ALSONIC

Modbus Specifications v1.30

Contents

1 Physical Layer

Physical layer of the transmission is RS-485 with 5V levels.

On special requests / developments UART, LIN or RS-232 can be implemented

2 Data Layer

2.1 Transmission Mode

The transmission mode is RTU (Remote Terminal Unit). The transmission of data is in binary format (hexadecimal) with 8 bits.

The LSB (least significant bit) is the first to be transmitted.

2.2 Data Blocks

All data blocks have the same structure.

Slave Address	Function Code	Data Field	Checksum CRC16
1 Byte	1 Byte	x Bytes	2 Bytes

Each data block contains 4 fields:

- Slave Address - Device address of a specific slave
- Function code - Function selection (read, write words)
- Data field - Contains the information:
    - Word address (2 bytes)
    - Number of words (2 bytes)
    - Word value
- Checksum

2.3 Checksum (CRC16)

The checksum (CRC16) transmission errors are detected. If an error is identified during evaluation, the corresponding device does not respond.

Checksum parameters:

- Type: CRC-16 (Modbus)
- Initial value: FFFF (hex)
- Polynomial: x16 + x15 + x2 + 1 = 8005 (hex)
- XOR Out: 0
- Reflection In: ON
- Reflection Out: ON

2.4 Examples

Data Request: Reading 2 words from address 1 (CRC16 = 0x0B20)

01	04	00	01	00	02	20	0B
Dev ID	Read Command	Register Address		Number of words		CRC16	

Answer: (CRC16 = 0xF789)

01	04	04	09	9B	00	00	89	F7
Dev ID	Read Command	Number of Data Bytes	Word 1		Word 2		CRC16	

2.5 Implemented Modbus Functions

04	Read n words
06	Write single register
16	Write n words

2.6 BAUD Rate

BAUD rates between 9600 and 1000000 are supported. BAUD rate can be limited by the selected MCU for a specific configuration or power consumption requirements.

Default BAUD rate is 115200.

Baud rate can be changed by writing the new BAUD rate to address 321-322 in UInt32 format. See section 3.2.

2.7 Device Address

Default device address is 0x01. Supported addresses are between 1 and 247.

Device address can be changed by writing the new address to address 320. See section 3.2.

2.8 Parity

Parity is EVEN.

Parity can be changed by writing the new address to address 324. See section 3.2.

2.9 Stop bit

Stop bit is 1.

Stop bit can be changed by writing the new address to address 325. See section 3.2.

2.10 Recovery Mode

If the device id, baudrate, parity and stopbits have been changed from default and is no longer possible to communicate with the device it is possible to recover / change the configuration by entering in recovery mode.

Default settings:

- Device id: 1
- Baudrate: 115200
- Parity: Even
- Stopbits: 1

Recovery mode access:

If an valid modbus command with default configuration (id, baud, parity, stopbit) is sent to the sensor during power-up the sensor will maintain the default configuration until the next restart.

3 Register map

This section describes the register access type and addresses.

3.1 Periodically updated values

Values that are updated after every measurement can be read using 04 function. These registers are read-only.

Register details are presented in the table below:

Address	Register name	Range	Resolution	Unit	Comments
0	Flow	Int32	0.1	l/h	
2	Temp Internal	Int16	0.01	°C	
3	Temp Remote	Int16	0.01	°C	(Optional)
4	Temp Difference	Int16	0.01	°C	(Optional)
5	Pressure	Int16	0.001	Bar	(Optional)
6	Power	Int32	0.01	kW	(Optional)
8	*Reserved*	UInt16			
9	Warning	UInt16		n/a	Not yet implemented

Address	Register name	Range	Resolution	Unit	Comments
10	Air Bubble signal	UInt16			0 – No air 1 – Air detected
11	Bubble detection level	UInt16			0 – No air 1 – Small amount of air 2 – Medium amount of air 3 – High amount of air 4 – Severe / completely air
12	Glycol concentration	Int16	0.01	%	Activation via address 327 necessary
13	*Reserved*	Int16			
14	Freezing Point	Int16	0.01	°C	Activation via address 327 necessary
15	Bubble amount	Int16	0.01	%	Percentage quantification of the bubble detection level
16	*Reserved*	Int16			
17	Temperature SoS	Int16	0.01	°C	Fast temperature reaction out of speed of sound. Works only with water up to 60°C. To be used only for monitoring fast temperature changes, not recommended for absolute accuracy.
277	Firmware version	Int32			Read only
500	Totalizer 1 Sum water volume	Int32	1	l	
502	Totalizer 2 Power on time	Int32	1	s	
504	Totalizer 3 Power on time with flow	Int32	1	s	Power on time with flow ≠ 0
506	Energy sum (Heating)	Int32	0.01	kWh	Adds-up while thermal energy register (Addr 6) is positive

508	Energy sum (Cooling)	Int32	0.01	kWh	Adds-up while thermal energy register (Addr 6) is negative
1000	Flow (alternative meas. units)	Float	1	SI US	Activation via address 329 necessary
1002	Temp Internal (alternative meas. units)	Float	1	SI US	Activation via address 330 necessary
1004	Temp Remote (alternative meas. units)	Float	1	SI US	Activation via address 330 necessary
1006	Temp Difference (alternative meas. units)	Float	1	SI US	Activation via address 330 necessary
1008	Pressure (alternative meas. units)	Float	1	SI US	Activation via address 331 necessary

3.2 Configuration Parameters with Read/Write access

The following values can be written to memory. Values are updated after the memory write command is executed.

Register details are presented in the table below:

Address	Register name	Range	Resolution	Unit	Comments
320	Device ID	Int8	1		1 to 247 Default: 1
321	BAUD Rate	UInt32	1	bps	9600 to 115200 Default: 115200
323	*Reserved*	Int8			
324	Parity	Int8			0 – None 1 – Even 2 – Odd Default: Even
325	Stop bit	Int8			0 – stopbit 1 1 – stopbit 2 Default: stopbit 1
326	*Reserved*	Int8			
327	Glycol detection configuration	Int8			0 – Deactivated 1 – Activated for Ethylene Glycol 2 – Activated for Propylene Glycol
328	Energy measurement configuration	Int8			0 – No Energy measurement 1 – Energy meas. $T_{Remote} > T_{Local}$ 2 – Energy meas. $T_{Local} > T_{Remote}$ 3 – Energy meas. $Abs(T_{Remote} - T_{Local})$ 4 – Energy meas. $T_{Remote} > T_{Local}$ (Heating + Cooling) 5 – Energy meas. $T_{Local} > T_{Remote}$ (Heating + Cooling) Default: 0 / 1 (with / without external temperature probe)

329	Flow Measurement Unit	Int8			0 – l/h 1 – l/min 2 – l/s 3 – ml/s 4 – m^3/h 5 – gal/h 6 – gal/min
330	Temperature Measurement Unit	Int8			0 – °C 1 – °F
331	Pressure Measurement Unit	Int8			0 – mBar 1 – Bar 2 – PSI
338	Third party calibration	Int8			Available for SW version≥ 0.54.08 0 – disabled 1 – enabled

3.3 Third Party Calibration Table Registers with Read/Write access

- ⚠ Implemented for SW versions ≥ 0.54.08
- ⚠ In order to perform the 3rd party calibration by accessing Modbus registers directly the feature has to be activated by setting register 338 value to 1.

The values in the following registers can be written when a 3rd part calibration based on fluid's kinematic properties over a defined temperature range is desired. The feature is implemented as a look-up table.

Register details are presented in the table below:

3.3.1 Kinematic viscosity table (*Activation via address 338/ User Configuration Parameters necessary*)

Address	Register name	Range	Resolution	Unit	Comments
1540 - 1559	Temperature LUT	Int16	0.01	°C	Default value: -1
1560 - 1579	Viscosity LUT	Int16	0.01	cSt	Default value: 0

The known temperature and viscosity values have to be written one after another in ascending order.

The unused registers should be left with default values.

The correlation between viscosity and temperature registers can be virtually represented as bellow:

Row No.	Temperature register address	Viscosity register address
1	1540	1640
2	1541	1641
…	…	…
60	1559	1579

3.3.2 Flow table (*Activation via address 338/ User Configuration Parameters necessary*)					
Address	Register name	Range	Resolution	Unit	Comments
1660-1669	Temp range (Temp1,Temp2...Temp n)	Int16	0.01	°C	default value = -1
1670-1679	Flow range (Flow1,Flow2...Flow n)	Int16	1	L/h	default value = -1
1680-1779	Flow table Amplification	Int16	0.0001		

3.3.2.1 Flow table register map										
Reg. no.	1660	1661	1662	1663	1664	1665	1666	1667	1668	1669
1670	1680	1681	1682	1683	1684	1685	1686	1687	1688	1689
1671	1690	1691	1692	1693	1694	1695	1696	1697	1698	1699
1672	1700	1701	1702	1703	1704	1705	1706	1707	1708	1709
1673	1710	1711	1712	1713	1714	1715	1716	1717	1718	1719
1674	1720	1721	1722	1723	1724	1725	1726	1727	1728	1729
1675	1730	1731	1732	1733	1734	1735	1736	1737	1738	1739
1676	1740	1741	1742	1743	1744	1745	1746	1747	1748	1749
1677	1750	1751	1752	1753	1754	1755	1756	1757	1758	1759
1678	1760	1761	1762	1763	1764	1765	1766	1767	1768	1769
1679	1770	1771	1772	1773	1774	1775	1776	1777	1778	1779

The known temperature and flow values have to be written one after another in ascending order.

The unused **Temp range** and **Flow range** registers should be set to **-1 (0xFFFF)**.

The values **to be written** into the registers are converted as follows:

Temperature	**Value** = Temp [°C] / Resolution = T[°C] / 0.01
Viscosity	**Value** = Visc [cSt] / Resolution = Visc [cSt] / 0.01
Flow	**Value** = Flow [L/h] / Resolution = Flow [L/h] / 1
Flow amplification*	**Value** = Scaling factor / Resolution = Scaling factor / 0.0001

When **reading** the register values, these can be interpreted using the formulas:

Temperature	Temp [°C] = **Value** × Resolution = Value × 0.01
Viscosity	Visc [cSt] = **Value** × Resolution = Value × 0.01
Flow	Flow [L/h] = **Value** × Resolution = Value × 1
Flow amplification*	Scaling factor = **Value** × Resolution = Value × 0.0001

*How to calculate **Scaling factor** for calibration over Modbus:

$$Diff = (F_{meas} - F_{ref})/F_{ref} \qquad (3.1)$$

$$Diff[\%] = Diff \times 100 \qquad (3.2)$$

Where,
$Diff$ – difference against reference
$Diff[\%]$ – difference against reference in %
F_{meas} – flow measured by ALSONIC
F_{ref} – flow measured by reference device

- Out of the difference value, identify the scaling factor (3.3) which has to be applied.

$$Scaling\ factor = \frac{1}{1+Diff} - 1 \qquad (3.3)$$

4 Changelog

Date	Version	Description
2023-04-19	V1.22	• Function code 6 (write single register) implemented • After change of the modbus ID the acknowledgement reply is made with the old ID instead of the new one • Added register for firmware version tracking • Implemented change of parity and stopbits and energy meas. Configuration • Implemented recovery mode
2024-02-07	V1.23	• Glycol detection added • Transferred to new layout
2024-05-17	V1.24	• Implemented Imperial units
2024-05-28	V1.25	• Glycol detection for propylene glycol (valid only for newer software values)
2024-09-30	V1.26	• Added fast temperature reaction register (Temperature out of speed of sound) • Added separate register cooling energy sum (when Addr 6 has negative values)
2024-11-04	V1.27	• Wording change for chapter 1
2024 -11-28	V1.28	• Added configuration parmeter for registers 1000-1008 (alternative measurement units - SI/US)
2025-03-13	V1.29	• Added Bubble Amount register for quantification of air bubbles percentage wise
2025-11-05	V1.30	• Added 3rd Party calibration registers

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Allengra's core technology, ultrasonic metering, has been refined over the years to a level where both high-end device integration and cost-effective applications are achievable. Allengra provides metering and regulating solutions for various industries, including gas heating boilers, automatic coffee machines, robotic scrubbers, and industrial automation, among others.

Über Uns

Die 2005 gegründete Allengra GmbH mit Sitz in Deutschland und Rumänien entwickelt und produziert sowohl Standard- als auch maßgeschneiderte Ultraschall-Durchflusssensoren und Regelventile für Flüssigkeiten und Gase. Allengra vereint alle notwendigen Engineering und Prototyping Fähigkeiten, um die Produkte interdisziplinär und ganzheitlich zu entwickeln. So können auch neue und innovative Ideen schnell und flexibel in robuste Serienprodukte überführt werden.

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