JUMO digiLine pH/ORP/T

digital transmitters for
JUMO pH, ORP, and temperature sensors
Type 202705



Modbus interface
description

20270500T92Z001K000

JUMO

V1.00/EN/00621036

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1.1 Warning symbols



DANGER!

This symbol indicates that **personal injury caused by electrical shock** may occur if the respective precautionary measures are not carried out.



WARNING!

This symbol in connection with the signal word indicates that **personal injury** may occur if the respective precautionary measures are not carried out.



CAUTION!

This symbol in connection with the signal word indicates that **damage to assets or data loss** will occur if the respective precautionary measures are not taken.



CAUTION!

This symbol indicates that **components could be destroyed** by electrostatic discharge (ESD = Electro Static Discharge) if the respective cautionary measures are not taken.

Only use the ESD packages intended for this purpose to return device inserts, assembly groups, or assembly components.



READ THE DOCUMENTATION!

This symbol, which is attached to the device, indicates that the associated **documentation for the device** must be **observed**. This is necessary to identify the nature of the potential hazard, and to take measures to prevent it.

1.2 Note signs



NOTE!

This symbol refers to **important information** about the product, its handling, or additional use.



REFERENCE!

This symbol refers to **further information** in other sections, chapters, or manuals.



FURTHER INFORMATION!

This symbol is used in tables and indicates that **further information** is provided after the table.



DISPOSAL!

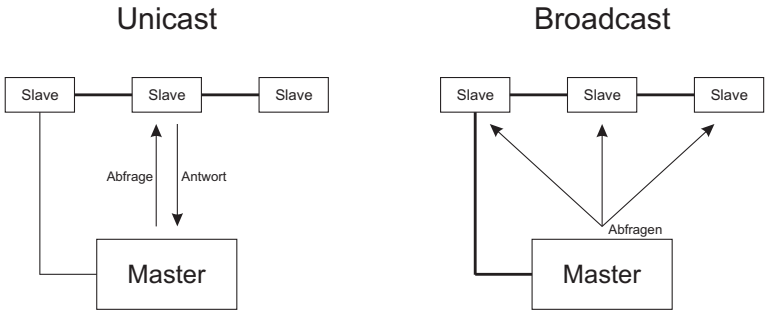
At the end of its service life, the device and any batteries present do not belong in the trash! Please ensure that they are **disposed of** properly and in an **environmentally friendly** manner.

1 Safety information

2.1 Master-slave principle

Communication between a master (e. g. SCADA system or PLC) and a JUMO digiLine pH/ORP/T as slave in in a Modbus takes place according to the master-slave principle in the form of data request/instruction - response. Slaves are identified by the device address. Master devices do not need an address.

⇨ chapter 5 „Modbus over a serial interface“, page 23



The master controls data exchange by cyclically querying the slaves on the overall bus. The slaves (e. g. JUMO digiLine pH/ORP/T) merely respond. The master has write and read access to the slaves. This enables data to be communicated between master and slave devices in real-time. Slaves cannot communicate with one another directly. In order to transmit data from slave to slave, the master must extract data from one slave and transfer it to the next.

As a rule, the master directs its queries to individual slaves. For this, it must communicate with the individual slaves by means of their Unicast address. Queries can be directed to all slaves on the bus also in the form of a broadcast message. In this case, the broadcast address is used as the slave address. Slaves do not respond to broadcast queries. Data collisions would otherwise result in serial bus systems. For this reason, use of broadcast addresses only makes sense with function codes for writing data. Broadcasts cannot be used with function codes for reading data.

NOTE!

The JUMO digiLine pH/ORP/T can be operated only as a slave.

2 Modbus protocol description

2.2 Transmission media for Modbus

Serial interface

For data communication via a **serial interface**, the Modbus specification provides the transmission modes **RTU mode** (**R**emote **T**erminal **U**nit) and ASCII mode (transmission of data in ASCII format). The JUMO digiLine pH/ORP/T supports only the **RTU mode**. Here, the data are transmitted over the serial bus in binary format (RS422/485).

⇨ chapter 5 „Modbus over a serial interface“, page 23

2.3 Structure of a Modbus telegram

Modbus telegrams have the following structure:

Slave address	Function code	Data field	Checksum CRC
1 byte	1 byte	x bytes	2 bytes

Every telegram has four fields:

Slave address	Device address of a specific slave
Function code	Function selection (read/write words)
Data field	Contains the information (depending on the function code) - word address/bit address - number of words/number of bits - word value(s)/bit value(s)
Checksum	Detection of transmission errors

2.4 Function codes

Function overview

The functions described in the following (from the Modbus Standard) are available for extracting measured values, device and process data, and for writing data.

Function code		**Function**	**Limit**
Hex	**Dec.**		
03 or 04	3 or 4	Reading n words	Max. 127 words (250 bytes)
06	6	Writing one word	Max. 1 word (2 bytes)
10	16	Writing in words	Max. 127 words (246 bytes)

2.4.1 Reading n words

This function is used to read n words, starting from a specific address.

Data query

Slave address	Function 0x03 or 0x04	Address First word	Number of words	Checksum CRC
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Response

Slave address	Function 0x03 or 0x04	Number of bytes read	Word value(s)	Checksum CRC
1 byte	1 byte	1 byte	x bytes	2 bytes

Example

Reading the device name. In the example here, the device name is "dl pH/ORP". Since the device name is up to 10 characters long (including ZERO characters as end identifier) and 2 ASCII characters of the device name are saved per word, it is necessary here to read 5 words, i.e. 10 bytes. For these and other Modbus addresses, see chapter 7 „Modbus address tables“, page 29.

Hex code for the data query:

01	03	00 00	00 05	85 C9
Slave	Function	Address 1st word	Number of words	CRC

Hex code for the response (values in byte format):

01	03	0A	64 6C 20 70 48 2F 4F 52 50 00	B9 4B
Slave	Function	Bytes read	Text in ASCII	CRC

2.4.2 Writing one word

The data blocks for the instruction and response are identical when writing a word.

CAUTION!

Write operations involving many R/W parameters are associated with saving in an EEPROM or flash memory. These memory modules have only a limited number of write cycles (approx. 100,000 or 10,000).

Thus, frequent writing of certain variables can result in a memory error.

▶ Fast writing cycles should thus be avoided.

Instruction

Slave address	Function 0x06	Word address	Word value	Checksum CRC
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Response

Slave address	Function 0x06	Word address	Word value	Checksum CRC
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Example

In this example, a command for the value "Time for CIP recognition" of the device name is to be written. In this case, the slave address of the device is 1, the word address is 0x22C2 (chapter 7.11 „Configuration of sensor monitoring“, page 34) and the word to write should be "2700" (2700 s corresponds to 45 min).

Hex code for the instruction:

01	06	22 C2	0A 8C	25 4B
Slave	Function	Word address	Value	CRC

Hex code for the response:

01	06	22 C2	0A 8C	25 4B

Slave	Function	Word address	Value	CRC

2.4.3 Writing n words

Instruction

Slave address	Function 0x10	Address of first word	Number of words	Number of bytes	Word value(s)	Checksum CRC
1 byte	1 byte	2 bytes	2 bytes	1 byte	x bytes	2 bytes

Response

Slave address	Function 0x10	Address of first word	Number of words	Checksum CRC
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Example

Writing the word "North plant" (UTF-8 encoding with end identifier: 0x41 0x6E 0x6C 0x61 0x67 0x65 0x20 0x4E 0x6F 0x72 0x64 0x00) after word address 0x021E as description of the measuring point.

⇨ chapter 7.4 „Measuring point info“, page 30

Hex code for the instruction:

01	10	02 1E	00 06	0C	41 6E 6C 61 67 65 20 4E 6F 72 64 00	F8 70
Slave	Function	Address 1st word	Number of words	Number of bytes	Text in UTF-8 encoding	CRC

Hex code for the response:

01	10	02 1E	00 06	21 B5
Slave	Function	Address 1st word	Number of words	CRC

2.5 Data types

Data type	Description	Access	Possible function codes	Number Modbus register
Byte	Low byte of a word as an integer value; the high byte is not used. Value ranges: 0 to 255 for unsigned data -128 to 127 for signed data	read only	03, 04	1
		read/write	03, 04, 06, 16	
Word	Word (16 bit) as integer value Value ranges: 0 to 65535 for unsigned data -32768 to 32767 for signed data	read only	03, 04	1
		read/write	03, 04, 06, 16	

<table>
<tr><th>Data type</th><th>Description</th><th>Access</th><th>Possible function codes</th><th>Number Modbus register</th></tr>
<tr><td rowspan="2">Float</td><td rowspan="2">2 words as 32-bit floating-point number with coding to IEEE 754, where it must be kept in mind that bytes 1 and 2 are interchanged with bytes 3 and 4 during transmission. In the configuration of the RS485 interface, the desired encoding can be selected under the "Floating-point format" setting.

S = Sign bit
E = Exponent (two's complement)
M = 23-bit normalized mantissa

IEEE 754 standard coding
<table><tr><th>Byte 1</th><th>Byte 2</th><th>Byte 3</th><th>Byte 4</th></tr><tr><td>SE₇EEEEEE₁</td><td>E₀M₂₃MMMMMM₁₆</td><td>M₁₅MMMMMMM₈</td><td>M₇MMMMMMM₀</td></tr></table>
IEEE 754 Little Endian
<table><tr><th>Byte 1</th><th>Byte 2</th><th>Byte 3</th><th>Byte 4</th></tr><tr><td>E₀M₂₃MMMMMM₁₆</td><td>SE₇EEEEEE₁</td><td>M₇MMMMMMM₀</td><td>M₁₅MMMMMMM₈</td></tr></table>
IEEE 754 Big Endian
<table><tr><th>Byte 1</th><th>Byte 2</th><th>Byte 3</th><th>Byte 4</th></tr><tr><td>M₁₅MMMMMMM₈</td><td>M₇MMMMMMM₀</td><td>SE₇EEEEEE₁</td><td>E₀M₂₃MMMMMM₁₆</td></tr></table>
Modbus coding of floating-point variables of digiLine transmitters using the example of IEEE 754 standard coding
<table><tr><th colspan="2">Address of the 1st Modbus register for variables</th><th colspan="2">Address of the 2nd Modbus register for variables</th></tr><tr><th>Byte 3</th><th>Byte 4</th><th>Byte 1</th><th>Byte 2</th></tr><tr><td>M₁₅MMMMMMM₈</td><td>M₇MMMMMMM₀</td><td>SE₇EEEEEE₁</td><td>E₀M₂₃MMMMMM₁₆</td></tr></table>
When creating customer-specific applications, the correct byte sequence in storage format needs to be checked. Many compilers use the following storage format:
Compiler coding
<table><tr><th>Byte 4</th><th>Byte 3</th><th>Byte 2</th><th>Byte 1</th></tr><tr><td>MMMMMMMM</td><td>MMMMMMMM</td><td>EMMMMMMM</td><td>SEEEEEEE</td></tr><tr><td>Address x</td><td>Address x+1</td><td>Address x+2</td><td>Address x+3</td></tr></table></td><td>read only</td><td>03, 04</td><td rowspan="2">2</td></tr>
<tr><td>read/write</td><td>03, 04, 16</td></tr>
<tr><td rowspan="2">Uint32</td><td rowspan="2">Double word (32-bit) as unsigned integer value

Value range: 0 to 4.294.967.295</td><td>read only</td><td>03, 04</td><td rowspan="2">2</td></tr>
<tr><td>read/write</td><td>03, 04, 16</td></tr>
</table>

Data type	Description	Access	Possible function codes	Number Modbus register
char[n]	Character string for up to n Unicode characters in UTF-8 encoding with up to 3 bytes per character	read only	03, 04	n
	The character string thus consists of up to 2n bytes. Each of the n Modbus register words contains 2 successive bytes of the character string. Note that the character string must always have "\0" (ASCII code 0x00) as the terminating code.	read/write	03, 04, 06, 16	
Bool	Least significant bit in a word as bit value 0000 0000 0000 000**1** = 1 or TRUE 0000 0000 0000 000**0** = 0 or FALSE	read only	03, 04	1
		read/write	03, 04, 06, 16	

2.6 Examples of data transmission

The function 0x03 or 0x04 (writing of a word) is used to extract integers, floating-point values and text values.

Data query

Slave address	Function 0x03 or 0x04	Address First word	Number of words	Checksum CRC
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Integer values are transmitted via the Modbus in the following format:
The high byte first, followed by the low byte.

Response

Slave address	Function 0x03 or 0x04	Number bytes read	Word value(s)	Checksum CRC
1 byte	1 byte	1 byte	x bytes	2 bytes

2.6.1 Integer values

Example

In this example, the time for CIP recognition should be read at address 0x22C2 (chapter 7.11 „Configuration of sensor monitoring“, page 34). The value here should be "2400" (word value 0x0960).

Data query:

01	03	22 C2	00 01	2F 8E
Slave	Function	Address 1st word	Number of words	CRC

Response (values in Modbus floating-point format):

01	03	02	09 60	BE 3C
Slave	Function	Bytes read	Integer value	CRC

2.6.2 Float values

The JUMO digiLine pH/ORP/T operates using the IEEE 754 standard format for floating-point values (32-bit), but with the difference that bytes 1 and 2 are interchanged with bytes 3 and 4.

Single float format (32-bit) acc. to Standard IEEE 754

SEEEEEEE	EMMMMMMM	MMMMMMMM	MMMMMMMM
Byte 1	Byte 2	Byte 3	Byte 4

S - Sign bit
E - Exponent (two's complement)
M - 23-bit normalized mantissa

Modbus floating-point format

Modbus address x		Modbus address x+1	
MMMMMMMM	MMMMMMMM	SEEEEEEE	EMMMMMMM
Byte 3	Byte 4	Byte 1	Byte 2

Example

In this example, the value "Temperature value CIP recognition" should be read at address 0x22C0 of the device. The value should be 70.25 (0x428C8000 in IEEE-754 format).

Data query:

01	03	22 C0	00 02	CE 4F
Slave	Function	Address 1st word	Number of words	CRC

Response (values in Modbus floating-point format):

01	03	04	80 00	42 8C	E2 F6
Slave	Function	Bytes read	Floating-point value		CRC

After being transmitted from the device, the bytes for the floating-point value must be interchanged accordingly. Many compilers (e.g. Microsoft Visual C++) store the floating-point values in the following sequence:

Floating-point value

Address x	Address x+1	Address x+2	Address x+3
MMMMMMMM	MMMMMMMM	EMMMMMMM	SEEEEEEE
Byte 4	Byte 3	Byte 2	Byte 1

NOTE!

The sequence of the bytes depends on how floating-point values are saved in the application concerned. It may be necessary for the bytes to be interchanged in the interface program accordingly.

2.6.3 Character strings (texts)

Character strings are transmitted in ASCII format.

NOTE!

A "\0" (ASCII code 0x00) must always be transmitted as the terminating code. Characters after this mark are without significance.
Knowing that the transmission of texts takes place word by word (16-bit register), 0x00 is additionally appended where an odd number of bytes is used (incl. "\0").
The maximum length specified in the address table for strings also includes the terminating "\0". This means that, in the case of "Char 60", the text, including "\0", must not be longer than 60 bytes.
In the case of 19 Unicode characters having a length of 3 bytes each, only 2 bytes remain for the 20th character. 1 byte is needed for the terminating code.

Example

Querying the text from address 0x021E, this address holds the character string for the description of the measuring point "North plant" (ASCII code: 0x41 0x6E 0x6C 0x61 0x67 0x65 0x20 0x4E 0x6F 0x72 0x64).

Hex code for the query:

01	03	02 1E	00 07	65 B6
Slave	Function	Address 1st word	Number of words	CRC

Hex code for the response:

01	03	00 0E	41 6E 6C 61 67 65 20 4E 6F 72 64 00 00 AA	C5 DF
Slave	Function	Bytes read	Word values (ASCII characters)	CRC

NOTE!

The values (here: 00 AA) before the CRC sum (here: C5DF) are not taken into consideration, since they are after the end identifier "\0".

2 Modbus protocol description

2.7 Checksum (CRC16)

Calculation principle

Transmission errors are detected with the aid of the checksum (CRC16). If an error is detected during evaluation, the device concerned does not respond.

CRC = 0xFFFF			
	CRC = CRC XOR BytesOfMessage		
	For (1 to 8)		
		CRC = SHR(CRC)	
		if (flag shifted to the right = 1)	
		then CRC = CRC XOR 0xA001	else
while (not all BytesOfMessage processed);			



NOTE!

The low byte of the checksum is transmitted first!
Example: The CRC16 checksum CC DD is transmitted and represented in the sequence DD CC.

Example

Query the binary value of the calibration alarm at address 0x26A0:

Instruction: Read one word from address 0x14E5

01	03	26 A0	00 01	8F 60
Slave	Function	Address	Reading one word	CRC

Response (CRC16 = 0x8479)

01	03	02	00 01	79 84
Slave	Function	Number of bytes	Word 1	CRC

Word 1 = 1 means that the binary value of wash timer 1 = 1.

2.8 Error messages

2.8.1 Modbus error codes

Requirements for Modbus communication

The following conditions must be met for a slave to receive, process, and respond to queries:

- Baud rate and data format of master and slave must match.
- The correct slave address must be used in the query.
- Slave devices respond only after a successful checksum check of the query by the slave. Otherwise, the query is rejected by the slave.
- The instruction from the master must be complete and conform to the Modbus protocol.
- The number of words to be read must be greater than 0.

Error codes

If the data query from the master has been received by the slave without transmission errors but cannot be processed, the slave responds with an error code. The following error codes may occur:

- 01 = invalid function; the function codes supported by the JUMO digiLine pH/ORP/T are listed in Chapter 1.4 "Function codes", p. 25.
- 02 = Invalid address or too many words or bits should be read or written
- 03 = Value is outside the admissible range
- 08 = Value is write-protected

Response to malfunction

Slave address	Function XX OR 80h	Error code	Checksum CRC
1 byte	1 byte	1 byte	2 bytes

The function code is OR-gated with 0x80. As a result, the highest-value bit (msb) is set to 1.

Example

Data query:

01	06	23 45	00 01	52 5B
Slave	Write word	Word address	Word value	CRC

Response (with error code 2):

01	86	02	C3 A1
Slave	OR function	Errors	CRC

Response with error code 02, because the address 0x2345 does not exist.

2.8.2 Error messages for invalid values

For measured values in float format, the error number itself is displayed as a value, i.e. instead of the measured value, the error number is returned.

Error code for float values	Error
1.0×10^{37}	Underrange
2.0×10^{37}	Overrange
3.0×10^{37}	Not a valid input value
4.0×10^{37}	Division by zero
5.0×10^{37}	Mathematical error
6.0×10^{37}	Invalid compensation temperature
7.0×10^{37}	Invalid floating-point value
8.0×10^{37}	Integrator or statistics destroyed

Example

Reading the compensated pH measured value at Modbus address 0x2600:

Data query:

08	03	26 00	00 02	CF DA
Slave	Function	Word address	Number of words	CRC

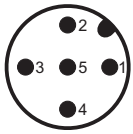
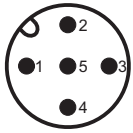
Response:

08	03	04	BD C2	7D 70	C6 17
Slave	Function	Bytes read	Error code		CRC

The measured value provided by the analog input 0x7DB48E52 (=2.0×10^{37}) indicates that an overrange situation exists.

3.1 Interface assignment

Variant with 5-pole M12 plug connector, A-coded

Pin	Potential	Symbol
1	+5 V (supply to Transmitter)	Connector  Socket 
2	not connected	
3	GND	
4	RS485 B (RxD/TxD-)	
5	RS485 A (RxD/TxD+)	
The connection to the serial interface of a master with screw or spring-cage terminals is made with the aid of the JUMO digiLine device connection cable (see Accessories)		

NOTE!

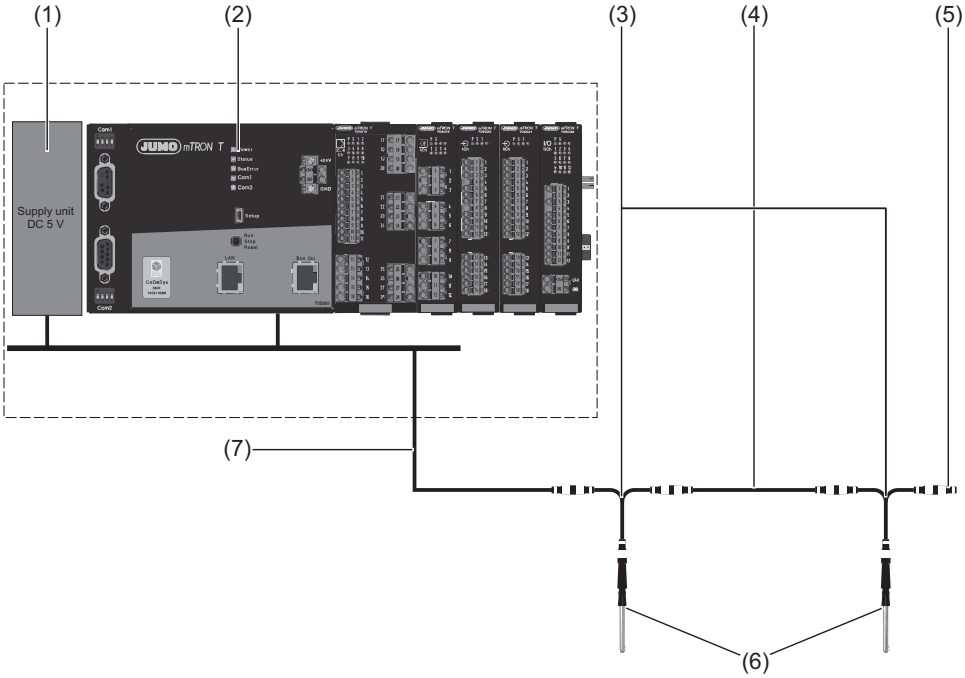
For connection to JUMO digiLine sensors preassembled connecting cables are available. Use these to assure a reliable cable connection and data transmission in the bus system. In the order details provided in the operating manual, you can find a list of cables and connectors available as accessories.

3.1.1 Terminating resistors

A digiLine bus cable needs to be terminated with terminating connectors at the ends distant from the master unit (part no.: 00461591). These are simply connected to the last free M12 coupling at the final Y-splitter (part no.: 00638327) in the bus. At the master unit end of the bus cable, termination of the RS485 bus cable must be made in accordance with the operating manual for the Modbus master.

3 Interfaces

Example of connecting 2 digiLine sensors to one Modbus master



(1) Stabilized power supply unit with DC 5-V output for feeding the JUMO digiLine sensors
(2) Modbus master (e. g. JUMO mTRON T with RS485 interface and Modbus functionality)
(3) T-adaptor, 5-pole with 2× M12 sockets and 1× M12 plug connector, each A-coded
(4) JUMO M12 connecting cableJUMO M12 digiLine master connecting cable 5-pole and A-coded
(5) JUMO M12 terminating connector 5-pole for bus termination
(6) JUMO digiLine sensors with 5-pole Transmittern
(7) JUMO M12 connecting cableJUMO M12 digiLine master connecting cable with open wire ends at one end for connection to devices with screw or spring-cage terminals (see Accessories); for connection to the Modbus system, refer to the wiring diagram in the following.

Important information



CAUTION!

Improper installation or the wrong settings on equipment can result in unexpected operating states of a plant.

This can disrupt processes or result in damage.

▶ For this reason, it is always necessary to provide safety devices that are independent of the device and to allow settings to be made only by technical personnel.



NOTE!

Changes to the configuration settings described in this chapter for the Transmitters can be made on the PC with the JUMO DSM software .

In the operating manual of the JUMO digiLine pH/ORP/T operation, configuration and parameterization procedures are explained in detail.

⇨ B 202705.0

4 Configuring interfaces

Settings for serial interfaces

For all user devices on a bus to be able to communicate with one another, their interface settings must match. The table below shows the setting options for the serial interfaces on the Transmitter.

NOTE!

The digiLine protocol assigns the interface parameters automatically during commissioning(plug & play). For operation on a Modbus master, the interface parameters must be set prior to initial commissioning with the JUMO DSM software .

Configuration item	Selection/settings	Description
Baud rate	9600 19200 38400	Transmission speed (symbol rate) of the serial interface
Data format	8 - 1 - no parity 8 - 1 - odd parity 8 - 1 - even parity 8 - 2 - no parity	Format of the data word Information bit - stop bit - parity
Floating-point format	Standard IEEE754_LITTLE IEEE754_BIG	Selectable transmission format for float values (floating-point numbers)
Minimum response time	0 to 500 ms	Minimum time from receipt of a query to sending of a response This parameter is used to adjust the response speed of the device to slower bus users.
Device address	1 to 247	A bus user's unique ID 0 = Broadcast address[a] 1 to 247 = Unicast addresses[b]

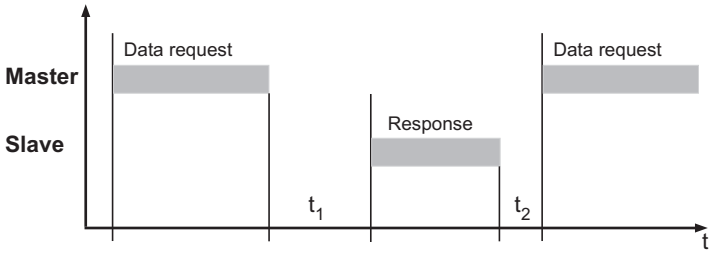
[a] Device addressing is specified in the Modbus standard. The broadcast address must not be used as a slave address. It is intended for broadcast messages.

[b] Unicast addresses are intended for use as slave addresses. They are used to specify the slave devices uniquely so that the master can communicate with them explicitly.

5.1 Modbus slave operation via RS485 serial interface

Timing of communication

A scanning cycle on a bus proceeds with the following timing:



t_1	Internal waiting period of the device prior to checking the data request and the internal processing time: min.: 3.5 byte times + minimum response time typically: 5 ms max.: 25 ms + minimum response time
t_2	The master has to observe this waiting period before starting a new data request: 3.5 characters or at least 2 ms

NOTE!

The minimum response time can be set in the configuration.
This preset time is the minimum waiting time before a response is transmitted (0 to 500 ms). If processing of a query from a master is completed in the slave before the minimum response time has elapsed, the response is not sent until the "minimum response time" has elapsed.

NOTE!

During t_1 and t_2 and during the response time of the slave, no data queries may be generated by the master. Queries during t_1 and t_2 are ignored by the slave. Queries during the response time invalidate all the data currently on the bus.

NOTE!

The terminating code after a data query or data response is 3.5 characters long. The time needed for these 3.5 characters depends on the baud rate.

Character transmission time

The beginning and end of a data block are identified by pauses in transmission. The character transmission time (time required to transmit one single character) depends on the baud rate.
For a data format of 8 data bits, no parity bit and one stop bit, this is:

Character transmission time [ms] = 1000 × 11 bits ÷ baud rate

For other data formats, the following results:

Character transmission time [ms] = 1000 × 10 bits ÷ baud rate

Example

Identifier for end of data request or end of response

Waiting period = 3.5 characters * 1000 * 11 bits ÷ baud rate

Baud rate [Baud]	**Data format** [Bit]	**Character transmission time** [ms]
38400	11	0.287
	10	0.26
19200	11	0.573
	10	0.521
9600	11	1.146
	10	1.042

6 Implementing the calibration procedure

For a JUMO digiLine transmitter to operate properly in conjunction with a Modbus master during calibration, it is necessary to implement the calibration procedures in the software of the Modbus master. The following tables explain in detail the order and function of the individual steps of each calibration procedure. The Modbus parameter "Calibration step" plays a major role here. The Modbus master controls the JUMO digiLine transmitter by incrementing this parameter in the individual steps of the particular calibration procedure. In addition to the "Calibration step", additional parameters must also be provided in the course of the calibration. For all required parameters and their Modbus address, please refer to the Modbus address table (see chapter 7.15.2 „Date for controlling the calibration procedure“, page 59 and chapter 7.15.8 „Date and time for time stamp“, page 62). During calibration, all Modbus parameters can be displayed and checked on the Modbus master. It is recommened that plausibility checks of the measured and reference value be performed in the course of calibration. If malfunctions or problems occur during the calibration procedure, the calibration can be canceled without having to accept the calibration values and calibration logbook entries. To cancel a calibration prematurely, the Modbus master must enter the value "0" in the parameter "Calibration step".

6 Implementing the calibration procedure

Controlling the pH/redox zero point calibration procedure

Step	Action of the Modbus master / Activity
1	The master unit must ensure that the parameter "Calibration step" (Modbus address 0x2662) has the value "0".
2	The master unit must enter the value "0" in the parameter "Calibration procedure" (Modbus address 0x2660) for the zero point calibration. In addition, the desired setting for the parameter "Temperature signal source for temperature compensation during calibration" (Modbus address 0x2661) must be entered. At all of the following steps, the calibration can be canceled at any time by having the Modbus master enter the value "0" in the parameter "Calibration step".
3	The master unit must enter the value "1" in the "Calibration step" (Modbus address 0x2662)to start the calibration process. The JUMO digiLine transmitter initializes the parameter for "Date and time of the current calibration" in process values with 0-values[a].
4	The sensor must now be immersed in the buffer or test solution. It is necessary to wait until the measured value has stabilized before proceeding to the next step.
5	The master unit must enter the value "2" in the "Calibration step" (Modbus address 0x2662) for the measured value to be accepted.
6	The master unit must enter the pH/redox value of the buffer or test solution in the array parameter "Reference [0]" (Modbus address 0x2663). If the value "1" (via interface) was selected in Step 2 for the temperature signal source, the temperature value of the buffer or test solution must be entered in the array parameter "Test solution temperature [0]" (Modbus address 0x2667).
7	The master unit must enter the value "3" in the "Calibration step" (Modbus address 0x2662) for the zero point to be calculated. From now on, the "Zero point calibration value" can be retrieved as a Modbus Parameter (Modbus address 0x266B).
8	At this point, it is essential that the master unit check the parameter "Zero point evaluation" (0x266F). The sensor evaluates the newly calculated calibration values. The sensor accepts the new calibration values only if the calibration result is "OK" (integer value = 1) or "Warning" (integer value = 2). In all other cases, the calibration has failed and must be canceled. Cancellation in the event of a failed calibration is initiated by entering the value "4" in the parameter "Calibration step" (Mobus address 0x2662). In this case, Steps 9 and 10 must be omitted. The calibration values are not accepted; no entry is made in the calibration logbook and the transmitter automatically sets the "Calibration step" to the value "0".
9	If the calibration was successful, the master unit can now enter the current data for date and time into the parameter "Date and time for time stamp" in the process values. If no date is transferred, this parameter remains at the 0-values and the calibration data are entered in the calibration logbook without a date.
10	The master unit must enter the value "4" in the "Calibration step" (Modbus address 0x2662) for the software of the transmitter to transfer the calculated calibration value for the zero point to the parameter "pH/redox zero point" in the configuration of the pH/redox input and update the calibration logbook. This completes the calibration. The transmitter automatically sets the "Calibration step" back to "0".

[a] A valid date must be transmitted by the master unit during the calibration procedure and is entered in the calibration logbook. If a valid date is not transmitted, the 0-values remain in the date and the calibration data are entered in the calibration logbook without a date.

Controlling the pH/redox two-point calibration procedure

Step	Action of the Modbus master / Activity
1	The master unit must ensure that the parameter "Calibration step" (Modbus address 0x2662) has the value "0".
2	The master unit must enter the value "1" in the parameter "Calibration procedure" (Modbus address 0x2660) for a two-point calibration. In addition, the desired setting for the parameter "Temperature signal source for temperature compensation during calibration" (Modbus address 0x2661) must be entered. At all of the following steps, the calibration can be canceled at any time by having the Modbus master enter the value "0" in the parameter "Calibration step".
3	The master unit must enter the value "1" in the "Calibration step" (Modbus address 0x2662)to start the calibration process. The JUMO digiLine transmitter initializes the parameter for "Date and time of the current calibration" in process values with 0-values[a].
4	The sensor must now be immersed in the first buffer or test solution. It is necessary to wait until the measured value has stabilized before proceeding to the next step.
5	The master unit must enter the value "2" in the "Calibration step" (Modbus address 0x2662) for the measured value to be accepted.
6	The master unit must enter the pH/redox value of the first buffer or test solution in the array parameter "Reference [0]" (Modbus address 0x2663). If the value "1" (via interface) was selected in Step 2 for the temperature signal source, the temperature value of the first buffer or test solution must be entered in the array parameter "Test solution temperature [0]" (Modbus address 0x2667).
7	The sensor must now be immersed in the second buffer or test solution. It is necessary to wait until the measured value has stabilized before proceeding to the next step.
8	The master unit must enter the value "3" in the "Calibration step" (Modbus address 0x2662) for the measured value to be accepted.
9	The master unit must enter the pH/redox value of the second buffer or test solution in the array parameter "Reference [1]" (Modbus address 0x2665). If the value "1" (via interface) was selected in Step 2 for the temperature signal source, the temperature value of the second buffer or test solution must be entered in the array parameter "Test solution temperature [1]" (Modbus address 0x2669).
10	The master unit must enter the value "4" in the "Calibration step" (Modbus address 0x2662) for the zero point and slope to be calculated. From now on, the "Zero point calibration value" and "Slope calibration value" can be retrieved as a Modbus parameter (Modbus address 0x266B and 0x266D).
11	At this point, it is essential that the master unit check the parameters "Zero point evaluation" (0x266F) and "Slope evaluation" (02670). The sensor evaluates the newly calculated calibration values. The sensor accepts the new calibration values only if the calibration result is "OK" (integer value = 1) or "Warning" (integer value = 2). In all other cases, the calibration has failed and must be canceled. Cancellation in the event of a failed calibration is initiated by entering the value "5" in the parameter "Calibration step" (Mobus address 0x2662). In this case, Steps 12 and 13 must be omitted. The calibration values are not accepted; no entry is made in the calibration logbook and the transmitter automatically sets the "Calibration step" to the value "0".
12	If the calibration was successful, the master unit can now enter the current data for date and time into the parameter "Date and time for time stamp" in the process values. If no date is transferred, this parameter remains at the 0-values and the calibration data are entered in the calibration logbook without a date.
13	The master unit must enter the value "5" in the "Calibration step" (Modbus address 0x2662) for the software of the transmitter to transfer the calculated calibration value for the zero point to the parameter "pH/redox zero point" in the configuration of the pH/redox input and update the calibration logbook. This completes the calibration. The transmitter automatically sets the "Calibration step" back to "0".

[a] A valid date must be transmitted by the master unit during the calibration procedure and is entered in the calibration logbook. If a valid date is not transmitted, the 0-values remain in the date and the calibration data are entered in the calibration logbook without a date.

7.1 Nameplate

NOTE!

If the device does not respond to these functions or generates an error code, these can be evaluated.

⇨ ExternalLink:

7.2 Manufacturer's data

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
256	0100	Char[20]	10	r	Serial number	ASCII encoding with "ZERO" as end identifier
266	010A	word	1	r	Sensor type	Meaning of integer values: 1 = pH, redox or temperature sensor
267	010B	word	1	r	Sensor subtype	Meaning of integer values: 0 = pH 1 = Redox 2 = T 3 = pH+T 4 = pH with analog output 5 = Redox with analog output 6 = T with analog output 7 = pH+T with analog output
268	010C	Char[10]	5	r	Job number	ASCII encoding with "ZERO" as end identifier
273	0111	Char[12]	6	r	Part number	ASCII encoding with "ZERO" as end identifier
279	0117	char[64]	32	r	Order code	ASCII encoding with "ZERO" as end identifier
311	0137	Char[8]	4	r	Customer number	ASCII encoding with "ZERO" as end identifier
315	013B	Char[16]	8	r	Ordering number	ASCII encoding with "ZERO" as end identifier
323	0143	Char[8]	4	r	Customer type	ASCII encoding with "ZERO" as end identifier
327	0147	Char[16]	8	r	Article number	ASCII encoding with "ZERO" as end identifier
335	014F	Uint32	2	r	Hardware address	
337	0151	Char[20]	10	r	Manufacturer	ASCII encoding with "ZERO" as end identifier
347	015B	Char[20]	10	r	Factory calibration date	ASCII encoding with "ZERO" as end identifier
357	0165	Uint32	2	r	Cal. status	
359	0167	Char[20]	10	r	Inspection ID	

7 Modbus address tables

7.3 Sensor info

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
8448	2100	Char[14]	7	r	Membrane glass, active pH component	ASCII encoding with "ZERO" as end identifier
8455	2107	Char[14]	7	r	Diaphragm	ASCII encoding with "ZERO" as end identifier
8462	210E	Char[14]	7	r	Connection	ASCII encoding with "ZERO" as end identifier
8469	2115	Char[14]	7	r	Approvals	ASCII encoding with "ZERO" as end identifier
8476	211C	word	1	r	Insertion length	
8477	211D	word	1	r	Measuring range start, pH	
8478	211E	word	1	r	Measuring range end, pH	
8479	211F	word	1	r	Measuring range start, redox	
8480	2120	word	1	r	Measuring range end, redox	
8481	2121	word	1	r	Minimum operating temperature	
8482	2122	word	1	r	Maximum operating temperature	
8483	2123	byte	1	r	Maximum operating pressure	
8484	2124	Char[12]	6	r	Electrode part no.	ASCII encoding with "ZERO" as end identifier

7.4 Measuring point info

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
512	0200	Char[60]	30	r/w	Tag number	UTF-8 encoding with "ZERO" as end identifier
542	021E	Char[192]	96	r/w	Description	UTF-8 encoding with "ZERO" as end identifier
638	027E	Char[60]	30	r/w	Sensor origin	UTF-8 encoding with "ZERO" as end identifier

7.5 Configuration of pH/redox input

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
8704	2200	word	1	r/w	Redox calculation	**for redox variant only relevant:** Meaning of integer values: 0 = mV 1 = percent
8705	2201	float	2	r/w	Filter time constant	
8707	2203	word	1	r/w	Temperature signal source for temperature-compensated pH measurement	Meaning of integer values: 0 = Fixed value 1 = Temperature input 2 = Via interface
8708	2204	float	2	r/w	Fixed temperature value for temperature-compensated pH measurement	
8710	2206	word	1	r/w	Binary input function	Meaning of integer values: 0 = Inactive 1 = Hold
8711	2207	float	2	r/w	pH zero point	
8713	2209	float	2	r/w	pH slope	
8715	220B	float	2	r/w	Redox zero point	**for redox variant only relevant**
8717	220D	float	2	r/w	Redox slope	

7.6 Configuration of temperature input

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Access	Hex.					
8736	2220	float	2	r/w	Filter time constant	
8738	2222	float	2	r/w	Offset	
8740	2224	word	1	r/w	Binary input function	Meaning of integer values: 0 = Inactive 1 = Hold

7.7 Configuration of analog output

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
8768	2240	word	1	r/w	Signal type	Meaning of integer values: 0 = 4 to 20 mA; 1 = 20 to 4 mA

7 Modbus address tables

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
8769	2241	word	1	r/w	Binary input function	Meaning of integer values: 0 = Inactive 1 = Hold 2 = Measured value selection pH/redox and temperature
8770	2242	float	2	r/w	Safety value, pH/redox	
8772	2244	float	2	r/w	Safety value, temperature	
8774	2246	float	2	r/w	Scaling start for pH	
8776	2248	float	2	r/w	Scaling end for pH	
8778	224A	float	2	r/w	Scaling start for redox	
8780	224C	float	2	r/w	Scaling end for redox	
8782	224E	float	2	r/w	Scaling start for temperature	
8784	2250	float	2	r/w	Scaling end for temperature	
8786	2252	word	1	r/w	Response at hold	Meaning of integer values: 0 = 4 mA 1 = 20 mA 2 = Frozen 3 = Substitute value
8787	2253	word	1	r/w	Response during calibration	Meaning of integer values: 0 = Moving 1 = Frozen 2 = Substitute value
8788	2254	word	1	r/w	Response in case of error	"Meaning of integer values: 0 = 4 mA 1 = 20 mA 2 = 3.4 mA 3 = 22 mA 4 = Frozen 5 = Substitute value

7.8 Configuration of sensor extreme conditions

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
8800	2260	word	1	r	Lower temperature limit value	
8801	2261	word	1	r	Upper temperature limit value	
8802	2262	word	1	r	Lower pH limit value	
8803	2263	word	1	r	Upper pH limit value	
8804	2264	word	1	r/w	Maximum total overall duration of the lower temperature limit value violation until pre-alarm	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
8805	2265	word	1	r/w	Maximum total overall duration of the upper temperature limit value violation until pre-alarm	
8806	2266	word	1	r/w	Maximum total overall duration of the lower pH limit value violation until pre-alarm	
8807	2267	word	1	r/w	Maximum total overall duration of the upper pH limit value violation until pre-alarm	
8808	2268	word	1	r/w	Maximum total overall duration of the lower temperature limit value violation until alarm	
8809	2269	word	1	r/w	Maximum total overall duration of the upper temperature limit value violation until alarm	
8810	226A	word	1	r/w	Maximum total overall duration of the lower pH limit value violation until alarm	
8811	226B	word	1	r/w	Maximum total overall duration of the upper pH limit value violation until alarm	
8812	226C	word	1	r/w	Maximum number of violations of lower temperature limit value until pre-alarm	
8813	226D	word	1	r/w	Maximum number of violations of upper temperature limit value until pre-alarm	
8814	226E	word	1	r/w	Maximum number of violations of lower pH limit value until pre-alarm	
8815	226F	word	1	r/w	Maximum number of violations of upper pH limit value until pre-alarm	
8816	2270	word	1	r/w	Maximum number of violations of lower temperature limit value until alarm	
8817	2271	word	1	r/w	Maximum number of violations of upper temperature limit value until alarm	
8818	2272	word	1	r/w	Maximum number of violations of lower pH limit value until alarm	
8819	2273	word	1	r/w	Maximum number of violations of upper pH limit value until alarm	

7 Modbus address tables

7.9 Configuration of calibration timers

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
8832	2280	word	1	r/w	Calibration interval	

7.10 Configuration of sensor stress

NOTE!

The parameters for detecting the sensor stress are relevant for the pH variant only.

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
8864	22A0	word	1	r/w	Sensor stress alarm	Meaning of integer values: 0 = Inactive 1 = Active
8865	22A1	float	2	r/w	Weighting factor for acidic sensor stress value	
8867	22A3	float	2	r/w	Weighting factor for alkaline sensor stress value	
8869	22A5	float	2	r/w	Weighting factor for temperature sensor stress value	

7.11 Configuration of sensor monitoring

NOTE!

The parameters for sensor monitoring are relevant for the pH variant only.

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
8896	22C0	float	2	r/w	CIP temperature	
8898	22C2	word	1	r/w	Time for CIP recognition	
8899	22C3	float	2	r/w	SIP temperature	
8901	22C5	word	1	r/w	Time for SIP recognition	
8902	22C6	word	1	r/w	Sensor monitoring alarm	Meaning of integer values: 0 = Inactive 1 = Active
8903	22C7	word	1	r/w	Maximum number of CIP cycles until alarm	
8904	22C8	word	1	r/w	Maximum number of SIP cycles until alarm	
8905	22C9	word	1	r/w	Maximum number of autoclaving cycles until alarm	
8906	22CA	word	1	r/w	Maximum number of CIP cycles until pre-alarm	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
8907	22CB	word	1	r/w	Maximum number of SIP cycles until pre-alarm	
8908	22CC	word	1	r/w	Maximum number of autoclaving cycles until pre-alarm	

7.12 Configuration of the interface

Modbus-PDU-Adresse		Datentyp	Anzahl Modbus-Register	Zugriff	Daten	Kodierung
Dez.	Hex.					
768	0300	byte	1	r/w	Geräteadresse	
769	0301	word	1	r/w	Baudrate	Bedeutung der Integerwerte: 0 = 9600 1 = 19200 2 = 38400
770	0302	word	1	r/w	Datenformat	Bedeutung der Integerwerte: 0 = 8 – 1 – no parity 1 = 8 – 1 – odd parity 2 = 8 – 1 – even parity 3 = 8 – 2 – no parity
772	0304	word	1	r/w	Sensor-Version[a]	
773	0305	word	1	r/w	minimale Antwortzeit	
775	0307	word	1	r/w	Floatwert-Format	0 = IEEE 754 Standard 1 = IEEE 754 Little Endian 2 = IEEE 754 Big Endian

[a] Nach einem Software-Update des Messumformer können Versionsprobleme auftreten, wenn am Modbus-Mastergerät nicht entsprechende Anpassungen vorgenommen werden. Der Modbus-Master kann daher die Version der Messumformer-Software, für die er aufgesetzt wurde, übertragen. Dadurch erzwingt der Modbus-Master beim Messumformer das Schnittstellenverhalten der gewünschten Sensorversion. So können Versionsprobleme durch Messumformer-Software-Updates verhindert werden.

7.13 Sensor operating data

7.13.1 Operation hours counter

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1024	0400	Uint32	2	r	Operation hours counter	
1026	0402	word	1	r/w	Sensor change counter	

7.13.2 Date and time of initial startup with a digiLine master unit

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1280	0500	word	1	r	Year	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1281	0501	byte	1	r	Month	
1282	0502	byte	1	r	Day	
1283	0503	byte	1	r	Hour	
1284	0504	byte	1	r	Minute	
1285	0505	byte	1	r	Second	
1286	0506	byte	1	r	Time zone of initial startup	
1287	0507	Uint32	2	r	Operations hour counter reading at initial startup	

7.13.3 Drag indicator

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1289	0509	float	2	r	Lowest temperature value	
1291	050B	float	2	r	Highest temperature value	

7.13.4 Date and time of occurrence of lowest operating temperature

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1293	050D	word	1	r	Year	
1294	050E	byte	1	r	Month	
1295	050F	byte	1	r	Day	
1296	0510	byte	1	r	Hour	
1297	0511	byte	1	r	Minute	
1298	0512	byte	1	r	Second	
1299	0513	byte	1	r	Time zone	
1300	0514	word	2	r	Operations hour counter reading	

7.13.5 Date and time of occurrence of highest operating temperature

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1302	0516	word	1	r	Year	
1303	0517	char	1	r	Month	
1304	0518	char	1	r	Day	
1305	0519	char	1	r	Hour	
1306	051A	char	1	r	Minute	
1307	051B	char	1	r	Second	
1308	051C	char	1	r	Time zone	
1309	051D	word	2	r	Operations hour counter reading	

7.13.6 Sensor extreme conditions

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9216	2400	Uint32	2	r	Total overall duration of the lower temperature limit value violation	
9218	2402	Uint32	2	r	Total overall duration of the upper temperature limit value violation	
9220	2404	Uint32	2	r	Total overall duration of the lower pH limit value violation	
9222	2406	Uint32	2	r	Total overall duration of the upper pH limit value violation	
9224	2408	Uint32	2	r	Number of violations of lower temperature limit value	
9226	240A	Uint32	2	r	Number of violations of upper temperature limit value	
9228	240C	Uint32	2	r	Number of violations of the lower pH limit value	
9230	240E	Uint32	2	r	Number of violations of the upper pH limit value	

7.13.7 Sensor monitoring

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9232	2410	word	1	r	CIP cycle counter	
9233	2411	word	1	r	SIP cycle counter	
9234	2412	word	1	r/w	Autoclaving cycle counter	

7.13.8 Calibration timer

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9248	2420	Uint32	2	r	Remaining running time of calibration timer	

7.14 Calibration data

NOTE!

In the JUMO digiLine transmitter contains 1 calibration logbook with 10 entry data sets. The addresses of the calibration logbook data are listed explicitly in the following tables. Since all calibration logbooks have the same storage capacity, addresses can also be calculated. The size of the address range in a calibration logbook is 0x0031 in hexadecimal or . 49 in decimal notation. Jumps from one calibration log-

book to another can be calculated with multiples of this value.
Example: 0x0600 + (n - 1) * 0x0031 yields the Modbus address of the parameter "Entry type" in the n-th calibration logbook.

NOTE!

In the JUMO digiLine transmitter contains 1 calibration logbook with 10 entry data sets. The addresses of the calibration logbook data are listed explicitly in the following tables. Since all calibration logbooks have the same storage capacity, addresses can also be calculated. The size of the address range in a calibration logbook is 0x0031 in hexadecimal or . 49 in decimal notation. Jumps from one calibration logbook to another can be calculated with multiples of this value.
Example: 0x0600 + (n - 1) * 0x0031 yields the Modbus address of the parameter "Entry type" in the n-th calibration logbook.

7.14.1 Calibration logbook entry 1

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1536	0600	word	1	r	Entry type	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for two-point pH entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2 Array elements at redox zero point entry type: [0] = Zero point [1] = Reference Array elements for two-point redox entry type: [0] = Zero point [1] = Slope [2] = Voltage 1 [3] = Percent 1 [4] = Voltage 2 [5] = Percent 2
1537	0601	word	1	r	Type of entry change	Meaning of integer values: 0 = Manual change 1 = Calibration

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1538	0602	word	1	r	Calibration evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok 2 = Warning

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1539	0603	Uint32	2	r	Operations hour counter reading	
1541	0605	word	1	r	Year	
1542	0606	byte	1	r	Month	
1543	0607	byte	1	r	Day	
1544	0608	byte	1	r	Hour	
1545	0609	byte	1	r	Minute	
1546	060A	byte	1	r	Seconds	
1547	060B	byte	1	r	Time zone	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1548	060C	byte	1	r	Sensor change counter reading	

7 Modbus address tables

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1549	060D	float[6]	12	r	Calibration values	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for two-point pH entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2 Array elements at redox zero point entry type: [0] = Zero point [1] = Reference Array elements for two-point redox entry type: [0] = Zero point [1] = Slope [2] = Voltage 1 [3] = Percent 1 [4] = Voltage 2 [5] = Percent 2
1561	0619	Char[48]	24	r	Units	Calibration value units in the following format: For each unit of the 6 calibration values, 8 bytes are available for the unit character string, including the ZERO character as end identifier in UTF-8 encoding. The character string may be up to 5 characters long.

7.14.2 Calibration logbook entry 2

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1585	0631	word	1	r	Entry type	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for two-point pH entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2 Array elements at redox zero point entry type: [0] = Zero point [1] = Reference Array elements for two-point redox entry type: [0] = Zero point [1] = Slope [2] = Voltage 1 [3] = Percent 1 [4] = Voltage 2 [5] = Percent 2
1586	0632	word	1	r	Type of entry change	Meaning of integer values: 0 = Manual change 1 = Calibration
1587	0633	word	1	r	Calibration evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok 2 = Warning

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1588	0643	Uint32	2	r	Operations hour counter reading	
1590	0636	word	1	r	Year	
1591	0637	byte	1	r	Month	
1592	0638	byte	1	r	Day	
1593	0639	byte	1	r	Hour	
1594	063A	byte	1	r	Minute	

7 Modbus address tables

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1595	063B	byte	1	r	Second	
1596	063C	byte	1	r	Time zone	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1597	063D	byte	1	r	Sensor change counter reading	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1598	063E	float[6]	12	r	Calibration values	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for pH-Z entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2
1610	064A	Char[48]	24	r	Units	Calibration value units in the following format: For each unit of the 6 calibration values, 8 bytes are available for the unit character string, including the ZERO character as end identifier in UTF-8 encoding. The character string may be up to 5 characters long.

7.14.3 Calibration logbook entry 3

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1634	0662	word	1	r	Entry type	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for two-point pH entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2 Array elements at redox zero point entry type: [0] = Zero point [1] = Reference Array elements for two-point redox entry type: [0] = Zero point [1] = Slope [2] = Voltage 1 [3] = Percent 1 [4] = Voltage 2 [5] = Percent 2
1635	0663	word	1	r	Type of entry change	Meaning of integer values: 0 = Manual change 1 = Calibration
1636	0664	word	1	r	Calibration evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok 2 = Warning

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1637	0665	Uint32	2	r	Operations hour counter reading	
1639	0667	word	1	r	Year	
1640	0668	byte	1	r	Month	
1641	0669	byte	1	r	Day	
1642	066A	byte	1	r	Hour	
1643	066B	byte	1	r	Minute	

7 Modbus address tables

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1644	066C	byte	1	r	Seconds	
1645	066D	byte	1	r	Time zone	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1646	066E	byte	1	r	Sensor change counter reading	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1647	066F	float[6]	12	r	Calibration values	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for pH-Z entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2
1659	067B	Char[48]	24	r	Units	Calibration value units in the following format: For each unit of the 6 calibration values, 8 bytes are available for the unit character string, including the ZERO character as end identifier in UTF-8 encoding. The character string may be up to 5 characters long.

7.14.4 Calibration logbook entry 4

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1683	0693	word	1	r	Entry type	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for two-point pH entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2 Array elements at redox zero point entry type: [0] = Zero point [1] = Reference Array elements for two-point redox entry type: [0] = Zero point [1] = Slope [2] = Voltage 1 [3] = Percent 1 [4] = Voltage 2 [5] = Percent 2
1684	0694	word	1	r	Type of entry change	Meaning of integer values: 0 = Manual change 1 = Calibration
1685	0695	word	1	r	Calibration evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok 2 = Warning

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1686	0696	Uint32	2	r	Operations hour counter reading	
1688	0698	word	1	r	Year	
1689	0699	byte	1	r	Month	
1690	069A	byte	1	r	Day	
1691	069B	byte	1	r	Hour	
1692	069C	byte	1	r	Minute	

7 Modbus address tables

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1693	069D	byte	1	r	Seconds	
1694	069E	byte	1	r	Time zone	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1695	069F	byte	1	r	Sensor change counter reading	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1696	06A0	float[6]	12	r	Calibration values	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for pH-Z entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2
1708	06AC	Char[48]	24	r	Units	Calibration value units in the following format: For each unit of the 6 calibration values, 8 bytes are available for the unit character string, including the ZERO character as end identifier in UTF-8 encoding. The character string may be up to 5 characters long.

7.14.5 Calibration logbook entry 5

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1732	06C4	word	1	r	Entry type	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for two-point pH entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2 Array elements at redox zero point entry type: [0] = Zero point [1] = Reference Array elements for two-point redox entry type: [0] = Zero point [1] = Slope [2] = Voltage 1 [3] = Percent 1 [4] = Voltage 2 [5] = Percent 2
1733	06C5	word	1	r	Type of entry change	Meaning of integer values: 0 = Manual change 1 = Calibration
1734	06C6	word	1	r	Calibration evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok 2 = Warning

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1735	06C7	Uint32	2	r	Operations hour counter reading	
1737	06C9	word	1	r	Year	
1738	06CA	byte	1	r	Month	
1769	06CB	byte	1	r	Day	
1770	06CC	byte	1	r	Hour	
1771	06CD	byte	1	r	Minute	

7 Modbus address tables

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1772	06CE	byte	1	r	Seconds	
1773	06CF	byte	1	r	Time zone	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1744	06D0	byte	1	r	Sensor change counter reading	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1745	06D1	float[6]	12	r	Calibration values	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for pH-Z entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2
1757	06DD	Char[48]	24	r	Units	Calibration value units in the following format: For each unit of the 6 calibration values, 8 bytes are available for the unit character string, including the ZERO character as end identifier in UTF-8 encoding. The character string may be up to 5 characters long.

7.14.6 Calibration logbook entry 6

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1781	06F5	word	1	r	Entry type	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for two-point pH entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2 Array elements at redox zero point entry type: [0] = Zero point [1] = Reference Array elements for two-point redox entry type: [0] = Zero point [1] = Slope [2] = Voltage 1 [3] = Percent 1 [4] = Voltage 2 [5] = Percent 2
1782	06F6	word	1	r	Type of entry change	Meaning of integer values: 0 = Manual change 1 = Calibration
1783	06F7	word	1	r	Calibration evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok 2 = Warning

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1784	06F8	Uint32	2	r	Operations hour counter reading	
1786	06FA	word	1	r	Year	
1787	06FB	byte	1	r	Month	
1788	06FC	byte	1	r	Day	
1789	06FD	byte	1	r	Hour	
1790	06FE	byte	1	r	Minute	

7 Modbus address tables

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1791	06FF	byte	1	r	Seconds	
1792	0700	byte	1	r	Time zone	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1793	0701	byte	1	r	Sensor change counter reading	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1794	0702	float[6]	12	r	Calibration values	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for pH-Z entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2
1806	070E	Char[48]	24	r	Units	Calibration value units in the following format: For each unit of the 6 calibration values, 8 bytes are available for the unit character string, including the ZERO character as end identifier in UTF-8 encoding. The character string may be up to 5 characters long.

7.14.7 Calibration logbook entry 7

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1830	0726	word	1	r	Entry type	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for two-point pH entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2 Array elements at redox zero point entry type: [0] = Zero point [1] = Reference Array elements for two-point redox entry type: [0] = Zero point [1] = Slope [2] = Voltage 1 [3] = Percent 1 [4] = Voltage 2 [5] = Percent 2
1831	0727	word	1	r	Type of entry change	Meaning of integer values: 0 = Manual change 1 = Calibration
1332	0728	word	1	r	Calibration evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok 2 = Warning

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1833	0729	Uint32	2	r	Operations hour counter reading	
1835	072B	word	1	r	Year	
1836	072C	byte	1	r	Month	
1837	072D	byte	1	r	Day	
1838	072E	byte	1	r	Hour	
1839	072F	byte	1	r	Minute	

7 Modbus address tables

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1840	0730	byte	1	r	Seconds	
1841	0731	byte	1	r	Time zone	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1842	0732	byte	1	r	Sensor change counter reading	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1843	0733	float[6]	12	r	Calibration values	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for pH-Z entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2
1855	073F	Char[48]	24	r	Units	Calibration value units in the following format: For each unit of the 6 calibration values, 8 bytes are available for the unit character string, including the ZERO character as end identifier in UTF-8 encoding. The character string may be up to 5 characters long.

7.14.8 Calibration logbook entry 8

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1879	0757	word	1	r	Entry type	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for two-point pH entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2 Array elements at redox zero point entry type: [0] = Zero point [1] = Reference Array elements for two-point redox entry type: [0] = Zero point [1] = Slope [2] = Voltage 1 [3] = Percent 1 [4] = Voltage 2 [5] = Percent 2
1880	0758	word	1	r	Type of entry change	Meaning of integer values: 0 = Manual change 1 = Calibration
1881	0789	word	1	r	Calibration evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok 2 = Warning

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1882	075A	Uint32	2	r	Operations hour counter reading	
1884	075C	word	1	r	Year	
1885	075D	byte	1	r	Month	
1886	075E	byte	1	r	Day	
1887	075F	byte	1	r	Hour	
1888	0760	byte	1	r	Minute	

7 Modbus address tables

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1889	0761	byte	1	r	Seconds	
1890	0762	byte	1	r	Time zone	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1891	0763	byte	1	r	Sensor change counter reading	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1892	0764	float[6]	12	r	Calibration values	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for pH-Z entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2
1904	0770	Char[48]	24	r	Units	Calibration value units in the following format: For each unit of the 6 calibration values, 8 bytes are available for the unit character string, including the ZERO character as end identifier in UTF-8 encoding. The character string may be up to 5 characters long.

7.14.9 Calibration logbook entry 9

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1928	0788	word	1	r	Entry type	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for two-point pH entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2 Array elements at redox zero point entry type: [0] = Zero point [1] = Reference Array elements for two-point redox entry type: [0] = Zero point [1] = Slope [2] = Voltage 1 [3] = Percent 1 [4] = Voltage 2 [5] = Percent 2
1929	0789	word	1	r	Type of entry change	Meaning of integer values: 0 = Manual change 1 = Calibration
1930	078A	word	1	r	Calibration evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok 2 = Warning

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1931	078B	Uint32	2	r	Operations hour counter reading	
1933	078D	word	1	r	Year	
1934	078E	byte	1	r	Month	
1935	078F	byte	1	r	Day	
1936	0790	byte	1	r	Hour	
1937	0791	byte	1	r	Minute	

7 Modbus address tables

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1938	0792	byte	1	r	Seconds	
1939	0793	byte	1	r	Time zone	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1940	0794	byte	1	r	Sensor change counter reading	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1941	0795	float[6]	12	r	Calibration values	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for pH-Z entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2
1953	07A1	Char[48]	24	r	Units	Calibration value units in the following format: For each unit of the 6 calibration values, 8 bytes are available for the unit character string, including the ZERO character as end identifier in UTF-8 encoding. The character string may be up to 5 characters long.

7.14.10 Calibration logbook entry 10

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1977	07B9	word	1	r	Entry type	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for two-point pH entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2 Array elements at redox zero point entry type: [0] = Zero point [1] = Reference Array elements for two-point redox entry type: [0] = Zero point [1] = Slope [2] = Voltage 1 [3] = Percent 1 [4] = Voltage 2 [5] = Percent 2
1978	07BA	word	1	r	Type of entry change	Meaning of integer values: 0 = Manual change 1 = Calibration
1979	07BB	word	1	r	Calibration evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok 2 = Warning

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1980	07BC	Uint32	2	r	Operations hour counter reading	
1982	07BE	word	1	r	Year	
1983	07BF	byte	1	r	Month	
1984	07C0	byte	1	r	Day	
1985	07C1	byte	1	r	Hour	
1986	07C2	byte	1	r	Minute	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1987	07C3	byte	1	r	Seconds	
1988	07C4	byte	1	r	Time zone	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1989	07C5	byte	1	r	Sensor change counter reading	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
1990	07C6	float[6]	12	r	Calibration values	Array elements at pH zero point entry type: [0] = Zero point [1] = Reference [2] = Temperature Array elements for pH-Z entry type: [0] = Zero point [1] = Slope [2] = Reference 1 [3] = Reference 2 [4] = Temperature 1 [5] = Temperature 2
2002	07D2	Char[48]	24	r	Units	Calibration value units in the following format: For each unit of the 6 calibration values, 8 bytes are available for the unit character string, including the ZERO character as end identifier in UTF-8 encoding. The character string may be up to 5 characters long.

7.15 Process values

7.15.1 Inputs

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9728	2600	float	2	r	Compensated pH value	
9730	2602	float	2	r	Uncompensated raw sensor value in mV	
9732	2604	float	2	r/w	Compensation temperature interface	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9734	2606	bool	1	r	pH measurement alarm (e. g. from pH values outside the measuring range or compensation error)	
9760	2620	float	2	r	Measured temperature in °Celsius	
9762	2622	float	2	r	Measured temperature in °Fahrenheit	
9764	2624	float	2	r	Resistance value of the temperature probe	
9766	2626	bool	1	r	Temperature measurement alarm (temp. outside the measuring range)	
9792	2640	bool	1	r	Binary input signal	

7.15.2 Date for controlling the calibration procedure

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9824	2660	word	1	r/w	Calibration procedure	Meaning of integer values: 0 = Zero-point calibration 1 = Two-point calibration
9825	2661	word	1	r/w	Temperature signal source for temperature compensation during the calibration process	Meaning of integer values: 0 = Temperature input 1 = Via interface
9826	2662	word	1	r/w	Calibration step	
9827	2663	float[2]	4	r/w	Reference	
9831	2667	float[2]	4	r/w	Temperature test solution	
9835	266B	float	2	r	Zero point calibration value	
9837	266D	float	2	r	Slope calibration value	
9839	266F	word	1	r	Calibrated zero point evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok 2 = Warning 3 = Calibration limits violated 4 = Failed calibration procedure
9840	2670	word	1	r	Calibrated slope evaluation	Meaning of integer values: 0 = No evaluation 1 = Ok; 2 = Warning 3 = Calibration limits violated 4 = Failed calibration procedure
9841	2671	byte	1	r	Index of the calibration logbook entry for the next calibration	

7.15.3 Sensor stress

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9856	2680	bool	1	r	Sensor stress alarm	
9857	2681	bool	1	r	Sensor stress pre-alarm	
9858	2682	word	1	r	Current sensor stress value	

7.15.4 Sensor monitoring

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9859	2683	bool	1	r	CIP/SIP/autoclaving cycles alarm	
9860	2684	bool	1	r	CIP/SIP/autoclaving cycles pre-alarm	

7.15.5 Sensor extreme conditions

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9861	2685	bool	1	r	Pre-alarm for maximum total overall duration of the lower temperature limit value violation	
9862	2686	bool	1	r	Pre-alarm for maximum total overall duration of the upper temperature limit value violation	
9863	2687	bool	1	r	Pre-alarm for maximum total overall duration of the lower pH limit value violation	
9864	2688	bool	1	r	Pre-alarm for maximum total overall duration of the upper pH limit value violation	
9865	2689	bool	1	r	Alarm for maximum total overall duration of the lower temperature limit value violation	
9866	268A	bool	1	r	Alarm for maximum total overall duration of the upper temperature limit value violation	
9867	268B	bool	1	r	Alarm for maximum total overall duration of the lower pH limit value violation	
9868	268C	bool	1	r	Alarm for maximum total overall duration of the upper pH limit value violation	

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9869	268D	bool	1	r	Pre-alarm for maximum number of violations of lower temperature limit value	
9870	268E	bool	1	r	Pre-alarm for maximum number of violations of upper temperature limit value	
9871	268F	bool	1	r	Pre-alarm for maximum number of violations of lower pH limit value	
9872	2690	bool	1	r	Pre-alarm for maximum number of violations of upper pH limit value	
9873	2691	bool	1	r	Alarm for maximum number of violations of lower temperature limit value	
9874	2692	bool	1	r	Alarm for maximum number of violations of upper temperature limit value	
9875	2693	bool	1	r	Alarm for maximum number of violations of lower pH limit value	
9876	2694	bool	1	r	Alarm for maximum number of violations of upper pH limit value	

7.15.6 Status summary

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9888	26A0	word	1	r	Error status	Meaning of the values: [0] = No error Values > 0 indicate an error. The value can be evaluated by service personnel and used for troubleshooting.

7.15.7 Calibration alarm

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9891	26A3	bool	1	r	Calibration alarm	

7.15.8 Date and time for time stamp

NOTE!

The "Date and time for time stamp" parameter set serves as incoming data stream for the current date and time. The transmitter copies the time stamp from these data for logging internal functions (e. g. calibration logbook entries or the drag indicator function). To ensure that the time stamp always contains correct data, the Modbus master should cyclically write this parameter with current data. This is a RAM-resident parameter that allows cyclical writing.

Modbus PDU address		Data type	No. of Modbus registers	Access	Data	Encoding
Dec.	Hex.					
9920	26C0	word	1	r/w	Year	
9921	26C1	byte	1	r/w	Month	
9922	26C2	byte	1	r/w	Day	
9923	26C3	byte	1	r/w	Hour	
9924	26C4	byte	1	r/w	Minute	
9925	26C5	byte	1	r/w	Second	
9926	26C6	byte	1	r/w	Time zone	

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