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## User Guide

UG000426

# Ultrasonic Water Meter

**iESLab Module with TDC-GP30**

Plastic Pipeline M-Shape

v1-01 • 2019-Jun-24

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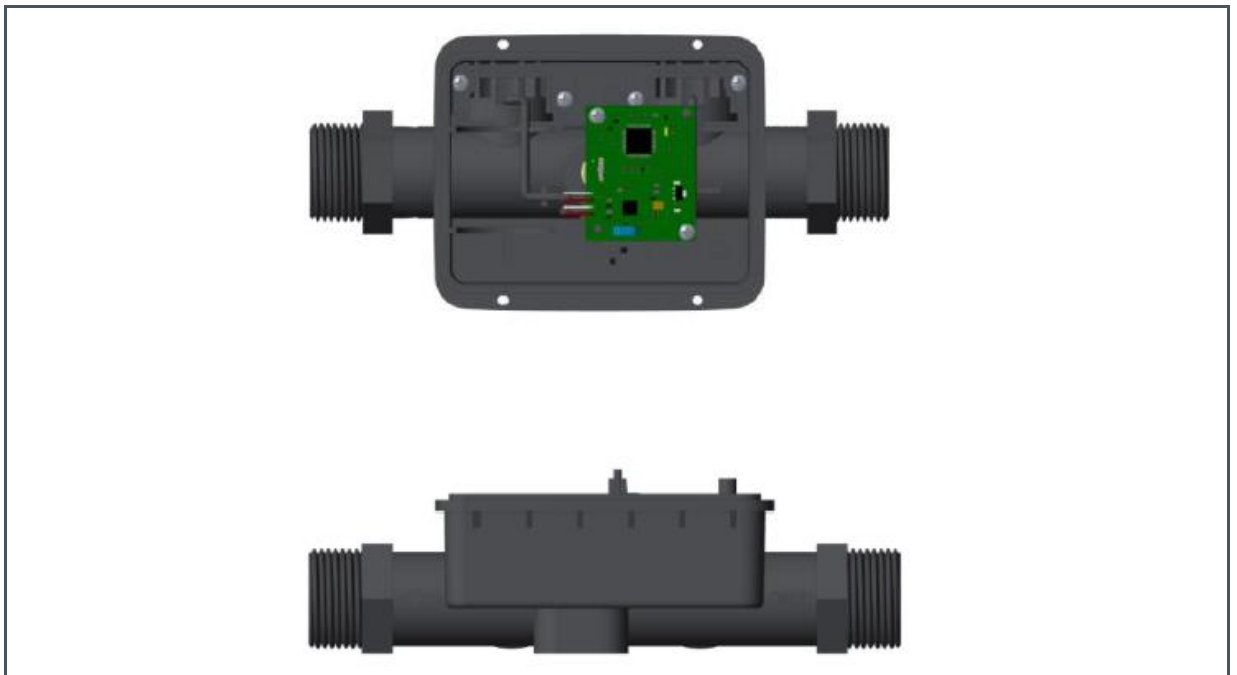
# Content Guide

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# 1 Introduction

## 1.1 Kit Content

**Figure 1:**  
**Water Meter Module Brass**



## 1.2 Ordering Information

Ordering Code	Description	Part Number	Markup Information <sup>(1)</sup>
	Water meter module with brass pipeline No calibration	IA-UWM-1-GP30-DN20	IA-UWM-1-GP30-DN20-YYYYMMDD-SSSSSS
	Water meter module with brass pipeline With calibration	IA-UWM-2-GP30-DN20	IA-UWM-2-GP30-DN20-YYYYMMDD-SSSSSS

<sup>(1)</sup> YYYY = year, MM = month, DD = day, SSSSSS = product serial number that day

## 2 Measurement Characteristics

The modules come calibrated, with flow and temperature calculation done on the module.

**Figure 2:**  
**Measurement Characteristics**

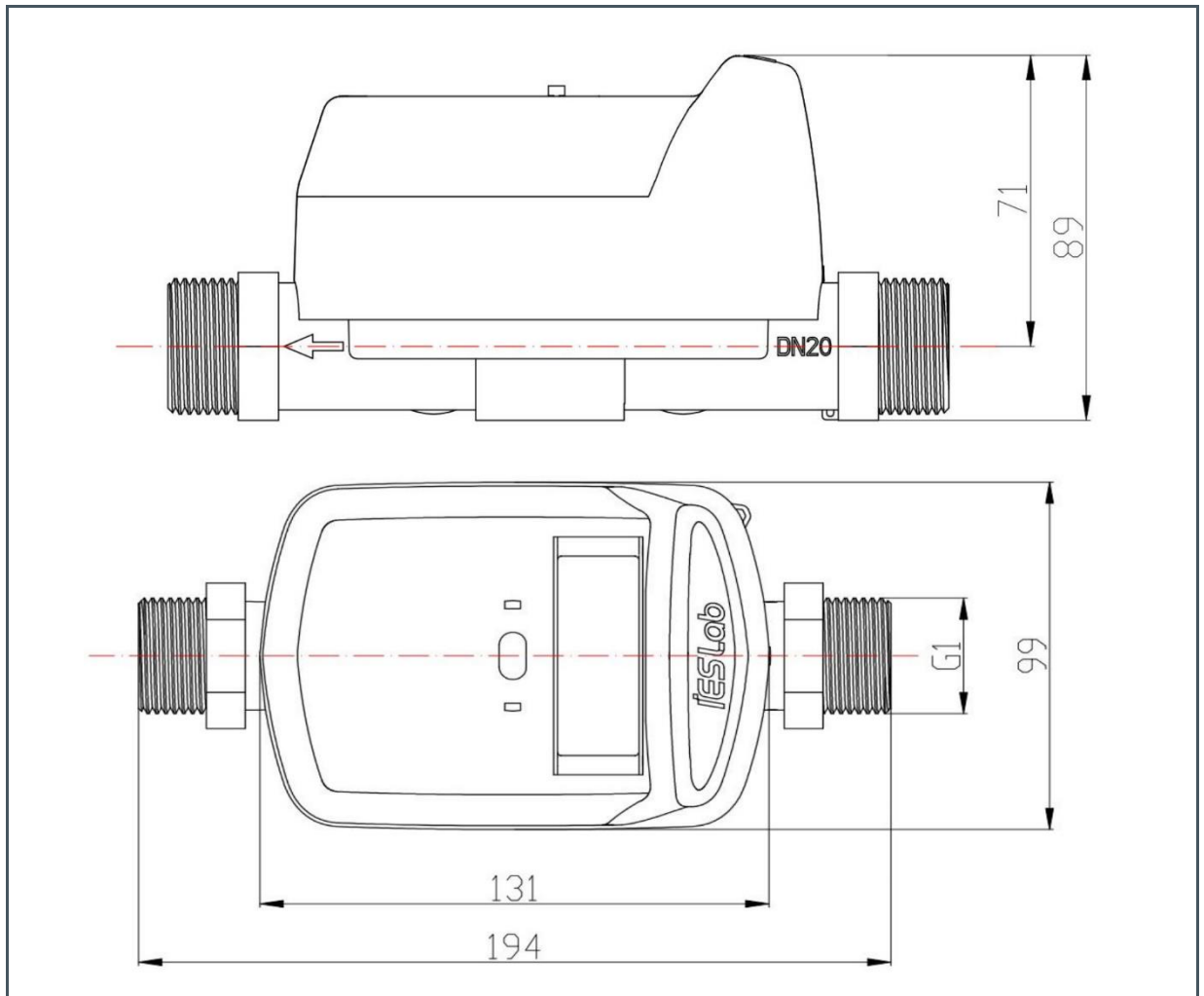
Nominal Diameter	15	20	25	32	40
Starting Flow [m <sup>3</sup> /h]	0.002	0.003	0.003	0.005	0.005
Minimum Flow Rate Q <sub>1</sub> [m <sup>3</sup> /h]	0.010	0.016	0.025	0.040	0.064
Transitional Flow Rate Q <sub>2</sub> [m <sup>3</sup> /h]	0.016	0.025	0.040	0.064	0.100
Permanent Flow Rate Q <sub>3</sub> [m <sup>3</sup> /h]	2.500	4.000	6.300	10.000	16.000
Overload Flow Rate Q <sub>4</sub> [m <sup>3</sup> /h]	3.125	5.000	7.875	12.500	20.000
Flow Range Ratio R (Q <sub>3</sub> /Q <sub>1</sub> )	R250 <sup>(1)</sup> , R400				
Accuracy Class	Class 2				
Temperature Class	T30 <sup>(1)</sup> , T50				
Sample Rate	8 Hz <sup>(1)</sup> to 32 Hz				
Maximum Admissible Pressure	1.0 MPa				
Pressure Loss Range	< 63 kPa		< 40 kPa		
Flow Data Storage	Accumulated volume 90days				

(1) Default

### 3 Hardware Description

#### 3.1 Mechanical Outline

Figure 3:  
Mechanical Dimensions



Length 194 mm, height 60mm, width 93mm

Make sure the pool piece is full of water, avoid bubble generation.

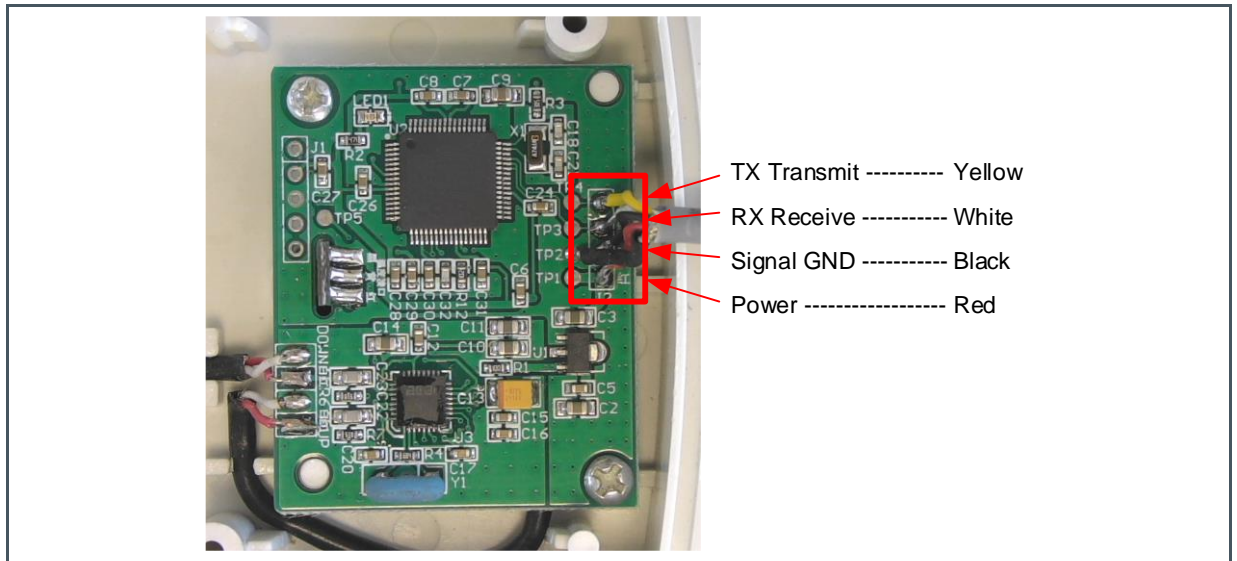
## 3.2 Electrical and Communication Interface

- Power
  - Regulated power supply, 3.4 to 5.5V, 20mA peak current, higher power is recommended
- Communication interface
  - UART
  - Voltage 3.3V
  - Baud rate 2400 bps
  - Even parity check, data bits: 8bits, stop bit: 1 bit
  - UART TX can be used to wake up the user's board, with falling edge active (water flow every 1l/in normal mode, water flow every 1s @ test mode, abnormalities)
  - After UART TX wakes up th user's board, UART communication can be performed after 100µs wait.
- Communication commands
  - Setup, Read data
- Power consumption
  - < 30µA @ self-adopting sample rate, 0.5 to 4 Hz

## 4 Communication Protocol

The module uses a UART interface for communication.

**Figure 4:**  
UART Connection



- Baud rate : 2400 Baud
- Word size : 8 Bits
- Stop bit : 1 Bit
- Parity check : Even

### 4.1 Format of Communication Protocol

#### 4.1.1 Simplified Data Frame Format

**Figure 5:**  
Simplified Data Frame

Byte	Length	Numeral System	Description
Data Identification	2 Byte	HEX	Sign D0
			Sign D1
Control Code	1 Byte	HEX	C
Data Field	Not Fixed		DATA



Byte	Length	Numeral System	Description
Check Code	1 Byte	HEX	CS

## 4.1.2 Conventional Data Frame Format

**Figure 6:**  
Conventional Data Frame

Byte	Length	Numeral System	Description
Frame Start	1 Byte	HEX	0x68
Module Type	1 Byte	HEX	T
Address Field	7 Byte	BCD	A0
			A1
			A2
			A3
			A4
			A5
			A6
Control Code	1Byte	HEX	C
Data Length Field	1Byte	HEX	L
Data Field	Not Fixed		DATA
Check Sum	1Byte	HEX	CS
Terminator	1Byte	HEX	0x16

### Notes

1. Module type (T): Currently including: UWM (0x10); Ultrasonic Gas meter Module (0x30).
2. Address Field (A0-A6): Communication address, unique identification code for UWM.
3. Data Length (L): byte length of the data field, "0" shows no data field.
4. Data Field (DATA): including data sig, serial number and data. The structure is followed by control code.
5. Check Sum (CS): Low 8 bits of the accumulation of all bytes from frame header to the frame check code flag

### Definitions

- NA0...NA6      The communication address of presupposition UWM.
- AA...AA:      Broadcast address is AAAAAAAAAAAAAA
- CTR:            Control code / Response control code
- DI0 DI1 :      Data identification

- CS: Low 8 bits of the accumulation of all bytes from frame header to the frame check code flag
- SER1/SER2: Serial number, a response frame used to confirm whether it is a corresponding protocol
- ST: Indicate the corresponding state, reserved bytes

## 4.2 Commands Overview

**Figure 7:**  
UART Commands Overview

Control Code	Command		Description
0x59	Read current data		Read the major UWM parameter: instantaneous flow velocity in [m <sup>3</sup> /h], current accumulative volume in [m <sup>3</sup> ], temperature [°C]
0x05	Read software version number		
0x31	Read factory serial number		
0x22	Time synchronization		Synchronize UWM to the sent date and time YY MM DD HH MM SS
0x24	Read current time		YY MM DD HH MM SS
0x27	Read history data	Detailed consumption data	Read the latest N volume data in [m <sup>3</sup> ]
0x28	Read all historic data		Read the latest 9 volume data in [m <sup>3</sup> ]
0x01	Read water meter data		Read current accumulated volume * 100 in [m <sup>3</sup> ], settlement day accumulated volume * 100 in [m <sup>3</sup> ], date and status
0x03	Read communication address		
0x42	Read settlement day		
0x43	Read settlement day data		Read accumulated volume over 24 months history * 100 in [m <sup>3</sup> ] for a given year and month,
0x48	Read flow coefficients		Reading flow coefficients: small , 3 x medium and large flow
0x49	Enter verification state	Verification	Verification state allows reading detailed data
0x4A	Read temperature coefficients		Read coefficients for inlet and outlet temperature
0x4C	Read verification data		Reading parameters temperature [°C], accumulative volume [m <sup>3</sup> ], instantaneous flow [m <sup>3</sup> /h], , TOF_UP [ns], default, DIFTOF [ps], Cumulative working time [h].
0x4F	Read instantaneous flow & temperature		Reading current accumulated volume, accumulative volume at settlement day, instantaneous flow, temperature:, date & time
0x51	Start & stop test		
0x57	Exit verification state		
0x58	Check verification state		

## 4.3 Commands in Detail

### 4.3.1 Read Current Data (Simplified data frame format)

Control code: 0x 59  
 Response control code: 0x C9  
 Data identification: 0x 47 A0

**Figure 8:**  
Read Current Data

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X47	HEX	Data identification D0
	3	0XA0	HEX	Data identification D1
	4	0X59	HEX	Check code
	5	CS	HEX	Check sum
Response frame	0	0X47	HEX	Data identification D0
	1	0XA0	HEX	Data identification D1
	2	0XC9	HEX	Check code
	3 to 6	F0-F3	BCD	Instantaneous flow * 100000 in [m³/h]
	7 to10	D0-D3	BCD	Current accumulative volume *100 in [m³]
	11 to 13	T0-T2	BCD	Temperature +100 in [°C], signed integer (MSB = sign)
	14	CS	HEX	Check sum

Example: Read the parameter of UWM, instantaneous flow velocity is 0.001, current accumulative flow is 12.66 temperature is 0°C

1. Send out frame: 0x FE FE 47 A0 59 40
2. Response frame: 0x 47 A0 C9 00 01 00 00 66 12 00 00 00 00 00 29

### 4.3.2 Read Software Version Number

Request control code: 0x 05  
 Response control code: 0x 85  
 Data identification: 0x 20 A0

**Figure 9:**  
**Read Software Version**

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X05	HEX	Control code
	12	0X03	HEX	Data length
	13	0X20	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	16	CS	HEX	Check sum
	17	0X16	HEX	End character
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0x85	HEX	Control code
	10	0x07	HEX	Data length
	11	0x20	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14	0xB1	HEX	SWVER (software version)
	15 to 17	SWVER	BCD	1 <sup>st</sup> byte: High version number B1 2 <sup>nd</sup> byte: Low version number. 11 indicates v1.1
	18	CS	HEX	Checksum
	19	0x16	HEX	End character

Example: Read the version number which is B1.00

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 05 03 20 A0 03 3D 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 85 07 20 A0 03 B1 00 00 00 72 16

### 4.3.3 Read Factory Serial Number

Request control code: 0x 31

Response control code: 0x E1

Data identification: 0x 01 89

**Figure 10:**  
**Read Factory Serial Number**

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X31	HEX	Control code
	12	0X03	HEX	Data length
	13	0X01	HEX	Data identification D0
	14	0X89	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	16	CS	HEX	Check sum
	17	0X16	HEX	End character
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xE1	HEX	Control code
	10	0x0C	HEX	Data length
	11	0x01	HEX	Data identification D0
	12	0x89	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14	0x00	HEX	Identifier bytes
	15 to 21	S0 to S6	HEX	Factory serial number
	22	0x5A	HEX	Identifier bytes
	23	CS	HEX	Checksum
	24	0x16	HEX	End character

Example: Factory serial number is 000000B1000000

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 31 03 01 89 04 34 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 E1 0C 01 89 04 00 00 00 00 B1  
00 00 00 5A F8 16

### 4.3.4 Time Synchronization

- Request control code: 0x 22
- Response control code: 0x A2
- Data identification: 0x 32 A0

**Figure 11:**  
**Synchronize Time**

	Byte	Code	Numerical System	Description	
Request frame	0	0XFE	HEX	Supplementary bytes	
	1	0XFE	HEX	Supplementary bytes	
	2	0X68	HEX	Start bytes	
	3	0X10	HEX	UWM type	
	4 to 10	A0 to A6	BCD	UWM address	
	11	0X22	HEX	Control code	
	12	0X0A	HEX	Data length	
	13	0X32	HEX	Data identification D0	
	14	0XA0	HEX	Data identification D1	
	15	SER1	HEX	Serial number low byte	
	16	SER1	HEX	Serial number high byte	
	17	YY	BCD	Year	Time synchronization
	18	MM	BCD	Month	
	19	DD	BCD	Day	
	20	HH	BCD	Hour	
	21	MM	BCD	Minute	
	22	SS	BCD	Second	
	16	CS	HEX	Check sum	
	17	0X16	HEX	End character	
Response frame	0	0X68	HEX	Start byte	
	1	0X10	HEX	UWM type	
	2 to 8	A0 to A6	BCD	UWM address	
	9	0xA2	HEX	Control code	
	10	0x05	HEX	Data length	
	11	0x32	HEX	Data identification D0	

	Byte	Code	Numerical System	Description
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14	SER1	HEX	Serial number high byte
	15	ST	HEX	Vendor reserved byte
	23	CS	HEX	Checksum
	24	0x16	HEX	End character

Example: Synchronization the UWM on date & time 2018.05.18 16:12:40

1. Send out frame:           0x FE FE 68 10 02 12 03 18 20 33 78 22 0A 32 A0 05 01  
                                          18 05 18 16 12 40 13 16
2. Response frame:           0x 68 10 02 12 03 18 20 33 78 A2 05 32 A0 05 01 00 10 16

### 4.3.5 Read Current Time

Request control code:           0x 24

Response control code:         0x A4

Data identification:            0x 32 A0

**Figure 12:**  
**Read Current Time**

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X24	HEX	Control code
	12	0X03	HEX	Data length
	13	0X32	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	16	CS	HEX	Check sum
	17	0X16	HEX	End character

	Byte	Code	Numerical System	Description
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xA4	HEX	Control code
	10	0x09	HEX	Data length
	11	0x32	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14	YY	BCD	Year
	15	MM	BCD	Month
	16	DD	BCD	Day
	17	HH	BCD	Hour
	18	MM	BCD	Minute
	19	SS	BCD	Second
	20	CS	HEX	Checksum
21	0x16	HEX	End character	

Example: Read the UWM time which is 2018.05.18 15:49:54

- 3. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 24 03 32 A0 09 74 16
- 4. Response frame: 0x 68 10 02 12 03 18 20 33 78 A4 09 32 A0 09 18 05 18 15 49 54 E1 16

### 4.3.6 Read History Data

Request control code: 0x 27

Response control code: 0x A7

Data identification: 0x 35 A0

**Figure 13:**  
Read History Data

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address



	Byte	Code	Numerical System	Description
	11	0X27	HEX	Control code
	12	0X04	HEX	Data length
	13	0X35	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	16	N	HEX	Number of data to be read
	17	CS	HEX	Check sum
	18	0X16	HEX	End character
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xA7	HEX	Control code
	10	0x07	HEX	Data length
	11	0x35	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14 to 16	D0 to D2	BCD	Historic data, lowest byte first e.g. 000012 indicates 10m <sup>3</sup>
	17	N	HEX	Number of data to be read
	18	CS	HEX	Checksum
	19	0x16	HEX	End character

Example: Read the UWM time which is 2018.05.18 15:49:54

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 27 04 35 A0 42 01 B5 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 A7 07 35 A0 42 12 00 00 01 4A 16

### 4.3.7 Read All History Data

Request control code: 0x 28

Response control code: 0x A8

Data identification: 0x 36 A0

**Figure 14:**  
**Read All History Data**

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X28	HEX	Control code
	12	0X03	HEX	Data length
	13	0X36	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	16	CS	HEX	Check sum
	17	0X16	HEX	End character
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xA8	HEX	Control code
	10	1E	HEX	Data length
	11	0x36	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14 to 40	D0 to D26	BCD	All 9 historic data, lowest byte first
	41	CS	HEX	Checksum
	42	0x16	HEX	End character

**Explanation:** The response frame has 10 bags, each bag transmits the 27 bytes history data. D0 to D26 gives the history data per day in BCD format. Three bytes represent one day, with the low byte sent first, e.g. 000003 indicates 3m<sup>3</sup>. In case of no history data 0x FF FF FF will be sent.

Example:

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 28 03 36 A0 0E 81 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E FF FF FF FF FF FF  
 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E 12 00 00 12 00 00 12 00 00 12 00 00 12 00 00 12 00 00  
 33 00 00 33 00 00 33 00 00 33 00 00 42 16  
 68 10 02 12 03 18 20 33 78 A8 1E 36 A0 0E 33 00 00 33 00 00 55 00 00 55 00 00 55 00 00  
 55 00 00 55 00 00 55 00 00 12 00 00 92 16

### 4.3.8 Read Water Meter Data

- Request control code: 0x 01
- Response control code: 0x 81
- Data identification: 0x 1F 90

**Figure 15:**  
Read Water Meter Data

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X01	HEX	Control code
	12	0X03	HEX	Data length
	13	0X1F	HEX	Data identification D0
	14	0X90	HEX	Data identification D1

	Byte	Code	Numerical System	Description	
	15	SER1	HEX	Serial number low byte	
	16	CS	HEX	Check sum	
	17	0X16	HEX	End character	
Response frame	0	0X68	HEX	Start byte	
	1	0X10	HEX	UWM type	
	2 to 8	A0 to A6	BCD	UWM address	
	9	0x81	HEX	Control code	
	10	0x16	HEX	Data length	
	11	0x1F	HEX	Data identification D0	
	12	0x90	HEX	Data identification D1	
	13	SER1	HEX	Serial number low byte	
	14 to 17	D0 to D3	BCD	Current accumulative flow, multiplied by 100	
	18	0x2C	HEX	Data identification	
	19 to 22	D4 to D7	BCD	Accumulative flow of this settlement day, multiplied by 100	
	23	0x2C	HEX	Data identification	
	24	DD	BCD	Day	Settlement day
	25	HH	BCD	Hour	
	26	MM	BCD	Minute	
	27	SS	BCD	Second	
	28	STA3	HEX	Status bytes	
	29	STA4	HEX		
30	STA0	HEX			
31	STA1	HEX			
32	STA2	HEX			
33	CS	HEX	Checksum		
34	0x16	HEX	End character		

Example: Reading meter data is 12m<sup>3</sup>, all FF indicates no settlement day data, time is day 18, 16:20:55

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 01 03 1F 90 10 35 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 81 16 1F 90 10 00 12 00 00 2C FF FF FF FF 2C 18 16 20 55 00 00 00 00 00 D1 16

**Definition Status Byte**

Both, STA0 and STA3 are 0x00

**Figure 16:**  
**Status Bytes**

Register	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
STA0	0x00							
STA1	-	-	Battery undervoltage	-	-	No water in pipe	Ultra-low flow alarm	Opposite direction
STA2		Current flow <Q1 or >Q4	Water temperature out of range	GP30 abnormal state	RTC time abnormal	Reserved	Reserved	
STA3	0x00							
STA4	AD Detection voltage in [V], multiplied by 100							

### 4.3.9 Read Communication Address

Request control code:           0x 03

Response control code:        0x 83

Data identification:            0x 0A 81

**Figure 17:**  
**Read Communication Address**

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	0xAA AA AA AA AA AA AA	BCD	Broadcast address
	11	0X03	HEX	Control code
	12	0X03	HEX	Data length
	13	0X0A	HEX	Data identification D0
	14	0X81	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	16	CS	HEX	Check sum
17	0X16	HEX	End character	

	Byte	Code	Numerical System	Description
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0x83	HEX	Control code
	10	0x03	HEX	Data length
	11	0x0A	HEX	Data identification D0
	12	0x81	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14	CS	HEX	Checksum
	15	0x16	HEX	End character

Example: Reading the communication address which is 2018031202

1. Send out frame: 0x FE FE 68 10 AA AA AA AA AA AA AA 03 03 0A 81 05 B4 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 83 03 0A 81 05 88 16

### 4.3.10 Read Settlement Day

Request control code: 0x 42

Response control code: 0x B2

Data identification: 0x 32 A0

**Figure 18:**  
Read Settlement Day

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X42	HEX	Control code
	12	0X03	HEX	Data length
	13	0X32	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	16	CS	HEX	Check sum
	17	0X16	HEX	End character

	Byte	Code	Numerical System	Description
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xB2	HEX	Control code
	10	0x04	HEX	Data length
	11	0x32	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14	DD	HEX	Current settlement day
	15	CS	HEX	Checksum
	16	0x16	HEX	End character

Example: Current settlement day is day 22 every month

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 42 03 32 A0 10 99 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 B2 04 32 A0 10 16 20 16

### 4.3.11 Read Settlement Day Data (24 Months)

- Request control code: 0x 43
- Response control code: 0x B3
- Data identification: 0x 33 A0

**Figure 19:**  
Read Settlement Day Data

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X43	HEX	Control code
	12	0X05	HEX	Data length
	13	0X33	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte

	Byte	Code	Numerical System	Description
	16	YY	HEX	Year of history settlement day
	17	MM	HEX	Month of history settlement day
	18	CS	HEX	Check sum
	19	0X16	HEX	End character
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xB3	HEX	Control code
	10	0x08	HEX	Data length
	11	0x33	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14 to 17	D0 to D3	BCD	Settlement day history data, BCD code, multiplied by 100
	18	0x05	HEX	Data identification
	19	CS	HEX	Checksum
	20	0x16	HEX	End character

Example: Reading history data on settlement day 12.66

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 43 05 33 A0 1B 12 05 BF 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 B3 08 33 A0 1B 66 12 00 00 05 98 16

### 4.3.12 Read Flow Coefficients

Request control code: 0x 48

Response control code: 0x B8

Data identification: 0x 38 A0

**Figure 20:**  
Read Settlement Day Data

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type



	Byte	Code	Numerical System	Description
	4 to 10	A0 to A6	BCD	UWM address
	11	0X48	HEX	Control code
	12	0X03	HEX	Data length
	13	0X38	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	18	CS	HEX	Check sum
	19	0X16	HEX	End character
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xB8	HEX	Control code
	10	0x1B	HEX	Data length
	11	0x38	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14 to 17	D1 to D4	HEX	Small flow coefficient 1 * 65536
	18 to 21	D5 to D8	HEX	Medium flow coefficient 1 * 65536
	22 to 25	D9 to D12	HEX	Medium flow coefficient 2 * 65536
	26 to 29	D13 to D16	HEX	Medium flow coefficient 3 * 65536
	30 to 33	D17 to D20	HEX	Medium flow coefficient 4 * 65536
	34 to 37	D21 to D24	HEX	Large flow coefficient * 65536
	19	CS	HEX	Checksum
	20	0x16	HEX	End character

Example: Reading flow coefficients: small 1.2, medium 1 1.2), medium 2 1.2, medium 3 (1.2), medium 4 (1.2), large (1.2).

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 48 03 38 A0 24 B9 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 B8 1B 38 A0 24 33 33 01 00 33 33 01 00 33 33 01 00 33 33 01 00 33 33 01 00 33 33 01 00 AB 16

### 4.3.13 Enter Verification State

Request control code: 0x 49

Response control code: 0x B9

Data identification: 0x 39 A0

**Figure 21:**  
**Enter Verification State**

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X49	HEX	Control code
	12	0X04	HEX	Data length
	13	0X39	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	16	SER2	HEX	Serial number high byte
	17	CS	HEX	Check sum
	18	0X16	HEX	End character
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xB9	HEX	Control code
	10	0x05	HEX	Data length
	11	0x39	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14	SER2	HEX	Serial number high byte
	15	ST	HEX	Vendor reserved byte
	16	CS	HEX	Checksum
	17	0x16	HEX	End character

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 49 04 39 A0 28 03 CS 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 B9 05 39 A0 28 03 00 CS 16

#### 4.3.14 Read Temperature

Request control code: 0x 4A

Response control code: 0x BA

Data identification: 0x 3A A0

**Figure 22:**  
**Read Temperature Coefficients**

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X4A	HEX	Control code
	12	0X03	HEX	Data length
	13	0X3A	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	17	CS	HEX	Check sum
18	0X16	HEX	End character	
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xBA	HEX	Control code
	10	0x0B	HEX	Data length
	11	0x3A	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14	T1 to T4	HEX	Inlet temperature coefficient, multiplied by 65536
	15	T5 to T8	HEX	Outlet temperature coefficient, multiplied by 65536
	16	CS	HEX	Checksum
17	0x16	HEX	End character	

Example: Reading inlet temperature coefficient is 1.12, outlet temperature coefficient is 1.00

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 4A 03 3A A0 03 9C 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 BA 0B 3A A0 03 33 33 01 00 00 00 01 00 7C 16

### 4.3.15 Read Verification Data

Request control code: 0x 4C

Response control code: 0x BC

Data identification: 0x 3C A0

**Figure 23:**  
**Read Verification Data**

	Byte	Code	Numerical System	Description	
Request frame	0	0XFE	HEX	Supplementary bytes	
	1	0XFE	HEX	Supplementary bytes	
	2	0X68	HEX	Start bytes	
	3	0X10	HEX	UWM type	
	4 to 10	A0 to A6	BCD	UWM address	
	11	0X4C	HEX	Control code	
	12	0X03	HEX	Data length	
	13	0X3C	HEX	Data identification D0	
	14	0XA0	HEX	Data identification D1	
	15	SER1	HEX	Serial number low byte	
	17	CS	HEX	Check sum	
18	0X16	HEX	End character		
Response frame	0	0X68	HEX	Start byte	
	1	0X10	HEX	UWM type	
	2 to 8	A0 to A6	BCD	UWM address	
	9	0xBC	HEX	Control code	
	10	0x28	HEX	Data length	
	11	0x3C	HEX	Data identification D0	
	12	0xA0	HEX	Data identification D1	
	13	SER1	HEX	Serial number low byte	
	14 to 15	T0 to T2	BCD	Temperature * 100, signed integer	
	16 to 19	D0 to D3	BCD	Accumulated volume * 100000 [m³]	
	20	0x2C	HEX	Data identification	
	21 to 24	D4 to D7	BCD	Instantaneous flow * 100000 [m³/h]	
	25	0x35	HEX	Data identification	
	26 to 29	H0 to H3	HEX	Time-of-flight in up direction (TOF_UP) *65536 in [ns]	
	30 to 33	H4 to H7	HEX	Default 0	
	34 to 37	H8 to H11	HEX	Time-of-flight difference (TOF_UP) *65536 in [ps], signed integer	
	38 to 40	H12 to H14	BCD	Cumulative working time in hours	
	41	YY1	BCD	Year, high byte	Current time
	42	YY2	BCD	Year, low byte	
	43	MM	BCD	Month	
44	DD	BCD	Day		
45	HH	BCD	Hour		

	Byte	Code	Numerical System	Description
	46	MM	BCD	Minute
	47	SS	BCD	Second
	48	STA1	HEX	UWM status byte
	49	STA1	HEX	UWM status byte
	50	CS	HEX	Checksum
	51	0x16	HEX	End character

Example: Reading parameters temperature 0 [°C], accumulative volume 0 [m³], instantaneous flow 0 [m³/h], , TOF\_UP 0 [ns], default, DIFTOF 0 [ps], Cumulative working time 21[h],

Real time : 2018.05.22 16:29:38

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 4C 03 3C A0 08 A5 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 BC 28 3C A0 08 00 00 00 00 00 00 00 2C 00 00 00 00 35 00 00 00 00 00 00 00 00 00 00 00 00 00 00 21 00 00 20 18 05 22 16 29 38 00 00 92 16

### 4.3.16 Read Instantaneous Flow and Temperature

Request control code: 0x 4F

Response control code: 0x BF

Data identification: 0x 3F A0

**Figure 24:**  
Read Instantaneous Flow & Temperature

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X4F	HEX	Control code
	12	0X03	HEX	Data length
	13	0X3F	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	17	CS	HEX	Check sum

	Byte	Code	Numerical System	Description	
	18	0X16	HEX	End character	
Response frame	0	0X68	HEX	Start byte	
	1	0X10	HEX	UWM type	
	2 to 8	A0 to A6	BCD	UWM address	
	9	0xBF	HEX	Control code	
	10	0x1E	HEX	Data length	
	11	0x3F	HEX	Data identification D0	
	12	0xA0	HEX	Data identification D1	
	13	SER1	HEX	Serial number low byte	
	14 to 17	D0 to D3	BCD	Current accumulated volume *100 [m³]	
	18	0x2C	HEX	Data identification	
	19 to 22	D4 to D7	BCD	Accumulated flow * 100 [m³] at settlement day	
	23	0x2C	HEX	Data identification	
	24 to 27	F0 to F3	BCD	Instantaneous flow * 100 [m³/h]	
	28	0x2C	HEX	Data identification	
	29 to 31	T0 to T2	BCD	Temperatures + 100 [°C], signed integer	
	32	DD	BCD	Day	Current time
	33	HH	BCD	Hour	
	34	MM	BCD	Minute	
	35	SS	BCD	Second	
	36 to 37	STA3 to STA4	HEX	UWM status byte	
38 to 40	STA0 to STA2	HEX	UWM status byte		
41	CS	HEX	Checksum		
42	0x16	HEX	End character		

Example: Reading current accumulated volume: 12.66, accumulative volume at settlement day: 12.66, instantaneous flow 0.001, temperature: +0°C, time: day 22, 16:34:13

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 4F 03 3F A0 09 AC 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 BF 1E 3F A0 09 66 12 00 00 2C 66 12 00 00 2C 00 01 00 00 35 00 00 00 22 16 34 13 00 00 00 00 00 34 16

### 4.3.17 Start & Stop Test

This is applicable only to verification state.

Request control code: 0x 51

Response control code: 0x C1

Data identification: 0x 3F A0

**Figure 25:**  
**Start Stop Test**

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X51	HEX	Control code
	12	0X05	HEX	Data length
	13	0X3F	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	16	SER2	HEX	Serial number high byte
	17	CMD	HEX	Command: 0x01: start 0x00: stop
	18	CS	HEX	Check sum
	19	0X16	HEX	End character
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xC1	HEX	Control code
	10	0x05	HEX	Data length
	11	0x3F	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14	SER2	HEX	Serial number high byte
	15	CMD	HEX	Command: 0x01: start 0x00: stop
	16	CS	HEX	Checksum
	17	0x16	HEX	End character

Example: Start off test (start testing is allowed only under verification)

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 51 05 3F A0 35 02 01 CS 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 C1 06 3F A0 35 02 01 00 CS 16

### 4.3.18 Exit Verification State

Request control code: 0x 57

Response control code: 0x C7

Data identification: 0x 45 A0

**Figure 26:**  
Exit Verification State

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X57	HEX	Control code
	12	0X03	HEX	Data length
	13	0X45	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	16	CS	HEX	Check sum
	17	0X16	HEX	End character
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xC7	HEX	Control code
	10	0x03	HEX	Data length
	11	0x3F	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	16	CS	HEX	Checksum
	17	0x16	HEX	End character



1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 57 03 45 A0 3B EC 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 C7 03 45 A0 3B 5C 16

### 4.3.19 Check Verification State

Checks whether verification state is active.

Request control code: 0x 58

Response control code: 0x C8

Data identification: 0x 46 A0

**Figure 27:**  
**Check Verification State**

	Byte	Code	Numerical System	Description
Request frame	0	0XFE	HEX	Supplementary bytes
	1	0XFE	HEX	Supplementary bytes
	2	0X68	HEX	Start bytes
	3	0X10	HEX	UWM type
	4 to 10	A0 to A6	BCD	UWM address
	11	0X58	HEX	Control code
	12	0X03	HEX	Data length
	13	0X46	HEX	Data identification D0
	14	0XA0	HEX	Data identification D1
	15	SER1	HEX	Serial number low byte
	16	CS	HEX	Check sum
17	0X16	HEX	End character	
Response frame	0	0X68	HEX	Start byte
	1	0X10	HEX	UWM type
	2 to 8	A0 to A6	BCD	UWM address
	9	0xC8	HEX	Control code
	10	0x04	HEX	Data length
	11	0x46	HEX	Data identification D0
	12	0xA0	HEX	Data identification D1
	13	SER1	HEX	Serial number low byte
	14	STATE	HEX	Status: 0x01: verification 0x10: non-verification
	15	CS	HEX	Checksum
	16	0x16	HEX	End character

Example: Read status bit to check whether verification state is active

1. Send out frame: 0x FE FE 68 10 02 12 03 18 20 33 78 58 03 46 A0 14 C7 16
2. Response frame: 0x 68 10 02 12 03 18 20 33 78 C8 04 46 A0 14 01 3A 16

## 5 Revision Information

Changes from previous version to current revision v1-01	Page
Initial version	All

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

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