Low alarm	float	132	133	60	
Current output 1: high alarm	float	132	133	51	
Current output 2: high alarm	float	132	133	61	
Current output 1: density value at I = 0 %	float	132	133	52	
Current output 2: density value at I = 0 %	float	132	133	62	
Current output 1: density value at I = 0 %	float	132	133	53	
Current output 2: density value at I = 0 %	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	
Current output 1: temperature value at I = 0 %	float	132	133	55	
Current output 2: temperature value at I = 0 %	float	132	133	65	
Current output 1: temperature value at I = 100 %	float	132	133	56	
Current output 2: temperature value at I = 100 %	float	132	133	66	

Menu title	Variable type	Command		Slot	Revision
		Read	Write		
Set totalizer net mass > F	float	132	133	73	5
Set totalizer net mass< R	float	132	133	74	5
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	5
Field optimization concentration submatrix 2	float	132	133	171	5
Min alarm concentration	float	132	133	172	5
Max alarm concentration	float	132	133	173	5
Flow range end value of the net mass flow for the pulse output	float	132	133	174	5
Pulse factor net mass flow	float	132	133	175	5
concentration value Current output 1 at I = 0 %	float	132	133	176	5
concentration value Current output 1 at I = 100 %	float	132	133	177	5
Flow range end value net mass flow Current output 1 at I = 100 %	float	132	133	178	5
concentration value Current output 2 at I = 0 %	float	132	133	179	5
concentration value Current output 2 at I = 100 %	float	132	133	180	5
Flow range end value net mass flow Current output 2 at I = 100 %	float	132	133	181	5
Minimum concentration of the copy of the variable matrix	float	132	133	182	5
Maximum concentration of the copy of the variable matrix	float	132	133	183	5

Remarks:

1. In addition to the "standard" dependencies (meter tube → Qmax meter tube, etc.), if changes are made to the "pulse width", "pulse factors", "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.
2. Enter the service code number in order to make a change.

2.4 Other commands which can be used by customers

This section lists all other commands which are not universal, common practice, or slot commands.

2.4.1 COMMAND 140

CLEAR Qm TOTALIZER > F AND OVERFLOW > F

COMMAND	Description	Revision 4
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

CLEAR Qm TOTALIZER < R AND OVERFLOW < R

COMMAND	Description	Revision 4
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

CLEAR Qm OVERFLOW > F

COMMAND	Description	Revision 4
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

CLEAR Qm OVERFLOW < R

COMMAND	Description	Revision 4
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

CLEAR Qv TOTALIZER > F AND OVERFLOW > F

COMMAND	Description	Revision 4
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

CLEAR Qv TOTALIZER < R AND OVERFLOW < R

COMMAND	Description	Revision 4
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

CLEAR Qv OVERFLOW > F

COMMAND	Description	Revision 4
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

CLEAR Qv OVERFLOW < R

COMMAND	Description	Revision 4
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 TOTALIZER Qm and Qv AND, if necessary, Qnm

COMMAND	Description	Revision 5
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 4
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	4
1	Start fast automatic system zero point adjustment	4

2.4.12 Matrix configuration

2.4.12.1 COMMAND 190

READ MATRIX CONFIGURATION

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

2.4.12.2 COMMAND 191

WRITE MATRIX CONFIGURATION

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

2.4.12.3 Table of slot indices for the matrix configuration

Slot number	Meaning	Access	Revision
0	Variable matrix	Read	5
4	Copy of the variable matrix	Read and write	5
8	Sodium hydroxide	Read	5
12	Alcohol in water	Read	5
16	Wheat starch	Read	5
20	Corn starch	Read	5
24	Sugar in water	Read	5

2.4.13 Float array

2.4.13.1 COMMAND 192

READ ELEMENTS OF A FLOAT ARRAY

COMMAND	Description	Revision 5
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 Comment: If fewer than five floats are requested, the frame is filled to five floats with the value "zero" (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	

2.4.13.2 COMMAND 193

WRITE ELEMENTS OF A FLOAT ARRAY

COMMAND	Description	Revision 5
Request 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
		Comment: If fewer than five floats are requested, the frame is filled to five floats with the value "zero" (constant frame length).
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
		Comment: If fewer than five floats are requested, the frame is filled to five floats with the value "zero" (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

2.4.14 Table of slot indices for reading and writing float arrays

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

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

2.4.15 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

2.4.15.1 COMMAND 194

READ ELEMENTS OF A STATUS ARRAY

COMMAND	Description	Revision 5
Request Data Bytes	#0 Slot Index #1 Offset #2 Number of Statuses to Be Read Comment: If fewer than 20 statuses are requested, the frame is filled to 20 statuses with the value "255" (constant frame length).	
Response Data Bytes	#0 Slot Index #1 Offset #2 Number of Statuses to Be Read #3 … 22 Statuses 1 to 20 Comment: If fewer than 20 statuses are requested, the frame is filled to 20 statuses with the value "255" (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	

2.4.15.2 COMMAND 195

WRITE ELEMENTS OF A STATUS ARRAY

COMMAND	Description	Revision 5
Request Data Bytes	#0 #1 #2 #3 … 22	Slot Index Offset Number of Statuses to Be Written Statuses 1 to 20 Comment: If fewer than 20 statuses are requested, the frame is filled to 20 statuses with the value "255" (constant frame length).
Response Data Bytes	#0 #1 #2 #3 … 22	Slot Index Offset Number of Statuses to Be Read Statuses 1 to 20 Comment: If fewer than 20 statuses are requested, the frame is filled to 20 statuses with the value "255" (constant frame length).
Response Codes	0 2 3 5 16	No Command Specific Error Invalid Selection → Slot Not Found or Status Is Not 0, 1, or 2 Parameter Too Large (Number of Statuses Too Large and / or Offset Plus Number Greater Than Overall Length) Incorrect Byte Count Access Restrict

2.4.16 Table of slot indices for reading and writing status arrays

Slot number	Meaning	Access	Revision
0	Variable matrix	Read	5
4	Copy of the variable matrix	Read and write	5

2.4.17 COMMAND 196

CALCULATE DENSITY VALUES OF THE COPY OF THE VARIABLE MATRIX

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

2.4.18 COMMAND 197

MATRIX INPUT END

COMMAND	Description	Revision 5
Request Data Bytes	#0	Action 1 : Check and, if Required, Save Matrix Data Other value: Reject changes. Copy of the variable matrix is overwritten with data from the variable matrix
Response Data Bytes	#0 #1	Action Error code 0 Action OK 1 Temperature Not Increasing 2 Concentration in Unit Not Increasing or Decreasing 3 Concentration in Percent Not Increasing or Decreasing 4 Density Not Increasing 5 Non-Calculated Density Values Are Present An error is assigned to a submatrix by adding 0 x 50 for submatrix 1 and 0 x 60 for submatrix 2. Example: Error code 0 x 64 indicates density values which are not increasing in submatrix 2.
Response Codes	0 5 16	No Command Specific Error Incorrect Byte Count Access Restrict

2.4.19 COMMAND 200

CLEAR NET MASS TOTALIZER > F AND OVERFLOW > F

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

2.4.20 COMMAND 201

CLEAR NET MASS TOTALIZER < R AND OVERFLOW < R

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

2.4.21 COMMAND 202

CLEAR NET MASS OVERFLOW > F

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

2.4.22 COMMAND 203

CLEAR NET MASS OVERFLOW < R

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

2.4.23 COMMAND 208

READ DENSIMASS CODE

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

2.4.24 COMMAND 209

WRITE DENSIMASS CODE

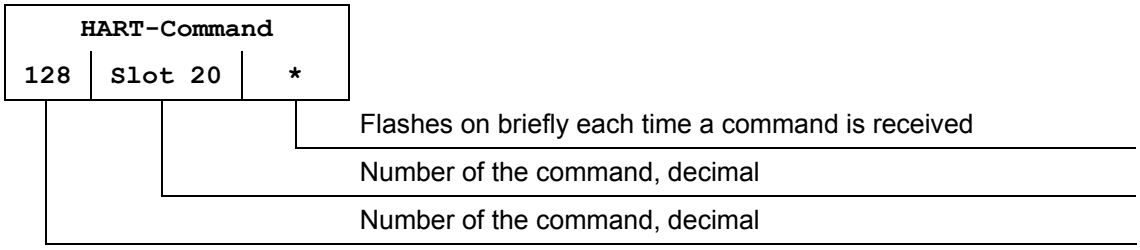
COMMAND	Description	Revision 5
Request Data Bytes	#0 … 3 DensiMass Code Minimum value: 0 Maximum value: 9999999	
Response Data Bytes	#0 … 3 DensiMass-Code	
Response Codes	0 No Command Specific Error 3 Parameter Too Large 4 Parameter Too Small 5 Incorrect Byte Count 16 Access Restrict	

3 Sources of error for HART

If HART communication does not work, check the following:

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 unit address in the Interface menu

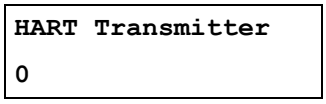
If the above conditions have been met and HART communication still does not work, the next thing to check is the reception. The "Self Check" submenu contains the function "HART Command":



If nothing appears here, the reception is not working properly. In this case, you should 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 (handheld communicator, for example) still reports errors, the transmitter's sending procedure should be checked by means of an oscilloscope. This can be done using the "HART Transmitter" self-check function:



The transmitter sends a logical 0 (= 2,200 Hz) when this function is called, and a logical 1 (= 1,200 Hz) when a button is pressed.

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

4 Concentration matrix

There follows 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. unit B 1	Concentr. unit A 1	Density 1,1	…	Density N, 1
…	…		…	…	
Concentr. percent M	Concentr. unit B M	Concentr. unit A M	Density 1, M		Density N, M

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

- should be entered,
- should be calculated, or
- 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 array:

Temp1 … Temp N, 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 "Concentr. percent" are used to calculate the net mass flow and the concentration in percent. Space is always reserved for the "Concentr. percent" column, 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.

ABB has Sales & Customer Support expertise in over 100 countries worldwide.

www.abb.com/flow

The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

Printed in the Fed. Rep. of Germany (09.2009)

D184B108U08 Rev. 05

ABB Limited
Oldends Lane, Stonehouse
Gloucestershire, GL10 3TA
UK
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671

ABB Inc.
125 E. County Line Road
Warminster, PA 18974
USA
Tel: +1 215 674 6000
Fax: +1 215 674 7183

ABB Automation Products GmbH
Dransfelder Str. 2
37079 Goettingen
Germany
Tel: +49 551 905-534
Fax: +49 551 905-555
CCC-support.deapr@de.abb.com