ABB MEASUREMENT & ANALYTICS | INTERFACE DESCRIPTION

VortexMaster FSV400, SwirlMaster FSS400

Vortex and Swirl flowmeter

HART Field Device Specification
Valid from software version
01.00.00

Measurement made easy

FSV430
FSV450
FSS430
FSS450

Introduction

The robust design of ABB's vortex flowmeters provides high performance and reliability in liquid, gas and steam measurements.
Swirl flow meters combine the measuring dynamics of turbine meters with the robustness and reliability of Vortex flow metering by requiring shortest upstream / downstream distances.

Additional Information

Additional documentation on VortexMaster FSV430, FSV450 and SwirlMaster FSS430, FSS450 is available for download free of charge at www.abb.com/flow. Alternatively simply scan this code:

FSV430 FSV450 FSS430 FSS450

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1 Introduction

The ABB, FSX400, revision 1 complies with HART protocol revision 7.2. This document specifies all the device specific features and documents HART protocol implementation details (for example the Engineering Unit Codes supported). The functionality of this field device is described sufficiently to allow its proper application in a process and its complete support in HART capable host applications.

This specification is designed to complement other documentation (for example the FSX400 operating instruction) by providing a complete, unambiguous description of this field device from a HART communication perspective.

The specification is designed to be a technical reference for HART capable host application developers, system integrators and knowledgeable end users. It also provides functional specifications (for example commands, enumerations and performance requirements) used during field device development, maintenance and testing. This document assumes the reader is familiar with HART protocol requirements and terminology.

Abbreviations

Abbreviation	Definition
ADC	Analog to Digital Converter
CPU	Central Processing Unit (of microprocessor)
DAC	Digital to Analog Converter
EEPROM	Electrically-Erasable Read-Only Memory
PT100	100-ohm Platinum (temperature sensor)
PT1000	1000-ohm Platinum (temperature sensor)
ROM	Read-Only Memory
RAM	Random-Access Memory
RTD	Resistance Temperature Detector

References

- HART Smart Communications Protocol Specification (HCF_SPEC-12).
- Universal Command Specification (HCF_SPEC-127).
- Common Practice Command Specification (HCF_SPEC-151).

2 Device Identification

Device identification	
Manufacturer name	ABB Engineering Ltd. (Shanghai)
Manufacture ID-code	26, (1A Hex)
HART protocol revision	7.2
Number of device variables	None
Physical layers supported	FSK
Physical device category	Transmitter, Non-DC-isolated bus device
Model name(s)	FSX400
Device type code	156, (9C Hex)
Device revision	2

The FSX400 is a designed to mount on a DIN-rail. The name plate is located opposite the field terminals and indicates the model name and revision.

3 Product overview

The FSX400 consists of the vortex and swirl flow meters. The measuring principle is based on detecting the frequency of vortices behind a bluff body (VORTEX) and the rotation frequency of the medium one conducting body (TWIST) by piezoelectric sensors.

4 Product interfaces

Process interfaces

Sensor input channels

The main sensor input provides five terminals, two terminals for two kinds of temperature sensor: PT100 or PT1000. Use switch to select which kind of temperature sensor will be used. Another three terminals for piezo sensor.

Host interface

Analog output 1

The transformer has a two-wire design. This means that the supply voltage and the measuring signal (4 to 20 mA) are routed on the same wire.

This is the only output from this transmitter, representing the process flow measurement, linearized and scaled according to the configured range of the instrument. This output corresponds to the primary variable. HART communication is supported on this loop.

Local interfaces

Local controls and displays

This device has no external local controls or displays.

Internal jumpers and switches

Pin No. of SW1	Function	Switch state	Description
SW 1.1	Data access right selection	On	0: Data read only right for HMI and HART.
		Off	1: Data read/write right for HMI and HART.
SW 1.2	Replace mode (nv backup) on or off	On	0: Enable replace mode.
		Off	1: Disable replace mode.
SW 1.3	Replace mode (nv backup) direction	On	0: Direction is CB to FE.
		Off	1: Direction is FE to CB.
SW 1.4	Current out alarm mode selection source	On	0: Current out alarm mode selected by pin SW 1.5
		Off	1: Current out alarm mode selected by software
SW 1.5	Current out alarm mode selection	On	0: Low alarm mode.
		Off	1: High alarm mode.
SW 1.6	NV format	On	0: Enable NV format during system stating up.
		Off	1: Disable NV format

Device Malfunction

The direction of indication of a detected malfunction by the analog current output is user-selectable to up or down, by means of a two-position jumper inside the instrument. Refer to the installation manual for details. See also **Analog output 1** on page 4.

Write Protection

A second jumper inside the instrument provides a write-protect function. When the jumper is absent, ‘write’ and ‘command’ commands are disabled. Refer to the installation manual for details. See also **Power up** on page 115.

5 Device variables

This field device does not expose any device variables.

6 HART variables

Factory settings of the HART variables PV, SV, TV and QV depending on the operating mode

The following table shows the factory assignment of the process variables to the HART variables (PV, SV, TV or Qv) depending on the operating mode.

Operating mode	HART variables			
	PV	**SV**	**TV**	**QV**
Liquid Volume	Operating volume	Temperature	Totalizer volumes	–
Liquid Std/Norm Vol.	Standard volume	Temperature	Meter standard volume	Operating volume
Liquid Mass	Mass	Temperature	Totalizer mass	Operating volume
Liquid Energy	Energy	Temperature	Totalizer energy	Operating volume
Gas Act. Volume	Operating volume	Temperature	Totalizer volumes	–
Gas Std/Norm Vol.	Standard volume	Temperature	Meter standard volume	Operating volume
Gas Mass	Mass	Temperature	Totalizer mass	Operating volume
Gas Power	Energy	Temperature	Totalizer energy	Operating volume
Bio Act. Volume	Partial operating volume	Temperature	Meter partial volume	Operating volume
Bio Std/Norm Vol.	Standard partial volume	Temperature	Meter standard partial volume	Standard volume
Steam Act. Volume	Operating volume	Temperature	Totalizer volumes	–
Steam/Water Mass	Mass	Temperature	Totalizer mass	Operating volume
Steam/Water Energy	Energy	Temperature	Totalizer energy	Mass

Selection options for the HART variables depending on the respective operating mode

The following table shows the possible process variables which can be assigned to the HART variables (PV, SV, TV or Qv) depending on the operating mode. The process variables can be assigned to the HART variables via the Device Type Manager or the EDD / FDI package in the Field Information Manager (FIM tool).

Operating mode	PV	Additional, selectable dynamic HART variable							
Liquid Volume	Operating volume	Temperature	Totalizer volumes	–	–	–	–	–	–
Liquid Std/Norm Vol.	Standard volume	Temperature	Totalizer standard volume	Operating volume	Totalizer volumes	–	–	–	–
Liquid Mass	Mass	Temperature	Totalizer mass	Operating volume	Totalizer volumes	–	–	–	–
Liquid Energy	Energy	Temperature	Totalizer energy	Operating volume	Totalizer volumes	Mass	Totalizer mass	–	–
Gas Act. Volume	Operating volume	Temperature	Totalizer volumes	–	–	–	–	–	–
Gas Std/Norm Vol.	Standard volume	Temperature	Totalizer standard volume	Operating volume	Totalizer volumes	–	–	–	–
Gas Mass	Mass	Temperature	Totalizer mass	Operating volume	Totalizer volumes	–	–	–	–
Gas Power	Energy	Temperature	Totalizer energy	Operating volume	Totalizer volumes	Standard volume	Totalizer standard volume	–	–
Bio Act. Volume	Partial operating volume	Temperature	Totalizer partial volume	Operating volume	Totalizer volumes	–	–	–	–
Bio Std/Norm Vol.	Standard partial volume	Temperature	Totalizer Standard Partial-volume	Operating volume	Totalizer volumes	Standard volume	Totalizer standard volume	Partial operating volume	Totalizer partial volume
Steam Act. Volume	Operating volume	Temperature	Totalizer volumes	–	–	–	–	–	–
Steam/Water Mass	Mass	Temperature	Totalizer mass	Operating volume	Totalizer volumes	–	–	–	–
Steam/Water Energy	Energy	Temperature	Totalizer energy	Operating volume	Totalizer volumes	Mass	Totalizer mass	–	–

7 Status information

Device status

Command 48 on page 27 response data byte 0 to 5 specify device status. The bit (in the table below) is set to indicate the specific status. Reserved bits are always set to 0.

Bytes	Bits order	Description
0	0	Sig. Sensor fault
	1	Int. T sensor fault
	2	Vibration sensor fault
	3	AI out of range
	4	Max alarm flow rate
	5	Max alarm int. Temp
	6	External output cutoff
	7	Max alarm pressure
1	8	Reserved.
	9	Reserved.
	10	Min alarm flow rate
	11	Min alarm int. Temp
	12	Current output saturated
	13	Min alarm pressure
	14	Reserved.
	15	Reserved.
2	16	Bad SNR
	17	Sensor NV error
	18	Sensor not calibrated
	19	Sync. signal error
	20	Sensor communication error
	21	Reserved.
	22	Reserved.
	23	Transmitter NV error
3	24	AI communication error
	25	Pulse output cutoff
	26	Re. out of range
	27	Reserved.
	28	Reserved.
	29	Reserved.
	30	Wrong steam type
	31	Maintenance warning

Bytes	Bits order	Description
4	32	Voltage warning
	33	Min alarm housing temp
	34	Max alarm housing temp
	35	Flow rate cutoff
	36	Flow rate > 103%
	37	Data simulated
	38	Alarm simulated
	39	Fixed current output
5	40	Current output fault
	41	Output read back high failure
	42	Output read back low failure
	43	Nv replace warning
	44	Sensor RAM fault
	45	Totalizer stopped
	46	Reserved.
	47	No HART input

Extended device status

Command 48 on page 27 response data byte 6 specify extended device status.

Bits	Description
0	Maintenance required. This bit is set to indicate that, while the device has not malfunctioned, the field Device requires maintenance.
1	Device variable alert. This bit is set if any device variable is in an alarm or warning state. The host Should identify the device variable(s) causing this to be set using the device variable status indicators.
2	Critical power failure. For devices that can operate from stored power. This bit is set when that power is Becoming critically low. For example, a device scavenging power loosing that power source would set this Bit. Devices must be able to sustain their network connection for at least 15 minutes from the when this bit is Set. A device may begin gracefully disconnecting from the network if its power level drops too low.
3 to 7	Reserved

Additional device status

Command 48 on page 27 response data byte14 specify the operation mode of this field device.

Bytes	Enum	Description
14	0	Liquid volume
	1	Liquid normal volume
	2	Liquid mass
	3	Liquid power
	4	Gas actual volume
	5	Gas standard volume
	6	Gas mass
	7	Gas power
	8	Biogas actual Volume
	9	Biogas standard Volume
	10	Steam actual Volume
	11	Water/steam mass
	12	Water/steam power
15 to 24	Reserved.	

8 Universal commands

Command 0: Read transmitter unique identifier

Command 0	Description		Offset	Size	Data type
Request data bytes	None				
Response data bytes	1	Device type code for expansion	#0	1	Unsigned-8
	2	Manufacturer identification code	#1	1	Unsigned-8
	3	Manufacturer device type	#2	1	Unsigned-8
	4	Number of request preambles	#3	1	Unsigned-8
	5	Revision level of universal command	#4	1	Unsigned-8
	6	Revision level of transmitter document	#5	1	Unsigned-8
	7	Software revision level	#6	1	Unsigned-8
	8	Hardware revision level	#7	1	Unsigned-8
	9	Flags, none defined at this time	#8	1	Unsigned-8
	10	Device identification number, 24 Bit, MSB	#9	1	Unsigned-8
	11	Device identification number, 24 Bit	#10	1	Unsigned-8
	12	Device identification number, 24 Bit, LSB	#11	1	Unsigned-8
	13	Minimum number of preambles	#12	1	Unsigned-8
	14	Maximum number of device variables	#13	1	Unsigned-8
	15	Configuration change counter	#14	2	USIGN16
			#15		
	16	Extended field device status	#16	1	
	17	Manufacturer identification code	#17	2	USIGN16
			#18		
	18	Private label distributor code	#19	2	USIGN16
			#20		
		Device profile	#21	1	Unsigned-8

Command 0	Code	Class	Description
Response code	0	success	No command –specification error
	1 to 127		Undefined

Command 1: Read primary variable

Command 1	Description		Offset	Size	Data type
Request data bytes	None				
Response data bytes	1	Primary variable units code	#0	1	Unsigned-8
	2	Primary variable	#1 to #4	4	Float

Command 1	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 5		Undefined
	6	error	Command–specification error
	7		Undefined
	8	warning	Update failure
	9 to 15		Undefined
	16	error	Access restricted
	17 to 127		Undefined

Command 2: Read current and percent of range

Command 2	Description		Offset	Size	Data type
Request data bytes	None				
Response data bytes	1	Primary variable loop current (mA)	#0 to #3	4	Float
	2	Primary variable percentage of range	#4 to #7	4	Float

Command 2	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 5		Undefined
	6	error	Command–specification error
	7		Undefined
	8	warning	Update failure
	9 to 15		Undefined
	16	error	Access restricted
	1 to 127		Undefined

… 8 Universal commands

Command 3: Read all dynamic variables and current

Command 3	Description			Offset	Size	Data type
Request data bytes	None					
Response data bytes	1	Analog output current mA, IEEE 754		#0 to #3	4	Float
	2	Primary variable units code	Refer to common table specification	#4	1	Unsigned-8
	3	Primary variable value		#5 to #8	4	Float
	4	Secondary variable units code	Refer to common table specification	#9	1	Unsigned-8
	5	Secondary variable value		#10 to #13	4	Float
	6	Tertiary variable units code	Refer to common table specification	#14	1	Unsigned-8
	7	Tertiary variable value		#15 to #18	4	Float
	8	Quaternary variable units code	Refer to common table specification	#19	1	Unsigned-8
	9	Quaternary variable value		#20 to #23	4	Float

Command 3	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 5		Undefined
	6	error	Command–specification error
	7		Undefined
	8	warning	Update failure
	9 to 15		Undefined
	16	error	Access restricted
	1 to 127		Undefined

Command 6: Write polling address

Command 6	Description			Offset	Size	Data type
Request data bytes	0	Polling address of device	0 ~ 15	#0	1	Unsigned-8
	1	Loop current mode	0 enable 1 disable	#1	1	Unsigned-8
Response data bytes	0	Polling address of device		#0	1	Unsigned-8
	1	Loop current mode		#1	1	Unsigned-8

Command 6	Code	Class	Description
Response code	0	success	No command–specification error
	1		Undefined
	2	error	Invalid polling address
	3 to 4		Undefined
	5	error	Too few data bytes received
	6	error	Command–specification error
	7	error	In write protected mode
	8 to 11		Undefined
	12	error	Invalid mode selection
	13 to 15		Undefined
	16	error	Access restricted
	17 to 31		Undefined
	32	error	Busy
	33 to 127		Undefined

… 8 Universal commands

Command 7: Read loop configuration

Command 7	Description			Offset	Size	Data type
Request data bytes	0	Polling address of device		#0	1	Unsigned-8
	1	Loop current mode		#1	1	Unsigned-8
Response data bytes	0	Polling address of device	0 ~ 15	#0	1	Unsigned-8
	1	Loop current mode	0 enable	#1	1	Unsigned-8
			1 disable			

Command 7	Code	Class	Description
Response code	0	success	No command–specification error
	1		Undefined
	2	error	Invalid polling address
	3 to 4		Undefined
	5	error	Too few data bytes received
	6	error	Command–specification error
	7	error	In write protected mode
	8 to 11		Undefined
	12	error	Invalid mode selection
	13 to 15		Undefined
	16	error	Access restricted
	17 to 31		Undefined
	32	error	Busy
	33 to 127		Undefined

Command 8: Read dynamic variables classifications

Command 8	Description		Offset	Size	Data type
Request data bytes	None				
Response data bytes	0	Primary variable value classifications	#0	1	Unsigned-8
	1	Secondary variable value classifications	#1	1	Unsigned-8
	2	Tertiary variable value classifications	#2	1	Unsigned-8
	3	Quaternary variable value classifications	#3	1	Unsigned-8

Command 8	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 15		Undefined
	16	error	Access restricted
	17 to 127		Undefined

Command 9: Read device variables with status

Command 9	Description			Offset	Size	Data type
Request data bytes	0	Slot0	0 to 7	#0	1	Unsigned-8
	1	Slot1	0 to 7	#1	1	Unsigned-8
	2	Slot2	0 to 7	#2	1	Unsigned-8
	3	Slot3	0 to 7	#3	1	Unsigned-8
	4	Slot4	0 to 7	#4	1	Unsigned-8
	5	Slot5	0 to 7	#5	1	Unsigned-8
	6	Slot6	0 to 7	#6	1	Unsigned-8
	7	Slot7	0 to 7	#7	1	Unsigned-8
Response data bytes	0	Extended device status	0 Default 1 Maintenance required 2 Device variable alert 4 Critical power failure	#0	1	Unsigned-8
	1	slot0		#1	1	Unsigned-8
	2	Device variable classification		#2	1	Unsigned-8
	3	PV unit		#3	1	Unsigned-8
	4	PV		#4	4	Float
	5	PV status		#5	1	Unsigned-8
	6	Slot1		#6	1	Unsigned-8
	7	Device variable classification		#7	1	Unsigned-8
	8	PV unit		#8	1	Unsigned-8
	9	Actual output value		#9	4	Float
	10	PV status		#10	1	Unsigned-8
	11	Slot2		#11	1	Unsigned-8
	12	Device variable classification		#12	1	Unsigned-8
	13	SV unit		#13	1	Unsigned-8
	14	SV		#14	4	Float
	15	SV status		#15	1	Unsigned-8
	16	Slot3		#16	1	Unsigned-8
	17	Device variable classification		#17	1	Unsigned-8
	18	TV unit		#18	1	Unsigned-8
	19	TV		#19	4	Float
	20	TV status		#20	1	Unsigned-8
	21	Slot4		#21	1	Unsigned-8
	22	Device variable classification		#22	1	Unsigned-8
	23	QV unit		#23	1	Unsigned-8
	24	QV		#24	4	Float
	25	QV status		#25	1	Unsigned-8
	26	Slot5		#26	1	Unsigned-8
	27	Device variable classification		#27	1	Unsigned-8
	28	QV unit		#28	1	Unsigned -8
	29	QV		#29	4	Float

… 8 Universal commands

… Command 9: Read device variables with status

Command 9	Description		Offset	Size	Data type
Response data bytes	30	QV status	#30	1	Unsigned-8
	31	Slot6	#31	1	Unsigned-8
	32	Device variable classification	#32	1	Unsigned-8
	33	QV unit	#33	1	Unsigned-8
	34	QV	#34	4	Float
	35	QV status	#35	1	Unsigned-8
	36	Slot7	#36	1	Unsigned-8
	37	Device variable classification	#37	1	Unsigned-8
	38	QV unit	#38	1	Unsigned-8
	39	QV	#39	4	Float
	40	QV status	#40	1	Unsigned-8
	41	Time stamp	#41	1	Unsigned-32

Command 9	Index	Slot code	Data description	Size	Data type
Slot code table	1	0	Volume flow classification	1	Unsigned-8
	2	0	Volume flow unit code	1	Unsigned-8
	3	0	Volume flow value	4	Float
	4	0	Volume flow status	1	Unsigned-8
	5	1	Standard volume flow classification	1	Unsigned-8
	6	1	Standard volume flow unit code	1	Unsigned-8
	7	1	Standard volume flow value	4	Float
	8	1	Standard volume flow status	1	Unsigned-8
	9	2	Mass flow classification	1	Unsigned-8
	10	2	Mass flow unit code	1	Unsigned-8
	11	2	Mass flow value	4	Float
	12	2	Mass flow status	1	Unsigned-8
	13	3	Power flow classification	1	Unsigned-8
	14	3	Power flow unit code	1	Unsigned-8
	15	3	Power flow value	4	Float
	16	3	Power flow status	1	Unsigned-8
	17	4	Partial gas volume flow classification	1	Unsigned-8
	18	4	Partial gas volume flow unit code	1	Unsigned-8
	19	4	Partial gas volume flow value	4	Float
	20	4	Partial gas volume flow status	1	Unsigned-8
	21	5	Standard biogas volume flow classification	1	Unsigned-8
	22	5	Standard partial gas volume flow unit code	1	Unsigned-8
	23	5	Standard partial gas volume flow value	4	Float

Command 9	Index	Slot code	Data description	Size	Data type
Slot code table	24	5	Standard partial gas volume flow status	1	Unsigned-8
	25	6	Frequency classification	1	Unsigned-8
	26	6	Frequency unit code	1	Unsigned-8
	27	6	Frequency value	4	Float
	28	6	Frequency status	1	Unsigned-8
	29	7	Internal temperature classification	1	Unsigned-8
	30	7	Internal temperature unit code	1	Unsigned-8
	31	7	Internal temperature value	4	Float
	32	7	Internal temperature status	1	Unsigned-8
	33	8	External temperature classification	1	Unsigned-8
	34	8	External temperature unit code	1	Unsigned-8
	35	8	External temperature value	4	Float
	36	8	External temperature status	1	Unsigned-8
	37	9	Pressure classification	1	Unsigned-8
	38	9	Pressure unit code	1	Unsigned-8
	39	9	Pressure value	4	Float
	40	9	Pressure status	1	Unsigned-8
	41	10	Density classification	1	Unsigned-8
	42	10	Density unit code	1	Unsigned-8
	43	10	Density value	4	Float
	44	10	Density status	1	Unsigned-8
	45	11	Content classification	1	Unsigned-8
	46	11	Content unit code	1	Unsigned-8
	47	11	Content value	4	Float
	48	11	Content status	1	Unsigned-8
	49	12	Volume totalizer classification	1	Unsigned-8
	50	12	Volume totalizer unit code	1	Unsigned-8
	51	12	Volume totalizer value	4	Float
	52	12	Volume totalizer status	1	Unsigned-8
	53	13	Standard volume totalizer classification	1	Unsigned-8
	54	13	Standard volume totalizer unit code	1	Unsigned-8
	55	13	Standard volume totalizer value	4	Float
	56	13	Standard volume totalizer status	1	Unsigned-8
	57	14	Mass flow totalizer classification	1	Unsigned-8
	58	14	Mass flow totalizer unit code	1	Unsigned-8
	59	14	Mass flow totalizer value	4	Float

… 8 Universal commands

… Command 9: Read device variables with status

Command 9	Index	Slot code	Data description	Size	Data type
Slot code table	60	14	Mass flow totalizer status	1	Unsigned-8
	61	15	Energy totalizer classification	1	Unsigned-8
	62	15	Energy totalizer unit code	1	Unsigned-8
	63	15	Energy totalizer value	4	Float
	64	15	Energy totalizer status	1	Unsigned-8
	65	16	Biogas volume totalizer classification	1	Unsigned-8
	66	16	Biogas volume totalizer unit code	1	Unsigned-8
	67	16	Biogas volume totalizer value	4	Float
	68	16	Biogas volume totalizer status	1	Unsigned-8
	69	17	Standard partial gas volume totalizer classification	1	Unsigned-8
	70	17	Standard partial gas volume totalizer unit code	1	Unsigned-8
	71	17	Standard partial gas volume totalizer value	4	Float
	72	17	Standard partial gas volume totalizer status	1	Unsigned-8
	73	244	PV percent classification	1	Unsigned-8
	74	244	PV percent unit code	1	Unsigned-8
	75	244	PV percent value	4	Float
	76	244	PV status	1	Unsigned-8
	77	245	Current classification	1	Unsigned-8
	78	245	Current unit code	1	Unsigned-8
	79	245	Current value	4	Float
	80	245	Current status	1	Unsigned-8
	81	246	PV classification	1	Unsigned-8
	82	246	PV unit code	1	Unsigned-8
	83	246	PV value	4	Float
	84	246	PV status	1	Unsigned-8
	85	247	SV classification	1	Unsigned-8
	86	247	SV unit code	1	Unsigned-8
	87	247	SV value	4	Float
	88	247	SV status	1	Unsigned-8
	89	248	TV classification	1	Unsigned-8
	90	248	TV unit code	1	Unsigned-8
	91	248	TV value	4	Float
	92	248	TV status	1	Unsigned-8
	93	249	QV classification	1	Unsigned-8
	94	249	QV unit code	1	Unsigned-8
	95	249	QV value	4	Float
	96	249	QV status	1	Unsigned-8

Command 9	Code	Class	Description
Response code	0	success	No command–specification error
	1		Undefined
	2	Error	Invalid selection
	3 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7		Undefined
	8	Warning	Update failure
	9 to 13		Undefined
	14	Warning	Dynamic variables returned for device variables
	15		Undefined
	16	Error	Access restricted
	17 to 19		Undefined
	30	Warning	Command response truncated
	31 to 127		Undefined

… 8 Universal commands

Command 11: Read unique identifier associated with tag

Command 11	Description		Offset	Size	Data type
Request data bytes	None				
Response data bytes	0	Device type code for expansion	#0	1	Unsigned-8
	1	Manufacturer identification code	#1	1	Unsigned-8
	2	Manufacturer device type	#2	1	Unsigned-8
	3	Number of request preambles	#3	1	Unsigned-8
	4	Revision level of universal command	#4	1	Unsigned-8
	5	Revision level of transmitter document	#5	1	Unsigned-8
	6	Software revision level	#6	1	Unsigned-8
	7	Hardware revision level	#7	1	Unsigned-8
	8	Flags, none defined at this time	#8	1	Unsigned-8
	9	Device identification number, 24 Bit, MSB	#9	1	Unsigned-8
	10	Number of response preamble	#10	1	Unsigned-8
	11	Max no of device variables	#11	1	Unsigned-8
	12	Configure change counter value	#12	2	TUSIGN16
	13	Extended device status	#13	1	Unsigned-8
	14	Manufacturer id code	#14	2	Unsigned-8
	15	Private label distributor code	#15	2	TUSIGN16
	16	Device profile	#16	1	Unsigned-8

Command 11	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 127		Undefined

Command 12: Read message

Command 12	Description	Offset	Size	Data type
Request data bytes	None			
Response data bytes	DeviceMessage[24]	#0	24	Unsigned-8

Command 12	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	32 to 127		Undefined

Command 13: Read tag, descriptor, date

Command 13	Description		Offset	Size	Data type
Request data bytes	None				
Response data bytes	0	Tag	#0 to 5	6	Unsigned-8
	1	descriptor	#6 to 17	12	Unsigned-8
	2	Date code	#18 to 20	3	Unsigned-8

Command 13	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

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Command 14: Read primary variable sensor information

Command 14	Description		Offset	Size	Data type
Request data bytes	None				
Response data bytes	0	Transducer serial number	#0 to 2	3	Unsigned-8
	1	Transducer limits and minimum span units code	#3	1	Unsigned-8
	2	Upper transducer limit	#4 to 7	4	Float
	3	Lower transducer limit	#8 to 11	4	Float
	4	Minimum span	#12 to 15	4	Float

Command 14	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 15: Read primary variable output information

Command 15	Description		Offset	Size	Data type
Request data bytes	None				
Response data bytes	0	PV alarm selection	#0	1	Unsigned-8
	1	PV transfer function code	#1	1	Unsigned-8
	2	PV upper and lower range values units code	#2	1	Unsigned-8
	3	PV upper range value	#3 to 6	4	Float
	4	PV lower range value	#7 to 10	4	Float
	5	PV damping value	#11 to 14	4	Float
	6	Write protect code	#15	1	Unsigned-8
	7	Reserved	#16	1	Unsigned-8
	8	PV analog channel flags	#17	1	Unsigned-8

Command 15	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 16: Final assembly number

Command 16	Description	Offset	Size	Data type
Request data bytes	None			
Response data bytes	Final assembly number	#0 to 2	3	Unsigned-24

Command 16	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 17: Write message

Command 17	Description	Offset	Size	Data type
Request data bytes	Device message	#0 to 23	24	String
Response data bytes	Device message	#0 to 23	24	String

Command 17	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined

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Command 18: Write tag, descriptor, date

Command 18	Description	Offset	Size	Data type
Request data bytes	Tag	#0 to 5	6	Unsigned-8
	Descriptor used by the master for record keeping	#6 to 17	12	Unsigned-8
	Device install date code	#18 to 20	3	Unsigned-8
Response data bytes	Tag	#0 to 5	6	Unsigned-8
	Descriptor used by the master for record keeping	#6 to 17	12	Unsigned-8
	Device install date code	#18 to 20	3	Unsigned-8

Command 18	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 19: Write final assembly number

Command 19	Description	Offset	Size	Data Type
Request data bytes	Final assembly number	#0 to 2	3	Unsigned-24
Response data bytes	Final assembly number	#0 to 2	3	Unsigned-8

Command 19	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 20: Read long tag

Command 20	Description	Offset	Size	Data type
Request data bytes	None	#0 to 31	32	Unsigned-8
Response data bytes	Long tag	#0 to 31	32	Unsigned-8

Command 20	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 21: Read unique identifier associated with long tag

Command 21	Description		Offset	Size	Data type
Request data bytes	None		#0 to 31	32	Unsigned-8
Response data bytes	0	Device type code for expansion	#0	1	Unsigned-8
	1	Manufacturer identification code	#1	1	Unsigned-8
	2	Manufacturer device type	#2	1	Unsigned-8
	3	Number of request preambles	#3	1	Unsigned-8
	4	Revision level of universal command	#4	1	Unsigned-8
	5	Revision level of transmitter document	#5	1	Unsigned-8
	6	Software revision level	#6	1	Unsigned-8
	7	Hardware revision level	#7	1	Unsigned-8
	8	Flags, none defined at this time	#8	1	Unsigned-8
	9	Device identification number, 24 bit, msb	#9	1	Unsigned-8
	10	Number of response preamble	#10	1	Unsigned-8
	11	Max no of device variables	#11	1	Unsigned-8
	12	Configure change counter value	#12	2	TUSIGN16
	13	Extended device status	#13	1	Unsigned-8
	14	Manufacturer id code	#14	2	Unsigned-8
	15	Private label distributor code	#15	2	TUSIGN16
	16	Device profile	#16	1	Unsigned-8

Command 21	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 127		Undefined

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Command 22: Write long tag

Command 22	Description	Offset	Size	Data type
Request data bytes	Long tag	#0 to 31	32	Unsigned-8
Response data bytes	Long tag	#0 to 31	32	Unsigned-8

Command 22	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 38: Reset configuration changed flag

Command 38	Description	Offset	Size	Data type
Request data bytes	Configuration change counter	#0 to 1	2	Unsigned-16
Response data bytes	Configuration change counter	#0 to 1	2	Unsigned-16

Command 38	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 5		Undefined
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8		Undefined
	9	Error	Configuration change counter mismatch
	10 to 15		Undefined
	16	Error	Access restricted
	17 to 127		Undefined
	0	success	No command –specification error

Command 48: Read Additional Device Status

Command 48	Description		Offset	Size	Data type
Request data bytes	0	Device-specific status (**Device status** on page 8)	#0 to 5	6	Unsigned-8
	1	Dummy unsigned-0	#6	1	Unsigned-8
	2	Dummy unsigned-0	#7	1	Unsigned-8
	4	Dummy unsigned-0	#8	1	Unsigned-8
	5	Dummy unsigned-0	#9	1	Unsigned-8
	6	Dummy unsigned-0	#10	1	Unsigned-8
	7	Dummy unsigned-0	#11	1	Unsigned-8
	8	Dummy unsigned-0	#12	1	Unsigned-8
	9	Dummy unsigned-0	#13	1	Unsigned-8
	10	Diagnosis high condition	#14	1	Unsigned-8
	11	Diagnosis high class	#15	1	Unsigned-8
	12	Diagnosis high group	#16	1	Unsigned-8
	13	Diagnosis history	#17	6	Unsigned-8
Response data bytes	0	Device-specific status (**Device status** on page 8)	#0 to 5	6	Unsigned-8
	1	Dummy unsigned-0	#6	1	Unsigned-8
	2	Dummy unsigned-0	#7	1	Unsigned-8
	3	Dummy unsigned-0	#8	1	Unsigned-8
	4	Dummy unsigned-0	#9	1	Unsigned-8
	5	Dummy unsigned-0	#10	1	Unsigned-8
	6	Dummy unsigned-0	#11	1	Unsigned-8
	7	Dummy unsigned-0	#12	1	Unsigned-8
	8	Dummy unsigned-0	#13	1	Unsigned-8
	9	Diagnosis high condition	#14	1	Unsigned-8
	10	Diagnosis high class	#15	1	Unsigned-8
	11	Diagnosis high group	#16	1	Unsigned-8
	12	Diagnosis history	#17	6	Unsigned-8
	13	Diagnosis simulation status	#24	1	Unsigned-8

… 8 Universal commands

… Command 48: Read Additional Device Status

Command 48	Index	Slot-code	Data-description	Size	Data type
Slot code table	0	5	Device-specific status (**Device status** on page 8)	6	Unsigned-8
	1	5	Dummy unsigned-0	1	Unsigned-8
	2	5	Dummy unsigned-0	1	Unsigned-8
	4	5	Dummy unsigned-0	1	Unsigned-8
	5	5	Dummy unsigned-0	1	Unsigned-8
	6	5	Dummy unsigned-0	1	Unsigned-8
	7	5	Dummy unsigned-0	1	Unsigned-8
	8	5	Dummy unsigned-0	1	Unsigned-8
	9	5	Dummy unsigned-0	1	Unsigned-8
	10	5	Diagnosis high condition	1	Unsigned-8
	11	5	Diagnosis high class	1	Unsigned-8
	12	5	Diagnosis high group	1	Unsigned-8
	13	5	Diagnosis simulation status	6	Unsigned-8
	14	7	Device-specific status (**Device status** on page 8)	1	Unsigned-8
	15	7	Extended device status	6	Unsigned-8
	16	7	Operating mode	1	Unsigned-8
	17	7	Standardized status0	1	Unsigned-8
	18	7	Dummy unsigned-0	1	Unsigned-8
	19	7	Dummy unsigned-0	1	Unsigned-8
	20	7	Dummy unsigned-0	1	Unsigned-8
	21	7	Dummy unsigned-0	1	Unsigned-8
	22	7	Fixed analog channel	1	Unsigned-8
	23	7	Diagnosis high condition	1	Unsigned-8
	24	7	Diagnosis high class	1	Unsigned-8
	25	7	Diagnosis high group	1	Unsigned-8
	26	7	Diagnosis history	1	Unsigned-8
	27	7	Diagnosis simulation status	6	Unsigned-8

Command 48	Code	Class	Description
Response code	0	success	No command–specification error
	1 to 5		Undefined
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8	Warning	Update in progress
	9 to 15		Undefined
	16	Error	Access restricted
	17 to 127		Undefined

9 Common-practise commands

The following common practise commands are implemented.

Command	Description
33	Read device variables
34	Write primary variable damping value
35	Write primary variable range values
36	Set primary variable upper range value
37	Set primary variable upper lower value
40	Enter exit fixed current mode
41	Perform self test
42	Perform device reset
43	Write primary variable zero
44	Write primary variable units
45	Trim loop current zero
46	Trim loop current gain
50	Read dynamic variables assignment
51	Write dynamic variables assignment
53	Write device variable units
54	Read device variable information
55	Write device variable damping value
59	Write number of response preambles
71	Lock device
76	Read lock device state
79	Write device variable

… 9 Common-practise commands

Command 33: Read Device Variables

Command 33	Description			Offset	Size	Data type
Request data bytes	0	Slot0	0 to 17	#0	1	Unsigned-8
	1	Slot1	0 to 17	#1	1	Unsigned-8
	2	Slot2	0 to 17	#2	1	Unsigned-8
	3	Slot3	0 to 17	#3	1	Unsigned-8
Response data bytes	0	Slot0		#0	1	Unsigned-8
	1	Dummy unsigned 8		#0	1	Unsigned-8
	2	Dummy float		#0	1	Unsigned-8
	3	Slot1		#0	1	Unsigned-8
	4	Dummy unsigned 8		#0	1	Unsigned-8
	5	Dummy float		#0	1	Unsigned-8
	6	Slot2		#0	1	Unsigned-8
	7	Dummy unsigned 8		#0	1	Unsigned-8
	8	Dummy float		#0	1	Unsigned-8
	9	Slot3		#0	1	Unsigned-8
	10	Dummy unsigned 8		#0	1	Unsigned-8
	11	Dummy float		#0	1	Unsigned-8

Command 33	Index	Slot-code	Data-description	Size	Data type
Slot code table	0	0	Volume flow unit	1	Unsigned-8
	1	0	Volume flow value	4	Float
	2	1	Standard volume flow unit	1	Unsigned-8
	3	1	Standard volume flow value	4	Float
	4	2	Mass flow unit	1	Unsigned-8
	5	2	Mass flow value	4	Float
	6	3	Power unit	1	Unsigned-8
	7	3	Power value	4	Float
	8	4	Partial gas volume unit	1	Unsigned-8
	9	4	Partial gas volume value	4	Float
	10	5	Standard partial gas volume unit	1	Unsigned-8
	11	5	Standard partial gas volume value	4	Float
	12	6	Frequency unit	1	Unsigned-8
	13	6	Frequency value	4	Float
	14	7	Temperature unit	1	Unsigned-8
	15	7	Temperature value	4	Float
	16	8	External temperature unit	1	Unsigned-8
	17	8	External temperature value	4	Float
	18	9	Pressure unit	1	Unsigned-8
	19	9	Pressure value	4	Float
	20	10	Density unit	1	Unsigned-8
	21	10	Density value	4	Float
	22	11	Dummy	1	Unsigned-8
	23	11	Gas content	4	Float
	24	12	Totalized volume flow unit	1	Unsigned-8
	25	12	Totalized volume flow value	4	Float
	26	13	Standard totalized volume flow unit	1	Unsigned-8
	27	13	Standard totalized volume flow value	4	Float
	28	14	Totalized mass flow unit	1	Unsigned-8
	29	14	Totalized mass flow value	4	Float
	30	15	Totalized energy unit	1	Unsigned-8
	31	15	Totalized energy value	4	Float
	32	16	Partial totalized volume flow unit	1	Unsigned-8
	33	16	Partial totalized volume flow value	4	Float
	34	17	Standard totalized volume flow unit	1	Unsigned-8
	35	17	Standard totalized volume flow value	4	Float
	36	244	Pv percent unit code	1	Unsigned-8
	37	244	Pv percent range	4	Float
	38	245	Current unit code	1	Unsigned-8
	39	245	Current value	4	Float

… 9 Common-practise commands

… Command 33: Read Device Variables

Command 33	Index	Slot-code	Data-description	Size	Data type
Slot code table	40	246	PV unit code	1	Unsigned-8
	41	246	PV value	4	Float
	42	247	SV unit code	1	Unsigned-8
	43	247	SV value	4	Float
	44	248	TV unit code	1	Unsigned-8
	45	248	TV value	4	Float
	46	249	QV unit code	1	Unsigned-8
	47	249	QV value	4	Float

Command 33	Code	Class	Description
Response code	0	Success	No command-specific errors
	1		Undefined
	2	Error	Invalid selection
	3 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7		Undefined
	8	Warning	Update failure
	9 to 15		Undefined
	16	Error	Access restricted
	17 to 127		Undefined

Command 34: Write primary variable damping value

Command 34	Description	Offset	Size	Data type
Request data bytes	Damping time	#0	4	Float
Response data bytes	Damping time	#0	4	Float

Command 34	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 2		Undefined
	3	Error	Passed parameter too large
	4	Error	Passed parameter too small
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8	Warning	Set to nearest possible value
	9 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Undefined
	33 to 127		Undefined

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Command 35: Write primary variable range values

Command 35	Description		Offset	Size	Data type
Request data bytes	0	Primary variable range u nit	#0	1	Unsigned-8
	1	Primary variable upper range	#1	4	Float
	2	Primary variable lower range	#2	4	Float
Response data bytes	0	Primary variable range u nit	#0	1	Unsigned-8
	1	Primary variable upper range	#1	4	Float
	2	Primary variable lower range	#2	4	Float

Command 35	Code	Class	Description
Response code	0	Success	No command-specific errors
	1		Undefined
	2	Error	Invalid selection
	3 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8	Warning	Set to nearest possible value
	9	Error	Lower range value too high
	10	Error	Lower range value too low
	11	Error	Upper range value too high
	12	Error	Upper range value too low
	13	Error	Upper and lower range values out of limits
	14	Warning	Span too small
	15		Undefined
	16	Error	Access restricted
	17		Undefined
	18	Error	Invalid units code
	19 to 28		Undefined
	29		Invalid span
	30 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 36: Write primary variable upper range value

Command 36	Description	Offset	Size	Data type
Request data bytes	None			
Response data bytes	None			

Command 36	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 5		Undefined
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8	Warning	Set to nearest possible value
	9	Error	Applied process too high
	10	Error	Applied process too low
	11 to 13		Undefined
	14	Warning	Span too small
	15		Undefined
	16	Error	Access restricted
	17 to 28		Undefined
	29	Error	Invalid span
	30 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

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Command 37: Set primary variable upper lower value

Command 37	Description	Offset	Size	Data type
Request data bytes	None			
Response data bytes	None			

Command 37	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 5		Undefined
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8	Warning	Set to nearest possible value
	9	Error	Applied process too high
	10	Error	Applied process too low
	11 to 13		Undefined
	14	Warning	Span too small
	15		Undefined
	16	Error	Access restricted
	17 to 28		Undefined
	29	Error	Invalid span
	30 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 40: Enter exit fixed current mode

Command 40	Description	Offset	Size	Data type
Request data bytes	Fixed current level	#0	4	Float
Response data bytes	Fixed current level	#0	4	Float

Command 40	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 2		Undefined
	3	Error	Passed parameter too large
	4	Error	Passed parameter too small
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8 to 10		Undefined
	11	Error	Loop current not active
	12 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy

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Command 41: Perform Self-Test

Command 41	Description	Offset	Size	Data type
Request data bytes	None			
Response data bytes	None			

Command 41	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 5		Undefined
	6	Error	Device-specific command error
	7 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 42: Perform Device Reset

Command 42	Description	Offset	Size	Data type
Request data bytes	None			
Response data bytes	None			

Command 42	Code	Class	Description
Response code	0	success	No command-specific errors
	1 to 5		Undefined
	6	Error	Device-specific command error
	7 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 43: Write primary variable zero

Command 43	Description	Offset	Size	Data type
Request data bytes	None			
Response data bytes	None			

Command 43	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 5		Undefined
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8		Undefined
	9	Error	Applied process too high
	10	Error	Applied process too low
	11 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 44: Write primary variable units

Command 44	Description	Offset	Size	Data type
Request data bytes	Primary variable unit (see common tables specification).	#0	1	Unisigned-8
Response data bytes	Primary variable unit (see common tables specification).	#0	1	Unisigned-8

Command 44	Code	Class	Description
Response code	0	Success	No command-specific errors
	1		Undefined
	2	Error	Invalid selection
	3 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

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Command 45: Trim loop current zero

Command 45	Description	Offset	Size	Data type
Request data bytes	Externally measured loop current level, units of milliampere	#0	4	Float
Response data bytes	Externally measured loop current level, units of milliampere	#0	4	Float

Command 45	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 2		Undefined
	3	Error	Passed parameter too large
	4	Error	Passed parameter too small
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8		Undefined
	9	Error	Incorrect loop current mode or value
	10		Undefined
	11	Error	Loop current not active
	12 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 46: Trim loop current gain

Command 46	Description	Offset	Size	Data type
Request data bytes	Externally measured loop current level, units of milliampere	#0	4	Float
Response data bytes	Externally measured loop current level, units of milliampere	#0	4	Float

Command 46	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 2		Undefined
	3	Error	Passed parameter too large
	4	Error	Passed parameter too small
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8		Undefined
	9	Error	Incorrect loop current mode or value
	10		Undefined
	11	Error	Loop current not active
	12 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 50: Read dynamic variables assignment

Command 50	Description		Offset	Size	Data type
Request data bytes	None		#0	4	Unisigned-8
Response data bytes	0	Device variable assigned to the primary variable	#0	1	Unisigned-8
	1	Device variable assigned to the second variable	#1	1	Unisigned-8
	2	Device variable assigned to the tertiary variable	#2	1	Unisigned-8
	3	Device variable assigned to the quaternary variable	#3	1	Unisigned-8

Command 50	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 5		Undefined
	6	Error	Device-specific command error
	7 to 15		Undefined
	16	Error	Access restricted
	17 to 127		Undefined

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Command 51: Write dynamic variables assignment

Command 51	Description		Offset	Size	Data type
Request data bytes	0	Device variable assigned to the primary variable	#0	1	Unsigned-8
	1	Device variable assigned to the second variable	#1	1	Unsigned-8
	2	Device variable assigned to the tertiary variable	#2	1	Unsigned-8
	3	Device variable assigned to the quaternary variable	#3	1	Unsigned-8
Response data bytes	0	Device variable assigned to the primary variable	#0	1	Unsigned-8
	1	Device variable assigned to the second variable	#1	1	Unsigned-8
	2	Device variable assigned to the tertiary variable	#2	1	Unsigned-8
	3	Device variable assigned to the quaternary variable	#3	1	Unsigned-8

Command 51	Code	Class	Description
Response code	0	Success	No command-specific errors
	1		Undefined
	2	Error	Invalid selection
	3 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 53: Write device variable units

Command 53	Description		Offset	Size	Data type
Request data bytes	0	Slot0	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8
Response data bytes	0	slot0	#0	1	Unsigned-8
	1	Dummy unsigned-8	#0	1	Unsigned-8

Command 53	Index	Slot-code	Data-description
Slot code table	0	0	Volume flow unit
	1	1	Volume flow value
	2	2	Standard volume flow unit
	3	3	Standard volume flow value
	4	4	Mass flow unit
	5	5	Mass flow value
	6	6	Power unit
	7	7	Power value
	8	8	Partial gas volume unit
	9	9	Partial gas volume value
	10	10	Standard partial gas volume unit
	11	11	Standard partial gas volume value
	12	12	Frequency unit
	13	13	Frequency value
	14	14	Temperature unit
	15	15	Temperature value
	16	16	External temperature unit
	17	17	External temperature value

Command 53	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8 to 10		Undefined
	11	Error	Invalid device variable code
	12	Error	Invalid units code
	13 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

… 9 Common-practise commands

Command 54: Read device variable information

Command 54	Description		Offset	Size	Data type
Request data bytes	0	Slot0	#0	1	Unsigned-8
Response data bytes	0	Slot0	#0	1	Unsigned-8
	1	Device variable transducer serial no.	#1	1	Unsigned-24
	2	Dummy unsigned-8	#2	1	Unsigned-8
	3	Dummy float	#3	4	Float
	4	Dummy float	#4	4	Float
	5	Dummy float	#5	4	Float
	6	Dummy float	#6	4	Float
	7	Device variable classification	#7	1	Unsigned-8
	8	Device variable family code	#8	1	Unsigned-8
	9	Dummy32	#9	4	Unsigned-32

Command 54	Index	Slot code	Data description
slot code table	0	0	Transducer serial number
	1	0	Volume flow upper range unit
	2	0	Volume flow upper range value
	3	0	Volume flow lower range value
	4	0	Damping time
	5	0	Volume flow minimum span
	6	0	Device variable classification of volume flow
	7	0	Device variable family codes of volume flow
	8	0	Max update time
	9	1	Transducer serial number
	10	1	Standard volume flow unit
	11	1	Standard volume flow upper range value
	12	1	Standard volume flow lower range value
	13	1	Damping time
	14	1	Standard volume flow minimum span
	15	1	Device variable classification of standard volume flow
	16	1	Device variable family codes of standard volume flow
	17	1	Max update time
	18	2	Transducer serial number
	19	2	Mass flow unit

Command 54	Index	Slot code	Data description
Slot code table	20	2	Mass flow upper range
	21	2	Mass flow lower range
	22	2	Mass flow damping time
	23	2	Mass flow minimum span
	24	2	Device variable classification of mass flow
	25	2	Device variable family codes of mass flow
	26	2	Max update time
	27	3	Transducer serial number
	28	3	Power unit
	29	3	Power upper range
	30	3	Power lower range
	31	3	Power damping time
	32	3	Power minimum span
	33	3	Device variable classification of power
	34	3	Device variable family codes of power
	35	3	Max update time
	36	4	Transducer serial number
	37	4	Partial gas volume flow unit
	38	4	Partial gas volume flow upper range
	39	4	Partial gas volume flow lower range
	40	4	Damping time
	41	4	Partial gas volume flow upper range
	42	4	Device variable classification of partial gas volume flow
	43	4	Device variable family codes of partial gas volume flow
	44	4	Max update time
	45	5	Transducer serial number
	46	5	Standard partial gas volume flow unit
	47	5	Standard partial gas volume flow upper range
	48	5	Standard partial gas volume flow lower range
	49	5	Damping time
	50	5	Standard partial gas volume flow minimum span
	51	5	Device classification
	52	5	Device variable family codes of standard partial gas volume flow
	53	5	Max update time
	54	6	Transducer serial number

… 9 Common-practise commands

… Command 54: Read device variable information

Command 54	Index	Slot code	Data description
Slot code table	55	6	Frequency unit
	56	6	Frequency upper range
	57	6	Frequency lower range
	58	6	Frequency damping time
	59	6	Frequency range span
	60	6	Device classification
	61	6	Device variable family codes of frequency
	62	6	Max update time
	63	7	Transducer serial number
	64	7	Temperature unit
	65	7	Temperature upper range
	66	7	Temperature lower range
	67	7	Temperature damping time
	68	7	Temperature minimum span
	69	7	Classification of temperature
	70	7	Device variable family codes of temperature
	71	7	Max update time
	72	8	Transducer serial number
	73	8	External (4 to 20 mA) temperature input unit
	74	8	External (4 to 20 mA) temperature input upper range
	75	8	External (4 to 20 mA) temperature input lower range
	76	8	Dummy250
	77	8	External (4 to 20 mA) temperature input minimum span
	78	8	External (4 to 20 mA) temperature input classification
	79	8	Device variable family codes of external(4 to 20 mA) temperature
	80	8	Max update time
	81	9	Transducer serial number
	82	9	External (4 to 20 mA) pressure input unit
	83	9	External (4 to 20 mA) pressure input upper range
	84	9	External (4 to 20 mA) pressure input lower range
	85	9	Dummy250
	86	9	External (4 to 20 mA) pressure input minimum span
	87	9	External (4 to 20 mA) pressure input classification
	88	9	Device variable family codes of external (4 to 20 mA) pressure input
	89	9	Max update time

Command 54	Index	Slot code	Data description
Slot code table	90	10	Transducer serial number
	91	10	External (4 to 20 mA) density input unit
	92	10	External (4 to 20 mA) density input upper range
	93	10	External (4 to 20 mA) density input lower range
	94	10	Dummy250
	95	10	External (4 to 20mA) density input minimum span
	96	10	External (4 to 20mA) density input classification
	97	10	Device variable family codes of external(4 to 20mA) density input
	98	10	Max update time
	99	11	Transducer serial number
	100	11	Dummy250
	101	11	External (4 to 20 mA) gas content upper range
	102	11	External (4 to 20 mA) gas content lower range
	103	11	External (4 to 20 mA) gas content span
	104	11	External (4 to 20 mA) gas minimum span
	105	11	External (4 to 20 mA) gas content input classification
	106	11	Device variable family codes of external (4 to 20 mA) gas content
	107	11	Max update time
	108	12	Transducer serial number
	109	12	Totalized volume flow unit
	110	12	Dummy float
	111	12	Dummy float
	112	12	Dummy float
	113	12	Dummy float
	114	12	Totalized volume flow classification
	115	12	Device variable family codes of totalized volume flow
	116	12	Max update time
	117	13	Transducer serial number
	118	13	Standard totalized volume flow unit
	119	13	Dummy float
	120	13	Dummy float
	121	13	Dummy float
	122	13	Dummy float
	123	13	Standard totalized volume flow classification
	124	13	Device variable family codes of standard totalized volume flow

… 9 Common-practise commands

… Command 54: Read device variable information

Command 54	Index	Slot code	Data description
Slot code table	125	13	Max update time
	126	14	Transducer serial number
	127	14	Totalized mass flow unit
	128	14	Dummy float
	129	14	Dummy float
	130	14	Dummy float
	131	14	Dummy float
	132	14	Totalized mass flow unit classification
	133	14	Device variable family codes of totalized mass flow
	134	14	Max update time
	135	15	Transducer serial number
	136	15	Totalized energy unit
	137	15	Dummy float
	138	15	Dummy float
	139	15	Dummy float
	140	15	Dummy float
	141	15	Totalized energy classification
	142	15	Device variable family codes of totalized energy
	143	15	Max update time
	144	16	Transducer serial number
	145	16	Totalized partial volume flow unit
	146	16	Dummy float
	147	16	Dummy float
	148	16	Dummy float
	149	16	Dummy float
	150	16	Totalized partial volume flow classification
	151	16	Device variable family codes of totalized partial volume flow
	152	16	Max update time
	153	17	Transducer serial number
	154	17	Totalized standard partial volume flow
	155	17	Dummy float
	156	17	Dummy float
	157	17	Dummy float
	158	17	Dummy float
	159	17	Totalized standard partial volume classification
	160	17	Device variable family codes of totalized standard partial volume
	161	17	Max update time

Command 54	Code	Class	Description
Responde code	0	Success	No command-specific errors
	1		Undefined
	2	Error	Invalid selection
	3 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

… 9 Common-practise commands

Command 55: Write device variable damping value

Command 55	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy float	#1	4	Float
Response data bytes	0	slot code	#0	1	Unsigned-8
	1	Dummy float	#1	4	Float

Command 55	Index	Slot-code	Data-description
Slot code table	0	0	Volume flow damping time
	1	1	Standard volume flow damping time
	2	2	Mass flow damping time
	3	3	Power damping time
	4	4	Partial gas volume damping time
	5	5	Standard partial gas volume damping time
	6	6	Frequency damping time
	7	7	Temperature damping time
	8	8	Dummy NAN
	9	9	Dummy NAN
	10	10	Dummy NAN
	11	11	Dummy NAN
	12	12	Dummy NAN
	13	13	Dummy NAN
	14	14	Dummy NAN
	15	15	Dummy NAN
	16	16	Dummy NAN
	17	17	Dummy NAN

Command 55	Code	Class	Description
Response code	0	Success	No command-specific errors
	1		Undefined
	2	Error	Invalid selection
	3	Error	Passed parameter too large
	4	Error	Passed parameter too small
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8	Warning	Set to nearest possible value
	9 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Command 59: Write number of response preambles

Command 59	Description		Offset	Size	Data type
Request data bytes	0	Number of response preambles	#0	1	Unsigned-8
Response data bytes	0	Number of response preambles	#0	1	Unsigned-8

Command 59	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 2		Undefined
	3	Error	Passed parameter too large
	4	Error	Passed parameter too small
	5	Error	Too few data bytes received
	6	Error	Device-specific command error
	7	Error	In write protect mode
	8	Warning	Set to nearest possible value
	9 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

… 9 Common-practise commands

Command 71: Lock device

Command 71	Description		Offset	Size	Data type
Request data bytes	Lock device selection	0 Device unlocked	#0	1	Unsigned-8
		1 Lock device temporary			
		2 Lock device permanent			
		3 Lock all device			
Response data bytes	Lock device selection	0 Device unlocked	#0	1	Unsigned-8
		1 Lock device temporary			
		2 Lock device permanent			
		3 Lock all device			

Command 71	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 4		Undefined
	5	Error	Too few data bytes received
	6	Error	Device-specific Command Error
	7 to 9		Undefined
	10	Error	Invalid lock code
	11	Error	Cannot lock device
	12 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33	Error	Dr initiated
	34	Error	Dr running
	35	Error	Dr dead
	36 to 127		Undefined

Command 76: Read Lock Device State

Command 76	Description		Offset	Size	Data Type
Request data bytes	None		#0	1	Unsigned-8
Response data bytes	Lock device selection	0 Device unlocked	#0	1	Unsigned-8
		1 Lock device temporary			
		2 Lock device permanent			
		3 Lock all device			

Command 76	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 5		Undefined
	6	Error	Device-specific command error
	7 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

… 9 Common-practise commands

Command 79: Write device variables

Command 79	Description		Offset	Size	Data type
Request data bytes	0	Slot 0	#0	1	Unsigned-8
	1	Device variable code	#1	1	Unsigned-8
	2	Dummy–8	#2	1	Unsigned-8
	3	Dummy float	#3	4	Float
	4	Device variable status	#7	1	Unsigned-8
Response data bytes	0	Slot 0	#0	1	Unsigned-8
	1	Device variable code	#1	1	Unsigned-8
	2	Dummy–8	#2	1	Unsigned-8
	3	Dummy float	#3	4	Float
	4	Device variable status	#7	1	Unsigned-8

Command 79	Index	Slot-code	Data-description	Size	Data type
Slot code table	0	0	Volume flow simulation enable	1	Unsigned-8
	1	0	Volume flow simulation unit code	1	Unsigned-8
	2	0	Volume flow simulation value	4	Float
	3	0	Volume flow status	1	Unsigned-8
	4	1	Standard volume flow simulation enable	1	Unsigned-8
	5	1	Standard volume flow simulation unit code	1	Unsigned-8
	6	1	Standard volume flow simulation value	4	Float
	7	1	Standard volume flow status	1	Unsigned-8
	8	2	Mass flow simulation enable	1	Unsigned-8
	9	2	Mass flow simulation unit code	1	Unsigned-8
	10	2	Mass flow simulation value	4	Float
	11	2	Mass flow status	1	Unsigned-8
	12	3	Power volume simulation enable	1	Unsigned-8
	13	3	Power volume simulation unit code	1	Unsigned-8
	14	3	Power volume simulation value	4	Float
	15	3	Power volume status	1	Unsigned-8
	16	4	Partial gas volume simulation enable	1	Unsigned-8
	17	4	Partial gas volume simulation unit code	1	Unsigned-8
	18	4	Partial gas volume simulation value	4	Float
	19	4	Partial gas volume status	1	Unsigned-8
	20	5	Standard partial gas volume simulation enable	1	Unsigned-8
	21	5	Standard partial gas volume simulation unit code	1	Unsigned-8
	22	5	Standard partial gas volume simulation value	4	Float
	23	5	Standard partial gas volume status	1	Unsigned-8
	24	6	Frequency simulation enable	1	Unsigned-8

Command 79	Index	Slot-code	Data-description	Size	Data-type
Slot code table	25	6	Frequency simulation unit code	1	Unsigned-8
	26	6	Frequency simulation value	4	Float
	27	6	Frequency status	1	Unsigned-8
	28	7	Internal temperature simulation enable	1	Unsigned-8
	29	7	Internal temperature simulation unit code	1	Unsigned-8
	30	7	Internal temperature simulation value	4	Float
	31	7	Internal temperature status	1	Unsigned-8
	32	8	External temperature simulation enable	1	Unsigned-8
	33	8	External temperature simulation unit code	1	Unsigned-8
	34	8	External temperature simulation value	4	Float
	35	8	External temperature status	1	Unsigned-8
	36	9	Pressure simulation enable	1	Unsigned-8
	37	9	Pressure simulation unit code	1	Unsigned-8
	38	9	Pressure simulation value	4	Float-8
	39	9	Pressure status	1	Unsigned-8
	40	10	Content simulation enable	1	Unsigned-8
	41	10	Content simulation unit code	1	Unsigned-8
	42	10	Content simulation value	4	Float
	43	10	Content status	1	Unsigned-8

Command 79	Code	Class	Description
Response code	0	Success	No command-specific errors
	1 to 5		Undefined
	6	Error	Device-specific command error
	7 to 15		Undefined
	16	Error	Access restricted
	17 to 31		Undefined
	32	Error	Busy
	33 to 127		Undefined

Catch device variable

This field device does not support catch device variable.

10 Device specific commands

The following device specific commands are implemented.

Command	Description
128	Read calculation unsigned char variable
129	Write calculation unsigned char variable
130	Read IOBUS unsigned char variable
131	Write IOBUS unsigned char variable
132	Read ES unsigned char variable
133	Write ES unsigned char variable
134	Read HMI unsigned char variable
135	Write HMI unsigned char variable
136	Read unsigned short variable
137	Write unsigned short variable
138	Read unsigned long variable
139	Write unsigned long variable
140	Read float variable
141	Write float variable
142	Read double variable
143	Write double variable
144	Log out HART service code
146	Perform action
150	Read diagnosis active alarm
151	Read diagnosis active alarm condition detail
152	Read flow status
153	Read family revision
154	Read vortex frequency
155	Read low flow cutoff
156	Read density preset
157	Read density preset unit
158	Read viscosity
159	Read tube diameter size
160	Write low flow cutoff
164	Write tube diameter size
165	Write hart service code
166	Read floats
167	Write floats
168	Read gas configure flag
169	Write gas configure flag

Command	Description
170	Read string
171	Write string
172	Read variable alarm range
173	Write variable alarm range
174	Read variable with unit
175	Write variable with unit
176	Read simulate device variable
177	Write simulate device variable
178	Read variable range
179	Write variable range
180	Read AI current
181	Read burst in configuration
182	Write burst in configuration
183	Burst in
184	Login with Password
185	Reset soft write protection
186	Read totalizer base unit value
512	Read country code
513	Write country code

… 10 Device specific commands

Common response code

Response bytes	Code	Class	Description
First response byte code	0	success	No command –specification error
	1		Undefined
	2	Error	Invalid selection
	3	Error	Passed parameter too large
	4	Error	Passed parameter too small
	5	Error	Too few data bytes receive
	6	Error	Transmitter specific command error
			Device-specific command error
	7	Error	Write protected
	8	Warning	Set to nearest possible value
			Burst condition conflict
	9	Error	Lower range value too high
			Configuration change counter mismatch
			Invalid burst message
			Invalid date code detected
	10	Error	Invalid lock code
			Lower range value too low
	11	Error	Upper range value too high
			Device was set to multi drop mode
			Invalid device variable classification
			Cannot lock device
	12	Error	Upper range value too low
	13 to 15		Undefined
	16	Error	Access restricted
	17 to 19		Undefined
	20	Error	Invalid extended command number
	21 to 23		Undefined
	29	Error	Invalid span error
	32	Error	Device is busy
	64	Error	Command not implemented
	66	Error	Set to nearest possible value error
	72	Error	Span too small error
	112		Lower range value too low
	113		Upper range value too high
	114	Error	Wrong state for command
	115	Error	Code or index not allowed for command
	Other Values		Undefined

Response byte	Bits	Description
Second response byte code	0	Primary variable out of limits
	1	Non-primary variable out of limits
	2	Primary variable analog output saturated
	3	Primary variable analog output fixed
	4	More status available
	5	Cold start
	6	Configuration changed
	7	Field device malfunction

… 10 Device specific commands

Command 128: Read calculation unsigned char variable

Command 128	Description			Offset	Size	Data type
Request data bytes	0	Slot code	0 to 23	#0	1	Unsigned-8
Response data bytes	0	Slot code		#0	1	Unsigned-8
	1	Dummy unsigned-8		#1	1	Unsigned-8

Command 128	Index	Slot-code	Data-description
Slot code table	1	1	K factor
	2	2	Converter type
	3	3	Swirl meter size
	4	4	Vortex meter size
	5	5	K linearization
	6	6	Volume flow unit
	7	7	Standard volume unit
	8	8	Mass flow unit
	9	9	Power unit code
	10	10	Partial gas volume unit
	11	11	Standard partial gas volume unit
	12	12	Frequency unit code
	13	13	Internal temperature unit
	14	14	External temperature unit
	15	15	Pressure unit
	16	16	Density unit
	17	17	Flow over 103% behavior
	18	18	Liquid correction
	19	19	Gas reference
	20	20	Gas compute type
	21	21	Gas density selection
	22	22	Internal temperature selection
	23	23	Operating mode
	24	24	Relative density reference
	25	25	Calorific value reference
	26	26	Steam status
	27	27	Steam type
	28	28	Volume totalizer unit

Command 128	Index	Slot-code	Data-description
Slot code table	29	29	Standard volume totalizer unit
	30	30	Mass flow totalizer unit
	31	31	Energy totalizer unit
	32	32	Partial gas volume totalizer unit
	33	33	Standard partial gas volume totalizer unit
	34	34	Gas k protection
	35	35	Diagnosis function check mask
	36	36	Diagnosis off specification mask
	37	37	Diagnosis maintain mask
	38	38	Diagnosis min flow mask
	39	39	Diagnosis max flow mask
	40	40	Diagnosis flow over 103% mask
	41	41	Diagnosis internal sensor off specification mask
	42	42	Diagnosis environment sensor off specification mask
	43	43	Diagnosis simulation type
	44	44	External temperature source
	45	45	Pressure source
	46	46	Density source
	47	47	Content source
	48	48	Matrix size
	49	49	Simulation mode
	50	50	Actual density for calculation selection
	51	51	Internal sensor fail diagnosis mask
	52	52	Transmitter calibration status
	53	53	Diagnosis low cut off mask
	53	53	Diagnosis low cut off mask
	54	54	Low flow thresh control
	55	55	Force replace control
	56	56	Auto self-check control
	57	57	Vibration correction control
	58	58	Vibration filter number
	59	59	Frequency lock in minimum period
	60	60	Frequency lock in maximum period
	61	61	Frequency lock in estimation
	62	62	High FFT estimation accuracy
	63	63	Middle FFT estimation accuracy

… 10 Device specific commands

… Command 128: Read calculation unsigned char variable

Command 128	Index	Slot-code	Data-description
Slot code table	64	64	Low FFT estimation accuracy
	65	65	Hardware signal gain selection
	66	66	Software gain control
	67	67	Hardware signal gain shifter
	68	68	Auto zero sample buffer length
	69	69	Static decimation factor
	70	70	Middle buffer decimation factor
	71	71	Percentage of minimum frequency margin
	72	72	Percentage of maximum frequency margin
	73	73	Steam power mode selection

Command 128	Description
Response code	**Common response code** on page 58

Command 129: Write calculation unsigned char variable

Command 129	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8

Command 129	Index	Slot-code	Data-description
Slot code table	1	1	K factor
	2	2	Converter type
	3	3	Swirl meter size
	4	4	Vortex meter size
	5	5	K linearization
	6	6	Volume flow unit
	7	7	Standard volume unit
	8	8	Mass flow unit
	9	9	Power unit code
	10	10	Partial gas volume unit
	11	11	Standard partial gas volume unit
	12	12	Frequency unit code
	13	13	Internal temperature unit
	14	14	External temperature unit
	15	15	Pressure unit
	16	16	Density unit
	17	17	Flow over 103% behavior
	18	18	Liquid correction
	19	19	Gas reference
	20	20	Gas compute type
	21	21	Gas density selection
	22	22	Internal temperature selection
	23	23	Operating mode
	24	24	Relative density reference
	25	25	Calorific value reference
	26	26	Steam status
	27	27	Steam type
	28	28	Volume totalizer unit
	29	29	Standard volume totalizer unit
	30	30	Mass flow totalizer unit

… 10 Device specific commands

… Command 129: Write calculation unsigned char variable

Command 129	Index	Slot-code	Data-description
Slot code table	31	31	Energy totalizer unit
	32	32	Partial gas volume totalizer unit
	33	33	Standard partial gas volume totalizer unit
	34	34	Gas k protection
	35	35	Diagnosis function check mask
	36	36	Diagnosis off specification mask
	37	37	Diagnosis maintain mask
	38	38	Diagnosis min flow mask
	39	39	Diagnosis max flow mask
	40	40	Diagnosis flow over 103% mask
	41	41	Diagnosis internal sensor off specification mask
	42	42	Diagnosis environment sensor off specification mask
	43	43	Diagnosis simulation type
	44	44	External temperature source
	45	45	Pressure source
	46	46	Density source
	47	47	Content source
	48	48	Matrix size
	49	49	Simulation mode
	50	50	Actual density for calculation selection
	51	51	Internal sensor fail diagnosis mask
	52	52	Transmitter Calibration status
	53	53	Diagnosis low cut off mask
	54	54	Low Flow Thresh control
	55	55	Force replace control
	56	56	Auto self-check control
	57	57	Vibration correction control
	58	58	Vibration filter number
	59	59	Frequency lock in minimum period
	60	60	Frequency lock in maximum period
	61	61	Frequency lock in estimation
	62	62	High FFT estimation accuracy
	63	63	Middle FFT estimation accuracy
	64	64	Low FFT estimation accuracy
	65	65	Hardware signal gain selection

Command 129	Index	Slot-code	Data-description
Slot code table	66	66	Software gain control
	67	67	Hardware signal gain shifter
	68	68	Auto zero sample buffer length
	69	69	Static decimation factor
	70	70	Middle buffer decimation factor
	71	71	Percentage of minimum frequency margin
	72	72	Percentage of maximum frequency margin
	73	73	Steam power mode selection

Command 129	Description
Response Code	**Common response code** on page 58

... 10 Device specific commands

Command 130: Read IO Bus unsigned char variable

Command 130	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8

Command 130	Index	Slot-code	Data-description
Slot code table	0	0	Current out source
	1	1	Loop current mode
	2	2	Alarm selection
	3	3	Alarm selection source
	4	4	Alarm selection effective
	5	5	Hart command revision
	6	6	Lock device selection
	7	9	Digital output mode
	8	10	Logical signal source
	9	11	General alarm
	10	12	Min flow rate alarm
	11	13	Max flow rate alarm
	12	14	Temperature alarm
	13	15	Low flow cut off
	14	16	Digital logical value selection
	15	17	Device variable assigned to analog input selection
	16	18	Analog input calibration status
	17	19	Digital out logical simulation selection
	18	20	Digital out logical active level option
	19	21	Analog input external cut off status
	20	22	Analog input external cut off option
	21	23	Digital out min temperature alarm option

Command 130	Description
Response Code	**Common response code** on page 58

Command 131: Write IO Bus unsigned char variable

Command 131	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8

Command 131	Index	Slot-code	Data-description
Slot code table	0	0	Current out source
	1	1	Loop current mode
	2	2	Alarm selection
	3	3	Alarm selection source
	4	3	Alarm selection effective
	5	4	Hart command revision
	6	6	Lock device selection
	7	9	Digital output mode
	8	10	Logical signal source
	9	11	General alarm
	10	12	Min flow rate alarm
	11	13	Max flow rate alarm
	12	14	Temperature alarm
	13	15	Low flow cut off
	14	16	Digital logical value selection
	15	17	Device variable assigned to analog input selection
	16	18	Analog input calibration status
	17	19	Digital out logical simulation command
	18	20	Digital out logical active level option
	19	21	Analog input external cut off status
	20	22	Analog input external cut off option
	21	23	Digital out min temperature alarm option

Command 131	Description
Response code	**Common response code** on page 58

… 10 Device specific commands

Command 132: Read ES unsigned char variable

Command 132	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8

Command 132	Index	Slot-code	Data-description
Slot code table	0	0	Software write protection
	1	1	Current out read back enable
	2	2	Voltage supply read back enable
	3	3	Ram test enable
	4	4	Rom test enable
	5	5	Dynamic variables check enable
	6	6	Auto zero status
	7	8	ERP no of transmitter change flag

Command 132	Description
Response code	**Common response code** on page 58

Command 133: Write ES unsigned char variable

Command 133	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8

Command 133	Index	Slot-code	Data-description
Slot code table	0	0	Software write protection
	1	1	Current out read back enable
	2	2	Voltage supply read back enable
	3	3	Ram test enable
	4	4	Rom test enable
	5	5	Dynamic variables check enable
	6	6	Auto zero status
	7	8	ERP no of transmitter change flag

Command 133	Description
Response code	**Common response code** on page 58

Command 134: Read HMI unsigned char variable

Command 134	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned 8	#1	1	Unsigned-8

Command 134	Index	Slot-code	Data-description
Slot code table	0	0	language
	1	1	HMI mainOperatorView_1_1
	2	2	HMI mainOperatorView_1_2
	3	3	HMI mainOperatorView_1_3
	4	3	HMI mainOperatorView_1_bargraph
	5	4	HMI mainOperatorView_2_1
	6	6	HMI mainOperatorView_2_2
	7	7	HMI mainOperatorView_2_3
	8	8	HMI mainOperatorView_2_bargraph
	9	9	HMI mainOperatorView_3_1
	10	10	HMI mainOperatorView_3_2
	11	11	HMI mainOperatorView_3_3
	12	12	HMI mainOperatorView_3_bargraph
	13	13	HMI mainOperatorView_4_1
	14	14	HMI mainOperatorView_4_2
	15	15	HMI mainOperatorView_4_3
	16	16	HMI mainOperatorView_4_bargraph
	17	17	HMI contrast
	18	18	HMI local operation enable
	19	19	HMI displayMode_1
	20	20	HMI displayMode_2
	21	21	HMI displayMode_3
	22	22	HMI displayMode_4
	23	23	HMI auto scroll enable
	24	24	HMI low level software revision
	25	25	HMI default contrast
	26	26	HMI diagnosis view
	27	27	HMI customDP_1
	28	28	HMI customDP_2

... 10 Device specific commands

... Command 134: Read HMI unsigned char variable

Command 134	Index	Slot-code	Data-description
Slot code table	29	29	HMI customDP_3
	30	30	HMI customDP_4
	31	31	HMI customDP_5
	32	32	HMI ustomDP_6
	33	33	HMI customDP_7
	34	34	HMI customDP_8
	35	35	HMI customDP_9
	36	36	HMI customDP_10
	37	37	HMI customDP_11
	38	38	HMI date format
	39	39	HMI display test

Command 134	Description
Response code	**Common response code** on page 58

Command 135: Write HMI unsigned char variable

Command 135	Description		offset	size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8

Command 135	Index	Slot-code	Data-description
Slot code table	0	0	language
	1	1	HMI mainOperatorView_1_1
	2	2	HMI mainOperatorView_1_2
	3	3	HMI mainOperatorView_1_3
	4	3	HMI mainOperatorView_1_bargraph
	5	4	HMI mainOperatorView_2_1
	6	6	HMI mainOperatorView_2_2
	7	7	HMI mainOperatorView_2_3
	8	8	HMI mainOperatorView_2_bargraph
	9	9	HMI mainOperatorView_3_1
	10	10	HMI mainOperatorView_3_2
	11	11	HMI mainOperatorView_3_3
	12	12	HMI mainOperatorView_3_bargraph

Command 135	Index	Slot code	Data description
Slot code table	13	13	HMI mainOperatorView_4_1
	14	14	HMI mainOperatorView_4_2
	15	15	HMI mainOperatorView_4_3
	16	16	HMI mainOperatorView_4_bargraph
	17	17	HMI contrast
	18	18	HMI local Operation enable
	19	19	HMI displayMode_1
	20	20	HMI displayMode_2
	21	21	HMI displayMode_3
	22	22	HMI displayMode_4
	23	23	HMI auto scroll enable
	24	24	HMI low level software revision
	25	25	HMI default contrast
	26	26	HMI diagnosis view
	27	27	HMI customDP_1
	28	28	HMI customDP_2
	29	29	HMI customDP_3
	30	30	HMI customDP_4
	31	31	HMI customDP_5
	32	32	HMI ustomDP_6
	33	33	HMI customDP_7
	34	34	HMI customDP_8
	35	35	HMI customDP_9
	36	36	HMI customDP_10
	37	37	HMI customDP_11
	38	38	HMI date format
	39	39	HMI display test

Command 135	Description
Response code	**Common response code** on page 58

... 10 Device specific commands

Command 136: Read unsigned short variable

Command 136	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	2	Unsigned-16

Command 136	Index	Slot-code	Data-description
Slot code table	0	0	Simulation pulses number
	1	1	Voltage supply read back high threshold
	2	2	Voltage supply read back low threshold
	3	3	Sample timer for one calibration point
	4	4	Sample number for one calibration point
	5	5	Low flow threshold
	6	6	Subsystem index which data will be save as default
	7	8	Signal amplitude
	8	9	Vibration signal amplitude
	9	10	Signal amplitude in frequency domain
	10	11	SNR threshold
	11	12	Signal amplitude threshold of sensor self-check function
	12	13	Vibration filter step
	13	14	Gain low threshold
	14	15	Gain high threshold
	15	16	Gain margin frequency
	16	17	Low flow threshold coefficient

Command 136	Description
Response code	**Common response code** on page 58

Command 137: Write unsigned short variable

Command 137	Description		offset	size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
	0	Slot code	#0	1	Unsigned-8
Response data bytes	1	Dummy unsigned-8	#1	2	Unsigned-16
	1	Dummy unsigned-8	#1	2	Unsigned-16

Command 137	Index	Slot-code	Data-description
Slot code table	0	0	Simulation pulses number
	1	1	Voltage supply read back high threshold
	2	2	Voltage supply read back low threshold
	3	3	Sample timer for one calibration point
	4	5	Low flow threshold
	5	6	Subsystem index which data will be save as default
	6	11	SNR threshold
	7	12	Signal amplitude threshold of sensor self-check function
	8	13	Vibration filter step
	9	14	Gain low threshold
	10	15	Gain high threshold
	11	16	Gain margin frequency
	12	17	Low flow threshold coefficient

Command 137	Description
Response code	**Common response code** on page 58

… 10 Device specific commands

Command 138: Read unsigned long variable

Command 138	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	4	Unsigned-32

Command 138	Index	Slot-code	Data-description
Slot code table	0	0	Total working time hour
	1	1	Partial working time hour
	2	2	Transducer maintenance cycle
	3	3	Front end maintain
	4	4	Front end operation hour
	5	5	Auto self-check time
	6	6	HART burst in alarm period threshold

Command 138	Description
Response code	**Common response code** on page 58

Command 139: Write unsigned long variable

Command 139	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	4	Unsigned-32
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	32	Unsigned-32

Command 139	Index	Slot-code	Data-description
Slot code table	0	0	Total working time hour
	1	1	Partial working time hour
	2	2	Transducer maintenance cycle
	3	3	Front end maintain
	4	4	Front end operation hour
	5	5	Auto self-check time
	6	6	HART burst in alarm period threshold

Command 139	Description
Response code	**Common response code** on page 58

Command 140: Read Float Variable

Command 140	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
Response data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy Float	#1	4	Float

Command 140	Index	Slot code	Data description
Slot code table	0	0	Gas K factor average
	1	1	Liquid K factor average
	2	2	Liquid K factor1
	3	3	Liquid K factor2
	4	3	Liquid K factor3
	5	4	Liquid K factor4
	6	6	Liquid K factor5
	7	7	Liquid K factor1 corresponding frequency
	8	8	Liquid K factor2 corresponding frequency
	9	9	Liquid K factor3 corresponding frequency
	10	10	Liquid K factor4 corresponding frequency
	11	11	Liquid K factor5 corresponding frequency
	12	12	Frequency
	13	13	Simulation frequency
	14	14	Temperature preset value
	15	15	Gas K factor1
	16	16	Gas K factor2
	17	17	Gas K factor3
	18	18	Gas K factor4
	19	19	Gas K factor5
	20	20	Gas K factor1 corresponding frequency
	21	21	Gas K factor2 corresponding frequency
	22	22	Gas K factor3 corresponding frequency
	23	23	Gas K factor4 corresponding frequency
	24	24	Gas K factor5 corresponding frequency
	25	25	Partial gas volume value
	26	26	Standard partial gas volume flow
	27	27	Partial gas volume flow damped value
	28	28	Standard partial gas volume flow damped value
	29	29	Volume flow value
	30	30	volume flow damped value

… 10 Device specific commands

… Command 140: Read Float Variable

Command 140	Index	Slot code	Data description
Slot code table	31	31	Volume flow range span
	32	32	Volume flow percentage
	33	33	Maximum limited volume flow for current dimension tube
	34	34	Standard volume flow value
	35	35	Standard volume flow damped value
	36	36	Standard volume flow percentage
	37	37	Maximum limited standard volume flow
	38	38	Mass flow value
	39	39	Mass flow damped value
	40	40	Mass flow percentage
	41	41	Maximum limited mass flow value
	42	42	Power flow value
	43	43	Power flow damped value
	44	44	Power flow percentage
	45	45	Maximum limited power flow
	46	46	Internal temperature
	47	47	Internal temperature damped value
	48	48	Internal temperature percentage
	49	49	External temperature value
	50	50	External temperature percentage
	51	51	External temperature preset value
	52	52	External temperature range span
	53	53	Pressure value
	54	54	Pressure preset value
	55	55	Pressure range span
	56	56	Density value
	57	57	Density preset value
	58	58	Density range span
	59	59	Content
	60	60	Content preset value
	61	61	Content range span
	62	62	Enthalpy of tube inlet
	63	63	Enthalpy of tube outlet
	64	64	Standard volume range span
	65	65	Mass flow range span

Command 140	Index	Slot code	Data description
Slot code table	66	66	Power flow range span
	67	67	Volume totalizer value
	68	68	Standard volume totalizer value
	69	69	Mass flow totalizer value
	70	70	Energy totalizer value
	71	71	Partial gas volume totalizer value
	72	72	Standard partial gas volume totalizer value
	73	73	Mean frequency of one calibration point within calibration time
	74	74	Frequency standard error of one calibration point within calibration time
	75	75	Minimum frequency of one calibration point within calibration time
	76	76	Maximum frequency of one calibration point within calibration time
	77	77	Digital out pulse value
	78	78	Digital out pulse width
	79	79	Digital out minimum frequency
	80	80	Digital out maximum frequency
	81	81	Frequency value
	82	82	Current out low alarm value
	83	83	Current out high alarm value
	84	84	Signal noise rate
	85	85	Energy calorific value
	86	86	Reference density
	87	87	Reference Temperature
	88	88	Volume expand beta1
	89	89	Density expand beta1
	90	90	Heat capacity
	91	91	Volume flow low alarm value
	92	92	Volume flow high alarm value
	93	93	Mass flow low alarm value
	94	94	Mass flow high alarm value
	95	95	Temperature low alarm value
	96	96	Temperature high alarm value
	97	97	Pressure low alarm value
	98	98	Pressure high alarm value
	99	99	Relative density
	100	100	Volume percentage simulation value
	101	101	Volume simulation value
	102	102	Mass flow percentage simulation value

… 10 Device specific commands

… Command 140: Read Float Variable

Command 140	Index	Slot code	Data description
Slot code table	103	103	Mass flow value
	104	104	Device board temperature
	105	105	Temperature composition
	106	106	Calorific reference value
	107	107	Hart in simulation
	108	108	Analog input lower end point trim value
	109	109	Analog input upper end point trim value
	110	110	Analog input raw current
	112	112	Analog input simulation data
	113	113	Current out fixed output value
	114	114	Enthalpy of inlet preset value
	115	115	Enthalpy of outlet preset value
	116	116	Digital out frequency simulation value
	117	117	Partial gas volume maximum limited value
	118	118	Standard partial gas volume maximum limited value
	119	119	Compressor factor R
	120	120	Compressor factor S
	121	121	Max history inlet temperature
	122	122	Liquid K factor6
	123	123	Liquid K factor7
	123	124	Liquid K factor8
	124	125	Liquid K factor6 corresponding frequency
	125	126	Liquid K factor7 corresponding frequency
	126	127	Liquid K factor8 corresponding frequency
	127	128	Gas K factor6
	128	129	Gas K factor7
	129	130	Gas K factor8
	130	131	Gas K factor6 corresponding frequency
	131	132	Gas K factor7 corresponding frequency
	132	133	Gas K factor8 corresponding frequency
	133	134	Qv partial percentage
	134	135	Qn partial percentage
	135	136	Dynamic viscosity
	136	137	Temperature offset correction
	137	138	Max flow frequency
	138	139	Min flow frequency
	139	140	Max history ambient temperature

Command 140	Description
Response code	**Common response code** on page 58

Command 141: Write Float Variable

Command 141	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy Float	#1	4	Float
Response data	0	Slot code	#0	1	Unisigned-8
bytes	1	Dummy Float	#1	4	Float

Command 141	Index	Slot code	Data description
Slot code table	0	0	Gas K factor average
	1	1	Liquid K factor average
	2	2	Liquid K factor1
	3	3	Liquid K factor2
	4	3	Liquid K factor3
	5	4	Liquid K factor4
	6	6	Liquid K factor5
	7	7	Liquid K factor1 corresponding frequency
	8	8	Liquid K factor2 corresponding frequency
	9	9	Liquid K factor3 corresponding frequency
	10	10	Liquid K factor4 corresponding frequency
	11	11	Liquid K factor5 corresponding frequency
	12	12	Frequency
	13	13	Simulation frequency
	14	14	Temperature preset value
	15	15	Gas K factor1
	16	16	Gas K factor2
	17	17	Gas K factor3
	18	18	Gas K factor4
	19	19	Gas K factor5
	20	20	Gas K factor1 corresponding frequency
	21	21	Gas K factor2 corresponding frequency
	22	22	Gas K factor3 corresponding frequency
	23	23	Gas K factor4 corresponding frequency
	24	24	Gas K factor5 corresponding frequency
	25	25	Partial gas volume value
	26	26	Standard partial gas volume flow
	27	27	Partial gas volume flow damped value
	28	28	Standard partial gas volume flow damped value
	29	29	Volume flow value
	30	30	volume flow damped value

… 10 Device specific commands

… Command 141: Write Float Variable

Command 141	Index	Slot code	Data description
Slot code table	31	31	Volume flow range span
	32	32	Volume flow percentage
	33	33	Maximum limited volume flow for current dimension tube
	34	34	Standard volume flow value
	35	35	Standard volume flow damped value
	36	36	Standard volume flow percentage
	37	37	Maximum limited standard volume flow
	38	38	Mass flow value
	39	39	Mass flow damped value
	40	40	Mass flow percentage
	41	41	Maximum limited mass flow value
	42	42	Power flow value
	43	43	Power flow damped value
	44	44	Power flow percentage
	45	45	Maximum limited power flow
	46	46	Internal temperature
	47	47	Internal temperature damped value
	48	48	Internal temperature percentage
	49	49	External temperature value
	50	50	External temperature percentage
	51	51	External temperature preset value
	52	52	External temperature range span
	53	53	Pressure value
	54	54	Pressure preset value
	55	55	Pressure range span
	56	56	Density value
	57	57	Density preset value
	58	58	Density range span
	59	59	Content
	60	60	Content preset value
	61	61	Content range span
	62	62	Enthalpy of tube inlet
	63	63	Enthalpy of tube outlet
	64	64	Standard volume range span
	65	65	Mass flow range span

Command 141	Index	Slot code	Data description
Slot code table	66	66	Power flow range span
	67	67	Volume totalizer value
	68	68	Standard volume totalizer value
	69	69	Mass flow totalizer value
	70	70	Energy totalizer value
	71	71	Partial gas volume totalizer value
	72	72	Standard partial gas volume totalizer value
	73	73	Mean frequency of one calibration point within calibration time
	74	74	Frequency standard error of one calibration point within calibration time
	75	75	Minimum frequency of one calibration point within calibration time
	76	76	Maximum frequency of one calibration point within calibration time
	77	77	Digital out pulse value
	78	78	Digital out pulse width
	79	79	Digital out minimum frequency
	80	80	Digital out maximum frequency
	81	81	Frequency value
	82	82	Current out low alarm value
	83	83	Current out high alarm value
	84	84	Signal noise rate
	85	85	Energy calorific value
	86	86	Reference density
	87	87	Reference Temperature
	88	88	Volume expand beta1
	89	89	Density expand beta1
	90	90	Heat capacity
	91	91	Volume flow low alarm value
	92	92	Volume flow high alarm value
	93	93	Mass flow low alarm value
	94	94	Mass flow high alarm value
	95	95	Temperature low alarm value
	96	96	Temperature high alarm value
	97	97	Pressure low alarm value
	98	98	Pressure high alarm value
	99	99	Relative density
	100	100	Volume percentage simulation value

… 10 Device specific commands

… Command 141: Write Float Variable

Command 141	Index	Slot code	Data description
Slot code table	101	101	Volume simulation value
	102	102	Mass flow percentage simulation value
	103	103	Mass flow value
	104	104	Device board temperature
	105	105	Temperature composition
	106	106	Calorific reference value
	107	107	Hart in simulation
	108	108	Analog input lower end point trim value
	109	109	Analog input upper end point trim value
	110	110	Analog input raw current
	112	112	Analog input simulation data
	113	113	Current out fixed output value
	114	114	Enthalpy of inlet preset value
	115	115	Enthalpy of outlet preset value
	116	116	Digital out frequency simulation value
	117	117	Partial gas volume maximum limited value
	118	118	Standard partial gas volume maximum limited value
	119	119	Compressor factor R
	120	120	Compressor factor S
	121	121	Max history inlet temperature
	122	122	Liquid K factor6
	123	123	Liquid K factor7
	123	124	Liquid K factor8
	124	125	Liquid K factor6 corresponding frequency
	125	126	Liquid K factor7 corresponding frequency
	126	127	Liquid K factor8 corresponding frequency
	127	128	Gas K factor6
	128	129	Gas K factor7
	129	130	Gas K factor8
	130	131	Gas K factor6 corresponding frequency
	131	132	Gas K factor7 corresponding frequency
	132	133	Gas K factor8 corresponding frequency
	133	134	Qv partial percentage
	134	135	Qn partial percentage
	135	136	Dynamic viscosity
	136	137	Temperature offset correction
	137	138	Max flow frequency
	138	139	Min flow frequency
	139	140	Max history ambient temperature

Command 141	Description
Response Code	**Common response code** on page 58

Command 142: Read IO double variable

Command 142	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy double	#1	8	Double

Command 142	Index	Slot-code	Data-description
Slot code table	2	2	Totalized volume flow preset value
	3	3	Totalized standard volume flow preset value
	4	4	Totalized mass flow preset value
	5	5	Totalized energy preset value
	6	6	Totalized partial volume flow preset value
	7	7	Totalized standard partial volume flow preset value
	8	8	Qv totalizer value
	9	9	Qn totalizer value
	10	10	Qm totalizer value
	11	11	Energy totalizer value
	12	12	Qv partial totalizer value
	13	13	Qv partial totalizer value

Command 142	Description
Response code	**Common response code** on page 58

Command 143: Write double variable

Command 143	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned -8
	1	Dummy double	#1	8	Double
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy double	#1	8	Double

Command 143	Index	Slot-code	Data-description
Slot code table	2	2	Totalized volume flow preset value
	3	3	Totalized standard volume flow preset value
	4	4	Totalized mass flow preset value
	5	5	Totalized energy preset value
	6	6	Totalized partial volume flow preset value
	7	7	Totalized standard partial volume flow preset value

Command 143	Description
Response code	**Common response code** on page 58

... 10 Device specific commands

Command 144: log out HART service code

Command 144	Description	Offset	Size	Data type
Request data bytes	None			
Response data bytes	None			
Response code	**Common response code** on page 58			

Command 146: Perform action

Command 146	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8

Command 146	Index	Slot-code	Data-description
Slot code table	0	0	Start all totalizer
	1	1	Start volume flow totalizer
	2	2	Start standard volume flow totalizer
	3	3	Start mass flow totalizer
	4	3	Start energy totalizer
	5	4	Start partial volume flow totalizer
	6	6	Start Standard partial Volume Flow Totalizer
	7	7	Stop all totalizer
	8	8	Stop volume flow totalizer
	9	9	Stop standard volume flow totalizer
	10	10	Stop mass flow totalizer
	11	11	Stop energy totalizer
	12	12	Stop partial volume flow totalizer
	13	13	Stop standard partial volume flow totalizer
	14	14	Reset all totalizer
	15	15	Reset volume flow totalizer
	16	16	Reset standard volume flow totalizer
	17	17	Reset mass flow totalizer
	18	18	Reset energy totalizer
	19	19	Reset partial volume flow totalizer

Command 146	Index	Slot code	Data description
Slot code table	20	20	Reset standard partial volume flow totalizer
	21	21	Preset all totalizer
	22	22	Preset volume flow totalizer
	23	23	Preset standard volume flow totalizer
	24	24	Preset mass flow totalizer
	25	25	Preset energy totalizer
	26	26	Preset partial volume flow totalizer
	27	27	Preset standard partial volume flow totalizer
	28	28	Trigger calibration
	29	29	Trigger self-diagnosis
	30	30	Clear diagnosis history
	31	31	Read parameters
	32	32	Write parameters
	33	33	Save customer default
	34	34	Save factory default
	35	35	Reset customer default
	36	36	Reset factory default
	37	37	Reset front end hour
	38	38	Format NV

Command 146	Description
Response code	**Common response code** on page 58

Command 150: Read diagnosis active alarm

Command 150	Description		Offset	Size	Data type
Request data bytes	0	Active diagnosis information	#0	6	Unsigned-8
Response data bytes	0	Active diagnosis information	#0	6	Unsigned-8

Response code	**Common response code** on page 58

... 10 Device specific commands

Command 151: Read diagnosis active alarm condition detail

Command 151	Description		Offset	Size	Data type
Request data bytes	0	Diagnosis condition number	#0	1	Unisigned-8
Response data bytes	0	Diagnosis condition number	#0	1	Unisigned-8
	1	Diagnosis condition details class	#1	1	Unisigned-8
	2	Diagnosis condition details group	#2	1	Unisigned-8
	3	Diagnosis condition details priority	#3	1	Unisigned-8
	4	Diagnosis condition details alarm counter	#4	2	Unisigned-16
	5	Diagnosis condition details alarm time counter day	#6	2	Unisigned-16
	6	Diagnosis condition details alarm time counter mini second	#8	4	Unisigned-32
	7	Diagnosis condition details last alarm time counter day	#12	2	Unisigned-16
	8	Diagnosis condition details last alarm time counter mini second	#14	4	Unisigned-16
	9	Diagnosis condition details code	#18	15	Unisigned-8
Response code	**Common response code** on page 58				

Command 152: Read flow status

Command 152	Description		Offset	Size	Data type
Request data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
Response data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
	1	Vortex device status	#1	1	Unisigned-8
	2	Additional vortex device status	#2	1	Unisigned-8
Response code	**Common response code** on page 58				

Command 153: Read family revision

Command 153	Description		Offset	Size	Data type
Request data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
Response data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
	1	Family revision	#1	1	Unisigned-8
Response code	**Common response code** on page 58				

Command 154: Read vortex frequency

Command 154	Description		Offset	Size	Data type
Request data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
Response data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
	1	Frequency unit	#1	1	Unisigned-8
	2	Frequency value	#2	4	Float
Response code	**Common response code** on page 58				

Command 155: Read low flow cutoff

Command 155	Description		Offset	Size	Data type
Request data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
Response data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
	1	Low cut off volume flow unit	#1	1	Unisigned-8
	2	Low cut off volume flow value	#2	4	Float
Response code	**Common response code** on page 58				

Command 156: Read density

Command 156	Description		Offset	Size	Data type
Request data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
Response data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
	1	Preset density unit	#1	1	Unisigned-8
	2	Preset density value	#2	4	Float
Response code	**Common response code** on page 58				

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Command 157: Read density unit

Command 157	Description		Offset	Size	Data type
Request data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
Response data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
	1	Preset density unit	#1	1	Unisigned-8
	2	Preset density value	#2	4	Float
Response code	**Common response code** on page 58				

Command 158: Read viscosity

Command 158	Description		Offset	Size	Data type
Request data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
Response data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
	1	Viscosity unit	#1	1	Unisigned-8
	2	Viscosity value	#2	4	Float
Response code	**Common response code** on page 58				

Command 159: Read tube diameter size

Command 159	Description		Offset	Size	Data type
Request data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
Response data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
	1	Diameter unit	#1	1	Unisigned-8
	2	Diameter value	#2	4	Float
Response code	**Common response code** on page 58				

Command 160: Write low flow cutoff

Command 160	Description		Offset	Size	Data type
Request data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
Response data bytes	0	Dummy unsigned-8	#0	1	Unisigned-8
	1	Low cut off volume flow unit	#1	1	Unisigned-8
	2	Low cut off volume flow value	#2	4	Float
Response code	**Common response code** on page 58				

Command 164: Write tube diameter size

Command 164	Description		Offset	Size	Data type
Request data bytes	0	Diameter value	#0	4	Float
Response data bytes	0	Diameter value	#0	4	Float
Response code	**Common response code** on page 58				

Command 165: Write service code

Command 165	Description		Offset	Size	Data type
Request data bytes	0	Service code	#0	20	Unsigned-8
Response data bytes	0	Diameter value	#0	20	Unsigned-8
Response code	**Common response code** on page 58				

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Command 166: Read floats

Command 166	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
Response data	0	Slot code	#0	1	Unisigned-8
bytes	1	Dummy float	#2	4	Float
	2	Dummy float	#6	4	Float
	3	Dummy float	#10	4	Float
	4	Dummy float	#14	4	Float
	5	Dummy float	#18	4	Float
	6	Dummy float	#22	4	Float
	7	Dummy float	#26	4	Float
	8	Dummy float	#30	4	Float
	9	Dummy float	#34	4	Float

Command 166	Index	Slot code	Data description
Slot code table	0	0	Compress factor matrix value 0
	1	0	Compress factor matrix value 1
	2	0	Compress factor matrix value 2
	3	0	Compress factor matrix value 3
	4	0	Compress factor matrix value 4
	5	0	Compress factor matrix value 5
	6	0	Compress factor matrix value 6
	7	0	Compress factor matrix value 7
	8	0	Compress factor matrix value 8
	9	1	Compress factor matrix value 9
	10	1	Compress factor matrix value 10
	11	1	Compress factor matrix value 11
	12	1	Compress factor matrix value 12
	13	1	Compress factor matrix value 13
	14	1	Compress factor matrix value 14
	15	1	Compress factor matrix value 15
	16	1	Compress factor matrix value 16
	17	1	Compress factor matrix value 17
	18	2	Compress factor matrix value 18
	19	2	Compress factor matrix value 19
	20	2	Compress factor matrix value 20
	21	2	Compress factor matrix value 21
	22	2	Compress factor matrix value 22
	23	2	Compress factor matrix value 23
	24	2	Compress factor matrix value 24
	25	2	Compress factor matrix value 25

Command 166	Index	Slot code	Data description
Slot code table	26	2	Compress factor matrix value 26
	27	3	Compress factor matrix value 27
	28	3	Compress factor matrix value 28
	29	3	Compress factor matrix value 29
	30	3	Compress factor matrix value 30
	31	3	Compress factor matrix value 31
	32	3	Compress factor matrix value 32
	33	3	Compress factor matrix value 33
	34	3	Compress factor matrix value 34
	35	3	Compress factor matrix value 35
	36	4	Compress factor matrix value 36
	37	4	Compress factor matrix value 37
	38	4	Compress factor matrix value 38
	39	4	Compress factor matrix value 39
	40	4	Compress factor matrix value 40
	41	4	Compress factor matrix value 41
	42	4	Compress factor matrix value 42
	43	4	Compress factor matrix value 43
	44	4	Compress factor matrix value 44
	45	5	Compress factor matrix value 45
	46	5	Compress factor matrix value 46
	47	5	Compress factor matrix value 47
	48	5	Compress factor matrix value 48
	49	5	Compress factor matrix value 49
	50	5	Compress factor matrix value 50
	51	5	Compress factor matrix value 51
	52	5	Compress factor matrix value 52
	53	5	Compress factor matrix value 53
	54	6	Compress factor matrix value 54
	55	6	Compress factor matrix value 55
	56	6	Compress factor matrix value 56
	57	6	Compress factor matrix value 57
	58	6	Compress factor matrix value 58
	59	6	Compress factor matrix value 59
	60	6	Compress factor matrix value 60
	61	6	Compress factor matrix value 61
	62	6	Compress factor matrix value 62
	63	7	Compress factor pressure array value 0
	64	7	Compress factor pressure array value 1
	65	7	Compress factor pressure array value 2

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… Command 166: Read floats

Command 166	Index	Slot code	Data description
Slot code table	66	7	Compress factor pressure array value 3
	67	7	Compress factor pressure array value 4
	68	7	Compress factor pressure array value 5
	69	7	Compress factor pressure array value 6
	70	7	Compress factor pressure array value 7
	71	7	Compress factor pressure array value 8
	72	8	Compress factor temperature array value 0
	73	8	Compress factor temperature array value 1
	74	8	Compress factor temperature array value 2
	75	8	Compress factor temperature array value 3
	76	8	Compress factor temperature array value 4
	77	8	Compress factor temperature array value 5
	78	8	Compress factor temperature array value 6
	79	8	Dummy float
	80	8	Dummy float
	81	9	Moll fractions value 0
	82	9	Moll fractions value 1
	83	9	Moll fractions value 2
	84	9	Moll fractions value 3
	85	9	Moll fractions value 4
	86	9	Moll fractions value 5
	87	9	Moll fractions value 6
	88	9	Moll fractions value 7
	89	9	Moll fractions value 8
	90	10	Moll fractions value 9
	91	10	Moll fractions value 10
	92	10	Moll fractions value 11
	93	10	Moll fractions value 12
	94	10	Moll fractions value 13
	95	10	Moll fractions value 14
	96	10	Moll fractions value 15
	97	10	Moll fractions value 16
	98	10	Moll fractions value 17
	99	11	Moll fractions value 18
	100	11	Moll fractions value 19

Command 166	Index	Slot code	Data description
Slot code table	101	11	Moll fractions value 20
	102	11	Dummy float
	103	11	Dummy float
	104	11	Dummy float
	105	11	Dummy float
	106	11	Dummy float
	107	11	Dummy float

Command 166	Description
Response code	**Common response code** on page 58

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Command 167: Write floats

Command 167	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy float	#2	4	Float
	2	Dummy float	#6	4	Float
	3	Dummy float	#10	4	Float
	4	Dummy float	#14	4	Float
	5	Dummy float	#18	4	Float
	6	Dummy float	#22	4	Float
	7	Dummy float	#26	4	Float
	8	Dummy float	#30	4	Float
	9	Dummy float	#34	4	Float
Response data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy float	#2	4	Float
	2	Dummy float	#6	4	Float
	3	Dummy float	#10	4	Float
	4	Dummy float	#14	4	Float
	5	Dummy float	#18	4	Float
	6	Dummy float	#22	4	Float
	7	Dummy float	#26	4	Float
	8	Dummy float	#30	4	Float
	9	Dummy float	#34	4	Float

Command 167	Index	Slot code	Data description
Slot code table	0	0	Compress factor matrix value 0
	1	0	Compress factor matrix value 1
	2	0	Compress factor matrix value 2
	3	0	Compress factor matrix value 3
	4	0	Compress factor matrix value 4
	5	0	Compress factor matrix value 5
	6	0	Compress factor matrix value 6
	7	0	Compress factor matrix value 7
	8	0	Compress factor matrix value 8
	9	1	Compress factor matrix value 9
	10	1	Compress factor matrix value 10
	11	1	Compress factor matrix value 11
	12	1	Compress factor matrix value 12
	13	1	Compress factor matrix value 13
	14	1	Compress factor matrix value 14
	15	1	Compress factor matrix value 15

Command 167	Index	Slot code	Data description
Slot code table	16	1	Compress factor matrix value 16
	17	1	Compress factor matrix value 17
	18	2	Compress factor matrix value 18
	19	2	Compress factor matrix value 19
	20	2	Compress factor matrix value 20
	21	2	Compress factor matrix value 21
	22	2	Compress factor matrix value 22
	23	2	Compress factor matrix value 23
	24	2	Compress factor matrix value 24
	25	2	Compress factor matrix value 25
	26	2	Compress factor matrix value 26
	27	3	Compress factor matrix value 27
	28	3	Compress factor matrix value 28
	29	3	Compress factor matrix value 29
	30	3	Compress factor matrix value 30
	31	3	Compress factor matrix value 31
	32	3	Compress factor matrix value 32
	33	3	Compress factor matrix value 33
	34	3	Compress factor matrix value 34
	35	3	Compress factor matrix value 35
	36	4	Compress factor matrix value 36
	37	4	Compress factor matrix value 37
	38	4	Compress factor matrix value 38
	39	4	Compress factor matrix value 39
	40	4	Compress factor matrix value 40
	41	4	Compress factor matrix value 41
	42	4	Compress factor matrix value 42
	43	4	Compress factor matrix value 43
	44	4	Compress factor matrix value 44
	45	5	Compress factor matrix value 45
	46	5	Compress factor matrix value 46
	47	5	Compress factor matrix value 47
	48	5	Compress factor matrix value 48
	49	5	Compress factor matrix value 49
	50	5	Compress factor matrix value 50
	51	5	Compress factor matrix value 51
	52	5	Compress factor matrix value 52
	53	5	Compress factor matrix value 53
	54	6	Compress factor matrix value 54
	55	6	Compress factor matrix value 55

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… Command 167: Write floats

Command 167	Index	Slot code	Data description
Slot code table	56	6	Compress factor matrix value 56
	57	6	Compress factor matrix value 57
	58	6	Compress factor matrix value 58
	59	6	Compress factor matrix value 59
	60	6	Compress factor matrix value 60
	61	6	Compress factor matrix value 61
	62	6	Compress factor matrix value 62
	63	7	Compress factor pressure array value 0
	64	7	Compress factor pressure array value 1
	65	7	Compress factor pressure array value 2
	66	7	Compress factor pressure array value 3
	67	7	Compress factor pressure array value 4
	68	7	Compress factor pressure array value 5
	69	7	Compress factor pressure array value 6
	70	7	Compress factor pressure array value 7
	71	7	Compress factor pressure array value 8
	72	8	Compress factor temperature array value 0
	73	8	Compress factor temperature array value 1
	74	8	Compress factor temperature array value 2
	75	8	Compress factor temperature array value 3
	76	8	Compress factor temperature array value 4
	77	8	Compress factor temperature array value 5
	78	8	Compress factor temperature array value 6
	79	8	Dummy float
	80	8	Dummy float
	81	9	Moll fractions value 0
	82	9	Moll fractions value 1
	83	9	Moll fractions value 2
	84	9	Moll fractions value 3
	85	9	Moll fractions value 4
	86	9	Moll fractions value 5
	87	9	Moll fractions value 6
	88	9	Moll fractions value 7
	89	9	Moll fractions value 8
	90	10	Moll fractions value 9
	91	10	Moll fractions value 10
	92	10	Moll fractions value 11
	93	10	Moll fractions value 12
	94	10	Moll fractions value 13
	95	10	Moll fractions value 14

Command 167	Index	Slot code	Data description
Slot code table	96	10	Moll fractions value 15
	97	10	Moll fractions value 16
	98	10	Moll fractions value 17
	99	11	Moll fractions value 18
	100	11	Moll fractions value 19
	101	11	Moll fractions value 20
	102	11	Dummy float
	103	11	Dummy float
	104	11	Dummy float
	105	11	Dummy float
	106	11	Dummy float
	107	11	Dummy float

Command 167	Description
Response code	**Common response code** on page 58

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Command 168: Read gas configure flag

Command 168	Description		Offset	Size	Data type
Request data bytes	0	Gas configure flag	#0	1	Unsigned-8
Response data bytes	0	Gas configure flag	#0	1	Unsigned-8
Response code	**Common response code** on page 58				

Command 169: Write gas configure flag

Command 169	Description		Offset	Size	Data type
Request data bytes	0	Gas configure flag	#0	1	Unsigned-8
Response data bytes	0	Gas configure flag	#0	1	Unsigned-8
Response code	**Common response code** on page 58				

Command 170: Read string

Command 170	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy char	#2	1	Unisigned-8
Response data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy char	#2	1	Unisigned-8

Command 170	Index	Slot code	Data description
Slot code table	0	0	Software revision
	1	1	Hardware revision
	2	2	Device serial number
	3	3	Front end board serial number
	4	4	HMI software revision
	5	5	HMI hardware revision
	6	6	Communication board serial number
	7	7	Low level HMI hardware and software revision
	8	8	Sensor ID
	9	9	Sensor SAP ERP no
	10	10	Sensor calibration date
	11	11	Sensor calibration certification no
	12	12	Sensor calibration location
	13	13	Boot loader revision
	14	14	Transmitter ID
	15	15	Transmitter SAP ERP no
	16	16	Transmitter calibration date
	17	17	Transmitter calibration certification no
	18	18	Transmitter calibration location
	19	19	Manufacturer
	20	20	Street of manufacturer
	21	21	City of manufacturer
	22	22	Contact phone of manufacturer
	23	23	Front end RTC
	24	24	Front end software revision
	25	25	Front end hardware revision
	26	26	Tag
	27	27	Device message
	28	28	Final assemble number
	29	29	Descriptor
	30	30	Device ID number

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… Command 170: Read string

Command 170	Index	Slot code	Data description
Slot code table	31	31	Device install date
	32	32	Measuring task
	33	33	Device variable transducer serial no
	34	34	Long tag
	35	35	Non valid device variable value
	36	36	Soft modem information
	37	37	Transducer serial number
	38	38	Country code
	39	39	Transmitter type
	40	40	Internal RTD function key
	41	41	Analog input function key
	42	42	Energy flow function key
	43	43	Password standard level
	44	44	Password advanced level
	45	45	Sensor location tag
	46	46	Sensor tag

Command 170	Description
Response code	**Common response code** on page 58

Command 171: Write string

Command 171	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy char	#2	1	Unisigned-8
Response data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy char	#2	1	Unisigned-8

Command 171	Index	Slot code	Data description
Slot code table	2	2	Device serial number
	3	3	Front end board serial number
	6	6	Communication board serial number
	8	8	Sensor ID
	9	9	Sensor SAP ERP no
	10	10	Sensor calibration date
	11	11	Sensor calibration certification no
	12	12	Sensor calibration location
	13	13	Boot loader revision
	14	14	Transmitter ID
	15	15	Transmitter SAP ERP no

Command 171	Index	Slot code	Data description
Slot code table	16	16	Transmitter calibration date
	17	17	Transmitter calibration certification no
	18	18	Transmitter calibration location
	19	19	Manufacturer
	20	20	Street of manufacturer
	21	21	City of manufacturer
	22	22	Contact phone of manufacturer
	23	23	Front end RTC
	24	24	Front end software revision
	25	25	Front end hardware revision
	26	26	Tag
	27	27	Device message
	28	28	Final assemble number
	29	29	Descriptor
	30	30	Device ID number
	31	31	Device install date
	32	32	Measuring task
	33	33	Device variable transducer serial no
	34	34	Long tag
	38	38	Country code
	39	39	Transmitter type
	40	40	Internal RTD function key
	41	41	Analog input function key
	42	42	Energy flow function key
	43	43	Password standard level
	44	44	Password advanced level
	45	45	Sensor location tag
	46	46	Sensor tag

Command 171	Description
Response code	**Common response code** on page 58

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Command 172: Read device variable alarm range

Command 172	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
Response data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy float	#1	4	Float
	2	Dummy float	#5	4	Float

Command 172	Index	Slot code	Data description
Slot code table	2	0	Volume flow low alarm value
	3	0	Volume flow high alarm value
	6	1	Mass flow low alarm value
	8	1	Mass flow high alarm value
	9	2	Temperature low alarm value
	10	2	Temperature high alarm value
	11	3	Pressure low alarm value
	12	3	Pressure high alarm value

Command 172	Description
Response code	**Common response code** on page 58

Command 173: Write device variable alarm range

Command 173	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy float	#1	4	Float
	2	Dummy float	#5	4	Float
Response data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy float	#1	4	Float
	2	Dummy float	#5	4	Float

Command 173	Index	Slot code	Data description
Slot code table	2	0	Volume flow low alarm value
	3	0	Volume flow high alarm value
	6	1	Mass flow low alarm value
	8	1	Mass flow high alarm value
	9	2	Temperature low alarm value
	10	2	Temperature high alarm value
	11	3	Pressure low alarm value
	12	3	Pressure high alarm value

Command 173	Description
Response code	**Common response code** on page 58

Command 174: Read device variable with unit

Command 174	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8
	2	Dummy float	#2	4	Float

Command 174	Index	Slot code	Data description
Slot code table	0	0	Internal temperature preset unit
	1	0	Internal temperature preset value
	2	1	External temperature preset unit
	3	1	External temperature preset value
	6	2	Pressure preset unit
	8	2	Pressure preset value
	9	3	Density preset unit
	10	3	Density preset value
	11	4	Dummy unsigned 8
	12	4	Content preset value
	13	5	Reference density unit
	14	5	Reference density value
	15	6	Reference temperature unit
	16	6	Reference temperature value
	17	7	Reference pressure unit
	18	7	Reference pressure value
	19	8	Board temperature simulation unit
	20	8	Board temperature simulation value
	21	9	Electronic temperature unit
	22	9	Electronic temperature value
	23	10	Reference density unit
	24	10	Reference density value

Command 174	Description
Response code	**Common response code** on page 58

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Command 175: Write device variable with unit

Command 175	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy unsigned-8	#1	1	Unisigned-8
	2	Dummy float	#2	4	Float
Response data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy unsigned-8	#1	1	Unisigned-8
	2	Dummy float	#2	4	Float

Command 175	Index	Slot code	Data description
Slot code table	0	0	Internal temperature preset unit
	1	0	Internal temperature preset value
	2	1	External temperature preset unit
	3	1	External temperature preset value
	6	2	Pressure preset unit
	8	2	Pressure preset value
	9	3	Density preset unit
	10	3	Density preset value
	11	4	Dummy unsigned 8
	12	4	Content preset value
	13	5	Reference density unit
	14	5	Reference density value
	15	6	Reference temperature unit
	16	6	Reference temperature value
	17	7	Reference pressure unit
	18	7	Reference pressure value
	19	8	Board temperature simulation unit
	20	8	Board temperature simulation value
	21	9	Electronic temperature unit
	22	9	Electronic temperature value
	23	10	Reference density unit
	24	10	Reference density value

Command 175	Description
Response code	**Common response code** on page 58

Command 176: Read simulation device variable

Command 176	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8
	2	Dummy unsigned-8	#2	1	Unsigned-8
	3	Dummy float	#3	4	Float

Command 176	Index	Slot code	Data description
Slot code table	0	0	Volume flow simulation enable
	1	0	Volume flow simulation unit
	2	0	Volume flow simulation value
	3	1	Standard volume flow simulation enable
	6	1	Standard volume flow simulation unit
	8	1	Standard volume flow simulation value
	9	2	Mass flow simulation enable
	10	2	Mass flow simulation unit
	11	2	Mass flow simulation value
	12	3	Power flow simulation enable
	13	3	Power flow simulation unit
	14	3	Power flow simulation value
	15	4	Partial gas volume flow simulation enable
	16	4	Partial gas volume flow simulation unit
	17	4	Partial gas volume flow simulation value
	18	5	Standard partial gas volume flow simulation enable
	19	5	Standard partial gas volume flow simulation unit
	20	5	Standard partial gas volume flow simulation value
	21	6	Frequency simulation enable
	22	6	Frequency simulation unit
	23	6	Frequency simulation value
	24	7	Internal temperature simulation enable
	25	7	Internal temperature simulation unit
	26	7	Internal temperature simulation value
	27	8	External temperature simulation enable
	28	8	External temperature simulation unit
	29	8	External temperature simulation value
	30	9	Pressure simulation enable

… 10 Device specific commands

… Command 176: Read simulation device variable

Command 176	Index	Slot code	Data description
Slot code table	31	9	Pressure simulation unit
	32	9	Pressure simulation value
	33	10	Density simulation enable
	34	10	Density simulation unit
	35	10	Density simulation value
	36	11	Content simulation enable
	37	11	Dummy unsigned u8
	38	11	Content simulation value

Command 176	Description
Response code	**Common response code** on page 58

Command 177: Read simulation device variable

Command 177	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8
	2	Dummy unsigned-8	#2	1	Unsigned-8
	3	Dummy float	#3	4	Float
Response data bytes	0	Slot code	#0	1	Unsigned-8
	1	Dummy unsigned-8	#1	1	Unsigned-8
	2	Dummy unsigned-8	#2	1	Unsigned-8
	3	Dummy float	#3	4	Float

Command 177	Index	Slot code	Data description
Slot code table	0	0	Volume flow simulation enable
	1	0	Volume flow simulation unit
	2	0	Volume flow simulation value
	3	1	Standard volume flow simulation enable
	6	1	Standard volume flow simulation unit
	8	1	Standard volume flow simulation value
	9	2	Mass flow simulation enable
	10	2	Mass flow simulation unit
	11	2	Mass flow simulation value
	12	3	Power flow simulation enable
	13	3	Power flow simulation unit
	14	3	Power flow simulation value
	15	4	Partial gas volume flow simulation enable

Command 177	Index	Slot code	Data description
Slot code table	16	4	Partial gas volume flow simulation unit
	17	4	Partial gas volume flow simulation value
	18	5	Standard partial gas volume flow simulation enable
	19	5	Standard partial gas volume flow simulation unit
	20	5	Standard partial gas volume flow simulation value
	21	6	Frequency simulation enable
	22	6	Frequency simulation unit
	23	6	Frequency simulation value
	24	7	Internal temperature simulation enable
	25	7	Internal temperature simulation unit
	26	7	Internal temperature simulation value
	27	8	External temperature simulation enable
	28	8	External temperature simulation unit
	29	8	External temperature simulation value
	30	9	Pressure simulation enable
	31	9	Pressure simulation unit
	32	9	Pressure simulation value
	33	10	Density simulation enable
	34	10	Density simulation unit
	35	10	Density simulation value
	36	11	Content simulation enable
	37	11	Dummy unsigned u8
	38	11	Content simulation value

Command 177	Description
Response code	**Common response code** on page 58

… 10 Device specific commands

Command 178: Read device variable range

Command 178	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
Response data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy unsigned-u8	#1	1	Unisigned-8
	2	Dummy float	#3	4	Float

Command 178	Index	Slot code	Data description
Slot code table	0	0	Volume flow range unit
	1	0	Volume flow upper range
	2	1	Volume flow range unit
	3	1	Volume flow lower range
	6	2	Standard volume flow range unit
	8	2	Standard volume upper range
	9	3	Standard volume flow range unit
	10	3	Standard volume lower range
	11	4	Mass flow range unit
	12	4	Mass flow upper range
	13	5	Mass flow range unit
	14	5	Mass flow lower range
	15	6	Power flow range unit
	16	6	Power flow upper range
	17	7	Power flow range unit
	18	7	Power flow lower range
	19	8	Partial gas volume flow range unit
	20	8	Partial gas volume flow upper range
	21	9	Partial gas volume flow range unit
	22	9	Partial gas volume flow lower range
	23	10	Standard partial gas volume flow range unit
	24	10	Standard partial gas volume flow upper range
	25	11	Standard partial gas volume flow range unit
	26	11	Standard partial gas volume flow lower range
	27	12	External temperature range unit
	28	12	External temperature upper range
	29	13	External temperature range unit
	30	13	External temperature lower range
	31	14	Pressure range unit
	32	14	Pressure upper range
	33	15	Pressure range unit
	34	15	Pressure lower range
	35	16	Density range unit

Command 178	Index	Slot code	Data description
Slot code table	36	16	Density upper range
	37	17	Density range unit
	38	17	Density lower range
	39	18	Dummy unsigned 8
	40	18	Content upper range
	41	19	Dummy unsigned 8
	42	19	Content lower range
	43	20	Internal temperature range unit
	44	20	Internal temperature upper range
	45	21	Internal temperature range unit
	46	21	Internal temperature lower range
	47	22	Relative pressure upper range unit
	48	22	Relative pressure upper range unit
	49	23	Relative pressure lower range unit
	50	23	Relative pressure lower range unit

Command 178	Description
Response code	**Common response code** on page 58

Command 179: Write device variable range

Command 179	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy unsigned-8	#1	1	Unisigned-8
	2	Dummy float	#3	4	Float
Response data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy unsigned-8	#1	1	Unisigned-8
	2	Dummy float	#3	4	Float

Command 179	Index	Slot code	Data description
Slot code table	0	0	Volume flow range unit
	1	0	Volume flow upper range
	2	1	Volume flow range unit
	3	1	Volume flow lower range
	6	2	Standard volume flow range unit
	8	2	Standard volume upper range
	9	3	Standard volume flow range unit
	10	3	Standard volume lower range
	11	4	Mass flow range unit
	12	4	Mass flow upper range

… 10 Device specific commands

… Command 179: Write device variable range

Command 179	Index	Slot code	Data description
Slot code table	13	5	Mass flow range unit
	14	5	Mass flow lower range
	15	6	Power flow range unit
	16	6	Power flow upper range
	17	7	Power flow range unit
	18	7	Power flow lower range
	19	8	Partial gas volume flow range unit
	20	8	Partial gas volume flow upper range
	21	9	Partial gas volume flow range unit
	22	9	Partial gas volume flow lower range
	23	10	Standard partial gas volume flow range unit
	24	10	Standard partial gas volume flow upper range
	25	11	Standard partial gas volume flow range unit
	26	11	Standard partial gas volume flow lower range
	27	12	External temperature range unit
	28	12	External temperature upper range
	29	13	External temperature range unit
	30	13	External temperature lower range
	31	14	Pressure range unit
	32	14	Pressure upper range
	33	15	Pressure range unit
	34	15	Pressure lower range
	35	16	Density range unit
	36	16	Density upper range
	37	17	Density range unit
	38	17	Density lower range
	39	18	Dummy unsigned 8
	40	18	Content upper range
	41	19	Dummy unsigned 8
	42	19	Content lower range
	43	20	Internal temperature range unit
	44	20	Internal temperature upper range
	45	21	Internal temperature range unit
	46	21	Internal temperature lower range
	47	22	Relative pressure upper range unit
	48	22	Relative pressure upper range unit
	49	23	Relative pressure lower range unit
	50	23	Relative pressure lower range unit

Command 179	Description
Response code	**Common response code** on page 58

Command 180: Read analog input current

Command 180	Description		Offset	Size	Data type
Request data bytes	0	Analog input current	#0	4	Float
Response data bytes	0	Analog input current	#0	4	Float
Response code	**Common response code** on page 58				

Command 181: Read hart burst in configuration

Command 181	Description		Offset	Size	Data type
Request data bytes	0	Burst in selection	#0	1	Unsigned-8
	1	Burt in variable unit type	#1	1	Unsigned-8
Response data bytes	0	Burst in selection	#0	1	Unsigned-8
	1	Burt in variable unit type	#1	1	Unsigned-8
Response code	**Common response code** on page 58				

Command 182: Read hart burst in configuration

Command 182	Description		Offset	Size	Data type
Request data bytes	0	Burst in selection	#0	1	Unsigned-8
	1	Burt in variable unit type	#1	1	Unsigned-8
Response data bytes	0	Burst in selection	#0	1	Unsigned-8
	1	Burt in variable unit type	#1	1	Unsigned-8
Response code	**Common response code** on page 58				

... 10 Device specific commands

Command 183: Hart burst in

Command 183	Description		Offset	Size	Data type
Request data bytes	0	Burst in variable unit code	#0	1	Unsigned-8
	1	Burst in variable value	#1	4	Float
Response data bytes	0	Burst in variable unit code	#0	1	Unsigned-8
	1	Burst in variable value	#1	4	Float
Response code	**Common response code** on page 58				

Command 184: Hart Log in

Command 184	Description		Offset	Size	Data type
Request data bytes	0	Hart access level	#0	1	Unsigned-8
	1	Password	#1	20	Unsigned-8
Response data bytes	0	Hart access level	#0	1	Unsigned-8
	1	Password	#1	20	Unsigned-8
Response code	**Common response code** on page 58				

Command 185: Reset software protection

Command 184	Description		Offset	Size	Data type
Request data bytes	0	Reset software protection Action	#0	1	Unsigned-8
Response data bytes	0	Reset software protection Action	#0	1	Unsigned-8
Response code	**Common response code** on page 58				

Command 186: Read totalizer base unit value

Command 186	Description		Offset	Size	Data type
Request data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy unsigned–8	#1	1	Unisigned-8
	2	Dummy float	#3	4	Float
Response data bytes	0	Slot code	#0	1	Unisigned-8
	1	Dummy unsigned–32	#1	4	Unisigned-32
	2	Dummy float	#3	4	Float

Command 186	Index	Slot code	Data description
Slot code table	0	0	Qv totalizer over flow counter in base unit
	1	0	Qv totalizer accumulated float value in base unit
	2	1	Qn totalizer over flow counter in base unit
	3	1	Qn totalizer accumulated float value in base unit
	4	2	Qm totalizer over flow counter in base unit
	5	2	Qm totalizer accumulated float value in base unit
	6	3	Energy totalizer over flow counter in base unit
	7	3	Energy totalizer accumulated float value in base unit
	8	4	Partial Qv totalizer over flow counter in base unit
	9	4	Partial Qv totalizer accumulated float value in base unit
	10	5	Partial Qn totalizer over flow counter in base unit
	11	5	Partial Qn totalizer accumulated float value in base unit
	12	6	Qv totalizer over flow counter in user unit
	13	6	Qv totalizer over flow threshold
	14	7	Qn totalizer over flow counter in user unit
	15	7	Qn totalizer over flow threshold
	16	8	Qm totalizer over flow counter in user unit
	17	8	Qm totalizer over flow threshold
	18	9	Energy totalizer over flow counter in user unit
	19	9	Energy totalizer over flow threshold
	20	10	Partial Qv totalizer over flow counter in user unit
	21	10	Partial Qv totalizer over flow threshold
	22	11	Partial Qn totalizer over flow counter in user unit
	23	11	Partial Qn totalizer over flow threshold
	24	12	Qv totalizer over flow counter in user unit
	25	12	Qv totalizer accumulated float value in user unit
	26	13	Qn totalizer over flow counter in user unit
	27	13	Qn totalizer accumulated float value in user unit
	28	14	Qm totalizer over flow counter in user unit
	29	14	Qm totalizer accumulated float value in user unit
	30	15	Energy totalizer over flow counter in user unit

… 10 Device specific commands

… Command 186: Read totalizer base unit value

Command 186	Index	Slot code	Data description
Slot code table	31	15	Energy totalizer accumulated float value in user unit
	32	16	Partial Qv totalizer over flow counter in user unit
	33	16	Partial Qv totalizer accumulated float value in user unit
	34	17	Partial Qn totalizer over flow counter in user unit
	35	17	Partial Qn totalizer accumulated float value in user unit

Command 186	Description
Response code	**Common response code** on page 58

Command 512: Read country code

Command 512	Description		Offset	Size	Data type
Request data bytes	0	Country code	#0	1	Unsigned-8
	1	SI unit	#1	1	Unsigned-8
Response data bytes	0	Country code	#0	1	Unsigned-8
	1	SI unit	#1	1	Unsigned-8
Response code	**Common response code** on page 58				

Command 513: Write country code

Command 513	Description		Offset	Size	Data type
Request data bytes	0	Country code	#0	1	Unsigned-8
	1	SI unit	#1	1	Unsigned-8
Response data bytes	0	Country code	#0	1	Unsigned-8
	1	SI unit	#1	1	Unsigned-8
Response code	**Common response code** on page 58				

11 Tables

Sensor type codes

0	Undefined
1	Piezoelectric sensor
2	PT100
3	PT1000
4 to 128	Undefined
129	Undefined
130	Undefined
131	Undefined
132	Undefined
133	Undefined
134 to 249	Undefined
250 to 255	Reserved

Number of wires codes

0 to 1	Undefined
2	Two wires
3	Three wires
4	Four wires
5 to 249	Undefined
250 to 255	Reserved

Temperature unit codes

(Subset of HART Common Table 2, Unit Codes)

32	degrees Celsius
33	degrees Fahrenheit

Unit conversion

Internally, the transmitter uses degrees Celsius. Conversion to and from degrees Fahrenheit is made using the equation:

- $C = (F - 32) * \frac{5}{9}$

12 Performance

Sampling rates

Typical sampling rates are shown in the following table:

Primary temperature update rate	10 per second
Housing temperature update rate	1 per 4 seconds
PV digital value calculation	10 per second
SV digital value calculation	10 per second
TV digital value calculation	10 per second
QV digital value calculation	10 per second
Analog output update	10 per second

Note
Both temperature calculations use an equally-weighted running mean of the last 3 input values.

Power up

On power up, the transmitter goes through a self-test procedure (**Self-test** on page 116), which takes approximately 2 seconds. During this period, the device will not respond to HART commands, and the analog output is set at 4.0 mA.
When the self-test is satisfactorily completed, and the first measurement has been made, the PV and SV values are set, and the analog output moves to a value representing the measurement. The slew rate of this movement is limited by the configured ‘damping time’. Only after the PV and SV are correctly set, will the device respond to HART commands.
If the self-test fails, all live measurement data (PV, SV, current and percent of range) are set to ‘Not A Number’, and the analog output is set to the configured malfunction-indicating current. The device will attempt to respond to HART commands.
Fixed-current mode is cancelled by power loss.

Reset

Command 41: Perform Self-Test on page 38 (‘Device Reset’) causes the device to reset its microprocessor. The resulting restart is identical to the normal power up sequence (**Power up** on page 115).

... 12 Performance

Self-test

The self-test procedure is executed at power up, following **Command 41: Perform Self-Test** on page 38, or following **Command 41: Perform Self-Test** on page 38. The self-test includes:

- Microprocessor
- RAM
- Program ROM
- Configuration storage EEPROM
- Analog-to-Digital converter
- Digital-to-Analog converter
- Cold-junction (internal) temperature sensor
- Primary (external) temperature sensor

This self-test takes about 2 seconds. During self-test following power-up or reset, the analog output is set to 4.0 mA and the device will not respond to HART commands.
During self-test following a self-test command, the analog output is held at its last value; the device may respond normally to HART commands, or may return 'busy' status.
Continuous self-testing is also part of the normal device operation. The same checks are made, but over a longer period, between measurement function cycles.

Command response times

Minimum	20 ms
Typical	50 ms
Maximum	100 ms*

* During self-test following a self-test command, the device may take up to 250 ms to respond.

Busy and delayed response

The transmitter may respond with 'busy' status if a further command is received while self-test is underway.
Delayed-response is not used.

Long messages

The largest data field used is in the response to Command 21: 34 bytes including the two status bytes.

Non-volatile memory

EEPROM is used to hold the device's configuration parameters. New data is written to this memory immediately on execution of a write command.

Modes

Fixed current mode is implemented, using Command 40. This mode is cleared by power loss or reset.

Write protection

Write-protection is provided, selected by an internal jumper (**Internal jumpers and switches** on page 5). When the jumper is present, all commands are available. When the jumper is absent, no 'write' or 'command' commands are accepted.

Damping

Damping is standard, affecting only the PV and the loop current signal.

13 Appendix

Annex A

Capability checklist

Manufacturer, model and revision	ABB Engineering Vortex Meter 5
Device type	Transmitter
HART revision	7.2 and 5.0
Device Description available	Yes
Number and type of sensors	2 (one external, one internal)
Number and type of actuators	0
Number and type of host side signals	1: 4 to 20 mA analog
Number of Device Variables	4
Number of Dynamic Variables	4
Mappable Dynamic Variables?	Yes
Number of Universal Commands	22
Number of common-practice commands	20
Number of device-specific commands	37
Alternative operating modes?	Yes
Burst mode?	Yes
Write-protection?	Yes

... 13 Appendix

Annex B

Default configuration

Parameter	Default value
Language	English
Operation Mode	Liquid Qv
Current output value	Q
Upper Frequency	10500 Hz
Unit Volume Flow Qv	m3/h
Unit Mass Flow	Kg/h
Unit Density	Kg/m3
Unit Temperature	Celsius
Unit Pressure	Bar
Temperature Upper Range	500.0 Celsius
Temperature Lower Range	−200.0 Celsius
Liquid Mass Correction	Without correction
Gas Ref conditions	UK
Steam Mass Compute	Saturated
Ref Density Value	998.00 kg/m3
Ref Temperature	20.0 Celsius
Qmax	80.00 m3/h
Qn Max	80.00 m3/h
Qm Max	80.00 kg/h
Power Max	0.022222222KW
Damping time	1.00 s
Current at Alarm	low
Low Alarm	3.6 mA
High Alarm	21.00 mA
Low flow cut-off	8.00 m3/h

Annex C

Revision history

Number	Revision
A1	Rev. 1.0 initial revision
A2	Rev. 2.0 update the commands according to latest firmware

Trademarks

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