TRIO-WIRL
V_4000
S_4000

HART-Protocol
Overview of the HART-Commands for the Standard Software D699F004U01

Instruction Bulletin

D184B108U04 Rev. 06 / 04.2002

TRIO-WIRL VT

TRIO-WIRL ST

TRIO-WIRL VR

TRIO-WIRL SR

CE

ABB

HART-Protocol		
Prepared by Name: **Harry Plotzki** Date: **17 Jul. 00**	Instrument: **TRIO WIRL** Software: **Standard Software** Designation: **D699F004U01 A.11**	Revision: **6** Name: **Andreas Thöne** Date: **08.04.02**

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HART-Protocol					
Prepared Name:	by **Harry Plotzki**	Instrument:	**TRIO WIRL**	Revision:	**6**
Date:	**17 Jul. 00**	Software:	**Standard Software**	Name:	**Andreas Thöne**
		Designation:	**D699F004U01 A.11**	Date:	**08.04.02**

HART-Protocol			
Prepared by Name: **Harry Plotzki**	Instrument: **TRIO WIRL**	Revision: **6**	
Date: **17 Jul. 00**	Software: **Standard Software**	Name: **Andreas Thöne**	
	Designation: **D699F004U01 A.11**	Date: **08.04.02**	

1 Revision List

Revision No.	Revision Soft.	Date	New Pages	Revised Pages	Extensions for new version	Name
1	A.10	17.07.2000	erstellt			HP
2	A.10	04.09.2000	-	5.1-1		HP
3	A.10	21.11.2000	6-1	5.5-2 , 5.3-1		HP
4	A.11	09.03.2001		5.1-2, 5.2-2, 5.3-2, 5. 5-2	**Kap. 5.1.3:** Slot-Nr. 162: Boot Page Slot-Nr. 163: Fmin Slot-Nr. 164: Fmax Slot-Nr. 165: Freq. Spec balance Slot-Nr. 166: BP Arithmet. **Kap. 5.2.3:** Slot-Nr. 160: Gain Max Slot-Nr. 161: Gain Vib Trigger Slot-Nr. 162: Low Dis Gain Slot-Nr. 163: High Dis Gain **Kap. 5.3.3:** Slot-Nr. 171: Input Minimum Slot-Nr. 172: Vib/Qv Fktor Slot-Nr. 173: Low Dis Frequenz Slot-Nr. 174: High Dis Frequenz **Kap. 5.5:** **List is extended by:** Boot Page Fmin	AP

5	A.11	21.06.2001		4-4	Fmax Freq. Spec Balance BP Arithmet Gain Max Gain Vib Trigger Low Dis Gain High Dis Gain Input Minimum Vib/Qv Faktor Low Dis Frequenz High Dis Frequenz **Kap. 4.8**	AP

2 Introduction

This overview lists all the presently available HART-Commands. The list includes the Universal and Common Practice Commands as well as the Slot- and Other Commands.
In the past it had been necessary to check all the Commands in order to identify which had been changed relative to the previous Command Overview List. This is no longer necessary, because any changes to a Command are readily recognizable from the Revision Level listed in the Section for each Command. In addition, the use of individual numbers for the individual sections makes it possible to replace only those pages which were revised, saving paper.

This document is applicable to the following Software Revisions:

A.10

A.11

3 Universal Commands

3.1 HART-Command 0 : Read Transmitter Unique Identifier			Revision
Request Data Bytes	none		
Response Data Bytes	#0	Device Type Code for Expansion	= 254
	#1	Manufacturer Identification Code	= 26 = ABB
	#2	Manufacturer Device Type	= 26 = TRIO-WIRL
	#3	Number of Request Preambles	= 5
	#4	Revision Level of Universal Command	= 5
	#5	Revision Level of Transmitter Document	= 0
	#6	Software Revision Level	= 0
	#7	Hardware Revision Level	= 0
	#8	Flags, none defined at this time	= 0
	#9	Device Identification Number, 24 Bit, MSB	= Byte 3 Instrument No.
	#10	Device Identification Number, 24 Bit	= Byte 2 Instrument No.
	#11	Device Identification Number, 24 Bit, LSB	= Byte 1 Instrument No.
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	

3.2 HART-Command 1 : Read Primary Variable			Revision
Request Data Bytes	none		
Response Data Bytes	#0	Primary Variable Units Code (Table 2)	
	#1..#4	Primary Variable, IEEE 754	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
Comments		Primary Variable => is a function of the Qv Operating Mode setting	

3.3 HART-Command 2 : Read Current and Percent of Range			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	

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3.4 HART-Command 3 : Read all Dynamic Variables and Current		Revision
Request Data Bytes	none	
Response Data Bytes	#0..#3 Analog Output Current mA, IEEE 754 #4 Primary Variable Units Code (Table 2) #5..#8 Primary Variable, IEEE 754 #9 Secondary Variable Units Code (Table 2) #10..#13 Secondary Variable, IEEE 754 #14 Tertiary Variable Units Code (Table 2) #15..#18 Tertiary Variable, IEEE 754 #19 4th Variable Units Code (Table 2) #20..#23 4th Variable, IEEE 754	
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count	
Comments	Primary Variable = is a function of the Qv Operating Mode setting Secondary Variable = Totalizer Tertiary Variable = Frequency Fourth Variable = Temperature	

3.5 HART-Command 6 : Write Polling Address		Revision
Request Data Bytes	#0 Polling Address of Device	
Response Data Bytes	#0 Polling Address of Device	
Response Codes	0 No Command Specific Error 2 Invalid Selection 5 Incorrect Byte Count	

3.6 HART-Command 11 : Read Unique Identifier Associated With Tag

Revision

Request Data Bytes	#0..#5	Tag, Packed ASCII	
Response Data Bytes	#0	Device Type Code for Expansion	= 254
	#1	Manufacturer Identification Code	= 26 = ABB
	#2	Manufacturer Device Type	= 26 = TRIO WIRL
	#3	Number of Request Preambles	= 5
	#4	Revision Level of Universal Command	= 5
	#5	Revision Level of Transmitter Document	= 0
	#6	Software Revision Level	= 0
	#7	Hardware Revision Level	= 0
	#8	Flags, none defined at this time	= 0
	#9	Device Identification Number, 24 Bit, MSB	= Byte 3 Instrument No.
	#10	Device Identification Number, 24 Bit	= Byte 2 Instrument No.
	#11	Device Identification Number, 24 Bit, LSB	= Byte 1 Instrument No.
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	

3.7 HART-Command 12 : Read Message

Revision

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

3.8 HART-Command 13 : Read Tag, Descriptor, Date

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

3.9 HART-Command 14 : Read Primary Variable Sensor Information

Revision

Request	none	

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Data Bytes		
Response Data Bytes	#0..#2	Sensor Serial Number MSB, 24-bit unsigned integer
	#3	Sensor Limits/Min Span Units, Table II Units Codes
	#4..#7	Upper Sensor Limit, IEEE754
	#8..#11	Lower Sensor Limit, IEEE754
	#12..#15	Minimum Span, IEEE754
Response Codes	0	No Command Specific Error
	5	Incorrect Byte Count
Comments		Sensor Serial Number = 0
		Upper Sensor Limit = Qmax
		Lower Sensor Limit = 0
		Minimum Span = Qmax DN

3.10 HART-Command 15 : Read Primary Variable Output Information			Revision
Request Data Bytes	none		
Response Data Bytes	#0	Alarm Select Code, Table VI	
	#1	Primary Variable Transfer Function Code, Table III	
	#2	Primary Variable Range Values Units Code, Table II	
	#3..#6	Primary Variable Upper Range Value, IEEE754	
	#7..#10	Primary Variable Lower Range Value, IEEE754, always Zero	
	#11..#14	Primary Variable Damping Value, IEEE754, Units of Seconds	
	#15	Write Protect Code, Table VII	
	#16	Private Label Distributor Code, Table VIII	
Response Codes	0	No Command Specific Error	
	5	Incorrect Byte Count	
Comments		Alarm Selection Code	= 0 = High, 1 = Low
		PV Transfer Function Code	= 0 = Linear
		PV Upper Range Value	= Qmax, function of the Operating Mode
		PV Lower Range Value	= 0
		PV Damping Value	= Damping
		Write Protect Code	= 251 = Not Implemented
		Private Label Distributor	= 26 =ABB

3.11 HART-Command 16 : Read Final Assembly Number			Revision
Request Data Bytes	none		
Response	#0..#2	Final Assembly Number	

Data Bytes		
Response Codes	0	No Command Specific Error
	5	Incorrect Byte Count

3.12 HART-Command 17 : Write Message		Revision
Request Data Bytes	#0..#23	Message, Packed-ASCII
Response Data Bytes	#0..#23	Message, Packed-ASCII
Response Codes	0	No Command Specific Error
	5	Incorrect Byte Count

3.13 HART-Command 18 : Write Tag, Descriptor, Date		Revision
Request Data Bytes	#0..#5	Tag, Packed-ASCII
	#6..#17	Descriptor, Packed-ASCII
	#18..#20	Date: Day, Month, Year
Response Data Bytes	#0..#5	Tag, Packed-ASCII
	#6..#17	Descriptor, Packed-ASCII
	#18..#20	Date: Day, Month, Year
Response Codes	0	No Command Specific Error
	5	Incorrect Byte Count

3.14 HART-Command 19 : Write Final Assembly Number		Revision
Request Data Bytes	#0..#2	Final Assembly Number
Response Data Bytes	#0..#2	Final Assembly Number
Response Codes	0	No Command Specific Error
	5	Incorrect Byte Count

4 Common Practice Commands

4.1 HART-Command 33 : Read Transmitter Variables			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 Units Code	
	#2..#5	Slot #0 Variable, IEEE 754	
	#6	Transmitter Variable assigned to Slot #1	
	#7	Slot #1 Units Code	
	#8..#11	Slot #1 Variable, IEEE 754	
	#12	Transmitter Variable assigned to Slot #2	
	#13	Slot #2 Units Code	
	#14..#17	Slot #2 Variable, IEEE 754	
	#18	Transmitter Variable assigned to Slot #3	
	#19	Slot #3 Units Code	
	#20..#23	Slot #3 Variable, IEEE 754	
Response Codes	0	No Command Specific Error	
	2	Invalid Selection	
	5	Incorrect Byte Count	
Comments		Transmitter Variables:	0: v_Qv 1: v_Qn 2: v_Qm 3: v_fl_totalizer 4: v_temp 5: v_press 6: v_frequency 7: v_percent

4.2 HART-Command 34 : Write Primary Variable Damping Value			Revision
Request Data Bytes	#0..#3	Damping Value, IEEE 754	
Response Data Bytes	#0..#3	Actual Damping Value, IEEE 754	
Response Codes	0	No Command Specific Error	
	3	Passed Parameter too Large	
	4	Passed Parameter too Small	
	5	Incorrect Byte Count	

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4.3 HART-Command 35 : Write Primary Variable Range Values		Revision
Request Data Bytes	#0 Primary Variable Upper and Lower Range Values Units Code, Table II #1..#4 Primary Variable Upper Range Value, IEEE 754 #5..#8 Primary Variable Lower Range Value, IEEE 754	
Response Data Bytes	#0 Primary Variable Upper and Lower Range Values Units Code, Table II #1..#4 Primary Variable Upper Range Value, IEEE 754 #5..#8 Primary Variable Lower Range Value, IEEE 754	
Response Codes	0 No Command Specific Error 2 Invalid Selection 5 Incorrect Byte Count 9 Lower Range to high 11 Upper Range Value to high 12 Upper Range Value to low	
Comments	PV Upper Range Value = Qmax DN default; function of the Operating Mode PV lower Range Value = 0	

4.4 HART-Command 38 : Reset Configuration Changed Flag		Revision
Request Data Bytes	none	
Response Data Bytes	none	
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count	

4.5 HART-Command 40 : Enter/Exit Primary Variable Current Mode		Revision
Request Data Bytes	#0..#3 Fixed Primary Variable Current Level, IEEE 754, mA	
Response Data Bytes	#0..#3 Actual Fixed Primary Variable Current Level, IEEE 754, mA	
Response Codes	0 No Command Specific Error 3 Passed Parameter too Large (> 24.8 mA) 4 Passed Parameter too Small (< 3.85 mA) 5 Incorrect Byte Count 11 In Multidrop Mode	

4.6 HART-Command 45 : Trim Primary Variable Current DAC Zero		Revision
Request Data Bytes	#0..#3	Externally Measured Primary Variable Current Level, IEEE 754, Units of mA
Response Data Bytes	#0..#3	Actual Measured Primary Variable Current Level, IEEE 754, mA
Response Codes	0	No Command Specific Error
	3	Passed Parameter too Large (> 5mA)
	4	Passed Parameter too Small (< 3mA)
	5	Incorrect Byte Count
	9	Not in Proper Current Mode
	11	In Multidrop Mode

4.7 HART-Command 46 : Trim Primary Variable Current DAC Gain		Revision
Request Data Bytes	#0..#3	Externally Measured Primary Variable Current Level, IEEE 754, Units of mA
Response Data Bytes	#0..#3:	Actual Measured Primary Variable Current Level, IEEE 754, mA
Response Codes	0	No Command Specific Error
	3	Passed Parameter too Large (> 22mA)
	4	Passed Parameter too Small (< 18mA)
	5	Incorrect Byte Count
	9	Not in Proper Current Mode
	11	In Multidrop Mode

4.8 HART-Command 48 : Read Additional Transmitter Status

Revision

Request Data Bytes	none				
Response Data Bytes	#0..#3 Additional transmitter status (errors)				
	Error -bytes			Status -bytes	
	#0, Bit 0	Error 8:	Not implemented	#2, Bit 0	Max.-Alarm Temperature
	#0, Bit 1	Error 9:	Qv >115% QmaxDN	#2, Bit 1	Min.-Alarm Temperature
	#0, Bit 2	Error A:	Kit-Fram	#2, Bit 2	For internal use only
	#0, Bit 3	Error B:	B(ackup) Data Base	#2, Bit 3	Max.-Alarm Flowrate
	#0, Bit 4	Error C:	Not implemented	#2, Bit 4	Min.-Alarm Flowrate
	#0, Bit 5	Error D:	Not implemented	#2, Bit 5	Error-Register-Alarm
	#0, Bit 6	Error E:	Not implemented	#2, Bit 6	Not used
	#0, Bit 7	Error F:	Not implemented	#2, Bit 7	Not used
	#1, Bit 0	Error 0:	Steam calculation	#3, Bit 0	Pulse factor limited
	#1, Bit 1	Error 1:	Front-End	#3, Bit 1	Pulse width limited
	#1, Bit 2	Error 2:	Not implemented	#3, Bit 2	Totalizer units limited
	#1, Bit 3	Error 3:	Flowrate > 115%	#3, Bit 3	Low flow cutoff
	#1, Bit 4	Error 4:	Not implemented	#3, Bit 4	Not implemented
	#1, Bit 5	Error 5:	M(ain) Data Base	#3, Bit 5	Self test contact output
	#1, Bit 6	Error 6:	Totalizer	#3, Bit 6	Self test flowrate
	#1, Bit 7	Error 7:	Temp. Measurement	#3, Bit 7	Self test current output
Response Codes	0 No Command Specific Error				
	5 Incorrect Byte Count				

5 Slot - Commands

The converter parameters can be divided into four groups:

unsigned char-Variables

Parameters in menus with selection lists or tables are stored as "unsigned char", e.g. Language:

German = 0
English = 1

unsigned int-Variables

Those numbers which only occur as integers are stored as "unsigned int", e.g. Instrument No..

float-Variables

The remaining numbers are stored as “float” (IEEE 754), e.g. Damping.

string-Variables

Parameters which are stored as character strings.

In the following lists the Read and Write Commands for the four groups are listed together with tables of the associated parameters.

5.1 Unsigned-char-Variables

5.1.1 HART-Command 128 : Read unsigned-char-Variable		Revision
Request Data Bytes	#0 Slot-Index	
Response Data Bytes	#0 Slot-Index #1 Contents of the Slot	
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count 6 Transmitter Specific Command Error -> Invalid Slot Number	

5.1.2 HART-Command 129 : Write unsigned-char-Variable		Revision
Request Data Bytes	#0 Slot-Index #1 Contents of the Slot	
Response Data Bytes	#0 Slot-Index #1 Contents of the Slot	
Response Codes	0 No Command Specific Error 2 Invalid Selection 3 Parameter too Large 5 Incorrect Byte Count 6 Transmitter Specific Command Error -> Invalid Slot Number	

5.1.3 Table of „unsigned char“ –Variables

Slot-Number	Parameter	Code	Meaning	Revision
0	Converter	0 1	SWIRL ST / SR VORTEX VT / VR	
2	SWIRL Meter Size	0 1 2 3 4 5 6 7 8 9 10 11	15 mm 1/2 in 20 mm 3/4 in 25 mm 1 in 32 mm 1-1/4in 40 mm 1-1/2in 50 mm 2 in 80 mm 3 in 100 mm 4 in 150 mm 6 in 200 mm 8 in 300 mm 12 in 400 mm 16 in	
3	VORTEX Meter Size	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	D 15mm 0.5in D 25mm 1in D 40mm 1.5in D 50mm 2in D 80mm 3in D 100mm 4in D 150mm 6in D 200mm 8in D 250mm 10in D 300mm 12in A 15mm 0.5in A 25mm 1in A 40mm 1.5in A 50mm 2in A 80mm 3in A 100mm 4in A 150mm 6in A 200mm 8in A 250mm 10in A 300mm 12in	
20	Operating Mode	0 1 2 3 4 5 6 7 8 9 10 11	Liquid Qv Liquid Qm (S) Liquid Qm (S,T) Liquid Qm (V,T) Gas Qv Gas Normal Qn (pT) Gas Std Qs (pT) Gas Normal Qn(KmpF) Gas Mass Qm (pT) Gas Mass Qm (S) Sat. Steam Qm Sat. Steam Qv	

21	Normal/Standard Conditions	0 1 2 3	1.0133 bara 0C 1.0133 bara 20C 14.7 psi-abs 60F 14.7 psi-abs 70F	
50	Language	0 1	German English	
51 52	Primary display Multiplex display	0 1 2 3 4 5	Q Operating Mode Qv Operate Percent Totalizer Temperature Frequency	
54	Multiplex display	0 1	Off ON	
60	Units 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	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	
61	Units Qm (mass)	70 71 72 73 74 75 76 77 78 79 80 81 82 83	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	

62	Units Totalizer Qv	41 43 112 40 42 46	l m³ ft³ ugl igl bbl	
63	Units Totalizer Qm	60 61 62 63	g kg t lb	
64	Units Temperature	32 33 35	°C °K °F	
65	Units Pressure	7 6 237 8	bar PSI MPA mbar	
66	Units Density	95 91 97 96 92 94 93	g/ml g/cm³ g/l kg/l kg/m³ lb/ft³ lb/ugl	
100	Hardware Configuration	0 1 2 3 4	I/HART I/HART/ Pulse_Bin I/HART/ Q_Alarm I/HART/ T_Alarm I/HART/ S_Alarm	
130	PT100-Sensor	0 1	Off On	
160	k-Linearization	0 1	Average 5 Points	
161	Enable K-Set	0 1 2	Gas Liquid Liquid &Gas	
162	Boot Page	0 1 2	Page 0 Standard Spectrum	
163	Fmin	0 1 2 3 4 5 6 7 8 9 10	954 Hz 477 Hz 238 Hz 119 Hz 60 Hz 30 Hz 15 Hz 8 Hz 4 Hz 2 Hz 1 Hz	

164	Fmax	0 1 2 3 4 5 6 7 8 9 10	2500 Hz 954 Hz 477 Hz 238 Hz 119 Hz 60 Hz 30 Hz 15 Hz 8 Hz 4 Hz 2 Hz	
165	Freq Spec Balance	0 1 2 3	OFF 1 2 3	
166	BP Arithmet	0 1 2	1.0 Sek 2.0 Sek 5.0 Sek	

5.2 Unsigned-int-Variables

5.2.1 HART-Command 130 : Read-unsigned int-Variable		Revision
Request Data Bytes	#0 Slot-Index	
Response Data Bytes	#0 Slot-Index #1 Units code #2..#3 Content of the Slot	
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count 6 Transmitter Specific Command Error -> Invalid Slot Number	

5.2.2 HART-Command 131 : Write unsigned-int-Variable		Revision
Request Data Bytes	#0 Slot-Index #1 Units code Contents of the Slot #2 MSB #3 LSB	
Response Data Bytes	#0 Slot-Index #1 Units code Contents of the Slot #2 MSB #3 LSB	
Response Codes	0 No Command Specific Error 2 Invalid Selection -> Invalid units code 3 Parameter Too Large -> Parameter too large 4 Parameter Too Small -> Parameter too small 5 Incorrect Byte Count -> Number of data bytes not equal to 4 6 Transmitter Specific Command Error -> Invalid Slot Number	
Comments	The units code received from the master is ignored during the processing of the command and the valid, set code is returned with response	

5.2.3 Tables of „unsigned int“-Variables

Slot-Number	Parameter	Meaning	Revision
0	Instrument No.	Units None = 250 Minimum = 0 Maximum = 65535	
80	Totalizer overflow counter	Units None = 250 Read only	
140	Mains interrupt counter	Units None = 250 Read only	
160	Gain Max	Units None = 250 Minimum = 1024 Maximum = 2047	
161	Gain Vib Trigger	Units None = 250 Minimum = 1024 Maximum = 2047	
162	Low Dis Gain	Units None = 250 Minimum = 1024 Maximum = 2047	
163	High Dis Gain	Units None = 250 Minimum = 1024 Maximum = 2047	

5.3 Float-Variables

5.3.1 HART-Command 132 : Read float-Variable		Revision
Request Data Bytes	#0 Slot-Index	
Response Data Bytes	#0 Slot-Index #1 Units code #2..#5 Contents of the Slot	
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count 6 Transmitter Specific Command Error -> Invalid Slot Number	

5.3.2 HART-Command 133 : Write float-Variable		Revision
Request Data Bytes	#0 Slot-Index #1 Units code #2..#5 Contents of the Slot	
Response Data Bytes	#0 Slot-Index #1 Units code #2..#5 Contents of the Slot	
Response Codes	0 No Command Specific Error 2 Invalid Selection -> Invalid units code 3 Parameter Too Large -> Parameter too large 4 Parameter Too Small -> Parameter too small 5 Incorrect Byte Count -> Number of data bytes not equal to 4 6 Transmitter Specific Command Error -> Invalid Slot Number	
Comments	The units code received from the master is ignored during the processing of the command and the valid, set code is returned with response	

5.3.3 Table of „Float“-Variables

Slot-Number	Parameter	Meaning				Revision
0	Qmax DN operate	Units				
		l/s	24	ugl/h	136	
		l/min	17	mgl/d	23	
		l/h	138	igps	137	
		m3/s	28	igpm	18	
		m3/min	131	igph	30	
		m3/h	19	igpd	31	
		m3/d	29	bbl/s	132	
		ft/s	26	bbl/min	133	
		ft/min	15	bbl/h	134	
		ft/h	130	bbl/d	135	
		ft/d	27			
		ugl/s	22			
		ugl/min	16			
		Comments:	Qmax DN is a read only variable!			
1	Qmax	Units Function of the Operating Mode Minimum = Maximum =				
2	Qmin operate	Units				
		l/s	24	ugl/h	136	
		l/min	17	mgl/d	23	
		l/h	138	igps	137	
		m3/s	28	igpm	18	
		m3/min	131	igph	30	
		m3/h	19	igpd	31	
		m3/d	29	bbl/s	132	
		ft/s	26	bbl/min	133	
		ft/min	15	bbl/h	134	
		ft/h	130	bbl/d	135	
		ft/d	27			
		ugl/s	22			
		ugl/min	16			
21	Reference temperature	Units				
		°C	32			
		°K	33			
		°F	35			
		Minimum =	-200 °C			
		Maximum =	500 °C			

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22	Pressure P-operate (Poper abs)	Units bara = 7 PSIA=6 Minimum = 0 bara Maximum = 100 bara	
23	Normal factor	Units 250 250=None Minimum = 0.001 Maximum = 1000	
26	Normal density	Units g/ml 95 g/cm³ 91 g/l 97 kg/l 96 kg/m³ 92 lb/ft³ 94 lb/ugl 93 Minimum = 0.0 kg/l Maximum = 0.1 kg/l	
27	Reference density	Units g/ml 95 g/cm³ 91 g/l 97 kg/l 96 kg/m³ 92 lb/ft³ 94 lb/ugl 93 Minimum = 0.0 kg/l Maximum = 1000 kg/l	
28 29	Volume expansion coefficient Density change coefficient	Units %/10/K 253=Special Minimum = 0.0 Maximum = 10.0	
90	Pulse factor	Units 1/ totalizer units Minimum = 0.001 / totalizer units Maximum = 1000 / totalizer units	
91	Pulse width	Units Milliseconds = 253 (Special) Minimum = 1 ms Maximum = 256 ms	

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100	Damping	Units s = 51 Minimum = 1 s Maximum = 100 s	
101	Current output : Upper alarm current	Units mA = 39 Minimum = 21.0 mA Maximum = 23.0 mA	
110	Max Q-Alarm Upper alarm limit for flowrate	Units % = 57 Minimum = 0 % Maximum = 100 %	
111	Min Q-Alarm Lower alarm limit for flowrate	Units % = 57 Minimum = 0 % Maximum = 100 %	
112	Max T-Alarm Upper alarm limit for temperature	Units °C 32 K 35 °F 33 Minimum = -50 °C (basic unit) Maximum =Units +180 °C (basic unit)	
113	Min T-Alarm Lower alarm limit for temperature	Units °C 32 K 35 °F 33 Minimum = -50 °C (basic unit) Maximum = Units +180 °C (basic unit)	
160	Current output adjustment: 4mA	Units mA = 39 Minimum = 2.0 mA Maximum = 6.0 mA	
161	Current output adjustment: 20mA	Units mA = 39 Minimum = 10.0 mA Maximum = 30.0 mA	

170	Temperature adjustment	Units °C K °F Minimum = Maximum =	 32 35 33 -10 °C (basic unit) +10 °C (basic unit)	
171	Input minimum	Units 250 Minimum = Maximum =	 250=None 0.0 0.99	
172	Vib/Qv Faktor	Units 250 Minimum = Maximum =	 250=None 0.0 0.99	
173	Low Dis Frequenz	Units Hz = 38 Minimum = Maximum =	 0.0 Hz 5000 Hz	
174	High Dis Frequenz	Units Hz = 38 Minimum = Maximum =	 0.0 Hz 5000 Hz	
191	Average K-Factor –Liquid Fl-km	Units 1/m3 = 43 Minimum = Maximum =	 1.0 1/m3 999999.02 1/m3	
192 : 196	K-Factor –Liquid l_k1 : l_k5	Units 1/m3 = 43 Minimum = Maximum =	 1.0 1/m3 999999.02 1/m3	
197 : 201	Frequency-Factor –Liquid f_k1 : f_k5	Units Hz = 38 Minimum = Maximum =	 0.0; f_k(n-1) Hz f_k(n+1); 2500 Hz	
202	Average K-Factor –Gas g-km	Units 1/m3 = 43 Minimum = Maximum =	 1.0 1/m3 999999.02 1/m3	
203 : 207	K-Factor –Gas g_k1 : g_k5	Units 1/m3 = 43 Minimum = Maximum =	 1.0 1/m3 999999.02 1/m3	

208 : 212	Frequency-Factor –Gas g_k1 : g_k5	Units Hz = 38 Minimum = 0.0; f_k(n-1) Hz Maximum = f_k(n+1); 2500 Hz	

5.4 String-Variables

5.4.1 HART-Command 134 : Read string-Variable		Revision
Request Data Bytes	#0 Slot-Index	
Response Data Bytes	#0 Slot-Index #1 String length #2.. Contents of the Strings	
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count	

5.4.2 HART-Command 135 : Write string-Variable		Revision
Request Data Bytes	#0 Slot-Index #1 String length #2.. Contents of the Strings	
Response Data Bytes	#0 Slot-Index #1 String length #2..#5 Contents of the Strings	
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count -> Number of data bytes does not agree with string buffer	
Comments		

5.4.3 Table of the „string-Variables

Slot-Number	Parameter	Meaning	Revision
160	Order number	String 16 characters	

5.5 Condensed Overview of the Slot-Commands

Menu Title	Variable Type	Command		Slot	Revision
		Read	Write		
Primary	unsigned char	128	129	0	
SWIRL meter size	Unsigned char	128	129	2	
VORTEX meter size	Unsigned char	128	129	3	
Operating Mode	Unsigned char	128	129	20	
Normal conditions	Unsigned char	128	129	21	
Language	Unsigned char	128	129	50	
Primary display	Unsigned char	128	129	51	
Multiplex display	Unsigned char	128	129	52	
Multiplex display	Unsigned char	128	129	54	
Units Qvol	Unsigned char	128	129	60	
Units Qm	Unsigned char	128	129	61	
Units totalizer Qv	Unsigned char	128	129	62	
Units totalizer Qm	Unsigned char	128	129	63	
Units temperature	Unsigned char	128	129	64	
Units density	Unsigned char	128	129	66	
Hardware configuration	Unsigned char	128	129	100	
PT100-Sensor	Unsigned char	128	129	130	
k-Linearization	Unsigned char	128	129	160	
Enable K-Set	Unsigned char	128	129	161	
Boot Page	Unsigned char	128	129	162	
Fmin	Unsigned char	128	129	163	
Fmax	Unsigned char	128	129	164	
FreqSpecBalance	Unsigned char	128	129	165	
BP Arithmet	Unsigned char	128	129	166	
Instrument No.	unsigned int	130	131	0	
Totalizer overflow counter	unsigned int	130		80	
Mains interrupt counter	unsigned int	130		140	
Gain Max	unsigned int	130	131	160	
Gain Vib Trigger	unsigned int	130	131	161	
Low Dis Gain	unsigned int	130	131	162	
High Dis Gain	unsigned int	130	131	163	
Qmax DN operate	float	132	133	0	
Qmax	float	132	133	1	
Qmin operate	float	132	133	2	
Reference temperature	float	132	133	21	
Pressure P- operate absolute	float	132	133	22	
Normal factor	float	132	133	23	
Normal density	float	132	133	26	
Reference density	float	132	133	27	
Volume expansion coefficient	float	132	133	28	
Density change coefficient	float	132	133	29	
Pulse factor	float	132	133	90	
Pulse width	float	132	133	91	
Damping	float	132	133	100	

HART-Protocol		
Prepared by Name: **Harry Plotzki** Date: **17 Jul. 00**	Instrument: **TRIO WIRL** Software: **Standard Software** Designation: **D699F004U01 A.11**	Revision: **6** Name: **Andreas Thöne** Date: **08.04.02**

Menu Title	Variable Type	Command		Slot	Revision
		Read	Write		
Current output upper alarm current	float	132	133	101	
Max. Q-Alarm	float	132	133	110	
Min. Q-Alarm	float	132	133	111	
Max. T-Alarm	float	132	133	112	
Min. T-Alarm	float	132	133	113	
Adjust 4 mA	float	132	133	160	
Adjust 20mA	float	132	133	161	
Temperature adjustment	float	132	133	170	
Input Minimum	float	132	133	171	
Vib/Qv Faktor	float	132	133	172	
Low Dis Frequenz	float	132	133	173	
High Dis Frequenz	float	132	133	174	
Average K-Factor-Liquid	float	132	133	191	
K-Factor-Liquid 1-5	float	132	133	192-196	
Freq.-Factor-Liquid 1-5	float	132	133	197-201	
Average K-Factor-Gas	float	132	133	202	
K-Factor-Gas	float	132	133	203-207	
Freq. –Factor-Gas 1-5	float	132	133	197-201	
Order Number	string16	134	135	160	

Comments:

1. In addition to the „normal“ defined interrelationships (Meter Size -> Qmax DN etc.), if any changes are made to the *Pulse width*, the *Pulse factor* or Qmax. the *first two* parameters must be read again, in order to assure that the converter did not assign new values.

6 Other User Accessible Commands

In this Section all the remaining Commands are listed, whether they are Universal, Common Practice or Slot-Commands.

6.1 HART-Command 140 : Reset Totalizer and Overflow	Revision
Request Data Bytes	none
Response Data Bytes	none
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count

6.2 HART-Command 141 : Reset Error Register and Mains Interrupt Counter	Revision
Request Data Bytes	none
Response Data Bytes	none
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count

6.3 HART-Command 150 : Read DSP Standard Data or Spectrum

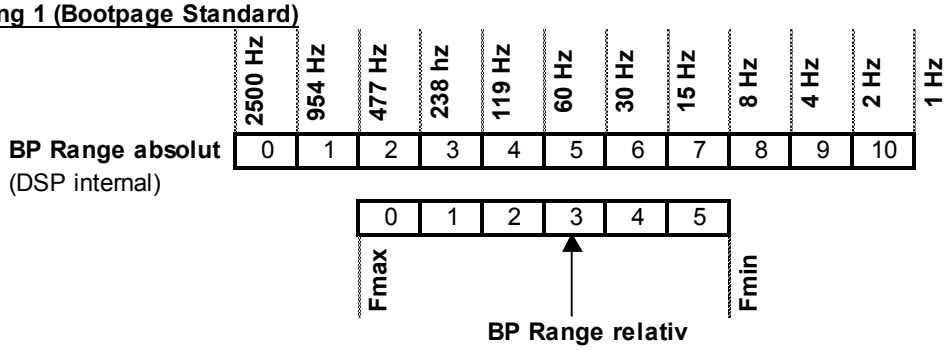
Note: Response data are dependant of the selected bootpage

Request Data Bytes	None				
	Byte	**Name**	**Data Type**	**Value Rane**	**Meaning**
Response Data Bytes Bootpage Standard (unsigned char Wert 1)	#0,#1	Amplificatiom	unsigned int	1024 up to 2047	1024 up to 2047
	#2,#3	Temp-Meas Count	unsigned int	0 up to 32768	-
	#4,#5	Freq-Meas Count	unsigned int	0 up to 32768	-
	#6,#7	BP-Status	unsigned int	0 up to 7	0:"No AD-Input" 1:"Vibrate Cut Off" 2:"IniBP-Range" 3:"Range Flws Freq" 4:"IniVib In Meas." 5:" Vib In Meas." 6:"IniTmp In Meas." 7:" Tmp In Meas."
	#8,#9	Periods	unsigned int	0 up to 32768	-
	#10,#11	Samples	unsigned int	0 up to 32768	-
	#12,#13	Temperature	unsigned int	0 up to 32768	-
	#14.#15	AD input	unsigned int	0 up to 32768	-
	#16,#17	BP output	unsigned int	0 up to 32768	-
	#18,#19	BP-Freq area relative (see note 1)	unsigned int	0 up to 5	actual selected relative bandwith area
	#20,#21	Vib output	unsigned int	0 up to 32768	-
Response Data Bytes Bootpage Spektrum (unsigned char Wert 2)					
	#0,#1	BP0 output	unsigned int	0 up to 32768	-
	#2,#3	BP1 output	unsigned int	0 up to 32768	-
	#4,#5	Freq-Meas Count	unsigned int	0 up to 32768	-
	#6,#7	BP-Status	unsigned int	0 up to 7	0:"No AD-Input" 1:"Vibrate Cut Off" 2:"IniBP-Range" 3:"Range Flws Freq" 4:"IniVib In Meas." 5:" Vib In Meas." 6:"IniTmp In Meas." 7:" Tmp In Meas."
	#8,#9	Periods	unsigned int	0 up to 32768	-

HART-Protocol			
Prepared by Name: **Harry Plotzki** Date: **17 Jul. 00**	Instrument: **TRIO WIRL** Software: **Standard Software** Designation: **D699F004U01 A.11**	Revision: **6** Name: **Andreas Thöne** Date: **08.04.02**	

	#10,#11	Samples/Periods	unsigned int	0 up to 32768	-
	#12,#13	BP2-Ausgang	unsigned int	0 up to 32768	-
	#14.#15	AD-Eingang	unsigned int	0 up to 32768	-
	#16,#17	BP3-Ausgang	unsigned int	0 up to 32768	-
	#18,#19	BP4-Ausgang	unsigned int	0 up to 32768	-
	#20,#21	BP5-Ausgang	unsigned int	0 up to 32768	-
Response Codes	0 No Command Specific Error 5 Incorrect Byte Count				

Bemerkung 1 (Bootpage Standard)



BP Range absolut = Offset **Fmax + BP Range relativ**

Beispiel: 5 = 2 + 3 "Fmax" erreichbar über HART Command 128 Slot 164

Bemerkung 2 (Bootpage Spektrum)

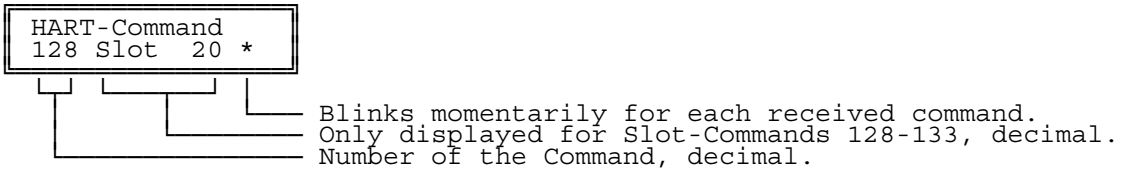
Zuordnung der Bandpass-Ausgänge **BP0** bis **BP5** über Auslesen von **Fmax** (HART Command 128 Slot 164) und **Fmin** (HART Command 128 Slot 163) möglich. Minimal wird ein Bandpass, maximal 6 Bandpässe ausgeben

7 Troubleshooting Hart

When the HART-Communication does not function the following points should be checked:

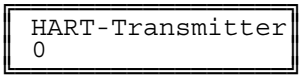
1. The converter must have a HART-Capable current output module installed.
2. The load on the current output circuit must be between 250 and 500 Ohm.
3. The Instrument Address in the Data Link menu.

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 mA_{pp}, the voltage across a 500 Ohm load (1 mA_{pp} * 500 Ohm) is 500 mV_{pp}.
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.

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