Interface Description
HART-Protocol 5.0
D184B126U02.

Electromagnetic Flowmeter FSM4000

Valid for software levels from C.10
Model FSM4000-S4

HART COMMUNICATION PROTOCOL

ABB

Electromagnetic Flowmeter
FSM4000-S4

Interface description HART-Protocol 5.0

D184B126U02

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Table of contents:

1 Introduction

This overview lists all the available HART-Commands. It includes both the Universal and Common Practice Commands as well as those Special Commands which contain Slot- or other commands. This documentation applies to the following Software Versions:

C.10 to C.19

2 Hart Commando Overview

2.1 Universal Commands

2.1.1 Command 0

Read Transmitter Unique Identifier

Command 0	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			
Response Data Bytes	Device Type Code for Expansion = 254	#0	1	USIGN8
	Manufacturer Identification Code = 26	#1	1	USIGN8
	Manufacturer Device Type = 1D	#2	1	USIGN8
	Number of Request Preambles = 5	#3	1	USIGN8
	Revision Level of Universal Command = 5	#4	1	USIGN8
	Revision Level of Transmitter Document = 0	#5	1	USIGN8
	Software Revision Level = 1	#6	1	USIGN8
	Hardware Revision Level = 0	#7	1	USIGN8
	Flags, none defined at this time = 0	#8	1	USIGN8
	Device Identification Number = 24 Bit, MSB	#9	1	USIGN8
	Device Identification Number = 24 Bit, LSB	#10	1	USIGN8
	Device Identification Number = 24 Bit enhanced	#11	1	USIGN8
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.2 Command 1

Read Primary Variable

Command 1	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			
Response Data Bytes	Primary Variable Unit Code = Unit of Q	#0	1	USIGN8
	Primary Variable [Q in Unit]	#1...4	4	FLOAT
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.3 Command 2

Read Current and Percent of Range

Command 2	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			
Response Data Bytes	Analog Output Current mA [Iout without Unit]	#0...3	4	FLOAT

Command 2	**Mnemonic**	**Offset**	**Size**	**Datatype**
	Percent of Range [Q in Prozent]	#4...7	4	FLOAT
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.4 Command 3

Read all dynamic Variables and Current

Command 3	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			
Response Data Bytes	Analog Output Current [Iout]	#0...3	4	FLOAT
	Primary Variable Unit Code Primary Variable[Q in Unit]	#4 #5...8	5	FLOAT
	Secondary Variable Unit Code Secondary Variable [Counter Forward]	#9 #10...13	5	FLOAT
	Tertiary Variable Unit Code (Table 2) Tertiary Variable [Counter Reverse]	#14 #15...18	5	FLOAT
	4th Variable Unit Code 4th Variable [Counter Differenz]	#19 #20...23	5	FLOAT
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.5 Command 6

Write Polling Address

Command 6	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	Polling Adress of Device	#0	1	USIGN8
Response Data Bytes	Polling Adress of Device	#0	1	USIGN8
Response Code	0 “No Command Specific Error” 2 “Invalid Selection” 5 “Incorrect Byte Count”			

2.1.6 Command 11

Read Unique Identifier Associated With Tag

Command 11	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	Tag	#0	6	PACKED ASCII
Response Data Bytes	Device Type Code for Expansion = 254	#0	1	USIGN8
	Manufacturer Identification Code = 26	#1	1	USIGN8
	Manufacturer Device Type = 1D	#2	1	USIGN8
	Number of Request Preambles = 8	#3	1	USIGN8
	Revision Level of Universal Command = 5	#4	1	USIGN8
	Revision Level of Transmitter Document = 0	#5	1	USIGN8

Command 11	**Mnemonic**	**Offset**	**Size**	**Datatype**
	Software Revision Level = 1	#6	1	USIGN8
	Hardware Revision Level = 0	#7	1	USIGN8
	Flags, none defined at this time = 0	#8	1	USIGN8
	Device Identification Number = 24 Bit, MSB	#9	1	USIGN8
	Device Identification Number = 24 Bit, LSB	#10	1	USIGN8
	Device Identification Number= 24 Bit enhanced	#11	1	USIGN8
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.7 Command 12

Read Message

Command 12	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			
Response Data Bytes	Hart Message	#0...23	24	PACKED ASCII
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.8 Command 13

Read Tag, Descriptor, Date

Command 13	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			
Response Data Bytes	Hart Tag	#0...5	6	PACKED ASCII
	Hart Descriptor	#6...17	12	PACKED ASCII
	Hart Day	#18	1	USIGN8
	Hart Month	#19	1	USIGN8
	Hart Year	#20	1	USIGN8
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.9 Command 14

Read Primary Variable Sensor Information

Command 14	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			
Response Data Bytes	Sensor Serial Number = 0	#0..#2	3	USIGN16
	Sensor Limits/Min Span Units = Unit of Q	#1	1	USIGN8

Command 14	**Mnemonic**	**Offset**	**Size**	**Datatype**
	Upper Sensor Limit = Qmax DN	#3...7	5	FLOAT
	Lower Sensor Limit = 0	#8...11	4	FLOAT
	Minimum Span =0.05 * Qmax DN ???	#12...15	4	FLOAT
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.10 Command 15

Read Primary Variable Output Information

Command 15	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			
Response Data Bytes	Alarm Select Code => Low = 0, High = 1	#0	1	USIGN8
	Primary Variable Transfer Function = Hart Pv Transfer Function = 0	#1	1	USIGN8
	Primary Variable Range Values Units Primary Variable Upper Range Value = Qmax	#2 #3...6	1 4	USIGN8 FLOAT
	Primary Variable Lower Range Value Hart Pv Lower Range Value = 0	#7...10	4	FLOAT
	Primary Variable Damping Value = Damping	#11...14	4	FLOAT
	Write Protect Code = Hart Write Protect = 251	#15	1	USIGN8
	Private Label Distributor Code = Hart Private Label Distributor = 26	#16	1	USIGN8
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.11 Command 16

Read Final Assembly Number

Command 16	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			
Response Data Bytes	Hart Final Assembly Number	#0...2	3	STRINGV
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.12 Command 17

Write Message

Command 17	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	Hart Message	#0...23	24	PC ASCII
Response Data Bytes	Hart Message	#0...23	24	PC ASCII

Command 17	**Mnemonic**	**Offset**	**Size**	**Datatype**
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.13 Command 18

Write Tag, Descriptor, Date

Command 18	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	Tag = Hart Tag	#0...5	6	PC ASCII
	Descriptor = Hart Descriptor	#6...17	12	PC ASCII
	Day = Hart Date Day	#18	1	USIGN8
	Month = Hart Date Month	#19	1	USIGN8
	Year = Hart Date Year	#20	1	USIGN8
Response Data Bytes	Tag = Hart Tag	#0...5	6	PC ASCII
	Descriptor = Hart Descriptor	#6...17	12	PC ASCII
	Day = Hart Date Day	#18	1	USIGN8
	Month = Hart Date Month	#19	1	USIGN8
	Year = Hart Date Year	#20	1	USIGN8
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.1.14 Command 19

Write Final Assembly Number

Command 19	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	Final Assembly Number	#0...2	3	STRINGV
Response Data Bytes	Final Assembly Number	#0...2	3	STRINGV
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.2 Common Practice

2.2.1 Command 33

Read Transmitter Variables

In this Command it is possible to request with one of the four Slots numbers two, tree or four. It is possible to request four times with the same slot number or with different slot numbers.
When a Device Variable requested is not supported in the Field Device, then the corresponding Value must be set to “0x7F,0xA0,0x00,0x00”and the Units Code must be set to “250”,Not Used.

Command 33	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	0 0,1 0,1,2 0,1,2,3	Transmitter Variable Transmitter Variable Transmitter Variable Transmitter Variable		1 2 3 4	
Response Data Bytes	0	Slot Number = 0		1	USIGN8
		Unit Code von Q in Unit		1	USIGN8
		Slot #0 Variable = Q in Unit		4	FLOAT
	1	Slot Number = 1		1	USIGN8
		Unit Code von Zähler Vorlauf		1	USIGN8
		Slot #0 Variable = Zähler Vorlauf		4	FLOAT
	2	Slot Number = 2		1	USIGN8
		Unit Code von Zähler Rücklauf		1	USIGN8
		Slot #0 Variable = Zähler Rücklauf		4	FLOAT
	3	Slot Number = 3		1	USIGN8
		Unit Code von Zähler Differenz		4	FLOAT
		Slot #0 Variable = Zähler Differenz			
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”				

2.2.2 Command 34

Write Primary Variable Damping Value

Command 34	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	Damping Value = Damping	#0...3	4	FLOAT
Response Data Bytes	Actual Damping Value = Damping	#0...3	4	FLOAT
Response Code	0 “No Command Specific Error” 3 “Passed Parameter to Large” 4 “Passed Parameter to Small” 5 “Incorrect Byte Count”			

2.2.3 Command 35

Write Primary Variable Range Values

Command 35	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	PV Upper and Lower Range Values Units Code, Primary Variable Upper Range Value = Qmax Primary Variable Lower Range Value = 0	#0 #1..#4 #5..#8	1 4 4	USIGN8 FLOAT FLOAT
Response Data Bytes	PV Upper and Lower Range Values Units Code Primary Variable Upper Range Value = Qmax Primary Variable Lower Range Value = 0	#0 #1..#4 #5..#8	1 4 4	USIGN8 FLOAT FLOAT
Response Code	0 "No Command Specific Error" 5 "Incorrect Byte Count" 11 "Upper Range Value too High" 12 "Upper Range Value too Low" 13 "Upper and Lower Range Value out of Limits"			

2.2.4 Command 38

Reset Configuration Changed Flag

Command 38	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			VOID
Response Data Bytes	None			VOID
Response Code	0 "No Command Specific Error" 5 "Incorrect Byte Count"			

2.2.5 Command 40

Enter/Exit Primary Variable Current Mode

If Primary Variable = 0 Simulation of Current Level stopped.

Command 40	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	Fixed Primary Variable Current Level	#0...3	4	FLOAT
Response Data Bytes	Actual Fixed Primary Variable Current Level	#0...3	4	FLOAT
Response Code	0 "No Command Specific Error" 3 "Passed Parameter to Large" 4 "Passed Parameter to Small" 5 "Incorrect Byte Count"			

2.2.6 Command 44

Write Primary Variable Units

Command 44	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	Primary Variable Unit Code	#0	1	USIGN8
Response Data Bytes	Primary Variable Unit Code	#0	1	USIGN8
Response Code	0 “No Command Specific Error” 2 “Invalid Selection” 5 “Incorrect Byte Count”			

2.2.7 Command 45

Trim Primary Variable Current DAC Zero

Command 45	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	Externally Measured Primary Variable Current Level (4 mA Trim)	#0...3	4	FLOAT
Response Data Bytes	Actual Measured Primary Variable Current Level (4 mA Trim)	#0...3	4	FLOAT
Response Code	0 “No Command Specific Error” 3 “Passed Parameter to Large (> 5mA)” 4 “Passed Parameter to Small (< 3mA)” 5 “Incorrect Byte Count” 9 “Not in Proper Current Mode”			

2.2.8 Command 46

Trim Primary Variable Current DAC Gain

Command 46	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	Externally Measured Primary Variable Current Level (20 mA Trim)	#0...3	4	FLOAT
Response Data Bytes	Actual Measured Primary Variable Current Level (20 mA Trim)	#0...3	4	FLOAT
Response Code	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”			

2.2.9 Command 48

Read Additional Transmitter Status

Command 48	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			
Response Data Bytes	Device Specific Status 4 Byte Aktuelle Fehler (siehe Kapitel 4.2)	#0...3	4	STRINGV
	Device Specific Status 2 Byte MU Status Register(siehe Kapitel 4.4)	#4...5	2	USIGN32
	Extended Device Status = 0	#6	1	USIGN8
	Device Operating Mode = 0	#7	1	USIGN8
	Reserved = 0	#8...9	2	USIGN16
	Reserved = 0	#10...11	2	USIGN16
	Reserved = 0	#12...13	2	USIGN16
	Device Specific Status = 4 Byte Aktuelle Warnungen (siehe Kapitel 4.3)	#14...17	4	STRINGV
	Device Specific Status = Not used	#18...19	2	USIGN16
	4 Byte Alte Fehler (siehe Kapitel 4.2)	#20...23	4	USIGN32
	Reserved = 0	#24	1	USIGN8
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

Please find detailed descriptions of the error register in the paragraph 5.2.1, to the warning register in 5.2.2 and to the status register in 5.2.3.

2.3 Slot Commands

The converter parameter can be divided into three groups:

unsigned char-Variables
: Parameter in Menus with selection tables are stored as "unsigned char" variables, e.g. Language:
German = 0
English = 1

unsigned int-Variables
: Certain numeric values which occur only as integers are stored as "unsigned int" variables, e.g. Instrument Number.

float-Variables
: The remaining values are stored as float (IEEE 754) variables, e.g. Damping.

The individual Read- and Write Commands for the three groups are listed in the following tables together with their corresponding parameters.

2.3.1 Command 128 (Read Unsigned Char)

Read unsigned-char-Variable

Command 128	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	#0 Slot Index	#0	1	USIGN8
Response Data Bytes	#0 Slot Index #1 Inhalt des Slot	#0 #1	1 1	USIGN8 USIGN8
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count”			

2.3.2 Command 129 (Write Unsigned Char)

Write unsigned-char-Variable

Command 129	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	#0 Slot Index #1 Inhalt des Slot	#0 #1	1 1	USIGN8 USIGN8
Response Data Bytes	#0 Slot Index #1 Inhalt des Slot	#0 #1	1 1	USIGN8 USIGN8
Response Code	0 “No Command Specific Error” 2 “Invalid Selection -> wrong Slotnumber 3 “Passed Parameter to Large” 4 “Passed Parameter to Small” 5 “Incorrect Byte Count”			

2.3.3 Table of Unsigned char Variables (Command 128 / 129)

Command 128 Command 129	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 128 Write 129	0	Language	#1	1	USIGN8 0 : German 1 : English 2 : French 3 : Finish 4 : Spanish 5 : Italian 6 : Dutch 7 : Danish 8 : Swedish 9 : Turkish
Read 128	1	Meter size	#1	1	USIGN8 43 : 1 mm 1/25 in 44 : 1,5 mm 1/17 in 45 : 2 mm 1/12 in 0 : 3 mm 1/10 in 1 : 4 mm 5/32 in 2 : 6 mm 1/4 in 3 : 8 mm 5/16 in 4 : 10 mm 3/8 in 5 : 15 mm 1/2 in 6 : 20 mm 3/4 in 7 : 25 mm 1 in 8 : 32 mm 1-1/4 in 9 : 40 mm 1-1/2 in 10 : 50 mm 2 in 11 : 65 mm 2-1/2 in 12 : 80 mm 3 in 13 : 100 mm 4 in 14 : 125 mm 5 in 15 : 150 mm 6 in 16 : 200 mm 8 in 17 : 250 mm 10 in 18 : 300 mm 12 in 19 : 350 mm 14 in 20 : 400 mm 16 in 21 : 450 mm 18 in 22 : 500 mm 20 in 23 : 600 mm 24 in 24 : 700 mm 28 in 25 : 750 mm 30 in 26 : 800 mm 32 in 27 : 900 mm 36 in 28 : 1000 mm 40 in

Command 128 Command 129	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 128 Write 129	3	Flow Unit Qmax	#1	1	USIGN8 24 : l/s 17 : l/min 138: l/h 28 : m3/s 131: m3/min 19 : m3/h 29 : m3/d 22 : usgps 16 : usgpm 136: usgph 23 : usmgd 137: igps 18 : igpm 30 : igph 31 : igpd 132: bbl/s 133: bbl/m 134: bbl/h 135: bbl/d 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 245: ml/s 246: ml/min 240: Prog.Unit/sec 241: Prog.Unit/min 242: Prog.Unit/h 243: Prog.Unit/Day
Read 128 Write 129	4	Flow Unit Totalizer	#1	1	USIGN8 247: ml 41 : l 43 : m3 40 : ugl 42 : igl 46 : bbl 60 : g 61 : kg 62 : t 63 : lb 244: Prog.Unit

Command 128 Command 129	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 128 Write 129	5	Density, when mass flow units or Totalizer mass units are selected	#1	1	USIGN8 0 : with Density 1 : without Density
Read 128 Write 129	6	Contact Output	#1	1	USIGN8 0 : No Function 1 : F/R-Signal /_ 13 : F/R-Signal __ 4 : General-Alarm /_ 5 : General-Alarm __ 6 : Max/Min Alarm/_ 7 : Max/Min Alarm __ 8 : Min Alarm /_ 9 : Min Alarm __ 10 : Max Alarm /_ 11 : Max Alarm __ 2 : Empty Pipe /_ 1) 3 : Empty Pipe __ 1) 14 : Ext..Diag Alarm /_ 15 : Ext..Diag Alarm __
Read 128 Write 129	7	Contact Input	#1	1	USIGN8 0 : No Function 2 : Totalizer Reset 1 : Ext. Zero Return. 3 : Ext. System Zero
Read 128 Write 129	9	Iout Alarm	#1	1	USIGN8 1 : Low Alarm 0 : High Alarm
Read 128 Write 129	13	ON/OFF Detector Empty Pipe (DEP)	#1	1	USIGN8 0 : Off 1 : On
Read 128 Write 129	14	Alarm Empty Pipe	#1	1	USIGN8 0 : Off 1 : On
Read 128 Write 129	15	Iout Empty Pipe	#1	1	USIGN8 0 : High Alarm 1 : Low Alarm 2 : 0%
Read 128 Write 129	16	Q Simulation On/Off	#1	1	USIGN8 0 : Off 1 : On
Read 128 Write 129	17	Test Mode On/Off	#1	1	USIGN8 0 : Off 1 : On

1) Only if the Detector Empty Pipe is switched ON
2) Only if 4 small lines selected

Command 128 Command 129	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 128 Write 129	19	Display 1st line	#1	1	USIGN8 0 : Q [Percent] 1 : Q [Unit] 2 : Iout [mA] 3 : Q [m/s] 4 : Q Bargraph 5 : Totalizer 6 : Totalizer ->F 7 : Totalizer <-R 8 : Totalizer Diff. 9 : HART TAG 10 : Detector e.Pipe 11 : Blank line 24 : Fprt1 2) 25 : Fprt2 2) 26 : Fprt3 2) 27 : Fprt4 2) 28 : Hist Max Error 2) 29 : Hist Min Error 2) 30 : Cur Max Error 2) 31 : Cur Min Error 2) 32 : Cur Max Warn 2) 33 : Cur Min Warn 2) 34 : Wiring Warning 2) 2) with extended Diagnostic only (see slot 130)

Command 128 Command 129	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 128 Write 129	20	Display 2nd line	#1	1	USIGN8 0 : Q [Percent] 1 : Q [Unit] 2 : Iout [mA] 3 : Q [m/s] 4 : Q Bargraph 5 : Totalizer 6 : Totalizer ->F 7 : Totalizer <-R 8 : Totalizer Diff. 9 : HART TAG 10 : Detector e.Pipe 11 : Blank line 24 : Fprt1 2) 25 : Fprt2 2) 26 : Fprt3 2) 27 : Fprt4 2) 28 : Hist Max Error 2) 29 : Hist Min Error 2) 30 : Cur Max Error 2) 31 : Cur Min Error 2) 32 : Cur Max Warn 2) 33 : Cur Min Warn 2) 34 : Wiring Warning 2) 2) with extended Diagnostic only (see slot 130)

Command 128 Command 129	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 128 Write 129	21	Display 3rd line	#1	1	USIGN8 0 : Q [Percent] 1 : Q [Unit] 2 : Iout [mA] 3 : Q [m/s] 4 : Q Bargraph 5 : Totalizer 6 : Totalizer ->F 7 : Totalizer <-R 8 : Totalizer Diff. 9 : HART TAG 10 : Detector e.Pipe 11 : Blank line 24 : Fprt1 2) 25 : Fprt2 2) 26 : Fprt3 2) 27 : Fprt4 2) 28 : Hist Max Error 2) 29 : Hist Min Error 2) 30 : Cur Max Error 2) 31 : Cur Min Error 2) 32 : Cur Max Warn 2) 33 : Cur Min Warn 2) 34 : Wiring Warning 2) 2) with extended Diagnostic only (see slot 130)

Command 128 Command 129	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 128 Write 129	22	Display 4th line	#1	1	USIGN8 0 : Q [Percent] 1 : Q [Unit] 2 : Iout [mA] 3 : Q [m/s] 4 : Q Bargraph 5 : Totalizer 6 : Totalizer ->F 7 : Totalizer <-R 8 : Totalizer Diff. 9 : HART TAG 10 : Detector e.Pipe 11 : Blank line 24 : Fprt1 2) 25 : Fprt2 2) 26 : Fprt3 2) 27 : Fprt4 2) 28 : Hist Max Error 2) 29 : Hist Min Error 2) 30 : Cur Max Error 2) 31 : Cur Min Error 2) 32 : Cur Max Warn 2) 33 : Cur Min Warn 2) 34 : Wiring Warning 2) 2) with extended Diagnostic only (see slot 130)
Read 128 Write 129	23	Operating Mode	#1	1	USIGN8 0 : Standard 1 : Piston Pump 2 : Fast
Read 128 Write 129	24	Flow indication	#1	1	USIGN8 0 : Forward/Reverse 1 : Forward
Read 128 Write 129	25	Flow direction	#1	1	USIGN8 0 : Standard 1 : Invers
Read 128	30	Primary Type	#1	1	USIGN8 0 : SE2_,SE4_ 1 : DS2_ 2 : DS4_ 3 : 10DS3111 (A-C) 4 : 10DS3111 (E-) 5 : 10D1422 6 : 10DI1425 7 : 10DS3111 D 8 : non 9 : 10D1462/72 10 : SE21_50Hz

Command 128 Command 129	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 128	31	Primary Excitation Frequency	#1	1	USIGN8 0 : Primary 70Hz 1 : Primary 50Hz 2 : Primary 60Hz 3 : Primary SE 50Hz
Read 128 Write 129	32	Hart Polling Address	#1	1	USIGN8
Read 128 Write 129	33	Display Mode	#1	1	USIGN8 0 : 1 big, 1 small 1 : 4 small
Read 128 Write 129	34	Display Contrast	#1	1	USIGN8
Read 128	35	HART Communication With/Without	#1	1	USIGN8 0 : Without 1 : HART
Read 128 Write 129	36	Driver	#1	1	USIGN8 0 : Control Loop 1 : Fixed
Read 128	37	Order Variant	#1	1	USIGN8
Read 128 Write 129	38	Main Frequency	#1	1	USIGN8 0 : 50 Hz 1 : 60 Hz 2 : 70 Hz
Read 128	39	Startup communication of service port connector	#1	1	USIGN8 0 : START-HART-TTL 1 : START-TERMI.-TTL
Read 128 Write 129	40	Function Test Pulse Output ON/OFF	#1	1	USIGN8 0 : Off 1 : On
Read 128	41	Current Output	#1	1	USIGN8 0 : 0-20 mA 1 : 4-20 mA 2 : 0-10 mA 3 : 2-10 mA
Read	42	Communication Service Connector	#1	1	USIGN8 0 : HART-TTL 1 : TERMINAL-TTL 2 : Display on
Read 128	43	Kind of puls output	#1	1	USIGN8 0 : active 1 : passiv

Command 128 Command 129	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 128	44	Actual Variant	#1	1	USIGN8 0 : Puls active w/o HART 1 : Puls active with HART 2 : Puls passive w/o HART 3 : Puls passive with HART 4 : Error variant 5 : Puls activ w/o HART CHW 6 : Puls active with HART CHW 7 : Puls passive w/o HART CHW 8 : Puls passive with HART CHW
Read 128 Write 129	45	Function Test Contact Input	#1	1	USIGN8 0 : OFF 1 : ON
Read 128 Write 129	46	Function Test Contact Output	#1	1	USIGN8 0 : OFF 1 : ON
Read 128 Write 129	47	DEP Modus	#1	1	USIGN8 0 : Standard 1 : New Adjust
Read 128 Write 129	50	Noise reduction	#1	1	USIGN8 0 : Noise reduction Off 1 : Noise reduction 1 2 : Noise reduction 2 3 : Noise reduction 3 4 : Noise reduction 4
Read 128 Write 129	51	Error 4 mask	#1	1	USIGN8 0 : Off 1 : On
Read 128 Write 129	52	Error 3 mask	#1	1	USIGN8 0 : Off 1 : On
Read 128 Write 129	128	Start Diagnostic measurement	#1	1	USIGN8 0 : Manual 1 : 10 s 2 : 60 s 3 : 10 min 4 : 60 min 5 : 6 h 6 : 12 h 7 : 24 h 8 : 7 d
Read 128	130	Diagnostic	#1	1	USIGN8 0 : Extended Diag. 1 : No extend..Diag.

2.3.4 Command 130 (Read Unsigned Integer)

Read Unsigned Integer Variables

Command 130	Mnemonic	Offset	Size	Datatype
Request Data Bytes	Slot Index	#0	1	USIGN8
Response Data Bytes	Slot Index Content of the Slot	#0 #1	1 2	USIGN8 USIGN16
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count”			

2.3.5 Command 131 (Write Unsigned Integer)

Write Unsigned Integer Variables

Command 131	Mnemonic	Offset	Size	Datatype
Request Data Bytes	Slot Number Content of the Slots	#0 #1	1 2	USIGN8 USIGN16
Response Data Bytes	Slot Index Content of the Slot	#0 #1	1 2	USIGN8 USIGN16
Response Code	0 “No Command Specific Error” 2 “Invalid Selection -> false Slotnumber” 3 “Passed Parameter to Large” 4 “Passed Parameter to Samll” 5 “Incorrect Byte Count”			

2.3.6 *Table of Unsigned Integer Variables (Command 130 / 131)*

Command 130 Command 131	Slot	Mnemonic	Offset	Size	Datatype
Read 130 Write 131	3	Overflow Totalizer Forward	#1...2	2	USIGN16
Read 130 Write 131	4	Overflow Totalizer Reverse	#1...2	2	USIGN16
Read 130	5	Counter Mains Interrupt	#1...2	2	USIGN16
Read 130 Write 131	6	Service Code	#1...2	2	USIGN16 Low Limit: 0 High Limit :9999
Read 130	7	Instrument number	#1...2	2	USIGN16
Read 130	8	Driver Controller DAC	#1...2	2	USIGN16 Low Limit: 0 High Limit :1023
Read 130	11	Min Dac Amplitude	#1...2	2	USIGN16 Low Limit: 0 High Limit :1023

Command 130 Command 131	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 130	12	Max Dac Amplitude	#1...2	2	USIGN16 Low Limit: 0 High Limit :1023
Read 130	13	Test rig Number	#1...2	2	USIGN16 Low Limit: 0 High Limit :9999
Read 130	14	Status	#1...2	2	USIGN16
Read 130	16	Prog. Code	#1...2	2	USIGN16 Low Limit: 0 High Limit :9999
Read 130 Write 131	18	Totalizer Overflow Difference	#1...2	2	INT16
Read 130	19	Driver Controller DAC	#1...2	2	USIGN16 Low Limit: 0 High Limit :1023
Read 130	20	Noise voltage Reset ON	#1...2	2	USIGN16 Low Limit: variable Limit High Limit :32767
Read 130	21	Noise voltage Reset Off	#1...2	2	USIGN16 Low Limit: 500 High Limit: variable Limit

2.3.7 Command 132 (Read Float)

Read float-Variable

Command 132	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	#0 Slot Number	#0	1	USIGN8
Response Data Bytes	Slot Index Unit Content of the Slot	#0 #1 #2..5	1 1 4	USIGN8 USIGN8 FLOAT
Response Code	0 “No Command Specific Error” 2 “Invalid Selection -> false Slot Number“ 5 “Incorrect Byte Count”			

2.3.8 Command 133 (Write Float)

Write float-Variable

Command 132	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	Slot Number Unit Inhalt des Slots	#0 #1 #2..5	1 1 4	USIGN8 USIGN8 FLOAT
Response Data Bytes	Slot Index Unit Inhalt des Slot	#0 #1 #2..5	1 1 4	USIGN8 USIGN8 FLOAT
Response Code	0 “No Command Specific Error” 2 “Invalid Selection -> false Slotnumber or false Unit“ 3 “Parameter To Large“ 4 “Parameter To Small” 5 “Incorrect Byte Count”			

2.3.9 *Table of Float Variables (Command 132 / 133)*

Command 132 Command 133	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 132	0	Unit Qmax DN	#1 #2...5	5	Unit: act. Flow Unit FLOAT Low Limit:: variable Limit High Limit :variable Limit
Read 132 Write 133	1	Unit Qmax	#1 #2...5	5	Unit: act. Flow Unit FLOAT Low Limit:: variable Limit High Limit :variable Limit
Read 132 Write 133	3	Unit Pulse Factor Volume	#1 #2...5	5	Unit: act. Totalizer Unit FLOAT Low Limit:: variable Limit High Limit :variable Limit
Read 132 Write 133	4	Unit Pulse Width [msec]	#1 #2...5	5	Unit: msec = 253(special) FLOAT Low: Limit 0.1 High Limit variable Limit

Command 132 Command 133	Slot	Mnemonic	Offset	Size	Datatype
Read 132 Write 133	5	Unit Low flow cut-off	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: 0 High Limit :10
Read 132 Write 133	6	Unit Damping [1Tau]]	#1 #2...5	5	Unit: sec = 51 FLOAT Low Limit: variable Limit 1) High Limit variable Limit 1) 1) Depending on Selection of Operating Mode Standard =0,2 to 20 sec, Fast = 0,07 to 20 sec, Piston pump = 0,2 to 20 sec
Read 132 Write 133	7	Unit Density	#1 #2...5	5	Unit: g/cm3 = 91 FLOAT Low Limit: 0.1 High Limit :5
Read 132 Write 133	8	Unit System Zero	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: -10 High Limit :10
Read 132 Write 133	9	Unit Unit Factor (P.Unit based on liters)	#1 #2...5	5	Unit: Liter = 41 FLOAT Low Limit: 0.000100 High Limit :5000000
Read 132 Write 133	11	Unit Totalizer Forward	#1 #2...5	5	Unit: present Totalizer value FLOAT Low Limit: 0 High Limit :9999999
Read 132 Write 133	12	Unit Totalizer Reverse	#1 #2...5	5	Unit: present Totalizer value FLOAT Low Limit: 0 High Limit :9999999
Read 132	13	Unit Primary Zero	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: -10 High Limit :10
Read 132	14	Unit Primary Span	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: -500 High Limit :500
Read 132	15	Unit Primary Phase	#1 #2...5	5	Unit: None = 250 FLOAT Low Limit: -180 High Limit :180
Read 132 Write 133	16	Unit Adjust Iout Converter Current output for 4mA	#1 #2...5	5	Unit: mA = 39 FLOAT Low Limit: 3.0 High Limit :5.0
Read 132 Write 133	17	Unit Adjust Iout Converter Current output for 20mA	#1 #2...5	5	Unit: mA = 39 FLOAT Low Limit: 15.0 High Limit :25.0

Command 132 Command 133	Slot	Mnemonic	Offset	Size	Datatype
Read 132	19	Unit Adjust Converter value for Channel at 50Hz	#1 #2...5	5	Unit : µs = 248 FLOAT Low Limit: -135 High Limit :-110
Read 132	20	Unit Adjust Converter value for Zero at 50Hz	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: -1 High Limit :1
Read 132	21	Unit Adjust Converter value for Span Forward at 50Hz	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: 80 High Limit :100
Read 132	22	Unit Adjust Converter value for Span Reverse at 50Hz	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: -80 High Limit :-100
Read 132	23	Unit Adjust Converter value for Channel at 60Hz	#1 #2...5	5	Unit : µs = 248 FLOAT Low Limit: -135 High Limit :-110
Read 132	24	Unit Adjust Converter value for Zero at 60Hz	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: -1 High Limit :1
Read 132	25	Unit Adjust Converter value for Span Forward at 60Hz	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: 80 High Limit :100
Read 132	26	Unit Adjust Converter value for Span Reverse at 60Hz	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: -80 High Limit :-100
Read 132	27	Unit Adjust Converter value for Channel at 70Hz	#1 #2...5	5	Unit : µs = 248 FLOAT Low Limit: -135 High Limit :-110
Read 132	28	Unit Adjust Converter value for Zero at 70Hz	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: -1 High Limit :1
Read 132	29	Unit Adjust Converter value for Span Forward at 70Hz	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: 80 High Limit :100
Read 132	30	Unit Adjust Converter value for Span Reverse at 70Hz	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: -80 High Limit :-100
Read 132 Write 133	31	Unit Adjust value DEP at full pipe	#1 #2...5	5	Unit: None = 250 FLOAT Low Limit: 100 High Limit :10000000

Command 132 Command 133	Slot	Mnemonic	Offset	Size	Datatype
Read 132 Write 133	32	Unit Adjust value DEP at empty pipe	#1 #2...5	5	Unit: None = 250 FLOAT Low Limit: 1 High Limit: 10000
Read 132 Write 133	33	Unit Current output value Low Alarm	#1 #2...5	5	Unit: mA = 39 FLOAT Low Limit: variable Limit High Limit variable Limit
Read 132 Write 133	34	Unit Current output value High Alarm	#1 #2...5	5	Unit: mA = 39 FLOAT Low Limit: variable Limit High Limit variable Limit
Read 132 Write 133	35	Unit Totalizer Difference	#1 #2...5	5	Unit: present Totalizer unit FLOAT Low Limit: -9999999 High Limit :9999999
Read 132 Write 133	39	Unit Q Simulation value	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: -130 High Limit :130
Read 132	40	Unit Span Adjust >V	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: 60 High Limit :180
Read 132	41	Unit Driver Controller Ref. Voltage	#1 #2...5	5	Unit: mV = 36 FLOAT Low Limit: 30 High Limit :500
Read 132	42	Unit Driver Controller Diff. V	#1 #2...5	5	Unit: None = 250 FLOAT Low Limit: 0 High Limit :1
Read 132 Write 133	44	Unit Min Alarm	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: 0 High Limit variable Limit
Read 132 Write 133	45	Unit Max Alarm	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: variable Limit High Limit :105
Read 132	46	Unit Reference Voltage	#1 #2...5	5	Unit: None = 250 FLOAT Low Limit: 0 High Limit :500
Read 132	47	Unit Span Adjust <R	#1 #2...5	5	Unit: % = 57 FLOAT Low Limit: -180 High Limit : -60
Read 132	48	Unit Adjust value Empty Pipe	#1 #2...5	5	Unit: None = 250 FLOAT Low Limit: 0.1 High Limit :100

Command 132 **Command 133**	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 132	49	Unit Data Output Cycle	#1 #2...5	5	Unit: None = 250 FLOAT Low Limit: 0 High Limit :5000
Read 132 Write 133	50	Unit Function Test Output Pulse	#1 #2...5	5	Unit: Hz = 38 FLOAT Low Limit: 0 High Limit :5000
Read 132	51	Unit Q [10ms]	#1 #2...5	5	Unit: msec = 253 FLOAT Low Limit: High Limit :
Read 132 Write 133	52	Unit Qmax Pulse	#1 #2...5	5	Unit: actu. Flow Unit FLOAT Low Limit: variable Limit High Limit variable Limit
Read 132 Write 133	53	Unit Adjust value Empty Pipe	#1 #2...5	5	Unit: None = 250 FLOAT Low Limit: 100 High Limit :10000000
Read 132 Write 133	54	Unit Detector Empty Pipe Threshold	#1 #2...5	5	Unit: None = 250 FLOAT Low Limit: 100 High Limit :1000000
Read 132 Write 133	129	Unit Cable length	#1 #2...5	5	Unit: m = 45 FLOAT Low Limit: 0 High Limit : 200
Read 132 Write 133	130	Unit Coil temperature	#1 #2...5	5	Unit: °C = 32 FLOAT Low Limit: -100 High Limit : 100
Read 132 Write 133	131	Unit Reference coil resistance at 20°C	#1 #2...5	5	Unit: Ohm = 37 FLOAT Low Limit: 0 High Limit : 500
Read 132 Write 133	132	Unit Temperature correction	#1 #2...5	5	Unit: °C = 32 FLOAT Low Limit: -100 High Limit : 100
Read 132	133	Unit Value Electrodevoltage E1	#1 #2...5	5	Unit: µV = 249 FLOAT
Read 132	134	Unit Phase Angle Electrodenvoltage E1	#1 #2...5	5	Unit: ° = 143 FLOAT
Read 132	135	Unit Value Electrodevoltage E2	#1 #2...5	5	Unit: µV = 249 FLOAT
Read 132	136	Unit Phase Angle Electrodevoltage E2	#1 #2...5	5	Unit: ° = 143 FLOAT

Command 132 **Command 133**	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 132	137	Unit Value Electrode zeropoint E1	#1 #2...5	5	Unit: µV = 249 FLOAT
Read 132	138	Unit Phase Angle Electrode zeropoint E1	#1 #2...5	5	Unit: ° = 143 FLOAT
Read 132	139	Unit Value Electrode zeropoint E2	#1 #2...5	5	Unit: µV = 249 FLOAT
Read 132	140	Unit Phase angle Electrode zeropoint E2	#1 #2...5	5	Unit: ° = 143 FLOAT

2.4 Special Commands

2.4.1 Command 140 (Start of the Reset Function)

Reset Commands

Command 140	Slot	Mnemonic	Offset	Size	Datatype
Request Data Bytes		#0 Slot Number	#0	1	USIGN8
Response Data Bytes	0	Totalizer Reset	#1...0	0	VOID
	7	Reset old Error Messages	#1...0	0	VOID
Response Code	0 "No Command Specific Error" 2 "Invalid Selection " 5 "Incorrect Byte Count"				

2.4.2 Command 145 (Read programmable Unit)

Read programmable Unit name

Command 145	Mnemonic	Offset	Size	Datatype
Request Data Bytes	None			
Response Data Bytes	Prog. Unit name	#0...3	4	STRINGV
Response Code	0 "No Command Specific Error" 5 "Incorrect Byte Count"			

2.4.3 Command 146 (Write programmable Unit)

Write programmable Unit name

Command 146	Mnemonic	Offset	Size	Datatype
Request Data Bytes	Prog. Unit name	#0...3	4	STRINGV
Response Data Bytes	Prog. Unit name	#0...3	4	STRINGV
Response Code	0 "No Command Specific Error" 5 "Incorrect Byte Count"			

2.4.4 Command 180 (Start of the autom. Adjustment)

Start automation Adjust

Command 180	Slot	Mnemonic	Offset	Size	Datatype
Request Data Bytes		#0 Slot Number	#0	1	USIGN8
Response Data Bytes	21	Adjust System Zero	#1...0	0	VOID
	22	50 sec Average value	#1...0	0	VOID

Command 180	Slot	Mnemonic	Offset	Size	Datatype
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count”				

2.4.5 Command 190 (Read of the adjusted values)

Command 190	Slot	Mnemonic	Offset	Size	Datatype
Request Data Bytes		#0 Slot Number			
Response Data Bytes	6	Adjust Converter value Channel Q 50Hz	#1...5	5	Unit : µs FLOAT Low Limit: -135 High Limit : -110
	7	Adjust Converter value Zero Q 50Hz	#1...5	5	Unit: % = 57 FLOAT Low Limit: -1 High Limit : 1
	8	Adjust Converter value Span F 50Hz	#1...5	5	Unit: % = 57 FLOAT Low Limit: 100 High Limit :80
	9	Adjust Converter value Span R 50Hz	#1...5	5	Unit: % = 57 FLOAT Low Limit: -100 High Limit :-80
	10	Adjust Converter value Channel Q 60Hz	#1...5	5	Unit : µs FLOAT Low Limit: -135 High Limit : -110
	11	Adjust Converter value Zero Q 60Hz	#1...5	5	Unit: % = 57 FLOAT Low Limit: -1 High Limit : 1
	12	Adjust Converter value Span F 60Hz	#1...5	5	Unit: % = 57 FLOAT Low Limit: 100 High Limit :80
	13	Adjust Converter value Span R 60Hz	#1...5	5	Unit: % = 57 FLOAT Low Limit: -100 High Limit :-80
	14	Adjust Converter value Channel Q 70Hz	#1...5	5	Unit : µs FLOAT Low Limit: -135 High Limit : -110
	15	Adjust Converter value Zero Q 70Hz	#1...5	5	Unit: % = 57 FLOAT Low Limit: -1 High Limit : 1
	16	Adjust Converter value Span F 70Hz	#1...5	5	Unit: % = 57 FLOAT Low Limit: 100 High Limit :80

Command 190	Slot	Mnemonic	Offset	Size	Datatype
	17	Adjust Converter value Span R 70Hz	#1...5	5	Unit: % = 57 FLOAT Low Limit: -100 High Limit :-80
	18	Adjust Primary value Phase Q	#1...5	5	Unit: None=250 FLOAT Low Limit: -180 High Limit :180
	19	Adjust Primary value Zero Q	#1...5	5	Unit: % = 57 FLOAT Low Limit: -10 High Limit :10
	20	Adjust Primary value Span	#1...5	5	Unit: % = 57 FLOAT Low Limit: -500 High Limit :500
	21	Adjust System Zero	#1...5	5	Unit: % = 57 FLOAT Low Limit: -10 High Limit :10
	22	50s Average value for Q[%]	#1...5	5	Unit: % = 57 FLOAT Low Limit: -500 High Limit :500
	23	Adjust Empty Pipe	#1...5	5	Unit: None=250 FLOAT Low Limit: 100 High Limit :10000000
	24	Detector Empty Pipe Threshold	#1...5	5	Unit: None=250 FLOAT Low Limit: 100 High Limit :10000000
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count”				

2.4.6 Command 225 (Start of Memory Test Function)

Command 225	Slot	Mnemonic	Offset	Size	Datatype
Request Data Bytes		#0 Slot Number	#0	1	USIGN8
Response Data Bytes	0	Test Main FRAM	#1...0	0	VOID
	1	Test Backup FRAM	#1...0	0	VOID
	7	Calc. Flash Checksum	#1...0	0	VOID
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count”				

2.4.7 Command 230 (Read Test rig information)

Command 230	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes		#0 Slot Number	#0	1	USIGN8
Response Data Bytes	0	Calibration Date	#1...8	8	STRINGV
	1	Model number	#1...16	16	STRINGV
	2	Hart Descriptor	#1...16	16	STRINGV
	4	Order Number	#1...16	16	STRINGV
	5	Software Version	#1...16	16	STRINGV
	6	Test rig no.	#1...12	12	STRINGV
	7	Primary Tag Nr	#1...32	32	STRINGV
	8	Converter Tag Nr	#1...32	32	STRINGV
	9	Manfacturer code	#1...8	8	STRINGV
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count”				

2.4.8 Command 235 (Reset Fehlerregister)

Command 235	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	None			
Response Data Bytes	None			
Response Code	0 “No Command Specific Error” 5 “Incorrect Byte Count”			

2.5 Special Commands extended Diagnosis

2.5.1 Format of Diagnostic data

All diagnostic values are standardized acc. to the table below and shown with the unit.

	Format	Unit	Standardization
Coil current	sign.int	mA	100 µA
Coil voltage	sign.int	V	10mV
Coil resistance	sign.int	Ohm	0,1 Ohm
Coil temperature	sign.int	°C	0,1°C
Coil insulation resistance	sign.int	MOhm	100kOhm
Magnet. linearity	sign.int	%	%
Elektrode voltage E1	sign.int	µV	µV
Elektrode voltage E2	sign.int	µV	µV
Elektrode balance	sign.int	%	1/10000
DAC	sign.int		1
Signal quality	sign.int	%	1/10000

The format the operation hour totalizer of primary and converter is USIGN32.
The unit is second with the standardization factor of 1.

	Format	Unit	Standardization
Operation hour counter converter	Usign32	s	1
Operation hour counter primary	Usign32	s	1

2.5.2 Command 160 (Read extended diagnostic data)

Command 160	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes		#0 Slot Number			
Response Data Bytes	0	Slotnumber Coil current current value Coil current 1 Coil current 2 Coil current 3 Coil current 4 Coil current 5 Coil current 6 Coil current 7 Coil current 8 Coil current 9 Not used = 0	#0 #1...2 #3 ...4 #5 ...6 #7 ...8 #9 ..10 #11.12 #13.14 #15.16 #17.18 #19.20 #21.22	1 2 2 2 2 2 2 2 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 SIGN16 SIGN16 SIGN16 SIGN16 SIGN16 SIGN16 SIGN16 SIGN16

Command 160	Slot	Mnemonic	Offset	Size	Datatype
Request Data Bytes		#0 Slot Number			
	1	Slotnumber	#0	1	USIGN8
		Coil voltage current value	#1...2	2	SIGN16
		Coil voltage 1	#3 ...4	2	SIGN16
		Coil voltage 2	#5 ...6	2	SIGN16
		Coil voltage 3	#7 ...8	2	SIGN16
		Coil voltage 4	#9 ..10	2	SIGN16
		Coil voltage 5	#11.12	2	SIGN16
		Coil voltage 6	#13.14	2	SIGN16
		Coil voltage 7	#15.16	2	SIGN16
		Coil voltage 8	#17.18	2	SIGN16
		Coil voltage 9	#19.20	2	SIGN16
		Not used = 0	#21.22	2	SIGN16
	2	Slotnumber	#0	1	USIGN8
		Coil resistance current value	#1...2	2	SIGN16
		Coil resistance 1	#3 ...4	2	SIGN16
		Coil resistance 2	#5 ...6	2	SIGN16
		Coil resistance 3	#7 ...8	2	SIGN16
		Coil resistance 4	#9 ..10	2	SIGN16
		Coil resistance 5	#11.12	2	SIGN16
		Coil resistance 6	#13.14	2	SIGN16
		Coil resistance 7	#15.16	2	SIGN16
		Coil resistance 8	#17.18	2	SIGN16
		Coil resistance 9	#19.20	2	SIGN16
		Not used = 0	#21.22	2	SIGN16
	3	Slotnumber	#0	1	USIGN8
		Coil temperature current value	#1...2	2	SIGN16
		Coil temperature 1	#3 ...4	2	SIGN16
		Coil temperature 2	#5 ...6	2	SIGN16
		Coil temperature 3	#7 ...8	2	SIGN16
		Coil temperature 4	#9 ..10	2	SIGN16
		Coil temperature 5	#11.12	2	SIGN16
		Coil temperature 6	#13.14	2	SIGN16
		Coil temperature 7	#15.16	2	SIGN16
		Coil temperature 8	#17.18	2	SIGN16
		Coil temperature 9	#19.20	2	SIGN16
		Not used = 0	#21.22	2	SIGN16
	4	Slotnumber	#0	1	USIGN8
		Coil insulation resistance current	#1...2	2	SIGN16
		Coil insulation resistance 1	#3 ...4	2	SIGN16
		Coil insulation resistance 2	#5 ...6	2	SIGN16
		Coil insulation resistance 3	#7 ...8	2	SIGN16
		Coil insulation resistance 4	#9 ..10	2	SIGN16
		Coil insulation resistance 5	#11.12	2	SIGN16
		Coil insulation resistance 6	#13.14	2	SIGN16
		Coil insulation resistance 7	#15.16	2	SIGN16
		Coil insulation resistance 8	#17.18	2	SIGN16
		Coil insulation resistance 9	#19.20	2	SIGN16
		Not used = 0	#21.22	2	SIGN16

Command 160	Slot	Mnemonic	Offset	Size	Datatype
Request Data Bytes		#0 Slot Number			
	5	Slotnumber	#0	1	USIGN8
		Magnet.Linearty current	#1...2	2	SIGN16
		Magnet. linearity 1	#3 ...4	2	SIGN16
		Magnet. linearity 2	#5 ...6	2	SIGN16
		Magnet. linearity 3	#7 ...8	2	SIGN16
		Magnet. linearity 4	#9 ..10	2	SIGN16
		Magnet. linearity 5	#11.12	2	SIGN16
		Magnet. linearity 6	#13.14	2	SIGN16
		Magnet. linearity 7	#15.16	2	SIGN16
		Magnet. linearity 8	#17.18	2	SIGN16
		Magnet. linearity 9	#19.20	2	SIGN16
		Not used = 0	#21.22	2	SIGN16
	6	Slotnumbe r	#0	1	USIGN8
		Electrode voltage E1 current	#1...2	2	SIGN16
		Electrode voltage E1 1	#3 ...4	2	SIGN16
		Electrode voltage E1 2	#5 ...6	2	SIGN16
		Electrode voltage E1 3	#7 ...8	2	SIGN16
		Electrode voltage E1 4	#9 ..10	2	SIGN16
		Electrode voltage E1 5	#11.12	2	SIGN16
		Electrode voltage E1 6	#13.14	2	SIGN16
		Electrode voltage E1 7	#15.16	2	SIGN16
		Electrode voltage E1 8	#17.18	2	SIGN16
		Electrode voltage E1 9	#19.20	2	SIGN16
		Not used = 0	#21.22	2	SIGN16
	7	Slot number	#0	1	USIGN8
		Electrode voltage E2 current	#1...2	2	SIGN16
		Electrode voltage E2 1	#3 ...4	2	SIGN16
		Electrode voltage E2 2	#5 ...6	2	SIGN16
		Electrode voltage E2 3	#7 ...8	2	SIGN16
		Electrode voltage E2 4	#9 ..10	2	SIGN16
		Electrode voltage E2 5	#11.12	2	SIGN16
		Electrode voltage E2 6	#13.14	2	SIGN16
		Electrode voltage E2 7	#15.16	2	SIGN16
		Electrode voltage E2 8	#17.18	2	SIGN16
		Electrode voltage E2 9	#19.20	2	SIGN16
		Not used = 0	#21.22	2	SIGN16
	8	Slot number	#0	1	USIGN8
		Electrode balance current	#1...2	2	SIGN16
		Electrode balance 1	#3 ...4	2	SIGN16
		Electrode balance 2	#5 ...6	2	SIGN16
		Electrode balance 3	#7 ...8	2	SIGN16
		Electrode balance 4	#9 ..10	2	SIGN16
		Electrode balance 5	#11.12	2	SIGN16
		Electrode balance 6	#13.14	2	SIGN16
		Electrode balance 7	#15.16	2	SIGN16
		Electrode balance 8	#17.18	2	SIGN16
		Electrode balance 9	#19.20	2	SIGN16
		Not used = 0	#21.22	2	SIGN16

Command 160	Slot	Mnemonic	Offset	Size	Datatype
Request Data Bytes		#0 Slot Number			
	9	Slot number	#0	1	USIGN8
		DAC current	#1...2	2	SIGN16
		DAC 1	#3 ...4	2	SIGN16
		DAC 2	#5 ...6	2	SIGN16
		DAC 3	#7 ...8	2	SIGN16
		DAC 4	#9 ..10	2	SIGN16
		DAC 5	#11.12	2	SIGN16
		DAC 6	#13.14	2	SIGN16
		DAC 7	#15.16	2	SIGN16
		DAC 8	#17.18	2	SIGN16
		DAC 9	#19.20	2	SIGN16
		Not used = 0	#21.22	2	SIGN16
	10	Slot number	#0	1	USIGN8
		Signal quality current	#1...2	2	SIGN16
		Signal quality 1	#3 ...4	2	SIGN16
		Signal quality 2	#5 ...6	2	SIGN16
		Signal quality 3	#7 ...8	2	SIGN16
		Signal quality 4	#9 ..10	2	SIGN16
		Signal quality 5	#11.12	2	SIGN16
		Signal quality 6	#13.14	2	SIGN16
		Signal quality 7	#15.16	2	SIGN16
		Signal quality 8	#17.18	2	SIGN16
		Signal quality 9	#19.20	2	SIGN16
		Not used = 0	#21.22	2	SIGN16
		Current Diagnostic values			
	100	Slot number	#0	1	USIGN8
		Coil current, current value	#1...2	2	SIGN16
		Coil voltage current value	#3 ...4	2	SIGN16
		Coil resistance aktuell	#5 ...6	2	SIGN16
		Coil temperature aktuell	#7 ...8	2	SIGN16
		Coil insulation resistance current	#9 ..10	2	SIGN16
		Magnet. linearity current	#11.12	2	SIGN16
		Electrode voltage E1 current.	#13.14	2	SIGN16
		Electrode voltage E2 current	#15.16	2	SIGN16
		Electrode balance current	#17.18	2	SIGN16
		DAC current	#19.20	2	SIGN16
		Signal quality current.	#21.22	2	SIGN16
		Fingerprint Product 1			
	101	Slot number	#0	1	USIGN8
		Coil current Product 1	#1...2	2	SIGN16
		Coil voltage Product 1	#3 ...4	2	SIGN16
		Coil resistance Product 1	#5 ...6	2	SIGN16
		Coil temperature Product 1	#7 ...8	2	SIGN16
		Coil insulation resist. Product 1	#9 ..10	2	SIGN16
		Magnet. linearity Product 1	#11.12	2	SIGN16
		Electrode voltage E1 Product1	#13.14	2	SIGN16
		Electrode voltage E2 Product 1	#15.16	2	SIGN16
		Electrode balance Product 1	#17.18	2	SIGN16
		DAC Product 1	#19.20	2	SIGN16
		Signal quality Product1	#21.22	2	SIGN16

Command 160	Slot	Mnemonic	Offset	Size	Datatype
Request Data Bytes		#0 Slot Number			
		Fingerprint Product 2			
	102	Slot number	#0	1	USIGN8
		Coil current Product 2	#1...2	2	SIGN16
		Coil voltage Product 2	#3 ...4	2	SIGN16
		Coil resistance Product 2	#5 ...6	2	SIGN16
		Coil temperature Product 2	#7 ...8	2	SIGN16
		Coil insulation resist..Product 2	#9 ..10	2	SIGN16
		Magnet. linearity Product 2	#11.12	2	SIGN16
		Electrode voltage E1 Product 2	#13.14	2	SIGN16
		Electrode voltage E2 Product 2	#15.16	2	SIGN16
		Electrode balance Product 2	#17.18	2	SIGN16
		DAC Product 2	#19.20	2	SIGN16
		Signal quality Product 2	#21.22	2	SIGN16
		Fingerprint Start up			
	103	Slot number	#0	1	USIGN8
		Coil current Start up	#1...2	2	SIGN16
		Coil voltage Start up	#3 ...4	2	SIGN16
		Coil resistance Start up	#5 ...6	2	SIGN16
		Coil temperature Start up	#7 ...8	2	SIGN16
		Coil insulation resist. Start up	#9 ..10	2	SIGN16
		Magnet. linearity Start up	#11.12	2	SIGN16
		Electrode voltage E1 Start up	#13.14	2	SIGN16
		Electrode voltage E2 Start up	#15.16	2	SIGN16
		Electrode balance Start up	#17.18	2	SIGN16
		DAC Start up	#19.20	2	SIGN16
		Signal quality Start up	#21.22	2	SIGN16
		Fingerprint Factory			
	104	Slot number	#0	1	USIGN8
		Coil current Factory	#1...2	2	SIGN16
		Coil voltage Factory	#3 ...4	2	SIGN16
		Coil resistance Factory	#5 ...6	2	SIGN16
		Coil temperature Factory	#7 ...8	2	SIGN16
		Coil insulation resist..Factory	#9 ..10	2	SIGN16
		Magnet. linearity Factory	#11.12	2	SIGN16
		Electrode voltage E1 Factory	#13.14	2	SIGN16
		Electrode voltage E2 Factory	#15.16	2	SIGN16
		Electrode balance Factory	#17.18	2	SIGN16
		DAC Factory	#19.20	2	SIGN16
		Signal quality Factory	#21.22	2	SIGN16
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count” 16 “access restricted” 32 “busy”				

2.5.3 Command 162 (Read Operation hour counter)

Command 162	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes		#0 Slot Number			
Response Data Bytes	0	Slot number	#0	1	USIGN8
		Oper. h counter conv. curr.	#1 ...4	4	USIGN32
		Oper. h counter conv. 1	#5 ...8	4	USIGN32
		Oper. h counter conv. 2	#9 ..12	4	USIGN32
		Oper. h counter conv. 3	#13.16	4	USIGN32
		Oper. h counter conv. 4	#17.20	4	USIGN32
	1	Slot number	#0	1	USIGN8
		Oper. h counter conv. 5	#1 ...4	4	USIGN32
		Oper. h counter conv. 6	#5 ...8	4	USIGN32
		Oper. h counter conv. 7	#9 ..12	4	USIGN32
		Oper. h counter conv. 8	#13.16	4	USIGN32
		Oper. h counter conv. 9	#17.20	4	USIGN32
	2	Slot number	#0	1	USIGN8
		Oper. h counter Primary curr.	#1 ...4	4	USIGN32
		Oper. h counter Prim.. 1	#5 ...8	4	USIGN32
		Oper. h counter Prim.. 2	#9 ..12	4	USIGN32
		Oper. h counter Prim.. 3	#13.16	4	USIGN32
		Oper. h counter Prim.. 4	#17.20	4	USIGN32
	3	Slot number	#0	1	USIGN8
		Oper. h counter Prim.. 5	#1 ...4	4	USIGN32
		Oper. h counter Prim.. 6	#5 ...8	4	USIGN32
		Oper. h counter Prim.. 7	#9 ..12	4	USIGN32
		Oper. h counter Prim.. 8	#13.16	4	USIGN32
		Oper. h counter Prim.. 9	#17.20	4	USIGN32
	101	Slot number	#0	1	USIGN8
		Oper. h counter current	#1 ...4	4	USIGN32
		Oper. h counter Prod. 1	#5 ...8	4	USIGN32
		Oper. h counter Prod. 2	#9 ..12	4	USIGN32
		Oper. h counter Start up	#13.16	4	USIGN32
		Oper. h counter Factory	#17.20	4	USIGN32
	102	Slot number	#0	1	USIGN8
		Oper. h counter Prim.. curr.	#1 ...4	4	USIGN32
		Oper. h counter Prim. Prod 1	#5 ...8	4	USIGN32
		Oper. h counter Prim. Prod 2	#9 ..12	4	USIGN32
		Oper. h counter Prim.Startup	#13.16	4	USIGN32
		Oper. h counter Prim.. Fact.	#17.20	4	USIGN32
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count” 16 “access restricted” 32 “busy”				

2.5.4 Command 166 (Read Min/Max-Values)

Command 166	Mnemonic	Offset	Size	Datatype
Request Data Bytes	Slot Number (see Table Min/Max-Values)	#0	1	USIGN8
Response Data Bytes	Slot number Variable min Variable max Variable min def Variable max def (see Table Min/Max-Values)	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 SIGN16
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count” 16 “access restricted” 32 “busy”			

2.5.5 Command 167 (Schreibe Min/Max-Werte)

Command 167	Mnemonic	Offset	Size	Datatype
Request Data Bytes	Slot number Variable min Variable max Variable min def Variable max def (see Table Min/Max-Values)	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 SIGN16
Response Data Bytes	Slot number Variable min Variable max Variable min def Variable max def (see Table Min/Max-Values)	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 SIGN16
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count” 16 “access restricted” 32 “busy”			

2.5.5.1 Table Min/Max-Values

Command 166 Command 167	Slot	Mnemonic	Offset	Size	Datatype
Read 166 Write 167	0	Slot number Coil current min Coil current max Coil current min def Coil current max def	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 (read only) SIGN16 (reafd only)
Read 166 Write 167	1	Slot number Coil voltage min Coil voltage max Coil voltage min def Coil voltage max def	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 (read only) SIGN16 (reafd only)
Read 166 Write 167	2	Slot number Coil resistance min Coil resistance max Coil resistance Min def Coil resistance Max def	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 (read only) SIGN16 (reafd only)
Read 166 Write 167	3	Slot number Coil temperat. min Coil temperat. max Coil temperat. Min def Coil temperat. Max def	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 (read only) SIGN16 (reafd only)
Read 166 Write 167	4	Slot number Coil insulation res.. min Coil insulation res.. max Coil insulation res. min def Coil insulation res. Maxdef	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 (read only) SIGN16 (reafd only)
Read 166 Write 167	5	Slot number Magnet. linearity min Magnet. linearity max Magnet. linearity min def Magnet. linearity max def	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 (read only) SIGN16 (reafd only)
Read 166 Write 167	6	Slot number Electrode vol. 1 min Electrode vol. 1 max Electrode vol. 1 min def Electrode vol. 1 max def	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 (read only) SIGN16 (reafd only)
Read 166 Write 167	7	Slot number Electrode vol. 2 min Electrode vol. 2 max Electrode vol. 2 min def Electrode vol. 2 Max def	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 (read only) SIGN16 (reafd only)
Read 166 Write 167	8	Slot number Electrode balance min Electrode balance max Electrode balance min def Electrode balance max def	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 (read only) SIGN16 (reafd only)
Read 166 Write 167	9	Slot number DAC min DAC max DAC min def DAC max def	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 (read only) SIGN16 (reafd only)

Command 166 **Command 167**	**Slot**	**Mnemonic**	**Offset**	**Size**	**Datatype**
Read 166 Write 167	10	Slot number Sig./Quality min Sig./Quality max Sig./Quality min def Sig./Quality max def	#0 #1...2 #3 ...4 #5 ...6 #7 ...8	1 2 2 2 2	USIGN8 SIGN16 SIGN16 SIGN16 (read only) SIGN16 (reafd only)

2.5.6 Command 168 (Read Status extended Diagnostic)

Command 168	**Mnemonic**	**Offset**	**Size**	**Datatype**
Request Data Bytes	none			
Response Data Bytes	Coil current	#0	1	USIGN8
	Coil voltage	#1	1	USIGN8
	Coil resistance	#2	1	USIGN8
	Coil temperature	#3	1	USIGN8
	Coil insulation resistance	#4	1	USIGN8
	Magnet. linearity	#5	1	USIGN8
	Electrode voltage E1	#6	1	USIGN8
	Electrode voltage E2	#7	1	USIGN8
	Electrode balance	#8	1	USIGN8
	DAC	#9	1	USIGN8
	Signal quality	#10	1	USIGN8
	Coil ground short cut	#11	1	USIGN8
	Not used	#12	1	USIGN8
	Not used	#13	1	USIGN8
	Electrode state	#14	1	USIGN8
	Not used	#15	1	USIGN8
	(For describtion refer to table status)			
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count” 16 “access restricted” 32 “busy”			

2.5.7 Command 169 (Write Status extended Diagnostic)

Command 169	Mnemonic	Offset	Size	Datatype
Request Data Bytes	Coil current	#0	1	USIGN8
	Coil voltage	#1	1	USIGN8
	Coil resistance	#2	1	USIGN8
	Coil temperature	#3	1	USIGN8
	Coil insulation resistance	#4	1	USIGN8
	Magnet. linearity	#5	1	USIGN8
	Electrode voltage E1	#6	1	USIGN8
	Electrode voltage E2	#7	1	USIGN8
	Electrode balance	#8	1	USIGN8
	DAC	#9	1	USIGN8
	Signal quality	#10	1	USIGN8
	Coil ground short cut	#11	1	USIGN8
	Not used	#12	1	USIGN8
	Not used	#13	1	USIGN8
	Electrode state	#14	1	USIGN8
	Not used	#15	1	USIGN8
	(For describtion refer to table status)			
Response Data Bytes	Coil current	#0	1	USIGN8
	Coil voltage	#1	1	USIGN8
	Coil resistance	#2	1	USIGN8
	Coil temperature	#3	1	USIGN8
	Coil insulation resistance	#4	1	USIGN8
	Magnet. linearity	#5	1	USIGN8
	Electrode voltage E1	#6	1	USIGN8
	Electrode voltage E2	#7	1	USIGN8
	Electrode balance	#8	1	USIGN8
	DAC	#9	1	USIGN8
	Signal quality	#10	1	USIGN8
	Coil ground short cut	#11	1	USIGN8
	Not used	#12	1	USIGN8
	Not used	#13	1	USIGN8
	Electrode state	#14	1	USIGN8
	Not used	#15	1	USIGN8
	(For describtion refer to table status)			
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count” 16 “access restricted” 32 “busy”			

Table Status

Selection	Meaning
0	Off
1	Warning
2	Error

2.5.8 Command 170 (Read current Diagnostic values)

Command 170	Mnemonic	Offset	Size	Datatype
Request Data Bytes	none			
Response Data Bytes	Coil current	#0 - 1	2	SIGN16
	Coil voltage	#2 - 3	2	SIGN16
	Coil resistance	#4 - 5	2	SIGN16
	Coil temperature	#6 - 7	2	SIGN16
	Coil insulation resistance	#8 - 9	2	SIGN16
	Magnet. linearity	#10-11	2	SIGN16
	Electrode voltage E1	#12-13	2	SIGN16
	Electrode voltage E2	#14-15	2	SIGN16
	Electrode balance	#16-17	2	SIGN16
	DAC	#18-19	2	SIGN16
	Signal quality	#20-21	2	SIGN16
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count” 16 “access restricted” 32 “busy”			

2.5.9 Command 172 (Read Error / Warning Diagnostic)

Command 172	Mnemonic	Offset	Bit	Datatype
Request Data Bytes	none			
Response Data Bytes	**Error**			
	Coil current min	#0	0x01	
	Coil current max	#0	0x02	
	Coil voltage min	#0	0x04	
	Coil voltage max	#0	0x08	
	Coil resistance min	#0	0x10	
	Coil resistance max	#0	0x20	
	Coil temperature min	#0	0x40	
	Coil temperature max	#0	0x80	
	Coil insulation resistance min	#1	0x01	
	Coil insulation resistance max	#1	0x02	
	Magnet. linearity min	#1	0x04	
	Magnet. linearity max	#1	0x08	
	Electrode voltage E1 min	#1	0x10	
	Electrode voltage E1 max	#1	0x20	
	Electrode voltage E2 min	#1	0x40	
	Electrode voltage E2 max	#1	0x80	
	Electrode balance min	#2	0x01	
	Electrode balance max	#2	0x02	
	DAC min	#2	0x04	
	DAC max	#2	0x08	
	Signal quality min	#2	0x10	
	Signal quality max	#2	0x20	
	Not used	#2	0x40	
	Not used	#2	0x80	
	Coil ground short cut	#3	0x01	
	Not used	#3	0x02	
	Not used	#3	0x04	
	Electrode state	#3	0x08	
	Not used	#3	0x10	
	Not used	#3	0x20	
	Not used	#3	0x40	
	Not used	#3	0x80	
	Not defined	#4		
	Not defined	#5		

	Warnings			
	Coil current min	#6	0x01	
	Coil current max	#6	0x02	
	Coil voltage min	#6	0x04	
	Coil voltage max	#6	0x08	
	Coil resistance min	#6	0x10	
	Coil resistance max	#6	0x20	
	Coil temperature min	#6	0x40	
	Coil temperature max	#6	0x80	
	Coil insulation resistance min	#7	0x01	
	Coil insulation resistance max	#7	0x02	
	Magnet. linearity min	#7	0x04	
	Magnet. linearity max	#7	0x08	
	Electrode voltage E1 min	#7	0x10	
	Electrode voltage E1 max	#7	0x20	
	Electrode voltage E2 min	#7	0x40	
	Electrode voltage E2 max	#7	0x80	
	Electrode balance min	#8	0x01	
	Electrode balance max	#8	0x02	
	DAC min	#8	0x04	
	DAC max	#8	0x08	
	Signal quality min	#8	0x10	
	Signal quality max	#8	0x20	
	Not used	#8	0x40	
	Not used	#8	0x80	
	Coil ground short cut	#9	0x01	
	Not used	#9	0x02	
	Not used	#9	0x04	
	Electrode state	#9	0x08	
	Not used	#9	0x10	
	Not used	#9	0x20	
	Not used	#9	0x40	
	Not used	#9	0x80	
	Not defined	#10		
	Not defined	#11		

	Register			
	Coil current min	#12	0x01	
	Coil current max	#12	0x02	
	Coil voltage min	#12	0x04	
	Coil voltage max	#12	0x08	
	Coil resistance min	#12	0x10	
	Coil resistance max	#12	0x20	
	Coil temperature min	#12	0x40	
	Coil temperature max	#12	0x80	
	Coil insulation resistance min	#13	0x01	
	Coil insulation resistance max	#13	0x02	
	Magnet. linearity min	#13	0x04	
	Magnet. linearity max	#13	0x08	
	Electrode voltage E1 min	#13	0x10	
	Electrode voltage E1 max	#13	0x20	
	Electrode voltage E2 min	#13	0x40	
	Electrode voltage E2 max	#13	0x80	
	Electrode balance min	#14	0x01	
	Electrode balance max	#14	0x02	
	DAC min	#14	0x04	
	DAC max	#14	0x08	
	Signal quality min	#14	0x10	
	Signal quality max	#14	0x20	
	Not used	#14	0x40	
	Not used	#14	0x80	
	Coil ground short cut	#15	0x01	
	Not used	#15	0x02	
	Not used	#15	0x04	
	Electrode state	#15	0x08	
	Not used	#15	0x10	
	Not used	#15	0x20	
	Not used	#15	0x40	
	Not used	#15	0x80	
	Not defined	#16		
	Not defined	#17		
	Not defined	#18		
	Not defined	#19		
	Not defined	#20		
	Not defined	#21		
	Not defined	#22		
	Not defined	#23		
Response Code	0 “No Command Specific Error” 16 “access restricted” 32 “busy”			

2.5.10 Command 173 (Actions for extended Diagnostic)

Command 173	Mnemonic	Offset	Size	Datatype
Request Data Bytes	Slot number	#0	1	USIGN8
Response Data Bytes	Slot number	#0	1	USIGN8
Response Code	0 “No Command Specific Error” 2 “Invalid Selection “ 5 “Incorrect Byte Count” 16 “access restricted” 32 “busy”			

2.5.11 Table Actions

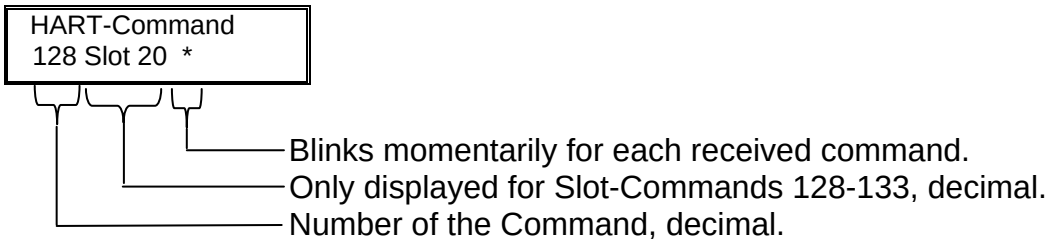
Command 173	Slot	Mnemonic	Offset	Size	Datatype
Write 173	50	Slot number Set all Min/Max-Values to Default	#0	1	USIGN8
Write 173	100	Slot number Copy current Diagnostic values to Fingerprint Product 1	#0	1	USIGN8
Write 173	101	Slot number Copy current Diagnostic values to Fingerprint Product 2	#0	1	USIGN8
Write 173	102	Slot number Copy current Diagnostic values to Fingerprint Start up	#0	1	USIGN8
Write 173	152	Slot number Reset all Bits in the Error/Warning-Register	#0	1	USIGN8
Write 173	203	Slot number Start Diagnostic (only possible if Diagnostic interval is set to manual	#0	1	USIGN8
Write 173	240	Slot number Copy Electrode zero	#0	1	USIGN8

Command 173	Slot	Mnemonic	Offset	Size	Datatype
Write 173	241	Slot number Copy Reference resistor	#0	1	USIGN8

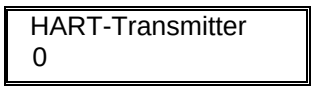
3 Troubleshooting HART

When the HART-Communication does not function the following points should be checked:
1. The converter must have a HART-Capable current output module installed.
2. The load on the current output circuit must be between 250 and 500 Ohm.
3. The Instrument Address in the Data Link menu.

If all these checks are correct and a problem still exists with the HART-Communication, the received commands can be checked using the function “HART-Command” in the Submenu "Function Test":

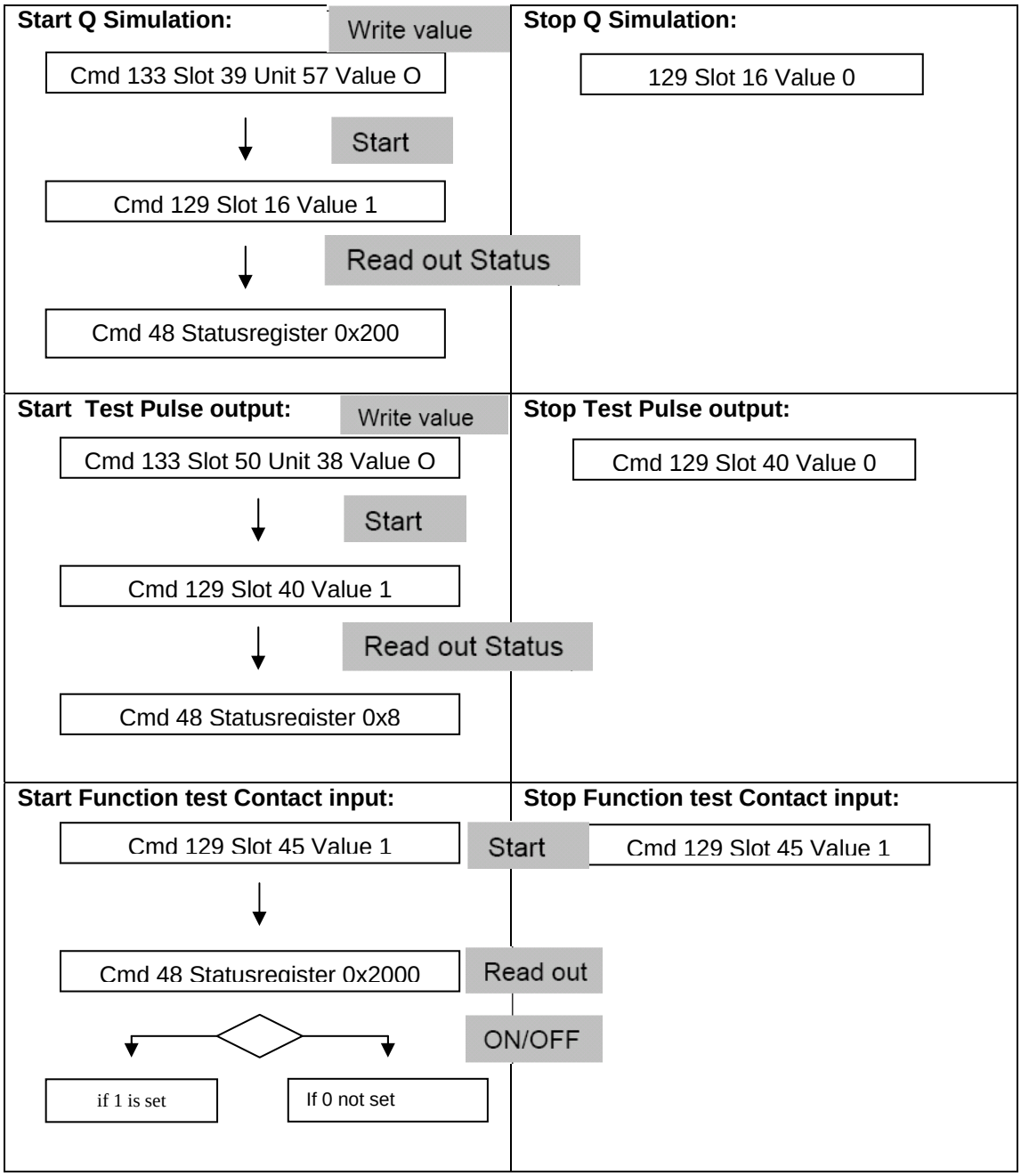


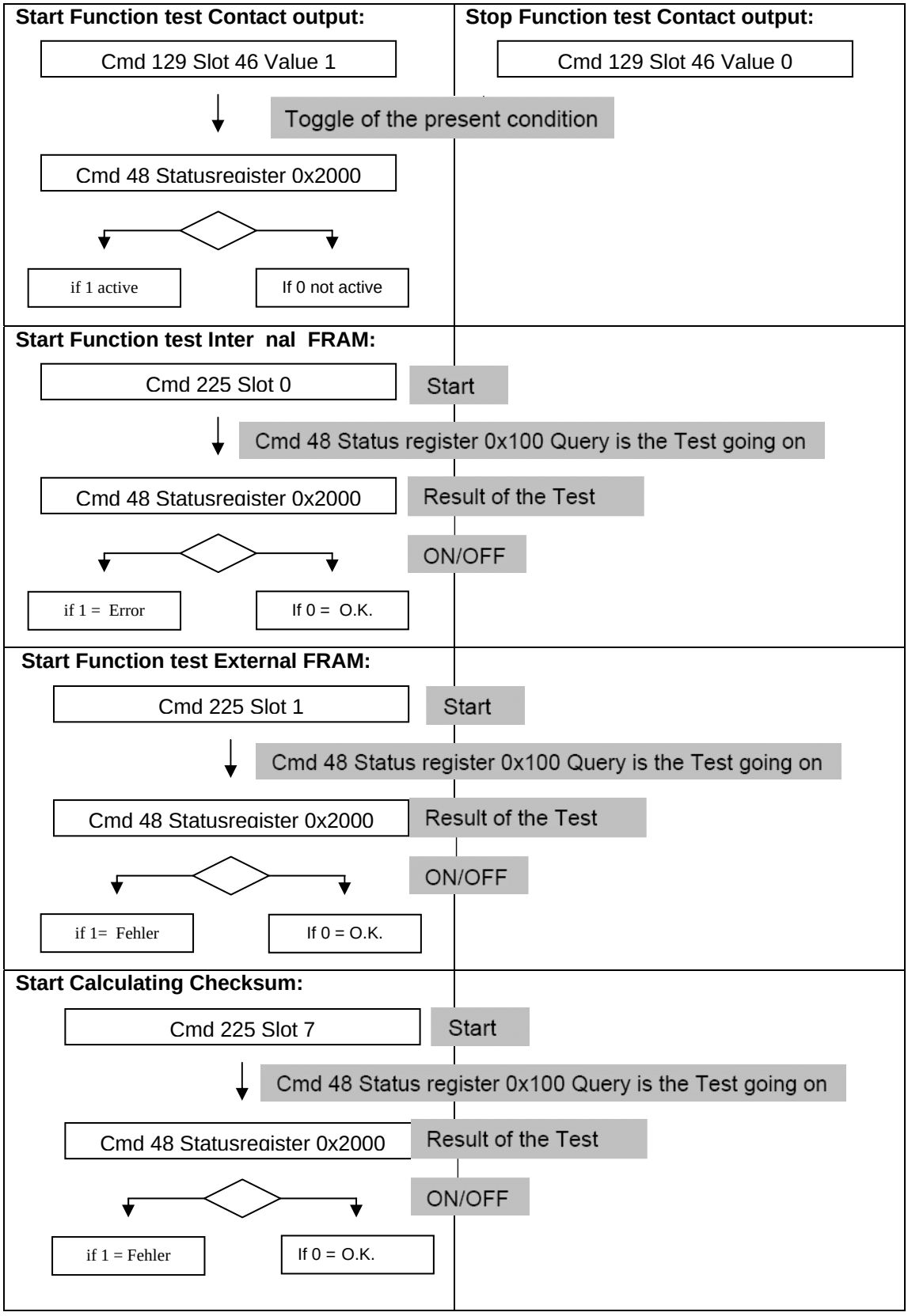
If nothing is displayed then the receive operation is not functioning properly. In this case an oscilloscope should be used to check if a HART-Signal is being received at the converter. Since the signal level is typically 1 mApp, the voltage across a 500 Ohm load (1 mApp * 500 Ohm) is 500 mVpp.
If a signal is being received but is not being recognized by the converter, it is possible that the signal quality is not adequate. In this case the test should be repeated under more favorable conditions.
If HART-Signals are being received but the transmitter (e.g. Hand-Held-Communicator) indicates an error, then the send output of the converter should be checked with an oscilloscope. A send command can be initiated using the Function Test "HART-Transmitter"



After calling this function the converter sends a logic 0 (=2200Hz) and after any key is pressed, a logic 1 (=1200Hz).
An additional oscilloscope check can be made to determine if the converter responds to the command.

4 Methods


Start Q Simulation:
Write value
Cmd 133 Slot 39 Unit 57 Value O
Start
Cmd 129 Slot 16 Value 1
Read out Status
Cmd 48 Statusregister 0x200
Stop Q Simulation:
129 Slot 16 Value 0
Start Test Pulse output:
Write value
Cmd 133 Slot 50 Unit 38 Value O
Start
Cmd 129 Slot 40 Value 1
Read out Status
Cmd 48 Statusregister 0x8
Stop Test Pulse output:
Cmd 129 Slot 40 Value 0
Start Function test Contact input:
Cmd 129 Slot 45 Value 1
Start
Cmd 129 Slot 45 Value 1
Cmd 48 Statusregister 0x2000
Read out
ON/OFF
if 1 is set
If 0 not set
Stop Function test Contact input:


Start Function test Contact output:
Cmd 129 Slot 46 Value 1
Toggle of the present condition
Cmd 48 Statusregister 0x2000
if 1 active
If 0 not active
Stop Function test Contact output:
Cmd 129 Slot 46 Value 0
Start Function test Inter nal FRAM:
Cmd 225 Slot 0
Start
Cmd 48 Status register 0x100 Query is the Test going on
Cmd 48 Statusregister 0x2000
Result of the Test
ON/OFF
if 1 = Error
If 0 = O.K.
Start Function test External FRAM:
Cmd 225 Slot 1
Start
Cmd 48 Status register 0x100 Query is the Test going on
Cmd 48 Statusregister 0x2000
Result of the Test
ON/OFF
if 1= Fehler
If 0 = O.K.
Start Calculating Checksum:
Cmd 225 Slot 7
Start
Cmd 48 Status register 0x100 Query is the Test going on
Cmd 48 Statusregister 0x2000
Result of the Test
ON/OFF
if 1 = Fehler
If 0 = O.K.

5 Register Occupancies

5.1 Response Byte Hart Command

Response Telegram:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
FF FF FF FF FF	86	9A	1D	00	00	03	RdPv	007	000	11000000	m³/s	0	D8

1. 5 Preambles
2. Acknowledge
3. 10011010 Bit (Bit 7 = Master Bit, Bit 6 = Bust Mode Bit, Bit 5 – 0 = Manufactor Code)
4. Device Type
5. Instrument No Expansion Number
6. Instrument No MSB
7. Instrument No LSB
8. Command No
9. Byte Count
10. Field Device Status First Byte
11. Field Device Status Second Byte
12. Unit
13. Value
14. Checkbyte

5.1.1 Field Device Status First Byte

First Byte is set to 1	***Description***
Bit #7	If this Bit is set to 1
Bit #6	Vertical Parity Error
Bit #5	Overrun Error
Bit #4	Framing Error
Bit #3	Longitudinal Parity Error
Bit #2	Reserved
Bit #1	Buffer Overflow
Bit #0	Reserved
First Byte is set to 0	***Description***
Bit #7	If this Bit is set to 0
0x00 hex = 0 dec	No command specific error
0x02 hex = 2 dec	Invalid selection
0x03 hex = 3 dec	Passed parameter too large
0x04 hex = 4 dec	Passed parameter too small
0x05 hex = 5 dec	Too few data bytes received (Incorrect byte count)
0x06 hex = 6 dec	Device Specific Command error
0x07 hex = 7 dec	In write protect mode
0x09 hex = 9 dec	Lower range value too high
0x0A hex = 10 dec	Lower range value too low
0x0B hex = 11 dec	Upper range value too high
0x0C hex = 12 dec	Upper range value too low
0x0D hex = 13 dec	Upper und lower Range values out of limits
0x0E hex = 14 dec	Span too small
0x10 hex = 16 dec	Access restricted
0x12 hex = 18 dec	Invalid Units Code
0x20 hex = 32 dec	Busy
0x40 hex = 64 dec	Command not implemented

5.1.2 Field Device Status Second Byte

Second Byte	*Description*
Bit #7	Field Device Malfunktion A hardware error or failure has been detected by the device. Further information may be available through the Read Additional Transmitter Status Command (Error register)
Bit #6	Configuration Changed A write or set command has been executed
Bit #5	Cold Start Power has been removed and reapplied resulting in the reinstallation of the setup information. The first command to recognize this condition will automatically reset this fag. This flag may also be set following a Master Reset or a Self Test.
Bit #4	More Status Available More Status information is available than con be returned in the Field Device Status. Command #48, Read Additional Status Information, will provide this additional status information.
Bit #3	Primary Variable Analog Output Fixed The analog and digital analog outputs for Primary Variable are held at the requested value. They will not respond to the applied process.
Bit #2	Primary Variable Analog Output Saturated The analog und digital outputs for the Primary Variable are beyond their limits and no longer represent the true applied process.
Bit #1	Non Primary Variable Out of Limits The process applied to a sensor, other than that of the Primary Variable, is beyond the operating limits of the device. The Read Additional Transmitter Status Command, #48, may be required to identify the variable.
Bit #0	Primary Variable Out of Limits The process applied to the sensor for the Primary Variable is beyond the operating limits of the device

5.2 Error register

Possible cause	Error byte	Priority	Error No	Field Device Status (Second Byte)
EMPTY PIPE	Byte1 0x01	5	“0“	Field Device Status Malfunction More Status Available
ADC DSP	Byte1 0x02	4	“1“	Field Device Status Malfunction More Status Available
DRIVER	Byte1 0x04	7	“2“	Field Device Status Malfunction More Status Available
Flow > 103 %	Byte1 0x08	6	“3“	Field Device Status Malfunction More Status Available Primary Variable Out of Limits

Possible cause	Error byte	Priority	Error No	Field Device Status (Second Byte)
EXT ZERO RETURN	Byte1 0x10	8	“4“	Field Device Status Malfunction More Status Available
TOTALIZER	Byte1 0x20	2	“5“	Field Device Status Malfunction More Status Available
ZAEHLER	Byte1 0x40	9	“6“	Field Device Status Malfunction More Status Available
MAX ALARM	Byte1 0x80	10	“A”	Field Device Status Malfunction More Status Available
MIN ALARM	Byte2 0x01	11	“B”	Field Device Status Malfunction More Status Available
EXT DATENBASIS	Byte2 0x02	3	“C”	Field Device Status Malfunction More Status Available
EXT FRAM PLUGGED IN	Byte2 0x04	1	“F”	Field Device Status Malfunction More Status Available
OLD PRIMARY	Byte2 0x08	12	“D”	Field Device Status Malfunction More Status Available
DC to high	Byte2 0x10	13	“E”	Field Device Status Malfunction More Status Available
Ext. Diagnostic	Byte2 0x20	14	“G”	Field Device Status Malfunction More Status Available (read extended Diagnosticdata by use of command 172)

5.3 **Warning register**

Cause of warning	Warning byte	Priority	Warning no	Hart signalization
Warning Ext Totalizer Reset	Byte1 0x01	1	"2"	-
Warning Simulation	Byte1 0x02	2	"1"	Primary Variable Analog Output Fixed
Warning Test Mode	Byte1 0x04	3	"3"	-
Warning Function test	Byte1 0x08	4	"4"	-
Warning Overflow Forward Totalizer	Byte1 0x10	5	"9a"	-
Warning Overflow Reverse Totalizer	Byte1 0x20	6	"9b"	-
Warning Overflow Differential Totalizer	Byte1 0x40	7	"9c"	-
Warning Backflow	Byte1 0x80	8	"10"	-

Cause of warning	Warning byte	Priority	Warning no	Hart signalization
Warning Primary data loaded	Byte2 0x01	9	"7"	-
Warning Update Int. FRAM	Byte2 0x02	10	"8a"	-
Warning Update Ext. FRAM	Byte2 0x04	11	"8b"	-
Warning Instrument Address not Zero	Byte2 0x08	12	"11"	Primary Variable Analog Output Fixed
Warning Simulation Iout	Byte2 0x10	13	"12a"	Primary Variable Analog Output Fixed
Warning Simulation Pulse output	Byte2 0x20	14	"12b"	-
Warning Automatic adjustment running	Byte2 0x40	15	"13"	-
Warning Measurement value halted	Byte2 0x80	16	“14“	-
–Warning extended Diagnostic (read extended Diagnostic data using command 172)	Byte3 0x01	17	“15“	-

5.4 Converter Status register

Status quality	Status register
Function test Current output 1	0x00000001L
Function test Current output 2	0x00000002L
Function test Contact output	0x00000004L
Function test Impuls output	0x00000008L
Adjust Current output 1	0x00000010L
Adjust Current output 2	0x00000020L
Function test Contact input	0x00000040L
Function test on	0x00000100L
Q-Simulation on	0x00000200L
Automatic Adjustment running	0x00000400L
Error Automatic Adjustment	0x00000800L
Average value Determination is active	0x00001000L
Result Function test	0x00002000L
Result Memory test	0x00004000L
Function test extended Diagnostic Errors/Warnings	0x00008000L

At Start more following functions about HART becomes the bit 7 for the time of the processing of these functions the status register set.

1. Init Dbase,
2. Calculate Flash Checksum
3. Test Externes FRAM
4. Test Internes FRAM
5. Load Ext GD 6. Load Anlagen Daten und Aufnehmer Daten
6. 7. Write Anlage Daten und Aufnehmer Daten
7. 8. Init Ext. FRAM

6 Overview of the Error Conditions

Overview of the Error Condition and Alarms

Error Code and Clear Text Message	Flow rate Display	Messages While Simulating Current Output	Current output	Pulse output	Contact output					Message with HART
					General alarm	Min-alarm	Max-alarm	Max/Min-alarm	Empty pipe	
0 = „Empty pipe“	0%	-	Prog.Al. EPD	0%	Alarm				Alarm	More Stat avail.
1 = „AD-Wandler/DSP“	0%	-	Prog.Al.	0%	Alarm					Trans Mal F.
2 = „Driver“	0%	-	Prog.Al.	0%	Alarm					Trans Mal F.
3 = „Flow rate >103%“	103%	Yes	High Al.	103%	Alarm					PV out Limits
4 = „Ext.Zero return“	0%	-	0%	0%	Alarm					More Stat avail.
5 = „Database“	0 %	Yes	Prog.Al	0%	Alarm					Trans Mal F.
6 = „Totalizer“	-	Yes	-	-	Alarm					More Stat avail.
A = „Max-Alarm“	-	Yes	-	-	Alarm		Alarm	Alarm		More Stat avail.
B = „Min-Alarm“	-	Yes	-	-	Alarm	Alarm		Alarm		More Stat avail.
C = „ext. Datenbase“	0%	Yes	Prog.Al	0%	Alarm					Trans Mal F.
F = „FRAM in Primary“	0%	Yes	Prog.Al	0%	Alarm					Trans Mal F.
D = „OLD PRIMARY”	0%	Yes	Prog.Al	0%	Alarm					Trans Mal F.
E = „DC to high”	0%	Yes	Prog.Al	0%	Alarm					Trans Mal F.
G = „ext.. Diagnostic”	-	-	_	-	Alarm					-

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