

RS485 Sensor Cable

Sensirion-HDLC Command Set

Summary

This document describes the UART communication with the Sensirion sensor products via the SCC1-RS485 Sensor Cable and its Sensirion-HDLC Command Set.

All commands and some basic descriptions of the Sensirion-HDLC protocol (SHDLC) are described for different types of sensors.

These commands are based on the generic protocol definition of “Sensirion-HDLC” (SHDLC). (see separate documentation)

RECENT CHANGES ON THIS DOCUMENT

Date	Version	Author	Why
13.10.10		UKA	Initial Verion
16.12.10		LWI	Changes in all chapters
11.03.11		LWI	3.1.11 Change description
23.03.11		LWI	3.1.10 Add test in selftest 3.5.1 Changed response time for sensor reset 3.1.10 Changed response time for device reset
11.11.11	2	LWI	Add document version 3.2.9, 3.2.10, 3.2.12 Add Totalizator commands 3.2.14 Add auto detection measurement 3.2.1 Add Status Bit 2+3 3.1.10 Changed description in selftest
26.04.12	3	LWI	3.2.4 Add Start continuous Measurement command with set Resolution, add TriggerContinuousMeasurement 3.2.7 Add Get last Measurement without clear option 3.2.8 Add Extended Measurement Buffer command 3.2.15 Add Advanced Measurement configuration 3.5.2 Add Autostart commands
27.08.12	4	LWI	General changes in descriptions 5 Add chapter measurement unit encoding
30.04.14	5	LWI	3.1.15 Add Command Reply Delay 3.2.1 Add bit 4 in Status 3.2.4 Add Trigger Measurement Mode 3.2.11 Add command Get Last Measurement Mode Duration 3.2.16 Add command Set Detect Mode 3.2.17 Add command Reset Advanced Measurement Configuration
07.01.16	6	LWI	3.1.12 Add Sensortype SF06 3.1.5 Add 230400 baud 3.2.4 Add new Start Command for SF06 3.2.5, 3.2.9, 3.2.10, 3.2.12 Enable command for SF06 3.2.8 Add new read buffer command for SF06 3.1.16 Add new Command Set I2C Delay 3.1.17 Add new Command Scan I2C address 3.4.1 Add Sensortype 3 for Get Sensor Part Name
08.05.18	7	LWI	3.2.4 Add additional parameter for start continuous measurement 3.2.6 Add command Stop Continuous Measurement with Command 3.2.7 Add output of last measure for all channels 3.4.5 Add command Scale Factor and Unit 3.4.6 Get Sensor Serial Number: Add sensortype 3 3.1.18 add command I2CTransceive

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2 COMMAND OVERVIEW

2.1 SENSOR CABLE COMMANDS

This commands are available for all sensor products.

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0xD0	1	String	Get Device Information	Get name, article code and serial number of RS485 Sensor Cable	0	-
0xD1	1	7	Get Version	Get Firmware/Hardware/SHDLC version	0	-
0xD3	0	0	Device Reset	Execute a reset on RS485 Sensor Cable	0	-
0x90	0 / 1	1 / 0	Device Address	8 Bit Address of RS485 Sensor Cable	0	E
0x91	0 / 4	4 / 0	Baudrate	Baudrate of RS485 Interface	0	E
0x92	0	0	Factory Reset	Set back all settings to default values	0	E
0x93	0	4	System up Time	Get the time since device is powered up or reset	0	R
0x20	0 / 1	1 / 0	Termination	Enable or disable the Termination resistor	0	E
0x21	1 / 21	21 / 0	User Data	Save 20 bytes of Userdata in EEPROM	0	E
0x22	0	2	Device Selftest*	Execute an selftest with device	0	-
0x23	0 / 1	1 / 0	Sensor Voltage	Defines the sensor supply voltage	0	E
0x24	0 / 1	1 / 0	Sensor Type*	Defines the sensor type	0	E
0x25	0 / 1	1	Sensor Address*	I ² C address for sensor access	0	E
0x26	0	2	Measure Sensor Voltage	Measure the sensor supply voltage of RS485 Sensor Cable	0	-
0x27	0/2	2/0	Reply Delay	Set a reply delay for RS485	0	E
0x28	0/2	2/0	I2C Delay	Set I2C communication delay	0	E
0x29	1	0...128	Scan I2C Address	Scan all I2C addresses for Ack	0	-
0x2A	5...205	0...200	I2C Transceive	Generic I2C Transceive	0	-

2.2 SF04 FLOW SENSORS

This commands are available for flow sensor products based on the SF04 chip used for flow meters and differential pressure sensors. (Sensor type = 0)

2.2.1 MEASUREMENT COMMANDS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x30	0	1	Sensor Status	Get the status of sensor and continuous measurement.	0	-
0x31	0	0	Start Single Measurement*	Start single measurement	0	-
0x32	0	0 / 2	Get Single Measurement	Read out measurement from sensor if finished	0	-
0x33	0 / 1 / 2 / 3	0 / 2	Start Continuous Measurement*	Start continuous measurement with optional interval and resolution	0	-
0x34	0	0	Stop Continuous Measurement	Stop continuous measurement	0	-
0x35	0 / 1	0 / 2	Get Last Measurement	Read out last measurement while continuous measurement	0	-
0x36	0 / 1	0...254	Get Measurement Buffer	Read out all measurements from buffer	0	-
0x37	0 / 1	1 / 0	Totalizator Status	Enable or disable the totalizator,	0	-
0x38	0 / 1	8 / 4	Totalizator Value	Get the value of the totalizator or duration	0	R
0x39	0	0	Reset Totalizator	Set the totalizator value to zero	0	-
0x3B	15/6	0	Start Auto Detection Measurement	Start auto detection measurement	0	-
0x3C	0/2/38	38/0	Advanced Measurement Configuration	Set advanced measurement configuration	0	-

2.2.2 SENSOR SETTINGS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x40	0 / 1	1 / 0	Measurement Type*	Measurement type (Flow/Temp/Vdd)	0	R
0x41	0 / 1	1 / 0	Resolution*	Resolution of flow, temperature, and Vdd measurement	0	SR
0x42	0 / 1	1 / 0	Heater Mode*	Heater mode for the flow sensor	0	SR
0x43	0 / 1	1 / 0	Calib Field*	Calibration field of the flow sensor	0	SR
0x44	0 / 1	1 / 0	Factory Settings*	Factory settings of the flow sensor	0	SR
0x45	0 / 1	1 / 0	Linearization*	Linearization of measurement	0	SR

2.2.3 SENSOR INFORMATION

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x50	0	21	Sensor Part Name*	Part name of the sensor	0	SE
0x51	0	13	Sensor Item Number*	Item number of the sensor	0	SE
0x52	0	2	Flow Unit*	Flow unit of sensor	0	SE
0x53	0	2	Scale Factor*	Scale factor of active measurement type and calibration field	0	SE
0x54	0	4	Sensor Serial Number*	Sensor serial number	0	SE
0x55	0	1	Measurement Data Type*	Get the data type of the measurements (signed or unsigned)	0	SE

2.2.4 ADVANCED SENSOR COMMANDS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x65	0	0	Sensor Reset*	Execute a reset on the sensor	0	-
0x66	0/1...n	101/0	Autostart	Define the command sequence to be executed after powerup	0	E

* Sensor must be idle for execution of this command

E: Eeprom RS485 Sensor Cable (if a value is set, the continuous measurement is interrupted while value is written to Eeprom)

R: RAM RS485 Sensor Cable

SR: Sensor Register

SE: Sensor Eeprom

2.3 HUMIDITY SENSORS

This Commands are available for SHTxx Humidity Sensors. (Sensor type = 1)

2.3.1 MEASUREMENT COMMANDS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x30	0	1	Sensor Status	Get the status of sensor.	0	-
0x31	0	0	Start Single Measurement*	Start single measurement	0	-
0x3A	0	0 / 8	Get single Temperature and Humidity	Read out temperature and humidity from humidity sensor (SHT7x, SHT1x or SHT2x) if finished	0	-

2.3.2 SENSOR SETTINGS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x41	0 / 1	1 / 0	Resolution*	Resolution of humidity / temperature measurement	0	SR

2.3.3 ADVANCED SENSOR COMMANDS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x65	0	0	Sensor Reset*	Execute a reset on the sensor	0	-
0x66	0/1...n	101/0	Autostart	Define the command sequence to be executed after powerup	0	E

* Sensor must be idle for execution of this command

E: Eeprom RS485 Sensor Cable (if a value is set, the continuous measurement is break while value is written to Eeprom)

R: RAM RS485 Sensor Cable

SR: Sensor Register

2.4 SF05 FLOW SENSORS

This commands are available for flow sensor products based on the SF05 chip. (Sensor type = 2)

2.4.1 MEASUREMENT COMMANDS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x30	0	1	Sensor Status	Get the status of sensor and continuous measurement.	0	-
0x31	0	0	Start Single Measurement*	Start single measurement	0	-
0x32	0	0 / 2	Get Single Measurement	Read out measurement from sensor if finished	0	-
0x33	0 / 2 / 3	0 / 2	Start Continuous Measurement*	Start continuous measurement with interval and optional resolution	0	-
0x34	0	0	Stop Continuous Measurement	Stop continuous measurement	0	-
0x35	0 / 1	0 / 2	Get Last Measurement	Read out last measurement while in continuous measurement	0	-
0x36	0 / 1	0...254	Get Measurement Buffer	Read out all measurements from buffer	0	-
0x37	0 / 1	1 / 0	Totalizator Status	Enable or disable the totalizator	0	-
0x38	0	8	Totalizator Value	Get the value of the totalizator	0	R
0x39	0	0	Reset Totalizator	Set the totalizator value to zero	0	-

2.4.2 SENSOR SETTINGS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x40	0 / 1	1 / 0	Measurement Type*	Measurement type (Flow/Temp)	0	R
0x41	0 / 1	1 / 0	Resolution*	Resolution of flow measurement	0	SR
0x45	0 / 1	1 / 0	Linearization*	Disable linearization of measurement or set default sensor setting for linearization	0	SR

2.4.3 SENSOR INFOS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x51	0	13	Sensor Item Number*	Item number of the sensor	0	SE
0x52	0	2	Flow Unit*	Flow unit of sensor	0	SE
0x53	0	2	Scale Factor*	scale factor of current set measurement type	0	SE
0x54	0	4	Sensor Serial Number*	Sensor serial number	0	SE
0x55	0	1	Measurement Data Type*	Get the datatype of the Flow measurements (always unsigned for SF05)	0	SE
0x56	0	2	Offset*	Offset of linearized measurement data	0	SE

2.4.4 ADVANCED SENSOR COMMANDS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x65	0	0	Sensor Reset*	Execute a reset on the sensor	0	-
0x66	0/1...n	101/0	Autostart	Define the command sequence to be executed after powerup	0	E

* Sensor must be idle for execution of this command

E: Eeeprom RS485 Sensor Cable (if a value is set, the continuous measurement is break while value is written to Eeprom)

R: RAM RS485 Sensor Cable

SR: Sensor Register

SE: Sensor Eeeprom

2.5 SF06 FLOW SENSORS

This commands are available for flow sensor products based on the SF06 chip. (Sensor type = 3)

2.5.1 MEASUREMENT COMMANDS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x30	0	1	Sensor Status	Get the status of sensor and continuous measurement.	0	-
0x33	0 / 4	4 / 0	Start Continuous Measurement*	Start continuous measurement with interval and command	0	-
0x34	0 / 2	0	Stop Continuous Measurement	Stop continuous measurement, with or without command.	0	-
0x35	0 / 1	0/2/6	Get Last Measurement	Read out last measurement while in continuous measurement	0	-
0x36	1	0...254	Get Measurement Buffer	Read out all measurements from buffer	0	-
0x37	0 / 1	1 / 0	Totalizator Status	Enable or disable the totalizator,	0	-
0x38	0	8	Totalizator Value	Get the value of the totalizator	0	R
0x39	0	0	Reset Totalizator	Set the totalizator value to zero	0	-

2.5.2 SENSOR INFOS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x50	0	25	Sensor Part Name*	Get product ID and serial number	0	SE
0x53	2	6	Scale Factor and Unit*	Get the scale factor, unit and result of chip sanity check. (only available on some SF06 sensor products)	0	SE
0x54	0	4	Sensor Serial Number*	Get the sensor serial number. (only available on some SF06 sensor products.)	0	SE

2.5.3 ADVANCED SENSOR COMMANDS

ID	Bytes send	Bytes receive	Name	Comment	Pw level	Storage
0x65	0	0	Sensor Reset*	Execute a reset on the sensor	0	-
0x66	0/1...n	101/0	Autostart	Define the command sequence to be executed after powerup	0	E

* Sensor must be idle for execution of this command

E: Eeprom RS485 Sensor Cable (if a value is set, the continuous measurement is break while value is written to Eeprom)

R: RAM RS485 Sensor Cable

SE: Sensor Eeprom

3 COMMAND REFERENCE

If a setting can be set and get, the same Command ID is used with different MOSI Data length. For the same Command ID, different functionality may be implemented depending on the MOSI Data length or via additional subcommands.

3.1 SENSOR CABLE COMMANDS

3.1.1 GET DEVICE INFORMATION

Get Device Information			
Description	On this command, the device will return an identification string which contains device type, article code and serial number.		
Command ID	0xD0	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	-
MOSI Data (1 Byte)	Byte #	Description	
	0	<i>Information Type : u8t</i> This parameter defines which information is requested: 1: Product Name → Name of the connected device 2: Article code 3: Serial number	
MISO Data (n Bytes)	Byte #	Description	
	0 ... n	<i>Identification : string</i> String which contains the requested information	

3.1.2 GET VERSION

Get Version			
Description	Returns version information of hardware, firmware and SHDLC protocol version.		
Command ID	0xD1	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	-
MOSI Data (0 Bytes)	no data		
MISO Data (7 Bytes)	Byte #	Description	
	0	<i>Firmware Major Version Number : u8t [0...255]</i>	
	1	<i>Firmware Minor Version Number : u8t [0...99]</i>	
	2	<i>Firmware in Debug State : bool</i> If the debug state is set, the firmware is in development state, based on the previous defined version.	
	3	<i>Hardware Major : u8t [0...255]</i>	
	4	<i>Hardware Minor: u8t [0...99]</i>	
	5	<i>SHDLC protocol version Major : u8t [0...255]</i>	
	6	<i>SHDLC protocol version Minor : u8t [0...99]</i>	

3.1.3 DEVICE RESET

Device Reset			
Description	Execute a reset on the sensor cable. The device will reply and then do the reset. If the command is sent with broadcast, the reset is done immediately after reception of the command. Wait 100ms before sending the next command to give time to reboot. The reset includes a hard-reset of the sensor.		
Command ID	0xD3	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	250ms	Storage	-
MOSI Data (0 Bytes)	no data		
MISO Data (0 Bytes)	no data		

3.1.4 DEVICE ADDRESS

Set Device Address			
Description	Change the RS485 slave address of the sensor cable. The device will reply with old address, then the new address is activated. If the command is sent with broadcast, the new address is activated immediately after reception of the command.		
Command ID	0x90	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	25ms	Storage	Device EEPROM
MOSI Data (1 Bytes)	Byte #	Description	
	0	Slave Address : u8t [0...254]	
MISO Data (0 Bytes)	no data		

Get Device Address			
Description	Get the RS485 slave address of device.		
Command ID	0x90	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	Slave Address: u8t [0...254]	

3.1.5 BAUDRATE

Set Baudrate			
Description	Change the baudrate of device. The device will reply with old baudrate, then the new baudrate is activated. If the command is sent with broadcast, the new baudrate is activated immediately after reception of the command.		
Command ID	0x91	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	25ms	Storage	Device EEPROM
MOSI Data (4 Bytes)	Byte #	Description	
	0...3	<i>Baudrate: u32t[baud]</i> The default baudrate is 115200 baud. Available baudrates are: 1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 115200, 230400.	
MISO Data (0 Bytes)	no data		

Get Baudrate			
Description	Get the Baudrate of the RS485 interface.		
Command ID	0x91	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (4 Bytes)	Byte #	Description	
	0...3	<i>Baudrate: u32t[baud]</i>	

3.1.6 FACTORY RESET

Factory Reset			
Description	<p>Set back all settings except Sensor Type and Sensor Voltage to default values and do a reset. Wait 100ms before sending the next command to give time to reboot.</p> <p>The Factory Reset sets back the following parameter to default values:</p> <p>Baudrate: 115200 Baud RS485 Address: 0 Termination: off Userdata: all to 0x00 I²C Address for Sensor type 0: 64 I²C Address for Sensor type 1: 64 I²C Address for Sensor type 2: 64 I²C Address for Sensor type 3: 8 I²C Delay: 2 Autostart Commands: 0 Reply Delay: 0 Access level: 0</p>		
Command ID	0x92	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	100ms	Storage	-
MOSI Data (0 Bytes)	no data		
MISO Data (0 Bytes)	no data		

3.1.7 SYSTEM UP TIME

Get System up Time			
Description	Get the time since device power up or last reset.		
Command ID	0x93	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	RAM
MOSI Data (0 Bytes)	no data		
MISO Data (4 Bytes)	Byte #	Description	
	0...3	System up time: u32t[s]	

3.1.8 TERMINATION

Set Termination			
Description	Enable or disable the Termination resistor (120 Ohm) of the RS485 interface and save it in EEPROM.		
Command ID	0x20	for Sensor Type	All sensors
Access Level	0	availability	always
Response Time max	25ms	Storage	Device EEPROM
MOSI Data (1 Bytes)	Byte #	Description	
	0	<i>Termination : bool</i>	
MISO Data (0 Bytes)	no data		

Get Termination			
Description	Get the Status (enabled / disabled) of the Termination resistor.		
Command ID	0x20	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	<i>Termination : bool</i>	

3.1.9 USER DATA

Write User Data			
Description	Save 20 bytes of Userdata in the EEPROM, there can be stored 5 x 20 bytes in EEPROM		
Command ID	0x21	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	15ms	Storage	Device EEPROM
MOSI Data (21 Bytes)	Byte #	Description	
	0	<i>Block Number: u8t [0...4]</i>	
	1...21	<i>User Data: 20 x u8t</i>	
MISO Data (0 Bytes)	no data		

Read User Data			
Description	Read 20 bytes of Userdata stored in given block number		
Command ID	0x21	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device EEPROM
MOSI Data (1 Bytes)	Byte #	Description	
	0	Block Number: u8t [0...4]	
MOSI Data (21 Bytes)	Byte #	Description	
	0	Block Number: u8t [0...4]	
	1...21	User Data: 20 x u8t	

3.1.10 DEVICE SELFTEST

Device Selftest			
Description	Execute a self test of the device. Test the Microcontroller and Sensor supply voltage, EEPROM functionality and Short circuits on I2C Line. During the self test the sensor supply voltage is turned off for testing which produces a hard reset of the sensor.		
Command ID	0x22	for Sensor Type	All sensors
Access Level	0	Availability	Sensor idle
Response Time max	250ms	Storage	Device EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (2 Bytes)	Byte #	Description	
	0,1	Selftest Result : u16t [bit encoded] Bit 0: Error with EEPROM Bit 1: Microcontroller supply voltage too high or low Bit 2: Failure on I2C Line Bit 3: Failure on sensor supply voltage	

3.1.11 SENSOR VOLTAGE

Set Sensor Voltage			
Description	Set the output voltage for sensor supply to 3.5V or 5V and save to EEPROM. Note: The voltage level on the communication lines is always 3.3 V, irrespective of the selected sensor supply voltage.		
Command ID	0x23	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	25ms	Storage	Device EEPROM
MOSI Data (1 Bytes)	Byte #	Description	
	0	Voltage Setting : u8t[0,1] 0: Sensor Voltage = 3.5V 1: Sensor Voltage = 5V	
MISO Data (0 Bytes)	no data		

Get Sensor Voltage			
Description	Get the sensor supply voltage setting.		
Command ID	0x23	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	<i>Voltage Setting : u8t[0,1]</i> 0: Sensor Voltage = 3.5V 1: Sensor Voltage = 5V	

3.1.12 SENSOR TYPE

Set Sensor Type			
Description	Set the Sensor Type and save to EEPROM.		
Command ID	0x24	for Sensor Type	All sensors
Access Level	0	Availability	Sensor Idle
Response Time max	25ms	Storage	Device EEPROM
MOSI Data (1 Bytes)	Byte #	Description	
	0	<i>Sensor Type: u8t[0...4]</i> 0: Flow Sensor (SF04 based products) 1: Humidity Sensor (SHTxx products) 2: Flow Sensor (SF05 based products) 3: Flow Sensor (SF06 based products) (Firmware ≥1.7) 4: not available	
MISO Data (0 Bytes)	no data		

Get SensorType			
Description	Get the Sensor Type.		
Command ID	0x24	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	<i>Sensor Type: u8t[0...4]</i> 0: Flow Sensor (SF04 based products) 1: Humidity Sensor (SHTxx products) 2: Flow Sensor (SF05 based products) 3: Flow Sensor (SF06 based products) (Firmware ≥1.7) 4: Pressure Sensor (SPTBx products) (Firmware ≥1.7)	

3.1.13 SENSOR ADDRESS

Set Sensor Address			
Description	Set the I ² C sensor address to access the flow sensor and save it to EEPROM.		
Command ID	0x25	for Sensor Type	All sensors
Access Level	0	Availability	If sensor idle
Response Time max	25ms	Storage	Device EEPROM
MOSI Data (1 Bytes)	Byte #	Description	
	0	Sensor Address: $u8t[0...127]$ default: 64	
MISO Data (0 Bytes)	no data		

Get Sensor Address			
Description	Get the I ² C sensor address to access the flow sensor.		
Command ID	0x25	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	Sensor Address: $u8t[0...127]$	

3.1.14 MEASURE SENSOR VOLTAGE

Measure Sensor Voltage			
Description	Measure the output voltage of the Sensor Cable, typical accuracy is $\pm 100\text{mV}$, max. $\pm 400\text{mV}$.		
Command ID	0x26	for Sensor Type	All sensors
Access Level	0	Availability	always
Response Time max	1ms	Storage	-
MOSI Data (0 Bytes)	no data		
MISO Data (2 Bytes)	Byte #	Description	
	0...1	Output Voltage in mV : $u16t$	

3.1.15 REPLY DELAY

Set Reply Delay			
Description	Set the delay time the Sensor Cable waits before sending the reply data (in order to give the master sufficient time to switch to receiver mode).		
Command ID	0x27	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	25ms	Storage	Device EEPROM
MOSI Data (2 Bytes)	Byte #	Description	
	0...1	Delay: $u16t[us]$ Max 400 us	
MISO Data (0 Bytes)	no data		

Get Reply Delay			
Description	Get the delay time the Sensor Cable waits before sending the reply data.		
Command ID	0x27	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (2 Bytes)	Byte #	Description	
	0...1	Delay: $u16t[us]$	

3.1.16 I2C DELAY

Set I2C Delay			
Description	(for Firmware ≥ 1.4) Set delay for I2C communication		
Command ID	0x28	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	25ms	Storage	Device EEPROM
MOSI Data (2 Bytes)	Byte #	Description	
	0...1	Delay: $u16t$ Value: I2C SCL Frequency 0: 600 kHz 1: 450 kHz 2 (default): 360 kHz 5: 230 kHz 10: 140 kHz 20: 80 kHz 50: 36 kHz 100: 18 kHz 200: 9 kHz 500: 3.6kHz 1000: 1.8kHz 2000: 0.9kHz	
MISO Data (0 Bytes)	no data		

Get I2C Delay			
Description	(for Firmware ≥ 1.4) Get delay for I2C communication		
Command ID	0x28	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (2 Bytes)	Byte #	Description	
	0...1	Delay: $u16t$ For I2C Frequency see "Set I2C Delay"	

3.1.17 SCAN I2C ADDRESS

Scan I2C Address			
Description	(for Firmware ≥ 1.7) Scan all I2C addresses for Ack		
Command ID	0x29	for Sensor Type	All sensors
Access Level	0	Availability	If sensor idle
Response Time max	25ms	Storage	-
MOSI Data (1 Bytes)	Byte #	Description	
	0	Define function: $u8t$ 0: Scan address Range 0...127 1: Scan address Range 8...119	
MISO Data (0...128 Bytes)	Byte #	Description	
	0...x	Array of 7 Bit I2C Address [$u8t$] No data returned if no I2C address is acknowledged	

3.1.18 I2CTRANSCEIVE

I2C Transceive			
Description	Transceives the data on I2C interface. The Transceive can contain write- and/or read headers. If continuous measurement is active, I2C transceive is only possible, if the I2C bus isn't blocked by a slave device with e.g. a master hold condition (clock stretching). It is recommended stop continuous measurement for reliable I2C transmission.		
Command ID	0x2A	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	Depending on arguments	Storage	-
MOSI Data	Byte #	Description	
	0	<i>I2C Address : u8t</i> I2C Address of the targeted Device	
	1	<i>Bytes to send : u8t [0...200]</i> Amount of bytes to send. This amount of bytes has to be attached to the command. Set to zero if only read header is needed.	
	2	<i>Bytes to receive : u8t [0...200]</i> Amount of bytes to receive. This amount of bytes have are returned as response. Set to zero if only write header is needed.	
	3...4	<i>TimeoutMs : u16t [0...1000]</i> I2C Timeout when having to read bytes in ms. If the read frame is NACKed it will be retried up to the timeout value. Same applies for clock stretching (only for MSB bit in every read byte)	
	4...n	<i>Data to send : u8t</i> Bytes to send if any.	
MISO Data	Byte #	Description	
	0...n	<i>I2C Response: u8t</i> If needed/available, the bytes from the I2C read are returned.	

3.1.19 I2CTRANSCEIVE

I2C Transceive			
Description	Transceives the data on I2C interface. The Transceive can contain write- and/or read headers. If continuous measurement is active, I2C transceive is only possible, if the I2C bus isn't blocked by a slave device with e.g. a master hold condition (clock stretching). It is recommended stop continuous measurement for reliable I2C transmission.		
Command ID	0x2A	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	Depending on arguments	Storage	-
MOSI Data	Byte #	Description	
	0	<i>I2C Address : u8t</i> I2C Address of the targeted Device	
	1	<i>Bytes to send : u8t [0...200]</i> Amount of bytes to send. This amount of bytes has to be attached to the command. Set to zero if only read header is needed.	
	2	<i>Bytes to receive : u8t [0...200]</i> Amount of bytes to receive. This amount of bytes have are returned as response. Set to zero if only write header is needed.	
	3...4	<i>TimeoutMs : u16t [0...1000]</i> I2C Timeout when having to read bytes in ms. If the read frame is NACKed it will be retried up to the timeout value. Same applies for clock stretching (only for MSB bit in every read byte)	
	4...n	<i>Data to send : u8t</i> Bytes to send if any.	
MISO Data	Byte #	Description	
	0...n	<i>I2C Response: u8t</i> If needed/available, the bytes from the I2C read are returned.	

3.2 SENSOR COMMANDS: MEASUREMENTS

3.2.1 SENSOR STATUS

Get Sensor Status			
Description	Get the status of the sensor and continuous measurement. See the separate application note for a detailed description of the Auto-Detection Mode.		
Command ID	0x30	for Sensor Type	0, 1, 2, 3
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device RAM
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	<p><i>Sensor Status : u8t [bit encoded]</i></p> <p>Bit 0: 0: Sensor idle 1: Sensor Busy</p> <p>Bit 1: 0: Continuous Measurement disabled, Sensor is idle or in Detect Mode 1: Continuous Measurement enabled, Sensor is in Measurement Mode</p> <p>Bit 2: (for Firmware ≥ 1.3 and sensor type 0 only) 0: Auto-Detection Mode disabled 1: Auto-Detection Mode enabled</p> <p>Bit 3: (for Firmware ≥ 1.3 and sensor type 0 only) 0: No confirmed measurement in Measurement Mode since last read of the Status. (Sensor has not entered Measurement Mode at all or all measurements in Measurement Mode were not confirmed.) 1: At least one measurement in Measurement Mode was confirmed and has finished since last read of the Status.</p> <p> This bit is set back to 0 after read out</p> <p>Bit 4: (for Firmware ≥ 1.6 and sensor type 0 only) 0: No un-confirmed measurement in Measurement Mode since last read out of the Status. (Sensor has not entered Measurement Mode at all or all measurements in Measurement Mode were confirmed.) 1: At least one measurement in Measurement Mode was not confirmed and has finished since the last read of the Status.</p> <p> This bit is set back to 0 after read out.</p> <p><i>Note:</i> Bits 3 & 4 may both be '1'. This means that both, confirmed and un-confirmed measurements in Measurement Mode have finished since last read of the Status.</p>	

3.2.2 START SINGLE MEASUREMENT

Start Single Measurement			
Description	Start single Measurement, result must be read out with “Get Single Measurement”. For Sensortype 1 the command “Get Single Temperature and Humidity” must be used for readout..		
Command ID	0x31	for Sensor Type	0, 1, 2
Access Level	0	Availability	Sensor Idle
Response Time max	1ms	Storage	-
MOSI Data (0 Bytes)	no data		
MISO Data (0 Bytes)	no data		

3.2.3 GET SINGLE MEASUREMENT

Get Single Measurement			
Description	Read out measurement result from sensor if finished. A single measurement must be started before, the finish of measurement can be polled with this command.		
Command ID	0x32	for Sensor Type	0, 2
Access Level	0	Availability	After start single Measurement
Response Time max	1ms	Storage	-
MOSI Data (0 Bytes)	no data		
MISO Data (0 Bytes)	no data (measurement not yet finished or Error)		
MISO Data (2 Bytes)	Byte #	Description	
	0,1	<i>Measurement result : u16t/i16t (if measurement finished)</i>	

3.2.4 START CONTINUOUS MEASUREMENT

Start Continuous Measurement			
Description	<p>Start continuous measurement with given measurement interval and clear the measurement buffer. The measurements are saved in a buffer, which can be read out with the "Get Measurement Buffer" command. Single measurements while continuous measurement can be read out with command "Get Last Measurement".</p> <p>The interval is 0 for measuring as fast as possible, else the allowed minimum interval depends on the selected Resolution.</p>		
Command ID	0x33	for Sensor Type	0, 2
Access Level	0	Availability	Sensor Idle
Response Time max	1ms	Storage	Device Ram
MOSI Data (2 Bytes)	Byte #	Description	
	0,1	<p><i>Measurement interval: u16t [ms]</i></p> <p>0: as fast as possible</p> <p>Sensortype 0:</p> <p>9 Bit : min. 1ms 10 Bit : min. 2ms 11 Bit : min. 3ms 12 Bit : min. 6ms 13 Bit : min. 10ms 14 Bit : min. 20ms 15 Bit : min. 40ms 16 Bit : min. 80ms</p> <p>Sensortype 2:</p> <p>12/14 Bit: min. 1ms</p>	
MISO Data (0 Bytes)	no data		

Start Continuous Measurement and Set Resolution			
Description	(for Firmware ≥ 1.4) Start continuous measurement with given interval and Resolution.		
Command ID	0x33	for Sensor Type	0
Access Level	0	Availability	Sensor Idle
Response Time max	1ms	Storage	Device Ram
MOSI Data (3 Bytes)	Byte #	Description	
	0,1	<i>Measurement interval: $u16t$ [ms]</i> 0: as fast as possible 9 Bit : min. 1ms 10 Bit : min. 2ms 11 Bit : min. 3ms 12 Bit : min. 6ms 13 Bit : min. 10ms 14 Bit : min. 20ms 15 Bit : min. 40ms 16 Bit : min. 80ms	
	2	<i>Resolution: $u8t[9...16]$</i>	
MISO Data (0 Bytes)	no data		

Start Continuous Measurement Advanced			
Description	(for Firmware ≥ 1.4) Start the continuous Measurement with the active advanced measurement configuration. (for Firmware ≥ 1.6) Force the Sensor to enter Measurement Mode.		
Command ID	0x33	for Sensor Type	0
Access Level	0	Availability	Mode 0: Sensor Idle Mode 1: Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (1 Bytes)	Byte #	Description	
	0	<i>Measurement Mode: $u8t$</i> 0: <i>Trigger Continuous Measurement (Firmware ≥ 1.4).</i> Start measurement in Detect Mode with the current advanced measurement configuration. If Detect Mode is disabled in the current advanced measurement configuration, measurement in Measurement Mode is started. 1: <i>Trigger Measurement Mode (Firmware ≥ 1.6).</i> Start measurement in Measurement Mode with the current advanced measurement configuration. If the sensor is already in Measurement Mode, this command has no effect. If the sensor is currently running in Detect Mode, this command forces the sensor to enter (confirmed) Measurement Mode.	
MISO Data (0 Bytes)	no data		

Start Continuous Measurement with Command			
Description	(for Firmware ≥1.7) Start continuous measurement with given interval, I ² C measurement command and optional I ² C parameter. The additional optional configuration word is used for continuous measurement configuration.		
Command ID	0x33	for Sensor Type	3
Access Level	0	Availability	Sensor Idle
Response Time max	1ms	Storage	Device Ram
MOSI Data (4 Bytes)	Byte #	Description	
	0,1	<i>Measurement interval: u16t [ms]</i> 0: as fast as possible >0: measurement interval [ms]	
	2,3	<i>I²C measurement command: u16t</i>	
MOSI Data (6 Bytes) (for Firmware ≥1.8)	Byte #	Description	
	0,1	<i>Measurement interval: u16t [ms]</i> 0: as fast as possible >0: measurement interval [ms]	
	2,3	<i>I²C measurement command: u16t</i>	
	4,5	<i>Configuration word: u16t</i> Optional configuration for continuous measurement: [Bit 15...13]: Configuration for signal 1 [Bit 12...10]: Configuration for signal 2 [Bit 9...7]: Configuration for signal 3 [Bit 6...1]: internal measurement interval [1...100ms] <i>Configuration definition for signal 1-3:</i> 0: default 1: signal isn't written to Buffer 2: Build average 3: bitwise OR 4: Write latest value to Buffer 5-7: Reserved	
MOSI Data (7 Bytes)	Byte #	Description	
	0,1	<i>Measurement interval: u16t [ms]</i> 0: as fast as possible >0: measurement interval [ms]	
	2,3	<i>I²C measurement command: u16t</i>	
	4,5,6	<i>Additional I²C parameter: 3 x u8t</i> 2 Byte parameter and one byte CRC	
MOSI Data (9 Bytes) (for Firmware ≥1.8)	Byte #	Description	
	0,1	<i>Measurement interval: u16t [ms]</i> 0: as fast as possible >0: measurement interval [ms]	
	2,3	<i>I²C Command: u16t</i>	
	4,5,6	<i>Additional I²C parameter: 3 x u8t</i> 2 Byte parameter and one byte CRC	
	7,8	<i>Configuration word: u16t</i> Optional configuration for continuous measurement. See definition above	
MISO Data (0 Bytes)	no data		

Get Continuous Measurement Status			
Description	Get the interval or status of the Continuous Measurement		
Command ID	0x33	for Sensor Type	0, 2, 3
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (0 Bytes)	no data		
MISO Data (0 Bytes)	no data (continuous measurement not started)		
MISO Data (2 Bytes)	Byte #	Description	
	0,1	<i>Measurement interval: u16t [ms]</i> (continuous Measurement started) 0: as fast as possible >0: Measurement interval in ms	

3.2.5 STOP CONTINUOUS MEASUREMENT

Stop Continuous Measurement			
Description	Stop continuous measurement after the current measurement is finished. The measurement buffer is saved until it is read out or a new continuous measurement is started.		
Command ID	0x34	for Sensor Type	0, 2, 3
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (0 Bytes)	no data		
MISO Data (0 Bytes)	no data		

3.2.6 STOP CONTINUOUS MEASUREMENT WITH COMMAND

Stop Continuous Measurement with Command			
Description	Stop continuous measurement after the current measurement is finished with the specified I ² C command. The measurement buffer is saved until it is read out or a new continuous measurement is started.		
Command ID	0x34	for Sensor Type	3
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (2 Bytes)	Byte #	Description	
	0,1	<i>I²C Stop Command: u16t</i>	
MISO Data (0 Bytes)	no data		

3.2.7 GET LAST MEASUREMENT

Get Last Measurement			
Description	Read out last measurement during continuous measurement. Start continuous measurement before using this command.		
Command ID	0x35	for Sensor Type	0, 2, 3
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (0 Bytes)	no data		
MISO Data (0 Bytes)	no data (Continuous measurement not started, first measurement not yet finished or no new measurement available since last command "Get Last Measurement")		
MISO Data (2 Bytes)	Byte #	Description	
	0,1	<i>Measurement result: u16t/i16t (if new Measurement available)</i>	

Get Last Measurement advanced			
Description	(for Firmware ≥ 1.4) Read out last measurement during continuous measurement with configurable clear after read out. Start continuous measurement before using this command.		
Command ID	0x35	for Sensor Type	0, 2, 3
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (1 Bytes)	Byte #	Description	
	0	Bit 0: Clear Measurement after read out. False: Measurement(s) not cleared after read out True: Measurement(s) cleared after read out (same as "Get last Measurement") Bit 1: Signal select (for Sensor Type 3 and Firmware ≥ 1.8 only) False: Read last flow value only (signal 1) True: Read last value of all 3 signals (signals 1, 2, and 3)	
MISO Data (0 Bytes)	no data (Continuous measure not started or first measure not yet finished)		
MISO Data (2 Bytes)	Byte #	Description	
	0,1	<i>Measurement result: u16t/i16t</i>	

3.2.8 GET MEASUREMENT BUFFER

Get Measurement Buffer			
Description	Read out the newest 127 measurements and clear the buffer. Use the "Extended Buffer Command" to work with more than 127 buffered measurements. If the returned length is 0, no new measurements are available.		
Command ID	0x36	for Sensor Type	0, 2
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (0 Bytes)	no data		
MISO Data (0...254 Bytes)	Byte #	Description	
	0, 1	<i>Measurement result 0 : u16t/i16t</i>	
	2, 3	<i>Measurement result 1 : u16t/i16t</i>	
	2*x, 2*x+1	<i>Measurement result x : u16t/i16t</i>	

Extended Measurement Buffer command			
Description	(for Firmware ≥ 1.4) Commands for read out, clear and get number of available samples in extended buffer. The size of extended buffer is 1000.		
Command ID	0x36	for Sensor Type	0, 2, 3
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (1 Byte)	Byte #	Description	
	0	<i>Define function: u8t</i> 0: (for Sensor Type 0, 2) Get 127 oldest value from extended Buffer and remove them from the buffer. 1: (for Sensor Type 0, 2, 3) Get actual used extended Buffer size 2: (for Sensor Type 0, 2, 3) Clear extended Buffer 3: (for Firmware ≥ 1.7 and for Sensor Type 3) Get buffer for the oldest interlaced data, with additional buffer information.	
MISO Data Function 0 (0...254 Bytes)	Byte #	Description	
	0, 1	<i>Measurement result 0 : u16t/i16t</i>	
	2, 3	<i>Measurement result 1 : u16t/i16t</i>	
	$2*x, 2*x+1$	<i>Measurement result x : u16t/i16t</i>	
MISO Data Function 1 (4 Bytes)	Byte #	Description	
	0, 1	<i>Actual used extended Buffer size : u32t</i>	
MISO Data Function 2 (0 Bytes)	no data		
MISO Data Function 3 (8...248 Bytes)	Byte #	Description	
	0...3	<i>Number of measured packages lost : u32t</i> If the time between the „Exdendet Buffer“ command calls is too large, the internal ring buffer will overrun. In this case, the oldest package of values in the buffer is cleared when a new value enters. This number is a counter which counts the missing values between the function calls (number of values which were not readout by the RS485 bus master).	
	4...5	<i>Number of packages remaining in buffer : u16t</i> The number of <i>packages</i> which remains in the buffer after this function call (the number of returned values is limited to 120 values because the maximum allowed data part in the SHDLC frame is 255 bytes).	
	6...7	<i>Number of interlaced data per package : u16t</i>	
	8...	<i>Interlaced measurement data, format depends on sensor and continuous measurement Configuration Word. See command “Start Continuous Measurement with Command” above. By default, all 3 signals are returned and the format is as follows:</i> <i>[Bytes 8,9]: Flow 0: i16t/u16t (depends on sensor)</i> <i>[Bytes 10,11]: Temp 0: i16t</i> <i>[Bytes 12,13]: Aux 0: u16t/i16t (depends on sensor)</i> <i>[Bytes 14,15]: Flow 1: i16t/u16t (depends on sensor)</i> <i>[Bytes 16,17]: Temp 1: i16t</i> <i>[Bytes 18,19]: Aux 1: u16t/i16t (depends on sensor)</i> ...	

3.2.9 TOTALIZATOR STATUS

Set Totalizator Status			
Description	Enable or disable the Totalizator. The value of the Totalizator is not changed with this command.		
Command ID	0x37	for Sensor Type	0, 2, 3
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (1 Bytes)	Byte #	Description	
	0	<i>Totalizator Status : bool</i> false(default): disabled true: enabled	
MISO Data (0 Bytes)	no data		

Get Totalizator Status			
Description	Get the Status (enabled / disabled) of the Totalizator.		
Command ID	0x37	for Sensor Type	0, 2, 3
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	<i>Totalisator Status: bool</i>	

3.2.10 TOTALIZATOR VALUE

Get Totalizator Value			
Description	Get the value of the Totalizator. This value is the sum of all unscaled measurements while in continuous measurement. Note for sensor type 3 only: Only the flow values (signal 1) are totalized and the values are interpreted as i16 signed integers.		
Command ID	0x38	for Sensor Type	0, 2, 3
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (0 Bytes)	no data		
MISO Data (8 Bytes)	Byte #	Description	
	0...7	<i>Totalisator: i64t</i>	

3.2.11 GET LAST MEASUREMENT MODE DURATION

Get Last Measurement Mode Duration			
Description	(for Firmware ≥ 1.6) Get the duration of last confirmed and finished measurement in Measurement Mode. (Only available for measurements in Auto-Detection Mode) Command extension of command 0x38, Sub-command 0x00.		
Command ID	0x38	for Sensor Type	0
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (1 Bytes)	Byte #	Description	
	0	Sub-Command: 0x00: Get Last Measurement Mode Duration	
MISO Data (4 Bytes)	Byte #	Description	
	0...3	Measurement duration in milliseconds: $u32t$	

3.2.12 RESET TOTALIZATOR

Reset Totalizator			
Description	Set the Totalizator value to zero, the Totalizator Status (enabled/disabled) is not changed. The Totalizator can be reset anytime.		
Command ID	0x39	for Sensor Type	0, 2, 3
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (0 Bytes)	no data		
MISO Data (0 Bytes)	no data		

3.2.13 GET SINGLE TEMPERATURE AND HUMIDITY

Get single Temperature and Humidity			
Description	Read out temperature and humidity from humidity sensor (SHT7x, SHT1x or SHT2x) if finished. A single measurement must be started before, the finish of measurement can be polled with this command. The measurement with high resolution requires a time of max. 400ms(SHT1x, SHT7x) or 110ms(SHT2x), low resolution requires 100ms(SHT1x, SHT7x) or 27ms(SHT2x). (for Firmware $\geq 1.7.1$) Add support for SHT3x, measurement is executed with high repeatability and requires max. 15ms.		
Command ID	0x3A	for Sensor Type	1
Access Level	0	Availability	After start single Measurement
Response Time max	1ms	Storage	-
MOSI Data (0 Bytes)	no data		
MISO Data (0 Bytes)	no data (measurement not yet finished or Error)		
MISO Data (8 Bytes)	Byte #	Description	
	0...3	Temperature in $^{\circ}\text{C}$: ft	

(measurement finished)	4...7	Humidity in %RH : ft
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3.2.14 START AUTO DETECTION MEASUREMENT

Start Auto Detection Measurement Advanced			
Description	(for Firmware ≥ 1.3) Start auto detection measurement for liquid flow dosing applications. This function measures with low precision/power (Detection Mode) and after detection of a flow above the detection limit, switches automatically to accurate Measurement Mode for the given duration. During accurate measurement the bit 1 of the Sensor Status (3.2.1) is high. After the measurement duration is finished, the Bit 3 in the Sensor Status is set until the Sensor Status is read out the next time. During or after the accurate measurement is running, the measurements can be read out with Get Measurement Buffer command (3.2.8). If enabled, the Totalizator (3.2.9) increases with the measured values only during accurate measurement.		
Command ID	0x3B	for Sensor Type	0
Access Level	0	Availability	Sensor Idle
Response Time max	tbd. ms	Storage	-
MOSI Data (15 Bytes)	Byte #	Description	
	0, 1	<i>Trigger Limit :</i> $u16t$ [ticks] Activate measurement if sensor signal in detect mode is greater or equal this value	
	2...5	<i>Measurement Duration :</i> $u32t$ [ms]	
	6	<i>Power Setting:</i> $u8t$ [0...31] Define following bits in Userregister for Search measurement: (V1.3) Bit 7+8 (factory settings) ($\geq V1.4$) Bit 4...8 (calibfield and factory settings)	
	7, 8	<i>Detect Interval:</i> $u16t$ [ms]	
	9	<i>Detect Resolution:</i> $u8t$ [9...16 Bit]	
	10, 11	<i>Measurement Interval:</i> $u16t$ [ms]	
	12	<i>Measurement Resolution:</i> $u8t$ [9...16 Bit]	
	13, 14	<i>Pulse Confirmation Period:</i> $u16t$ [ms] 0: Pulse Confirmation disabled >0: Pulse Confirmation enabled with given time	
MISO Data (0 Bytes)	no data		

Start standard Auto Detection Measurement			
Description	(for Firmware ≥ 1.3) Same function as “Start Auto Detection Measurement Advanced”, but the followings setting are set to default values: Power Setting: 0 Search Interval: 10 ms Search Resolution: 10 Bit Measurement Interval: 20 ms Measurement Resolution: 14 Bit Pulse Confirmation Period: 100 ms		
Command ID	0x3B	for Sensor Type	0
Access Level	0	Availability	Sensor Idle
Response Time max	1 ms	Storage	-
MOSI Data (6 Bytes)	Byte #	Description	
	0, 1	<i>Trigger Limit : u16t [ticks]</i>	
	2..5	<i>Measurement Duration : u32t [ms]</i>	
MISO Data (0 Bytes)	no data		

3.2.15 ADVANCED MEASUREMENT CONFIGURATION

Set Advanced Measurement Configuration			
Description	(for Firmware ≥ 1.4) Set the advanced measurement configuration to configure continuous measurement, auto detection, and advanced measurement features. See the dedicated application note for details on the parameters. Note: The commands 'Start Continuous Measurement', 'Start Continuous Measurement and Set Resolution', 'Start Auto Detection Measurement Advanced', and 'Start standard Auto Detection Measurement' will overwrite these settings.		
Command ID	0x3C	for Sensor Type	0
Access Level	0	Availability	Sensor Idle
Response Time max	tbd. ms	Storage	Device Ram
MOSI Data (38 Bytes)	Byte #	Description	
	0, 1	<i>Measurement Config 0: u16t</i>	
	2, 3	<i>Measurement Config 1: u16t</i>	
	4, 5	<i>Measurement Config 2: u16t</i>	
	6, 7	<i>Measurement Config 3: u16t</i>	
	8, 9	<i>Measurement Config 4: u16t</i>	
	10, 11	<i>Measurement Config 5: u16t</i>	
	12, 13	<i>Measurement Config 6: u16t</i>	
	14, 15	<i>On Trigger Confirmation Time: u16t[ms]</i>	
	16...19	<i>Measurement Duration: u32t[ms]</i> 0 = infinite Measurement duration	
	20, 21	<i>Off Trigger Confirmation Time: u16t[ms]</i>	
	22, 23	<i>On Trigger level: u16t [ticks]</i>	
	24, 25	<i>Off Trigger level: u16t [ticks]</i>	

	26, 27	High Range:	<i>u16t [ticks]</i>
	28, 29	Low Range:	<i>u16t [ticks]</i>
	30, 31	Lowest calibrated Flow:	<i>u16t [ticks]</i>
	32, 33	Detection Period Time:	<i>u16t[ms]</i>
	34, 35	Measurement Period Time:	<i>u16t[ms]</i>
	36, 37	Measurement Selector:	<i>u16t</i>
MISO Data (0 Bytes)	no data		

Get Advanced Measurement Configuration

Description	(for Firmware ≥ 1.4) Get the actually set measurement configuration. Note: the modes 'Continuous Measurement', 'Auto Detection Measurement Advanced' and 'Standard Auto Detection Measurement' are internally mapped to special cases of the advanced configuration. Their parameter settings can be read out with this command as well.		
Command ID	0x3C	for Sensor Type	0
Access Level	0	Availability	Always
Response Time max	1 ms	Storage	Device Ram
MOSI Data (0 Bytes)	no data		
MISO Data (38 Bytes)	Byte #	Description	
	0...37	<i>For definition see "Set Advanced Measurement Configuration"</i>	

3.2.16 SET DETECT MODE

Set Detect Mode

Description	(for Firmware ≥ 1.6) Enable/Disable the Detect Mode while in auto detection mode. Command extension of command 0x3C, Sub-command 0x00.		
Command ID	0x3C	for Sensor Type	0
Access Level	0	Availability	Always
Response Time max	1 ms	Storage	Device Ram
MOSI Data (2 Bytes)	Byte #	Description	
	0	<i>Sub-Command: 0x00: Set Detect Mode</i>	
	1	<i>Detect Mode Enabled State u8t[0...1]</i> 0: Detect Mode disabled. The auto detection is deactivated and the Sensor measures always in Measurement Mode. 1: Detect Mode enabled. The sensor will switch from Measurement Mode to Detect Mode according to the criteria defined in the Advanced Measurement Configuration.	
MISO Data (0 Bytes)	no data		

3.2.17 RESET ADVANCED MEASUREMENT CONFIGURATION

Reset Advanced Measurement Configuration			
Description	(for Firmware ≥ 1.6) Reset the Advanced Measurement Configuration to its default value and perform a reset of the sensor. (continuous measurement with sensor's default settings at 100 ms sampling time) Command extension of command 0x3C, Sub-command 0x01.		
Command ID	0x3C	for Sensor Type	0
Access Level	0	Availability	Sensor Idle
Response Time max	250 ms	Storage	Device Ram
MOSI Data (2 Bytes)	Byte #	Description	
	0	<i>Sub-Command: 0x01: Reset Advanced Measurement Configuration.</i>	
	1	<i>Config number: u8{0...0}</i> 0: Clear advanced measurement configuration and perform a reset on the sensor	
MISO Data (0 Bytes)	no data		

3.3 SENSOR COMMANDS: SETTINGS

3.3.1 MEASUREMENT TYPE

Set Measurement Type			
Description	Set the Measurement Type		
Command ID	0x40	for Sensor Type	0, 2
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Device Ram
MOSI Data (1 Bytes)	Byte #	Description	
	0	<i>Measurement Type: u8t[0...2]</i> 0: Flow (default) 1: Temp 2: VDD	
MISO Data (0 Bytes)	no data		

Get Measurement Type			
Description	Get the Measurement Type		
Command ID	0x40	for Sensor Type	0, 2
Access Level	0	Availability	Always
Response Time max	1ms	Storage	Device Ram
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	<i>Measurement Type: u8t[0...2]</i> 0: Flow (default) 1: Temp 2: VDD	

3.3.2 RESOLUTION

Set Resolution			
Description	Sensortype 0: Set the resolution of the flow measurement. The resolution of Temp and Vdd measurement is (Resolution-3) Bit . Sensortype 1: Set the resolution of the measurement. Temperature: 12Bit, (Humidity: 8Bit) Temperature: 14Bit, (Humidity: 12Bit) Sensortype 2: Set the resolution of the Flow measurement.		
Command ID	0x41	for Sensor Type	0, 1, 2
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor Register
MOSI Data (1 Bytes)	Byte #	Description	
	0	<i>Sensortype 0: Resolution: u8t[9...16]</i> <i>Sensortype 1: Resolution: u8t[12,14]</i> <i>Sensortype 2: Resolution: u8t[12,14]</i>	
MISO Data (0 Bytes)	no data		

Get Resolution			
Description	Get the resolution of the measurement		
Command ID	0x41	for Sensor Type	0, 1, 2
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor Register
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	<i>Sensortype 0: Resolution: u8t[9...16] Sensortype 1: Resolution: u8t[12,14] Sensortype 2: Resolution: u8t[12,14]</i>	

3.3.3 HEATER MODE

Set Heater Mode			
Description	Set the heater mode for the flow sensor		
Command ID	0x42	for Sensor Type	0
Access Level	0	Availability	If sensor idle
Response Time max	2ms	Storage	Sensor Register
MOSI Data (1 Bytes)	Byte #	Description	
	0	<i>Heater Mode: u8t[0...2] 0: always off 1: always on 2: only on for Measurement</i>	
MISO Data (0 Bytes)	no data		

Get Heater Mode			
Description	Get the heater mode of the flow sensor		
Command ID	0x42	for Sensor Type	0
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor Register
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	<i>Heater Mode: u8t[0...2] 0: always off 1: always on 2: only on for Measurement</i>	

3.3.4 CALIB FIELD

Set Calib Field			
Description	Set the active calibration field of the flow sensor		
Command ID	0x43	for Sensor Type	0
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor Register
MOSI Data (1 Bytes)	Byte #	Description	
	0	Calib Field: <i>u8t[0...4]</i>	
MISO Data (0 Bytes)	no data		

Get Calib Field			
Description	Get the active calibration field of the flow sensor		
Command ID	0x43	for Sensor Type	0
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor Register
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	Calib Field: <i>u8t[0...4]</i>	

3.3.5 FACTORY SETTINGS

Set Factory Settings			
Description	Set the active factory settings of the flow sensor		
Command ID	0x44	for Sensor Type	0
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor Register
MOSI Data (1 Bytes)	Byte #	Description	
	0	Factory Settings: <i>u8t[0...3]</i>	
MISO Data (0 Bytes)	no data		

Get Factory Settings			
Description	Get the active factory settings of the flow sensor		
Command ID	0x44	for Sensor Type	0
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor Register
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	Factory Settings: <i>u8t[0...3]</i>	

3.3.6 LINEARIZATION

Set Linearization			
Description	Enable or disable linearization of the flow measurement.		
Command ID	0x45	for Sensor Type	0, 2
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor Register
MOSI Data (1 Bytes)	Byte #	Description	
	0	<i>Linearization: bool</i> false: Raw measurement true: Linearized measurement (for sensor type 2 startup settings are set)	
MISO Data (0 Bytes)	no data		

Get Linearization			
Description	Get the Linearization setting of the flow sensor		
Command ID	0x45	for Sensor Type	0, 2
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor Register
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	<i>Linearization: bool</i> false: Raw measurement true: Linearized measurement	

3.4 SENSOR INFORMATION

3.4.1 SENSOR PART NAME

Get Sensor Part Name			
Description	Sensor Type 0: Get the part name of the sensor Sensor Type 3: Get product ID and serial number as hex numbers in a string.		
Command ID	0x50	for Sensor Type	0, 3
Access Level	0	Availability	If sensor idle
Response Time max	3ms	Storage	Sensor EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (1...255 Bytes)	Byte #	Description	
	0...255	<i>Part Name: String</i>	

3.4.2 SENSOR ITEM NUMBER

Get Sensor Item Number			
Description	Get the item number of the sensor		
Command ID	0x51	for Sensor Type	0, 2
Access Level	0	Availability	If sensor idle
Response Time max	2ms	Storage	Sensor EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (13 Bytes)	Byte #	Description	
	0...12	<i>Item Number: String</i>	

3.4.3 FLOW UNIT

Get Flow Unit			
Description	Get the flow unit of the sensor		
Command ID	0x52	for Sensor Type	0, 2
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (2 Bytes)	Byte #	Description	
	0,1	<i>Flow Unit: u16t</i> for definition see section 5 <i>Measurement Unit Encoding</i>	

3.4.4 SCALE FACTOR

Get Scale Factor			
Description	Get the scale factor of the sensor for the active measurement type and calibration field		
Command ID	0x53	for Sensor Type	0, 2
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (2 Bytes)	Byte #	Description	
	0,1	Scale Factor: <i>u16t</i>	

SCALE FACTOR AND UNIT

Get Scale Factor and Unit			
Description	Get the scale factor, unit and sensor sanity check result of the sensor for the given argument. (only available on some SF06 sensor products)		
Command ID	0x53	for Sensor Type	3
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor EEPROM
MOSI Data (2 Bytes)	Byte #	Description	
	0,1	2 Byte Argument: <i>u16t</i>	
MISO Data (6Bytes)	Byte #	Description	
	0,1	Scale Factor: <i>u16t</i>	
	2,3	Flow Unit: <i>u16t</i> for definition see section 5 Measurement Unit Encoding	
	3,4	Sensor sanity check result: <i>u16t</i>	

3.4.6 SENSOR SERIAL NUMBER

Get Sensor Serial Number			
Description	Get the serial number of the sensor. For Sensor Type 3 only: This is noly available on some sensor products)		
Command ID	0x54	for Sensor Type	0, 2, 3
Access Level	0	Availability	If sensor idle
Response Time max	2ms	Storage	Sensor EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (4 Bytes)	Byte #	Description	
	0...3	Sensor Serial Number: <i>u32t</i>	

3.4.7 MEASUREMENT DATA TYPE

Get Measurement Data Type			
Description	Get the datatype of the flow measurements (signed or unsigned)		
Command ID	0x55	for Sensor Type	0, 2
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (1 Bytes)	Byte #	Description	
	0	<i>Data Type : bool</i> false: (signed i16t) true: (unsigned u16t)	

3.4.8 OFFSET

Get Offset			
Description	Get the offset for the flow or temperature measurements.		
Command ID	0x56	for Sensor Type	2
Access Level	0	Availability	If sensor idle
Response Time max	1ms	Storage	Sensor EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (2 Bytes)	Byte #	Description	
	0,1	<i>Offset: u16t</i>	

3.5 ADVANCED SENSOR COMMANDS

3.5.1 SENSOR RESET

Sensor Reset			
Description	Execute a hard reset on the sensor and check for correct response. Active continuous/single measurement is stopped and the sensor is left in idle state.		
Command ID	0x65	for Sensor Type	0, 1, 2, 3
Access Level	0	Availability	Always
Response Time max	250ms	Storage	-
MOSI Data (0 Bytes)	no data		
MISO Data (0 Bytes)	no data		

3.5.2 AUTOSTART

Set Autostart																			
Description	(for Firmware ≥1.4) Define a command sequence to be executed upon start up of the device.																		
Command ID	0x66	for Sensor Type	All sensors																
Access Level	0	Availability	If sensor idle																
Response Time max	50ms	Storage	Device EEPROM																
MOSI Data (1...101 Bytes)	Byte #	Description																	
	0	Nbr of Autostart commands : <i>u8t</i> 0 for disable autostart																	
	1...N	Startup Commands: <i>u8t[]</i> Max 100 Bytes Structure of Commands																	
		<table border="1"> <thead> <tr> <th>Byte Nr</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Command ID 1</td> </tr> <tr> <td>1</td> <td>Nbr of Data</td> </tr> <tr> <td>...</td> <td>Data for command ID 1</td> </tr> <tr> <td>n</td> <td>Command ID 2</td> </tr> <tr> <td>n+1</td> <td>Nbr of Data</td> </tr> <tr> <td>...</td> <td>Data for command ID 2</td> </tr> <tr> <td>...</td> <td>...</td> </tr> </tbody> </table>	Byte Nr	Description	0	Command ID 1	1	Nbr of Data	...	Data for command ID 1	n	Command ID 2	n+1	Nbr of Data	...	Data for command ID 2	
Byte Nr	Description																		
0	Command ID 1																		
1	Nbr of Data																		
...	Data for command ID 1																		
n	Command ID 2																		
n+1	Nbr of Data																		
...	Data for command ID 2																		
...	...																		
MISO Data (0 Bytes)	no data																		

Get Autostart			
Description	(for Firmware ≥1.4) Get commands executed after startup of device.		
Command ID	0x66	for Sensor Type	All sensors
Access Level	0	Availability	Always
Response Time max	5ms	Storage	Device EEPROM
MOSI Data (0 Bytes)	no data		
MISO Data (101 Bytes)	Byte #	Description	
	0	Nbr of Autostart commands : <i>u8t</i> 0 autostart disabled	
	1...100	Startup Commands: <i>u8t[]</i> See "Set Autostart" for Structure	

4 ERRORS

4.1 RS485 COMMUNICATION ERRORS

Code	Name	Meaning
0x00	no error	No error occurred on device/command execution
0x01	wrong data size	A MOSI frame had the wrong size for selected command
0x02	unknown command	Command not supported from device
0x03	no access rights for command	You need higher access rights to execute command
0x04	invalid parameter	One of the parameters for command execution was illegal or out of range
0x05	Wrong checksum	The checksum in MOSI was wrong. (Note: the device will not response in case of this error)

4.2 SENSOR ERRORS

Code	Name	Meaning
0x20	Sensor Busy	command could not be executed because sensor is busy
0x21	No Ack from Sensor	Sensor gives no I2C acknowledge
0x22	I2C CRC false	CRC error while communication with sensor
0x23	Sensor Timeout	Timeout of sensor while measurement
0x24	No Measurement Started	No measurement is started
0x25		
0x26		
0x27		
0x28		
0x29		

5 MEASUREMENT UNIT ENCODING

The 16bit flow unit code includes different types of information:

1. Dimensions (e.g. milli, 0.001) (16 possibilities)
2. Time base (e.g. per second) (16 possibilities)
3. Unit (e.g. standard liter) (32 possibilities)

Bit <3:0> (x*1)	Dimension	Prefix
0 – 2	reserved	
3	1e-9	n
4	1e-6	u
5	0.001	m
6	0.01	c
7	0.1	d
8	1	1
9	10	-
10	100	h
11	1000	k
12	1e6	M
13	1e9	G
14 – 15	reserved	

Bit <7:4> (x*16)	Time Base	Comment
0	no time base	e.g. pressure / totalized flow
1	per microsecond	us
2	per millisecond	ms
3	per second	s
4	per minute	min

5	per hour	h
6	per day	day
7 – 15	reserved	

Bit <12:8> (x*256)	Volume / Pressure	Comment
0	norm liter (0°C, 1013 hPa)	nl, typically for gas flow
1	standard Liter (20°C, 1013 hPa)	sl, typ. gas flow
2 – 7	reserved	
8	liter (liquid)	l, typ. liquid flow
9	gram	g, typ. liquid flow
10 – 15	reserved	
16	pascal	Pa, pressure
17	bar	bar, pressure
18	meter H ₂ O	m H ₂ O, pressure
19	inch H ₂ O	in H ₂ O, pressure
20 – 31	reserved	

Bit <15:13> (x*8192) are reserved

1.1 EXAMPLES

Unit	Code
nl/s	$8*256 + 3*16 + 3 = 2099$
m ³ /s	$8*256 + 3*16 + 11 = 2107$
mln/min	$0*256 + 4*16 + 5 = 69$
hPa	$16*256 + 0*16 + 10 = 4106$