

## Supplementary documentation

# **Liquiline CM44x, Liquiline CM44Rx, Liquiline CM44P, Liquiline System CA80xx, Liquistation CSFxx**

## Data transmission via Modbus®

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# 1 Note

## 1.1 About this manual

This supplementary document must only be used in conjunction with a field device Liquiline CM44x Modbus, an analyzer Liquiline System CA80xx Modbus or a sampler Liquistation CSFxx Modbus.

This supplementary document is an integral part of the Operating Instruction and extends it with additional information for use with Modbus.

Additional information is contained in the Operating Instructions of each product.

This document is aimed at individuals who are integrating the device into a Modbus network. It is assumed that the reader has fundamental knowledge of Modbus technology.

Additional information about Modbus technology is available, for example, on the website:

[www.modbus.org](http://www.modbus.org)

## 1.2 Abbreviations

|      |                                          |
|------|------------------------------------------|
| n.a. | Not applicable                           |
| NaN  | Not a Number (IEEE-754, 7Fh A0h 00h 00h) |
| ENP  | Electronic name plate                    |
| AI   | Analog Input                             |
| DI   | Discrete Input                           |
| AO   | Analog Output                            |
| DO   | Discrete Output                          |

## 2 Installation and wiring

Installation and wiring are described in detail in the operating instructions of each product.

### 2.1 A-, B-wire

The 485/ETH communication module uses the same connector labeling as for PROFIBUS devices. It must be stated that the usage of A and B is not consistent over all available Modbus devices. The 485/ETH modules use the following definition:

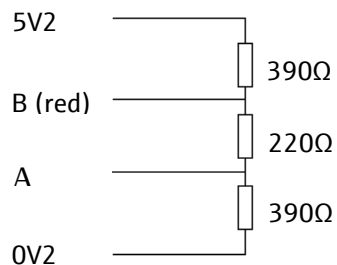
| Label on connector | color | signal    | meaning                         |
|--------------------|-------|-----------|---------------------------------|
| B                  | Red   | RxD/TxD-P | Received/transmitted data - P   |
| A                  | Green | RxD/TxD-N | Received/transmitted data - N   |
| C                  | --    | DGND      | Data reference potential output |

 In case RS485 communication is not working, please verify that the RS485-signals are connected correctly, otherwise switch the signals. Switching the RS485-signals does not damage the RS485 interface of the device.

### 2.2 Termination

The communication module provides the possibility of activating a bus termination via a 4-pin DIL slide switch. Here, the downstream Modbus devices are not separated from the Modbus RS485 segment. The communication module must be removed to activate the bus termination. If the communication module is installed and supplied with voltage, the bus termination state is indicated by the T LED (yellow).

The termination is according the definition for PROFIBUS DP, as the RS485 interface can be used for PROFIBUS DP communication.



The procedure of activating and deactivating the bus termination is described in the operating instructions of each product.

### 3 Modbus Protocol

Modbus is an open, standardized communication protocol that is used in the areas of Manufacturing, Process- and Building automation.

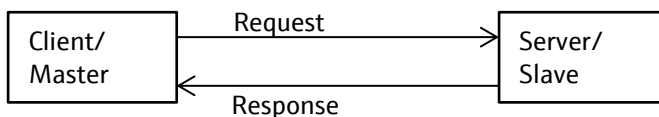
The Modbus protocol is used for data exchange with intelligent field devices via master/slave (client/server) connections. Here, the Modbus protocol can be used with different transmission media and embedded in other communication protocols.

The specifications for the Modbus protocol are freely available on the web site of the Modbus Organization.

<http://www.modbus.org/>

#### 3.1 Mode of operation

Modbus communication (unicast) uses a simple request-response mechanism.



There are three different scenarios:

If the device (server) receives a valid telegram with a valid request and can reply to it, it replies with a response telegram containing the function code of the request.

If the device (server) receives an invalid telegram (e.g. CRC error), it does not reply. The application (client) must carry out an error diagnosis once a specified time-out has elapsed.

If the device (server) receives a valid telegram with an invalid request, it replies with a Modbus exception. The application (client) must carry out an error diagnosis.

#### 3.2 Transmission Modes

There are three data transmission modes: ASCII, RTU and TCP.

##### 3.2.1 ASCII

This mode is supported for Modbus RS485. The data are transmitted as ASCII characters and are therefore readable by humans.

| Start       | Address      | Function     | Data         | LRC          | End          |
|-------------|--------------|--------------|--------------|--------------|--------------|
| 1 character | 2 characters | 2 characters | N characters | 2 characters | 2 characters |
| = „“        |              |              |              |              | CRLF         |

| Field   | Length | Info                         | Client            | Server                                 |
|---------|--------|------------------------------|-------------------|----------------------------------------|
| Address | 2 Byte | Identifies the target device | Set by the client | Copied from the request into the reply |
| LRC     | 2 Byte | see Modbus specification     | Set by the client | Set by the server                      |

### 3.2.2 RTU

This mode is supported for Modbus RS485. The data are transmitted in binary format and are therefore more compact.

| Address                        | Function    | Data        | CRC16        |
|--------------------------------|-------------|-------------|--------------|
| 1 character                    | 1 character | N character | 2 characters |
| 0 = Broadcast<br>247 = Unicast |             |             |              |

 A delimiter of at least 3.5 characters must be maintained between two Modbus telegrams.

| Field   | Length | Info                     | Client            | Server                                 |
|---------|--------|--------------------------|-------------------|----------------------------------------|
| Address | 1 Byte | Identifies target        | Set by the client | Copied from the request into the reply |
| CRC16   | 2 Byte | see Modbus specification | Set by the client | Set by the server                      |

### 3.2.3 TCP

This mode is supported for Modbus TCP. As with RTU, the data are transmitted in binary format. Address and checksum used in RTU mode are dispensed with. The Modbus ADU is embedded in the TCP/IP telegram.

| Modbus TCP/IP ADU  |                    |                           |         |            |         |
|--------------------|--------------------|---------------------------|---------|------------|---------|
| MBAP header        |                    |                           |         | Modbus PDU |         |
| Transaction number | Protocol attribute | Number of bytes to follow | Address | Function   | Data    |
| 2 Byte             | 2 Bytes            | 2 Bytes                   | 1 Byte  | 1 Byte     | N Bytes |
|                    | = 0x0000           | = N + 2                   | = 0     |            |         |

| Field                     | Length | Info                                                                                                                                                                                            | Client            | Server                                 |
|---------------------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|----------------------------------------|
| Transaction number        | 2 Byte | Identifies the transaction                                                                                                                                                                      | Set by the client | Copied from the request into the reply |
| Protocol attribute        | 2 Byte |                                                                                                                                                                                                 | Set by the client | Copied from the request into the reply |
| Number of bytes to follow | 2 Byte | Number of bytes to follow                                                                                                                                                                       | Set by the client | Set by the server                      |
| Address                   | 1 Byte | Identifies a slave that is connected to a serial bus located downstream.<br>Note<br>The devices in the Liquiline product family do not use the unit identifier. This should always be set to 0. | Set by the client | Copied from the request into the reply |

 Via the TCP port 502, you can use up to 3 parallel TCP connections with the device simultaneously. Please note the correct structure of the MBAP header.

### 3.3 Modbus exception codes

If the MODBUS slave detects an error in the request telegram from the master, it replies to the master with an error message comprising the slave address, function code, error code (exception code) and checksum. To indicate that it is an error message, the leading bit of the returned function code is set. The cause of the error is transmitted to the master via the error code (exception code).

| Exception Code | Info                                                                                                                                                                                                                                |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01             | ILLEGAL_FUNCTION<br>The function code sent by the master is not supported by the measuring device (slave).                                                                                                                          |
| 02             | ILLEGAL_DATA_ADDRESS<br>The register addressed by the master is not assigned (i.e. it does not exist), or the length of the data queried is too long.                                                                               |
| 03             | ILLEGAL_DATA_VALUE<br>The master attempts to write to a register which allows only read access.<br>The value that appears in the data field is not permitted: e.g. range limits have been exceeded or the data format is incorrect. |
| 04             | SLAVE_DEVICE_FAILURE<br>The slave has not replied to the request telegram from the master, or an error has occurred while processing the request telegram.                                                                          |

A parameter must be read or written completely, otherwise SLAVE\_DEVICE\_FAILURE is returned.

-  The numbering of the Modbus registers in this document starts with 0 as it is transmitted over the wire. In case your PLC is using Modicon addressing you must add 1 to the register addresses.
-  Please note that Modbus requests must read or write parameters completely. Trying to read or write only a part of a parameter returns Modbus exception SLAVE\_DEVICE\_FAILURE.

### 3.4 Response times

Response time of the measuring device to the request telegram of the Modbus master:  
typically, below 100 ms

### 3.5 Byte transmission sequence

Byte addressing, i.e. the transmission sequence of the bytes, is not specified in the Modbus specification. For this reason, it is important to coordinate or match the addressing method between the master and slave during commissioning. This can be configured in the measuring device using the **Byte order** parameter. The bytes are transmitted depending on the selection in the **Byte order** parameter:

| <b>FLOAT</b>                                            |                      |                      |                      |                      |
|---------------------------------------------------------|----------------------|----------------------|----------------------|----------------------|
|                                                         | Sequence             |                      |                      |                      |
| Options                                                 | 1.                   | 2.                   | 3.                   | 4.                   |
| 1-0-3-2*                                                | Byte 1<br>(MMMMMMMM) | Byte 0<br>(MMMMMMMM) | Byte 3<br>(SEEEEEEE) | Byte 2<br>(EMMMMMMM) |
| 0-1-2-3                                                 | Byte 0<br>(MMMMMMMM) | Byte 1<br>(MMMMMMMM) | Byte 2<br>(EMMMMMMM) | Byte 3<br>(SEEEEEEE) |
| 2-3-0-1                                                 | Byte 2<br>(EMMMMMMM) | Byte 3<br>(SEEEEEEE) | Byte 0<br>(MMMMMMMM) | Byte 1<br>(MMMMMMMM) |
| 3-2-1-0                                                 | Byte 3<br>(SEEEEEEE) | Byte 2<br>(EMMMMMMM) | Byte 1<br>(MMMMMMMM) | Byte 0<br>(MMMMMMMM) |
| * Factory default, S = Sign, E = Exponent, M = Mantissa |                      |                      |                      |                      |

| <b>INTEGER</b>                                                                 |                 |                 |
|--------------------------------------------------------------------------------|-----------------|-----------------|
|                                                                                | Sequence        |                 |
| Options                                                                        | 1.              | 2.              |
| 1-0-3-2*                                                                       | Byte 1<br>(MSB) | Byte 0<br>(LSB) |
| 3-2-1-0                                                                        | Byte 0<br>(LSB) | Byte 1<br>(MSB) |
| 0-1-2-3                                                                        | Byte 0<br>(LSB) | Byte 1<br>(MSB) |
| 2-3-0-1                                                                        | Byte 0<br>(LSB) | Byte 1<br>(MSB) |
| * = factory setting, MSB = most significant byte, LSB = least significant byte |                 |                 |

| <b>STRING</b>                                                                         |                  |                  |     |                 |                 |
|---------------------------------------------------------------------------------------|------------------|------------------|-----|-----------------|-----------------|
| Presentation taking the example of a device parameter with a data length of 18 bytes. |                  |                  |     |                 |                 |
|                                                                                       | Sequence         |                  |     |                 |                 |
| Options                                                                               | 1.               | 2.               |     | 17.             | 18.             |
| 1-0-3-2*                                                                              | Byte 17<br>(MSB) | Byte 16          | ... | Byte 1          | Byte 0<br>(LSB) |
| 3-2-1-0                                                                               | Byte 16          | Byte 17<br>(MSB) | ... | Byte 0<br>(LSB) | Byte 1          |
| 0-1-2-3                                                                               | Byte 16          | Byte 17<br>(MSB) | ... | Byte 0<br>(LSB) | Byte 1          |
| 2-3-0-1                                                                               | Byte 16          | Byte 17<br>(MSB) | ... | Byte 0<br>(LSB) | Byte 1          |
| * = factory setting, MSB = most significant byte, LSB = least significant byte        |                  |                  |     |                 |                 |

Any other data type with a size of more than two bytes uses the transmission sequence for STRING.

### 3.6 Data types

The measuring device supports the following data types:

|                                                                                      |           |           |           |
|--------------------------------------------------------------------------------------|-----------|-----------|-----------|
| <b>FLOAT</b> (floating point number IEEE 754)<br>Data length = 4 bytes (2 registers) |           |           |           |
| Byte 3                                                                               | Byte 2    | Byte 1    | Byte 0    |
| SEEEEEEE                                                                             | EMMMMMMMM | MMMMMMMMM | MMMMMMMMM |
| S = sign, E = exponent, M = mantissa                                                 |           |           |           |

|                                                      |                              |
|------------------------------------------------------|------------------------------|
| <b>INTEGER</b><br>Data length = 2 bytes (1 register) |                              |
| Byte 1                                               | Byte 0                       |
| Most significant byte (MSB)                          | Least significant byte (LSB) |

|                                                                                                                                                    |         |     |        |                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----|--------|------------------------------|
| <b>STRING</b><br>Data length = depends on the device parameter, e.g. presentation of a device parameter with a data length = 18 byte (9 registers) |         |     |        |                              |
| Byte 17                                                                                                                                            | Byte 16 | ... | Byte 1 | Byte 0                       |
| Most significant byte (MSB)                                                                                                                        |         | ... |        | Least significant byte (LSB) |

| <b>DATETIME</b><br>Data length = 7 bytes (4 registers) |                 |                 |                 |                 |                 |                 |                |                |                                                                                         |
|--------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|-----------------------------------------------------------------------------------------|
| Byte                                                   | Bit             |                 |                 |                 |                 |                 |                |                | Description                                                                             |
|                                                        | 7               | 6               | 5               | 4               | 3               | 2               | 1              | 0              |                                                                                         |
| 0                                                      | 2 <sup>15</sup> | 2 <sup>14</sup> | 2 <sup>13</sup> | 2 <sup>12</sup> | 2 <sup>11</sup> | 2 <sup>10</sup> | 2 <sup>9</sup> | 2 <sup>8</sup> | 0 ... 59999 ms                                                                          |
| 1                                                      | 2 <sup>7</sup>  | 2 <sup>6</sup>  | 2 <sup>5</sup>  | 2 <sup>4</sup>  | 2 <sup>3</sup>  | 2 <sup>2</sup>  | 2 <sup>1</sup> | 2 <sup>0</sup> |                                                                                         |
| 2                                                      | 0               | 0               | 2 <sup>5</sup>  | 2 <sup>4</sup>  | 2 <sup>3</sup>  | 2 <sup>2</sup>  | 2 <sup>1</sup> | 2 <sup>0</sup> | 0 ... 59 min                                                                            |
| 3                                                      | S               | 0               | 0               | 2 <sup>4</sup>  | 2 <sup>3</sup>  | 2 <sup>2</sup>  | 2 <sup>1</sup> | 2 <sup>0</sup> | Bits 0 to 4: 0 ... 23 h<br>S=0: standard time, S=1: summer time                         |
| 4                                                      | 2 <sup>2</sup>  | 2 <sup>1</sup>  | 2 <sup>0</sup>  | 2 <sup>4</sup>  | 2 <sup>3</sup>  | 2 <sup>2</sup>  | 2 <sup>1</sup> | 2 <sup>0</sup> | Bits 6 to 8: 1...7 day of week (1=Monday, 7=Sunday)<br>Bits 1 to 5: 1...31 day of month |
| 5                                                      | 0               | 0               | 0               | 0               | 2 <sup>3</sup>  | 2 <sup>2</sup>  | 2 <sup>1</sup> | 2 <sup>0</sup> | Month (1...12)                                                                          |
| 6                                                      | 2 <sup>7</sup>  | 2 <sup>6</sup>  | 2 <sup>5</sup>  | 2 <sup>4</sup>  | 2 <sup>3</sup>  | 2 <sup>2</sup>  | 2 <sup>1</sup> | 2 <sup>0</sup> | Year (0...255) / 0 = 1900                                                               |
| 7                                                      | Padding         |                 |                 |                 |                 |                 |                |                |                                                                                         |

 Other data types with a data length of more than 2 bytes are treated like strings.

### 3.7 Device variables with status

The measuring device does support a fix number of device variables which can be connected to various data sources and sinks:

| Device variable     | Name           | Description                         | Application / Example         |
|---------------------|----------------|-------------------------------------|-------------------------------|
| <b>AI1 ... AI16</b> | Analog Input   | Value that is read from the device  | Read measurement values       |
| <b>DI1 ... DI8</b>  | Digital Input  | Value that is read from the device  | Read limit switch state       |
| <b>AO1 ... AO4</b>  | Analog Output  | Value that is written to the device | Write PID controlled variable |
| <b>DO1 ... DO8</b>  | Digital Output | Value that is written to the device | Start cleaning sequence       |

A device variable consists of multiple elements:

| <b>AI (Analog Input)</b>                                                        |           |           |                   |
|---------------------------------------------------------------------------------|-----------|-----------|-------------------|
| These device variables are transmitted from measurement device to Modbus master |           |           |                   |
| Register-Offset                                                                 | Name      | Data type | Description       |
| + 0-1                                                                           | Value     | Float     | Measurement value |
| + 2                                                                             | Status    | Unsigned8 | Status of value   |
| + 3                                                                             | Unit code | Unsigned8 | Unit of value     |

| <b>DI (Digital Input)</b>                                                       |        |           |                   |                     |
|---------------------------------------------------------------------------------|--------|-----------|-------------------|---------------------|
| These device variables are transmitted from measurement device to Modbus master |        |           |                   |                     |
| Register-Offset                                                                 | Name   | Data type | Description       |                     |
| + 0-1                                                                           | Value  | Unsigned8 | Measurement value | 0: False<br>1: True |
| + 2                                                                             | Status | Unsigned8 | Status of value   |                     |

| <b>AO (Analog Output)</b>                                                       |         |           |                   |
|---------------------------------------------------------------------------------|---------|-----------|-------------------|
| These device variables are transmitted from Modbus master to measurement device |         |           |                   |
| Register-Offset                                                                 | Name    | Data type | Description       |
| + 0-1                                                                           | Value   | Float     | Measurement value |
| + 2                                                                             | Status  | Unsigned8 | Status of value   |
| + 3                                                                             | Unicode | Unsigned8 | Unit of value     |

| <b>DO (Digital Output)</b>                                                      |        |           |                   |                           |
|---------------------------------------------------------------------------------|--------|-----------|-------------------|---------------------------|
| These device variables are transmitted from Modbus master to measurement device |        |           |                   |                           |
| Register-Offset                                                                 | Name   | Data type | Description       | Semantics                 |
| + 0-1                                                                           | Value  | Unsigned8 | Measurement value | 0: False<br>1...255: True |
| + 2                                                                             | Status | Unsigned8 | Status of value   |                           |

Each device variable is accompanied by a **Status** which provides information on the validity and therefore the usability of this device variable. The status can become the following values:

| Status | Quality      | Description                                                                                                  |
|--------|--------------|--------------------------------------------------------------------------------------------------------------|
| 0      | Good         | The value is valid and can be used by the application.                                                       |
| 1      | Uncertain    | The value of this device variable is not accurate. The application must decide whether it can use the value. |
| 2      | Bad          | The value of this device variable is not valid.                                                              |
| 3      | Not assigned | No data source is selected for this device variable.                                                         |

- i** The status of AO or DO device variables must be set to 0 (good) to be used by the device. Otherwise the device considers the value of this device variable as invalid.

### 3.8 Supported function codes

Function codes are used to define which read or write action is carried out via the Modbus protocol. The measuring device supports the following function codes:

| Code | Name                          | Description                                                                                                                                                                                                                                                                                                       | Application                                                                                                                                                 |
|------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 03   | Read holding register         | Master reads one or more Modbus registers from the device.<br>A maximum of 125 consecutive registers can be read with 1 telegram: 1 register = 2 bytes                                                                                                                                                            | Read device parameters with read and write access.<br>Example:<br>Read measurement value                                                                    |
| 04   | Read input register           | Master reads one or more Modbus registers from the device.<br>A maximum of 125 consecutive registers can be read with 1 telegram: 1 register = 2 bytes                                                                                                                                                            | Read device parameters with read access.<br>Example:<br>Read Heartbeat Monitoring                                                                           |
| 08   | Diagnostics                   | Master checks the communication connection to the measuring device.<br><br>The following codes are supported:<br><ul style="list-style-type: none"> <li>■ Sub function 00 = Return query data (loopback test)</li> <li>■ Sub function 02 = Return diagnostics register</li> </ul>                                 | Verify communication and read basic diagnostics information including NE 107 status signal.<br>More diagnostic information is available in input registers. |
| 16   | Write multiple registers      | Master writes a new value to multiple Modbus registers of the device. A maximum of 120 consecutive registers can be written with 1 telegram.<br>All registers that are addressed using the written registers must be writable, as otherwise the request may be responded to with an ILLEGAL DATA VALUE exception. | Write multiple device parameters.<br>Example:<br>Write set point values                                                                                     |
| 23   | Read/write multiple registers | Master reads and writes a maximum of 118 Modbus registers of the measuring device simultaneously with 1 telegram. Write access is executed <b>before</b> read access.                                                                                                                                             | Write and read multiple device parameters.<br>Example:<br>Read and write device variables with a single Modbus transaction                                  |

 Broadcast messages are only permitted with function codes 06, 16 and 23. Function code 08 is only supported for Modbus RS485.

 The measuring device does not make a distinction between function codes 03 and 04; these codes therefore yield the same result.

### 3.8.1 FC03 Read Holding Register

#### Request

|                       |        |                  |
|-----------------------|--------|------------------|
| Function code         | 1 Byte | 0x03             |
| Starting address      | 2 Byte | 0x0000 to 0xFFFF |
| Quantity of Registers | 2 Byte | 1 to 125 (0x7D)  |

#### Response

|                        |                                  |                           |
|------------------------|----------------------------------|---------------------------|
| Function code          | 1 Byte                           | 0x03                      |
| Byte Count             | 1 Byte                           | 2 * Quantity of Registers |
| Holding register value | (2 * Quantity of Registers) Byte | 2 to 250                  |

#### Error

|                |        |                      |
|----------------|--------|----------------------|
| Error code     | 1 Byte | 0x83                 |
| Exception code | 1 Byte | 01 or 02 or 03 or 04 |

### 3.8.2 FC04 Read Input Register

#### Request

|                       |        |                  |
|-----------------------|--------|------------------|
| Function code         | 1 Byte | 0x04             |
| Starting address      | 2 Byte | 0x0000 to 0xFFFF |
| Quantity of Registers | 2 Byte | 1 to 125 (0x7D)  |

#### Reply

|                        |                                  |                           |
|------------------------|----------------------------------|---------------------------|
| Function code          | 1 Byte                           | 0x04                      |
| Byte Count             | 1 Byte                           | 2 * Quantity of Registers |
| Holding register value | (2 * Quantity of Registers) Byte | 2 to 250                  |

#### Error

|                |        |                      |
|----------------|--------|----------------------|
| Error code     | 1 Byte | 0x84                 |
| Exception code | 1 Byte | 01 or 02 or 03 or 04 |

### 3.8.3 FC08 Diagnostics (only serial)

#### Request

|                       |            |      |
|-----------------------|------------|------|
| Function code         | 1 Byte     | 0x06 |
| Starting address      | 2 Byte     |      |
| Quantity of Registers | N x 2 Byte |      |

#### Reply

|                        |            |        |
|------------------------|------------|--------|
| Function code          | 1 Byte     | 1 Byte |
| Byte Count             | 2 Byte     |        |
| Holding register value | N x 2 Byte |        |

#### Error

|                |        |                |
|----------------|--------|----------------|
| Error code     | 1 Byte | 0x88           |
| Exception code | 1 Byte | 01 or 03 or 04 |

Subfunction 0x00: Return Query Data (Loopback)

#### Example Request

|                |                     |
|----------------|---------------------|
| Function code  | 0x08                |
| Subfunction    | 0x00                |
| Data (example) | 0x01 0x02 0x03 0x04 |

Response is identical to Request

|               |                     |
|---------------|---------------------|
| Function code | 0x08                |
| Subfunction   | 0x00                |
| Data          | 0x01 0x02 0x03 0x04 |

Subfunction 0x02: Return diagnostic register

Reads the parameter:

| Parameter        | Register | Bit   |                                        |
|------------------|----------|-------|----------------------------------------|
| MB_FC08_DIAGNOSE | 500      | 0     | Sensor 1 has a diagnostic message      |
|                  |          | 1     | Sensor 2 has a diagnostic message      |
|                  |          | 2     | Sensor 3 has a diagnostic message      |
|                  |          | 3     | Sensor 4 has a diagnostic message      |
|                  |          | 4     | Sensor 5 has a diagnostic message      |
|                  |          | 5     | Sensor 6 has a diagnostic message      |
|                  |          | 6     | Sensor 7 has a diagnostic message      |
|                  |          | 7     | Sensor 8 has a diagnostic message      |
|                  |          | 8     | General diagnostic message             |
|                  |          | 9..11 | Reserved = 0                           |
|                  |          | 12    | Status signal F (failure)              |
|                  |          | 13    | Status signal C (function check)       |
|                  |          | 14    | Status signal M (maintenance request)  |
|                  |          | 15    | Status signal S (out of specification) |

 The definition of the status signal complies with Namur recommendation NE 107 and is described in section 5.3.

### 3.8.4 FC16 Write Multiple Register

#### Request

|                       |                                  |                                  |
|-----------------------|----------------------------------|----------------------------------|
| Function code         | 1 Byte                           | 0x10                             |
| Starting address      | 2 Byte                           | 0x0000 to 0xFFFF                 |
| Quantity of Registers | 2 Byte                           | 0x0001 to 0x007B                 |
| Byte Count            | 1 Byte                           | (2 * Quantity of Registers) Byte |
| Register Value        | (2 * Quantity of Registers) Byte | value                            |

#### Response

|                       |        |                  |
|-----------------------|--------|------------------|
| Function code         | 1 Byte | 0x10             |
| Byte Count            | 2 Byte | 0x0000 to 0xFFFF |
| Quantity of Registers | 2 Byte | 1 to 123 (0x7B)  |

#### Error

|                |        |                      |
|----------------|--------|----------------------|
| Error code     | 1 Byte | 0x90                 |
| Exception code | 1 Byte | 01 or 02 or 03 or 04 |

### 3.8.5 FC23 Read/Write Multiple Register

#### Request

|                        |                         |                         |
|------------------------|-------------------------|-------------------------|
| Function code          | 1 Byte                  | 0x17                    |
| Read starting address  | 2 Byte                  | 0x0000 to 0xFFFF        |
| Quantity to read       | 2 Byte                  | 0x0001 to 0x007D        |
| Write starting address | 2 Byte                  | 0x0000 to 0xFFFF        |
| Quantity to write      | 2 Byte                  | 0x0001 to 0x0079        |
| Write byte count       | 1 Byte                  | 2 x (Quantity to write) |
| Write register value   | 2 x (Quantity to write) |                         |

#### Response

|               |            |        |
|---------------|------------|--------|
| Function code | 1 Byte     | 1 Byte |
| Byte Count    | 2 Byte     |        |
| Data          | N x 2 Byte |        |

#### Error

|                |        |                |
|----------------|--------|----------------|
| Error code     | 1 Byte | 0x97           |
| Exception code | 1 Byte | 01 or 03 or 04 |

 This function can be used to read or to write the complete process data with one Modbus transaction.

## 3.9 Register information

For an overview of device parameters with their respective Modbus register information, please refer to the "Modbus register information" section 7.3.

## 4 Commissioning

### 4.1 Modbus RS485

To ensure that a Modbus RS485 connection can be established with the device, it is first necessary to adjust the device's network settings (Bus address, Transmission Mode, Baud rate and Parity). The settings depend on the network into which the device is being integrated.

Menu: Setup/General settings/Extended setup/Modbus/Settings

| Menu/...d setup/Modbus/Settings |                  | OK |
|---------------------------------|------------------|----|
| Bus address                     | 247              |    |
| Transmission Mode               | RTU              |    |
| Baudrate                        | 19200            |    |
| Parity                          | Even (1 Stopbit) |    |
| Byte order                      | 1-0-3-2          |    |
| Watchdog                        | 5 s              |    |

|     |  |      |  |
|-----|--|------|--|
| ESC |  | SAVE |  |
|-----|--|------|--|

| Parameter         | Default value     | Selection                                                                                                                                                                                                                                    |
|-------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bus address       | 247               | 1 ... 247                                                                                                                                                                                                                                    |
| Transmission Mode | RTU               | RTU, ASCII                                                                                                                                                                                                                                   |
| Baud rate         | 19200             | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200                                                                                                                                                                                          |
| Parity            | Even (1 Stop bit) | Even (1 Stop bit), Odd (1 Stop bit), None (1 Stop bit), None (2 Stop bit)                                                                                                                                                                    |
| Byte order        | 1-0-3-2           | 1-0-3-2, 0-1-2-3, 2-3-0-1, 3-2-1-0                                                                                                                                                                                                           |
| Watchdog          | 5 s               | 0 ... 999, 0 = Watchdog is deactivated.<br><br>If the device does not receive a valid MODBUS request telegram, a diagnostic code S969 (Modbus Watchdog) and the red BF LED are set. The next valid Modbus request will remove this diagnose. |

The setting of the bus address with the Address-Switch of the module has priority over the menu setting. If a valid address is set, the bus address in the menu is read only.

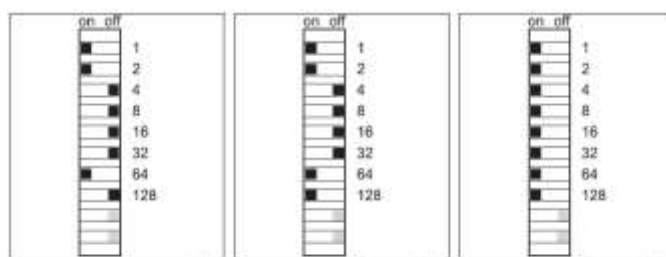


Fig. 70: Valid PROFIBUS address 67

Fig. 71: Valid Modbus address 195

Fig. 72: Invalid address 255 <sup>1)</sup>

1) Order configuration: software addressing is enabled, software address configured at the factory: PROFIBUS 126, Modbus 247

Valid bus addresses are between 1 and 247. If you configure an invalid address, software addressing is automatically enabled via the menu setting.

## 4.2 Modbus TCP

### 4.2.1 Ethernet

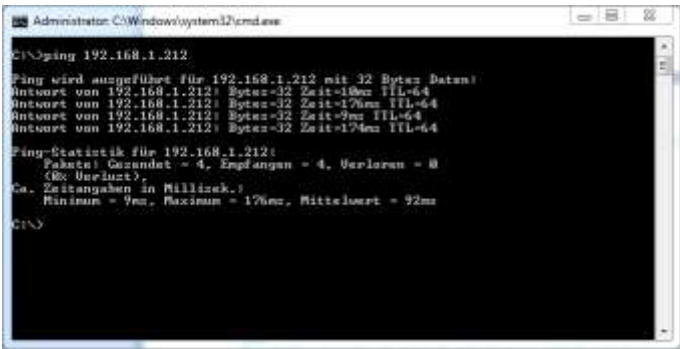
To ensure that a Modbus TCP connection can be established with the device, it is first necessary to adjust the device's network settings (IP address, subnet mask and gateway). The settings depend on the network into which the device is being integrated.

Menu: /Setup/General settings/Extended setup/Ethernet/Settings

| Menu/... setup/Ethernet/Settings |                   | OK   |
|----------------------------------|-------------------|------|
| IP-Address mode                  | DHCP              |      |
| DHCP                             | On                |      |
| IP-Address                       | 0.0.0.0           |      |
| Netmask                          | 255.255.255.0     |      |
| Gateway                          | 0.0.0.0           |      |
| Service switch                   | Off               |      |
| MAC-Address                      | 00:00:00:00:00:00 |      |
| Modbus TCP Port                  | 502               |      |
| ESC                              |                   | SAVE |

| Parameter       | Default value | Selection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IP-Address mode | DHCP          | <p>DHCP:</p> <p>If a DHCP server is used within the TCP/IP network, the IP address, gateway and subnet mask are set automatically when the DHCP client function is enabled. The DHCP client function is enabled when the measuring device is delivered. The DHCP client function is activated by default but can be disabled in the "Ethernet settings" menu.</p> <p>Software:</p> <p>The network settings can be edited in the menu.</p> <p>Hardware:</p> <p>The low-byte of the IP-Address can be set with the DIP switch located on the front of the 485/ETH module. The other parts of the IP-Address are unchanged. This allows you to set the higher 3 bytes using e.g. software addressing and the low-byte by Hardware.</p> |
| DHCP            | On            | Off, On                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| IP-Address      | 0.0.0.0       | Valid IP address                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Netmask         | 255.255.255.0 | Valid Netmask                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Gateway         | 0.0.0.0       | IP-Address of Gateway (optional)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Service switch  |               | <p>The service switch is located on the module. While this switch is in position "On", the following network settings are active:</p> <p>IP-Address = 192.168.1.212</p> <p>Netmask = 255.255.255.0</p> <p>Gateway = 0.0.0.0</p> <p>When returning the switch to "Off", the original network settings are restored.</p>                                                                                                                                                                                                                                                                                                                                                                                                              |
| MAC-Address     |               | <p>The MAC address is imprinted on the communication module or can be read via the menu. The MAC address of the measuring device is used for identification purposes and is uniquely and permanently assigned in the factory.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Modbus TCP Port | 502           | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

The device implements the ICMP protocol. The "ping" command allows you to check if the measuring device is accessible via the network.



4.2.2 Modbus

Menu: /Setup/General settings/Extended setup/Modbus/Settings

|                                 |         |    |
|---------------------------------|---------|----|
| Menu/...d setup/Modbus/Settings |         | OK |
| Transmission Mode               | TCP     |    |
| Byte order                      | 1-0-3-2 |    |
| Watchdog                        | 5 s     |    |

|     |  |  |      |  |
|-----|--|--|------|--|
| ESC |  |  | SAVE |  |
|-----|--|--|------|--|

| Parameter         | Factory default | Selection                                                                                                                                                                                                                                   |
|-------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Transmission Mode | 247             | 1 ... 247                                                                                                                                                                                                                                   |
| Byte order        | 1-0-3-2         | Byte transmission sequence<br>1-0-3-2, 1-0-2-3, 2-3-0-1, 3-2-1-0                                                                                                                                                                            |
| Watchdog          | 5 s             | 0 ... 999, 0 = Watchdog is deactivated<br><br>If the device does not receive a valid MODBUS request telegram, a diagnostic code S969 (Modbus Watchdog) and the red BF LED are set. The next valid Modbus request will remove this diagnose. |

4.3 Configuration of the Modbus output: device variables

A device variable acts as a kind of place holder for measured values or actuating values that can be transmitted via Modbus communication.

The device platform is based on a modular multi-channel, plug & play sensor concept. Therefore, there is no general relationship between the sensor measured value and a device variable. The data sources for the device variables must be selected by the user as required of the application.

Data sources for device variables are configured in the menu Setup/Outputs like data sources for other outputs like 4...20 mA current outputs. Data sinks for device variables are selected in the menu of the consuming component, e.g. a PID controller or a sampling program.

### 4.3.1 Select analog data sources for device variables AI

The value mapped to a device variable AI must be configured in the menu:  
/Setup/Outputs/Modbus/AI 1 (Analog Input) ... AI 16 (Analog Input)

| Function       | Options                                                                                                                                                               | Info                                                                                                                                                                                                                                                                                                    |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source of data | Options <ul style="list-style-type: none"> <li>None</li> <li>Any data source</li> </ul> Factory setting <ul style="list-style-type: none"> <li>None</li> </ul>        | The data sources presented for selection depend on your device version. You can choose from all the sensors connected to the inputs, controllers as well as mathematic functions and current inputs.<br><br>For more information and an overview about the available options see main operation manual. |
| Measured value | Options <ul style="list-style-type: none"> <li>None</li> <li>Depends on data source</li> </ul> Factory setting <ul style="list-style-type: none"> <li>None</li> </ul> | The measured value that you can choose depends on the option selected under "Source of data".<br><br>For more information and an overview about the available options see main operation manual.                                                                                                        |
| Unit           | Options <ul style="list-style-type: none"> <li>Any compatible unit</li> </ul>                                                                                         |                                                                                                                                                                                                                                                                                                         |
| Unit text      | Textual unit                                                                                                                                                          | Visible only for user defined units                                                                                                                                                                                                                                                                     |
| Hold behavior  | Options <ul style="list-style-type: none"> <li>Freeze last value</li> <li>Status only</li> </ul>                                                                      | Behavior in device or sensor hold state <ul style="list-style-type: none"> <li>The last value is hold</li> <li>A hold does not affect the value</li> </ul>                                                                                                                                              |

| Example |                                                                                 |        |
|---------|---------------------------------------------------------------------------------|--------|
| Step    | Action                                                                          | Result |
| 1       | Enter menu<br>/Setup/Outputs/Modbus                                             |        |
| 2       | Select an AI device variable, e.g. AI1                                          |        |
| 3       | Select data source and measurement value<br>Select unit<br>Select hold behavior |        |

After these steps the value, status and unit code can be read from Modbus holding register 0...3.

### 4.3.2 Select digital data sources for device variables DI

The value mapped to a device variable DI must be configured in the menu:

Menu: /Setup/Outputs/Modbus/DI 1 (Digital Input) ... DI 8 (Digital Input)

| Function                    | Options                                                                                                                                                                                                                              | Info                                                                                                                     |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Function                    | Options <ul style="list-style-type: none"> <li>• Off</li> <li>• Source value</li> <li>• Diagnostics</li> </ul> Factory setting <ul style="list-style-type: none"> <li>• Off</li> </ul>                                               |                                                                                                                          |
| If Function = Source value: |                                                                                                                                                                                                                                      |                                                                                                                          |
| Source of data              | Options <ul style="list-style-type: none"> <li>• None</li> <li>• Limit switches</li> <li>• Alarm relay</li> <li>• Relay</li> <li>• Binary inputs</li> </ul> Factory setting <ul style="list-style-type: none"> <li>• None</li> </ul> | The data sources presented for selection depend on your device configuration. For more information see operating manual. |
| Hold behavior               | Options <ul style="list-style-type: none"> <li>• Freeze</li> <li>• None</li> </ul> Factory setting<br>None                                                                                                                           | For more information see operating manual.                                                                               |
| If Function = Diagnostics:  |                                                                                                                                                                                                                                      |                                                                                                                          |
| Operating mode              | Options <ul style="list-style-type: none"> <li>• as assigned</li> <li>• Namur M</li> <li>• Namur S</li> <li>• Namur C</li> <li>• Namur F</li> </ul> Factory setting <ul style="list-style-type: none"> <li>• as assigned</li> </ul>  | For more information see operating manual.                                                                               |

### 4.3.3 Select analog data sinks for device variables AO

The value mapped to a device variable AO must be configured in the menu of the component using the device variable as input. A device variable AO is used to transmit an analog value to the measuring device instead of using a 4...20 mA current input of the measuring device.

 A device variable AO correspond to a current input and has the same connection possibilities.

#### 4.3.3.1 Example: Value of controlled variable of PID controller from Modbus

Menu: /Setup/General Settings/Additional functions/Controller 1/Controlled variable

Menu...oller 1/Controlled variable S  
 Source of data Modbus  
 Input mode Modbus AO 01

ESC

#### 4.3.3.2 List of data sinks

| CM44x | CM44P | CSFxx | CA80xx | Menu                                                                          |
|-------|-------|-------|--------|-------------------------------------------------------------------------------|
| x     | x     | x     | x      | Setup/Additional functions/Limit switches/.../Source of data                  |
| x     | x     | x     | x      | Setup/Additional functions/Controllers/.../Controlled variable/Source of data |
| x     | x     | x     | x      | Setup/General settings/Logbooks/Data logbooks/Source of data                  |
| x     | x     | x     | x      | Display/User definable screens/.../Source of data                             |
| x     | x     | x     | x      | Setup/Inputs/Conductivity/Temperature source                                  |

### 4.3.4 Select digital data sinks for device variables DO

The value mapped to a device variable DO must be configured in the menu of the component using the device variable as input. A device variable DO is used to transmit an analog value to the measuring device instead of using a binary input of the measuring device.

 A device variable DO correspond to a binary input and has the same connection possibilities.

#### 4.3.4.1 Example: Hold over Modbus

Menu: /Setup/General Settings/Hold Settings/External Hold

Multiple DO signals can be selected. If at least one of these signals is set (1), the hold function is active.

Menu...old settings/External hold S  
☐ Binary input 6:1  
☒ Binary input 6:2  
☐ Modbus DO 01  
☐ Modbus DO 02  
☐ Modbus DO 03  
☒ Modbus DO 04  
☒ Modbus DO 05  
☐ Modbus DO 06  
 ESC ALL NONE OK

#### 4.3.4.2 Example: Enable or disable PID controller

Menu: /Setup/General Settings/Additional functions/Controller 1/

Menu...s/Controllers/Controller 1 ☐ OK

|                       |                    |
|-----------------------|--------------------|
| Control               | Automatic          |
| ► Manual mode         |                    |
| Name                  | name of controller |
| Controller Enable     | Modbus DO 01       |
| Setup Level           | Standard           |
| Process type          | Inline             |
| Controller type       | PID 2-sided        |
| ► Controlled variable |                    |

ESC CAL DIAG

#### 4.3.4.3 List of data sinks

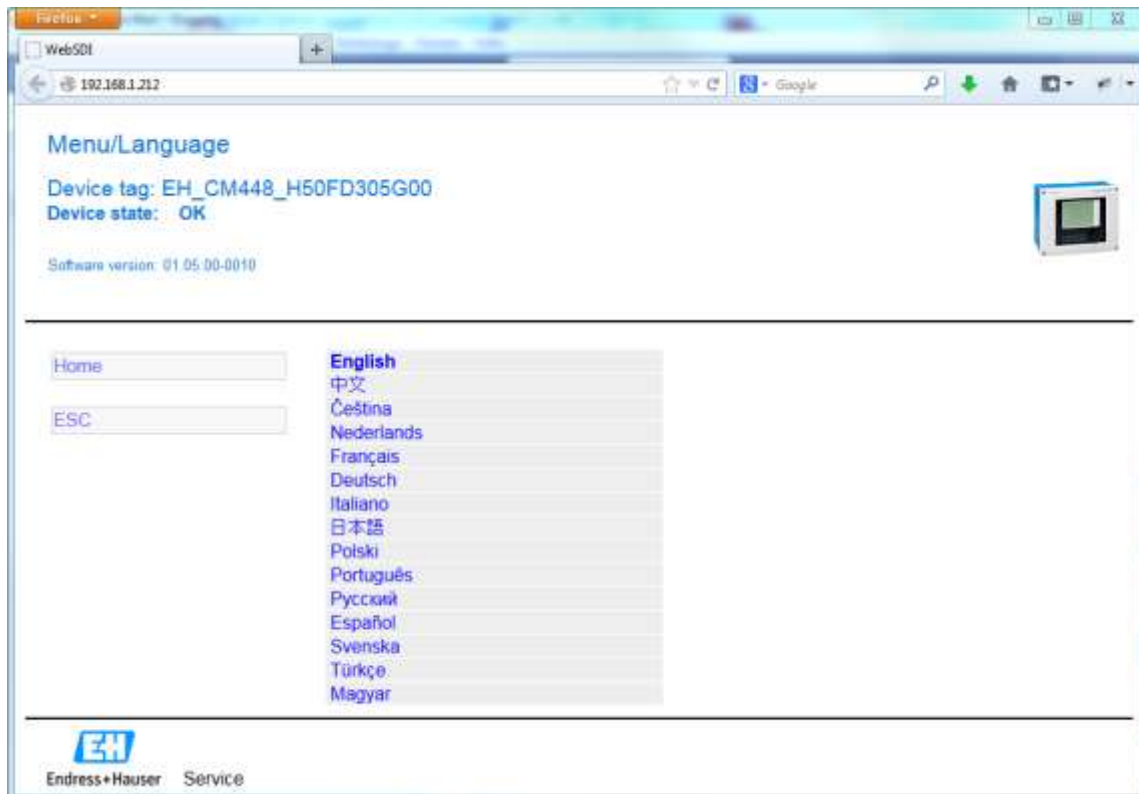
| CM44x | CM44P | CSFxx | CA80xx | Menu                                                           |
|-------|-------|-------|--------|----------------------------------------------------------------|
| x     | x     | x     | x      | Setup/Additional functions/Controllers/.../Controller Enable   |
| x     | x     | x     | x      | Setup/Additional functions/Cleaning/.../Start signal           |
| x     | x     | x     | x      | Setup/General settings/Hold settings/External hold             |
| x     | x     | x     | x      | Setup/General settings/Logbooks/Data logbooks/Source of data   |
| x     | x     | x     | x      | Setup/Inputs/Sensor/Extended setup/External hold/Source        |
| x     | x     | x     | x      | Display/User definable screens/.../Source of data              |
| x     | x     | x     | x      | Setup/Additional functions/Diagnostic modules                  |
| x     | x     | x     | x      | Setup/Inputs/Oxygen/Extended setup/Input pressure              |
| x     | x     | x     | x      | Setup/Additional functions/Mathematical functions/MF X/Formula |
| x     | x     | x     | x      | Setup/Additional functions/Measuring range switch/MRS set X    |
|       | x     |       |        | Setup/Inputs/Photometer/Lamp control input                     |
|       | x     |       |        | Setup/Inputs/Photometer/Extended Setup/Ext. dataset control    |
|       |       | x     |        | Sample-Program/Programsetup/Advanced/Startcondition            |
|       |       | x     |        | Sample-Program/Programsetup/Advanced/Startsignal               |
|       |       | x     |        | Sample-Program/Programsetup/Advanced/Stopcondition             |
|       |       | x     |        | Sample-Program/Programsetup/Advanced/Stopsignal                |
|       |       | x     |        | Sample-Program/Advanced/Subprogramsetup/Samplemode             |
|       |       | x     |        | Sample-Program/Advanced/Subprogramsetup/Samplesignal           |
|       |       | x     |        | Sample-Program/Advanced/Subprogramsetup/Bottle change          |
|       |       | x     |        | Sample-Program/Advanced/Subprogramsetup/Change signal          |
|       |       | x     |        | Sample-Program/Advanced/Subprogramsetup/Change signal          |
|       |       | x     |        | Sample-Program/Advanced/Subprg.setup/Subprogram-Activation     |
|       |       | x     |        | Sample-Program/Advanced/Subprogramsetup/Activationsignal       |

## 4.4 Web server

### 4.4.1 Function description

You can remotely access local device operation via the integrated Web server.

All the languages of the local operation system are supported.



### 4.4.2 Security

Please note that communication via the HTTP protocol is not encrypted.

The Web server does support Basic HTTP Authentication.

A factory default reset resets the access data to the default login.

You can disable the Web server via the menu:

Setup/General settings/Extended setup/Webserver → Webserver (on/off)

Furthermore, the Web server can also be disabled via Modbus Register 519 (WEBSERVER\_ENABLE). This allows you to control access for the Web server via Modbus.

### 4.4.3 Web server settings

Menu/Setup/General settings/Extended setup/Webserver

Device tag: EH\_CM448\_EA06BD05G00  
Device state: OK

Software version: 01.05.00-0021




---

Home  
ESC  
CAL  
DIAG

**Webserver** On  
Webserver TCP Port 80  
Webserver login On  
▶ User administration

---

 Endress+Hauser Service

| Parameter           | Options             | Info                                                                                                                                     |
|---------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Web server          | On (default)<br>Off | When the Web server is disabled it is not possible to access the Web server via any interface (Ethernet, CDI or DTM).                    |
| Web server TCP port | 80                  | Fixed value                                                                                                                              |
| Web server login    | On (default)<br>Off |                                                                                                                                          |
| User administration | Wizard              | You can change the user name and/or the user password. You require the access data that are currently valid to change the name/password. |

#### 4.4.4 Web server login

The following access data are pre-programmed into the device when the device is delivered:

User name: admin  
Password: admin

 Please note that communication via the HTTP protocol is not encrypted. The user name and the password are transmitted as non-encrypted information.

#### 4.4.5 Exporting the logbooks

The logbooks can be exported via the Web server and saved to a PC. Open a Web browser and enter one of the following URLs to get to an overview page.

[http://<IP address>/logbooks\\_csv.fhtml](http://<IP address>/logbooks_csv.fhtml)

This file format can be read with any text editor or can be imported into Microsoft Excel, for instance. Separator: ";"

[http://<IP address>/logbooks\\_fdm.fhtml](http://<IP address>/logbooks_fdm.fhtml)

This data format can be imported into the Endress+Hauser Field Data Manager Software:

<http://www.endress.com/MS20>

#### 4.4.5.1 Web server login

Device software version 1.05.00 and higher supports login to the Web server using HTTP Basic Authentication. The user must be logged in to view the logbook overview. The individual logbooks can be downloaded directly without the need to log in beforehand.

#### 4.4.5.2 Direct URLs of the logbooks

| *.csv                                         | *.dat                                         |
|-----------------------------------------------|-----------------------------------------------|
| http://<IP address>/Calibration_logbook.csv   | http://<IP address>/Calibration_logbook.dat   |
| http://<IP address>/Diagnostic_logbook.csv    | http://<IP address>/Diagnostic_logbook.dat    |
| http://<IP address>/Configuration_logbook.csv | http://<IP address>/Configuration_logbook.dat |
| http://<IP address>/HW_version_logbook.csv    | http://<IP address>/HW_version_logbook.dat    |
| http://<IP address>/Version_logbook.csv       | http://<IP address>/Version_logbook.dat       |
| http://<IP address>/Data0_logbook.csv         | http://<IP address>/Data0_logbook.dat         |
| http://<IP address>/Data1_logbook.csv         | http://<IP address>/Data1_logbook.dat         |
| http://<IP address>/Data2_logbook.csv         | http://<IP address>/Data2_logbook.dat         |
| http://<IP address>/Data3_logbook.csv         | http://<IP address>/Data3_logbook.dat         |
| http://<IP address>/Data4_logbook.csv         | http://<IP address>/Data4_logbook.dat         |
| http://<IP address>/Data5_logbook.csv         | http://<IP address>/Data5_logbook.dat         |
| http://<IP address>/Data6_logbook.csv         | http://<IP address>/Data6_logbook.dat         |
| http://<IP address>/Data7_logbook.csv         | http://<IP address>/Data7_logbook.dat         |

 The \*.dat format can be used for data import into the Endress+Hauser Field Data Manager Software.

### 4.5 Exporting Heartbeat Verification Report

The last Heartbeat Verification Report can be downloaded from:

http://<IP-Adresse>/heartbeat.fhtml



## 5 Diagnostics

Diagnostic information for the device is provided through various mechanisms:

- LEDs of the 485/ETH module
- Status of device variables
- Modbus registers

### 5.1 LED displays

| LED  | Name                   | Color  | Info                                                                                    |
|------|------------------------|--------|-----------------------------------------------------------------------------------------|
| RJ45 | LNK/ACT                | Green  | off = Connection inactive<br>on = Connection is enabled<br>Flashing = Data transmission |
| RJ45 | 10/100                 | Yellow | off = Transmission rate 10 MBit/s<br>on = Transmission rate 100 MBit/s                  |
| PWR  | Power (Voltage supply) | Green  | Supply voltage is present, and module is initialized.                                   |
| BF   | Bus Failure            | Red    | Bus Failure                                                                             |
| SF   | System Failure         | Red    | Device error                                                                            |
| COM  | Communication          | Yellow | Modbus telegram is being received or used.                                              |
| T    | Bus Termination        | Yellow | off = No termination<br>on = Termination is used                                        |

### 5.2 Status of device variables

The status information of a device variable provides information about its validity and usability. It should be evaluated in the PLC program. Device variables AO/DO transmit from the PLC have to be sending with a status "good" to be used by the device.

For more information about the encoding of the status see section 3.7.

### 5.3 Status signal

The status signal is in accordance with NAMUR recommendation NE 107.

| Signal | Diagnostics category | Description                                                                                                                                                                                                                                       |
|--------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| F      | Failure              | The measured value of the affected channel is no longer reliable. The cause can be found in the measuring point. Any control unit that may be connected should be switched to manual operation.                                                   |
| C      | Function Check       | Maintenance work is being carried out on the device. Wait until it is completed.                                                                                                                                                                  |
| S      | Out of Specification | The measuring point is being operated out of specification. Operation is still possible. However, there is the risk of increased wear and tear, a shorter operating life or reduced accuracy. The cause can be found outside the measuring point. |
| M      | Maintenance required | The measurement functionality is still available. There is no immediate need for action. However, maintenance will prevent the future occurrence of possible faults.                                                                              |

The status signal can be read via the Modbus diagnostic function code #08 or directly as a parameter.

| Parameter        | Input Register | Bit   |                                        |
|------------------|----------------|-------|----------------------------------------|
| MB_FC08_DIAGNOSE | 500            | 0     | Sensor 1 has a diagnostic message      |
|                  |                | 1     | Sensor 2 has a diagnostic message      |
|                  |                | 2     | Sensor 3 has a diagnostic message      |
|                  |                | 3     | Sensor 4 has a diagnostic message      |
|                  |                | 4     | Sensor 5 has a diagnostic message      |
|                  |                | 5     | Sensor 6 has a diagnostic message      |
|                  |                | 6     | Sensor 7 has a diagnostic message      |
|                  |                | 7     | Sensor 8 has a diagnostic message      |
|                  |                | 8     | General diagnostic message             |
|                  |                | 9..11 | Reserved = 0                           |
|                  |                | 12    | Status signal F (failure)              |
|                  |                | 13    | Status signal C (function check)       |
|                  |                | 14    | Status signal M (maintenance required) |
|                  |                | 15    | Status signal S (out of specification) |

 The FCMS error category can be adapted individually for each diagnostic message.

For device related diagnostic messages:

Menu: Setup/General settings/Extended setup/Diagnostics settings/Diag. behavior

For sensor related diagnostic messages:

Menu: Setup/Inputs/<Sensor>/Extended setup/Diagnostics settings/Diag. behavior

## 5.4 Diagnostic messages

Via Modbus registers, the device provides detailed information on the current diagnostic message with the highest priority and the last diagnostic message to be displayed. This information is available for the device and for each sensor.

The diagnostic codes and the corrective measures which can be taken based on the error code, are described in the Operating Instructions "Maintenance & diagnostics".

### 5.4.1 Device related diagnostics

Current, active diagnostic message with the highest priority:

| Parameter                        | Input Register | Data Type  | Info                                                                                                                                  |
|----------------------------------|----------------|------------|---------------------------------------------------------------------------------------------------------------------------------------|
| DEVICE_CURRENT_DIAG_MODUL        | 504            | UNSIGNED16 | Slot number 0 to 7 of the module.                                                                                                     |
| DEVICE_CURRENT_DIAG_PORT         | 505            | UNSIGNED8  | Connection 0 to 3 on the module.                                                                                                      |
| DEVICE_CURRENT_DIAG_NE107_STATUS | 506            | UNSIGNED8  | Bit 0: Failure (F)<br>Bit 1: Function check (C)<br>Bit 2: Maintenance (M)<br>Bit 3: Out of specification (S)<br>Bit 4-7: Reserved = 0 |
| DEVICE_CURRENT_DIAG_CODE         | 507            | UNSIGNED16 | Diagnostic code (0 to 999)                                                                                                            |
| DEVICE_CURRENT_DIAG_TIMESTAMP    | 508            | UNSIGNED32 | Time stamp (seconds since                                                                                                             |

| Parameter                     | Input Register | Data Type | Info                                                                                                                                                                  |
|-------------------------------|----------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               |                |           | 1.1.1970)                                                                                                                                                             |
| DEVICE_NUMBER_ADDITIONAL_DIAG | 510            | UNSIGNED8 | Number of low-priority diagnostic messages present at the same time: A complete list of all diagnostic messages can be found on the onsite display or the web server. |

Last diagnostic message to be displayed:

| Parameter                     | Input Register | Data Type  | Info      |
|-------------------------------|----------------|------------|-----------|
| DEVICE_LAST_DIAG_MODUL        | 512            | UNSIGNED8  | see above |
| DEVICE_LAST_DIAG_NE107_STATUS | 514            | UNSIGNED8  |           |
| DEVICE_LAST_DIAG_PORT         | 513            | UNSIGNED8  |           |
| DEVICE_LAST_DIAG_CODE         | 515            | UNSIGNED16 |           |
| DEVICE_LAST_DIAG_TIMESTAMP    | 516            | UNSIGNED32 |           |

## 5.4.2 Sensor related diagnostics

For each of the 8 sensors, the current diagnostic message and the last diagnostic message to be displayed can be read independently of each other via Modbus.

X = 1 (sensor 1) to 8 (sensor 8)

### 5.4.2.1 Current diagnostic message

| Parameter                          | Input Register | Data Type  | Info                                                                                                                                                                    |
|------------------------------------|----------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SENSOR_X_CURRENT_DIAG_MODUL        | X*1000+92      | UNSIGNED16 | Slot number 0 to 7 of the module.                                                                                                                                       |
| SENSOR_X_CURRENT_DIAG_PORT         | X*1000+93      | UNSIGNED8  | Connection 0 to 3 of the module.                                                                                                                                        |
| SENSOR_X_CURRENT_DIAG_NE107_STATUS | X*1000+94      | UNSIGNED8  | Status signal as per NE107:<br>Bit 0: Failure (F)<br>Bit 1: Function check (C)<br>Bit 2: Maintenance (M)<br>Bit 3: Out of specification (S)<br>Bit 4-7: Reserved = 0    |
| SENSOR_X_CURRENT_DIAG_CODE         | X*1000+95      | UNSIGNED16 | Diagnostic code (0 to 999)                                                                                                                                              |
| SENSOR_X_CURRENT_DIAG_TIMESTAMP    | X*1000+96      | UNSIGNED32 | Time stamp (seconds since 1.1.1970)                                                                                                                                     |
| SENSOR_X_NUMBER_ADDITIONAL_DIAG    | X*1000+98      | UNSIGNED8  | Number of simultaneously occurring lower-priority diagnostic messages. A complete list of all diagnostic messages can be found on the onsite display or the web server. |

### 5.4.2.2 Last active diagnostic message

| Parameter                       | Input Register | Data Type  | Info      |
|---------------------------------|----------------|------------|-----------|
| SENSOR_X_LAST_DIAG_MODUL        | X*1000+100     | UNSIGNED8  | see above |
| SENSOR_X_LAST_DIAG_PORT         | X*1000+101     | UNSIGNED8  |           |
| SENSOR_X_LAST_DIAG_NE107_STATUS | X*1000+102     | UNSIGNED8  |           |
| SENSOR_X_LAST_DIAG_CODE         | X*1000+103     | UNSIGNED16 |           |
| SENSOR_X_LAST_DIAG_TIMESTAMP    | X*1000+104     | UNSIGNED32 |           |

## 5.5 Communication related diagnostics

### 5.5.1 Bus termination

Each Modbus segment must be terminated at each end using a bus terminator resistor.

The device has a terminating resistor with on/off switch. The status of this terminating resistor is displayed via the T-LED on the communication module and can also be read via the device menu or Modbus.

Menu: Diagnostics/System information/Modbus

|                                 |     |   |
|---------------------------------|-----|---|
| Menu...ystem information/Modbus |     | S |
| Enable                          | On  |   |
| Bus address                     | 247 |   |
| Termination                     | Off |   |

ESC

| Parameter               | Input Register | Data Type | Info                                                                          |
|-------------------------|----------------|-----------|-------------------------------------------------------------------------------|
| RS485_TERMINATION_STATE | 941            | UNSIGNED8 | 0 = RS485 terminating resistor is OFF<br>1 = RS485 terminating resistor is ON |

### 5.5.2 Protocol counters

The device monitors communication and makes error counters available. The error counters can be read via Modbus. The protocol counters can be accessed with user role Expert at the device:

Menu: Expert/Diagnostics/System information/Modbus

|                                 |     |   |
|---------------------------------|-----|---|
| Menu...ystem information/Modbus |     | S |
| Enable                          | On  |   |
| Bus address                     | 247 |   |
| Termination                     | Off |   |
| ▷ Reset Statistics              |     |   |
| Valid Frames                    | 0   |   |
| Invalid Frames                  | 0   |   |
| Parity error                    | 0   |   |
| Framing error                   | 0   |   |
| ESC                             |     |   |

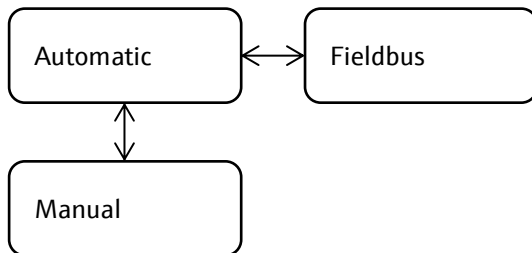
## 6 Applications

### 6.1 CA80xx: How to start Measurement, Calibration and Cleaning

 This chapter applies only to the Liquiline CA80xx analyzer.

The actions "Measurement", "Calibration" and "Cleaning" can be controlled by Modbus while the analyzer is in the operation mode "Fieldbus".

The operation mode "Fieldbus" can be activated either by Modbus or the device menu.



#### 6.1.1 Activate "Fieldbus"-mode using the device menu

| Step | Action                                                                                   | Result                                                                                                                                                                                                 |
|------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Press the soft key "MODE" to enter the menu in which the operation mode can be selected. | <pre> Menu/...asic setup analyzer/Mode      OK Current mode      Automatic ▷ Manual mode ▷ Fieldbus mode ▷ Abort all actions ▷ Hold ▶ Info  ESC [ ] [ ] [ ] [ ] </pre>                                 |
| 2    | Activate the "Fieldbus mode".                                                            | <pre> Menu/...asic setup analyzer/Mode      OK Current mode      Fieldbus ▷ Manual mode ▷ Continue automatic mode ▷ Start automatic mode ▷ Abort all actions ▷ Hold ▶ Info  ESC [ ] [ ] [ ] [ ] </pre> |

The operation mode can be changed at any time using the device menu. The setting of the device menu has priority over the setting by Modbus. This is a safety measure to prevent the start of actions over Modbus while the analyzer is in operation mode "Manual" during maintenance work.

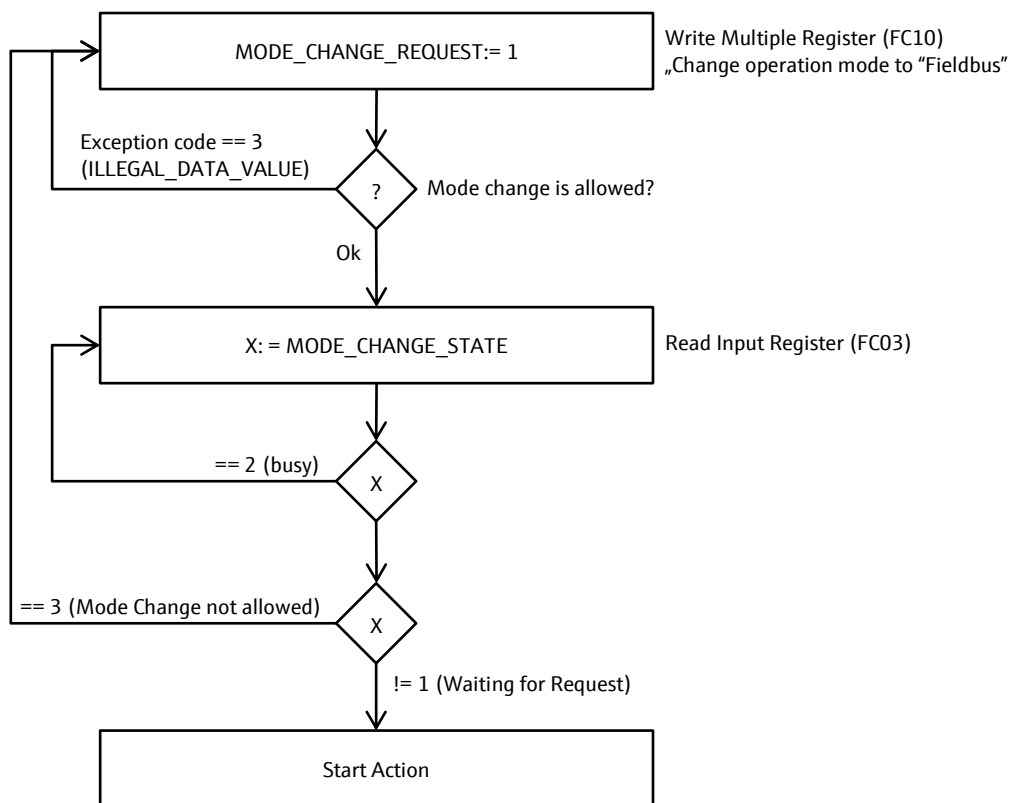
**Important:**

A change from "Manual" directly to "Fieldbus" is now allowed by Modbus. Modbus can only change the operation mode from "Automatic" to "Fieldbus".

### 6.1.2 Activate "Fieldbus"-mode using Modbus

The following diagram shows an example sequence without error handling. The application program should at least consider the following additional cases:

- The analyzer is not reachable by Modbus communication, e.g. because it is switched off
- A write access to a register fails and an exception code is returned in the Modbus reply
- A read access to a register fails and an exception code is returned in the Modbus reply
- The analyzer is switched temporarily to manual mode during maintenance



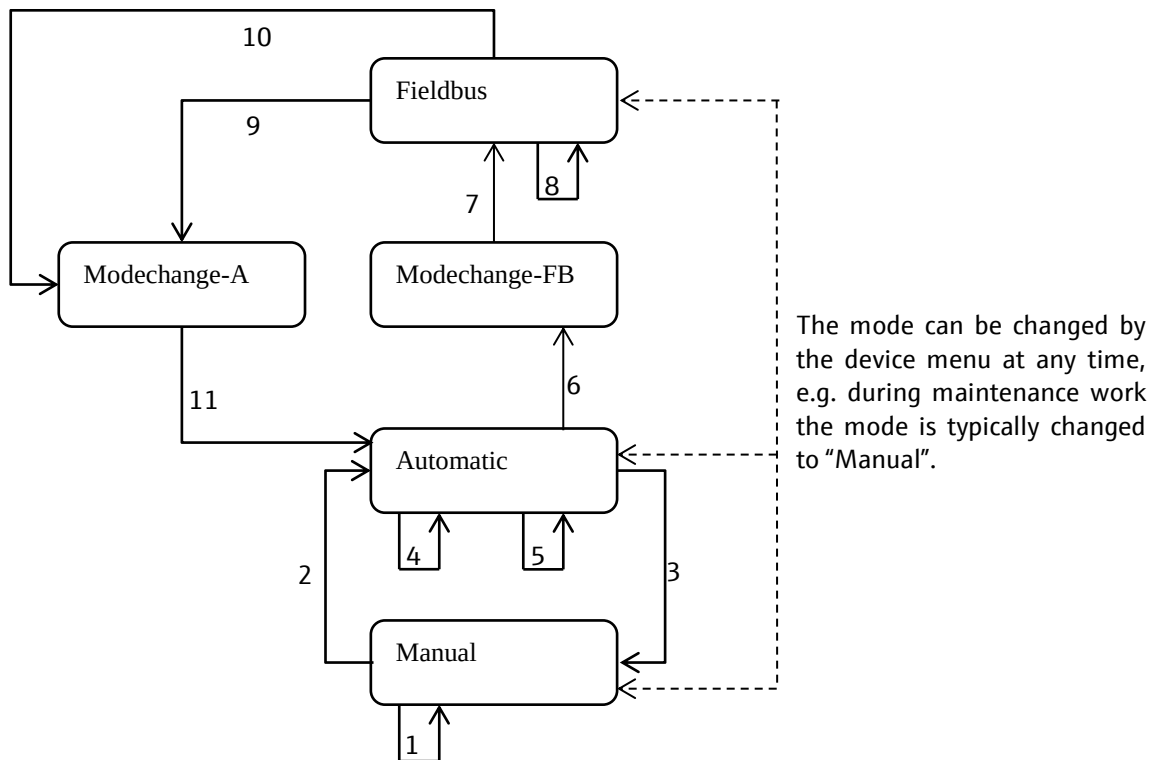
The following examples in Pseudocode show how a program can access the functionality over Modbus.

```

// Example program (Pseudocode)
Write ModeChangeRequest "Fieldbus"
IF Write access returns error
  Abort procedure with error
DO
  Read ModeChangeStatus
  WHILE ModeChangeStatus is "Busy"
  IF ModeChangeStatus is NOT "WaitingForRequest"
    Abort procedure with error
  // now fieldbus mode is active
  
```

### 6.1.3 State machine

The following state diagram describes the operation mode and state transitions.



**Important:**

A change of the operation mode does not interrupt a pending action. A new action can only be started after the pending action has finished or is aborted.

| #  | Current state | Condition → Action                                                                                                                             | Next state     |
|----|---------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1  | Manual        | → MODE_CHANGE_STATE:=3, ACTION_REQUEST_STATE:=2                                                                                                | Manual         |
| 2  | Manual        | Mode Automatic →<br>MODE_CHANGE_STATE:=1, ACTION_REQUEST_STATE:=2                                                                              | Automatic      |
| 3  | Automatic     | Mode Manual →<br>MODE_CHANGE_STATE:=3, ACTION_REQUEST_STATE:=2                                                                                 | Manual         |
| 4  | Automatic     | MODE_CHANGE_REQUEST:=0 →<br>MODE_CHANGE_STATUS:=1, ACTION_REQUEST_STATE:=2                                                                     | Automatic      |
| 5  | Automatic     | MODE_CHANGE_REQUEST:=1<br>and mode change is not possible →<br>MODE_CHANGE_STATE:=3, ACTION_REQUEST_STATE:=2                                   | Automatic      |
| 6  | Automatic     | MODE_CHANGE_REQUEST:=1<br>and mode change is accepted →<br>MODE_CHANGE_STATUS:=2, ACTION_REQUEST_STATE:=2                                      | Modechange -FB |
| 7  | Modechange-FB | Mode change finished →<br>ACTION_REQUEST_STATE:=1, ACTION_REQUEST_STATE:=0                                                                     | Fieldbus       |
| 8  | Fieldbus      | See "Fieldbus status machine"                                                                                                                  | Fieldbus       |
| 9  | Fieldbus      | MODE_CHANGE_REQUEST:=2 →<br>MODE_CHANGE_STATUS:=2                                                                                              | Modechange -A  |
| 10 | Fieldbus      | MODE_CHANGE_REQUEST:=3 →<br>MODE_CHANGE_STATE:=1,<br>ACTION_REQUEST_STATE:=2,<br>Time-controlled programs are restarted with the current time. | Modechange -A  |
| 11 | Modechange -A | Mode changed finished →<br>MODE_CHANGE_STATE:=1, ACTION_REQUEST_STATE:=2                                                                       | Automatic      |

## 6.1.4 How-to execute actions

### 6.1.4.1 How-to execute a Measurement

The analyzer must be in the operation mode "Fieldbus" to start an action. The current operation mode can be verified by pressing the soft-key labeled "MODE" at the device menu or by reading the Modbus register MANUAL\_CHANGE\_STATUS.

```
// execute a measurement
Write AnalyzerRequest "Measurement"
IF Write access returns error
    Abort procedure with error
DO
    Read FunctionExecutionStatus
WHILE FunctionExecutionStatus is "Busy" OR
    FunctionExecutionStatus is "MeasurementInProgress"
IF FunctionExecutionStatus is NOT "MeasurementFinished"
    Abort procedure with error
// now measurement was successfully executed
```

If the user locally switches to manual or automatic the Modbus write requests gets an error response. An error is also, if a measurement shall be executed and another action is running (e.g. a calibration). As the above pseudo code shows, this will be detected as an error.

### 6.1.4.2 How-to run a Calibration

The analyzer must be in the operation mode "Fieldbus" to start an action. The current operation mode can be verified by pressing the soft-key labeled "MODE" at the device menu or by reading the Modbus register MANUAL\_CHANGE\_STATUS.

```
// execute a measurement
Write AnalyzerRequest "Measurement"
IF Write access returns error
    Abort procedure with error
DO
    Read FunctionExecutionStatus
WHILE FunctionExecutionStatus is "Busy" OR
    FunctionExecutionStatus is "MeasurementInProgress"
IF FunctionExecutionStatus is NOT "MeasurementFinished"
    Abort procedure with error
// now measurement was successfully executed
```

If the user locally switches to manual or automatic the Modbus write requests gets an error response. An error is also, if a measurement shall be executed and another action is running. As the above pseudo code shows, this will be detected as an error.

### 6.1.4.3 How-to start a Cleaning

The analyzer must be in the operation mode "Fieldbus" to start an action. The current operation mode can be verified by pressing the soft-key labeled "MODE" at the device menu or by reading the Modbus register MANUAL\_CHANGE\_STATUS.

```
// execute a measurement
Write AnalyzerRequest "Measurement"
IF Write access returns error
```

```

    Abort procedure with error
DO
    Read FunctionExecutionStatus
WHILE FunctionExecutionStatus is "Busy" OR
    FunctionExecutionStatus is "MeasurementInProgress"
IF FunctionExecutionStatus is NOT "MeasurementFinished"
    Abort procedure with error
// now measurement was successfully executed

```

If the user locally switches to manual or automatic the Modbus write requests gets an error response. An error is also, if a measurement shall be executed and another action is running. As the above pseudo code shows, this will be detected as an error.

#### 6.1.4.4 How-to abort an action

```

// "Abort" can be executed at any time
Write CommonRequest "AbortOfCurrentActivity"
IF Write access returns error
    Abort procedure with error
DO
    Read FunctionExecutionStatus
WHILE FunctionExecutionStatus is "AbortOfCurrentActivityInProgress"
IF FunctionExecutionStatus is NOT "AbortOfCurrentActivityFinished"
    Abort procedure with error

```

#### 6.1.4.5 Error evaluation

The examples in the former chapters show how to detect an error. How to handle an error may dependent from the cause of error.

Two errors can occur:

1. Write access fails and returns fieldbus specific error codes. In most cases the analyzer is in a state where it cannot execute the desired function. This can be checked by reading the parameters "OperationMode" and "FunctionExecutionStatus".
2. The parameter "FunctionExecutionStatus" has not the expected value. Since the PLC has already read the function execution status, it can rely on this value to check the cause of error, e.g.:
  - a. Other function is running or even finished or failed. So, another user accessed the analyzer and started this function.
  - b. The desired function failed. In most times a failure is signaled by a diagnosis that can be read via fieldbus specific mechanism, e.g. diagnosis parameters. Remark: The user shall be aware that the diagnosis may not reflect the function error because other diagnosis events might be triggered. All diagnosis events are logged.

Example for a simple error handling is to wait until device is available again:

```

DO
DO
    Write ModeChangeRequest "Fieldbus"
WHILE Write access returns error
DO
    Read ModeChangeStatus
WHILE ModeChangeStatus is "Busy"
WHILE ModeChangeStatus is NOT "WaitingForRequest"

```

**DO**

Write ResetRequest "ResetOfStatus"

**WHILE** Write access returns error

Of course, such a simple error handling will generate some traffic on Modbus.

This procedure is also recommended on startup of a PLC program. To limit traffic on fieldbus, it is enough to read or write the fieldbus every 15 seconds or even less frequently.

## 6.1.5 Modbus Registers

### Important:

The register addresses in the tables start with 0 as transmitted over the wire. Depending on the system it is necessary to add +1 to the register according the tables to access the parameters correctly.

### 6.1.5.1 Analyzer Manual Actions

The following parameters are available to switch into fieldbus mode, which enables the remote control over Modbus function, and to start an action and read back its progress.

| Register block | Analyzer Manual Actions       |       |           |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------|-------------------------------|-------|-----------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Register type  | Holding                       |       |           |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Function code  | 3 (Read Holding Registers)    |       |           |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                | 16 (Write Multiple Registers) |       |           |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Register       | Parameter                     | Bytes | Data Type | Access | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 9400           | MODE_CHANGE_REQUEST           | 1     | Unsigned8 | R/W    | <p>This parameter is used to control the active operation mode and can be written with the following values:</p> <p>0: None<br/>           1: Enter fieldbus mode.<br/>           The CA80xx changes from automatic mode to fieldbus mode.<br/>           2: Continue automatic mode:<br/>           The CA80xx changes from fieldbus mode to automatic mode continuing with the time schedule as it was calculated when entering automatic mode, the first time.<br/>           3: Restart automatic mode:<br/>           The system changes from fieldbus mode to automatic mode and restarts the time schedule with the current time as starting point.</p> |
| 9401           | ABORT_ACTION_REQUEST          | 1     | Unsigned8 | R/W    | <p>The parameter is used to abort the current activity and can be written with the following values:</p> <p>0: None<br/>           1: Abort current action</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|      |                       |   |           |     |                                                                                                                                                                                       |
|------|-----------------------|---|-----------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9402 | MANUAL_ACTION_REQUEST | 1 | Unsigned8 | R/W | <p>This parameter is used to start an action and can be written with the following values:</p> <p>0: None<br/>1: Start measurement<br/>2: Start calibration<br/>3: Start cleaning</p> |
|------|-----------------------|---|-----------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### 6.1.5.2 Analyzer manual actions state

The parameters in the register block "Analyzer manual actions state" are used to read the status of the status machine.

| Register block | Analyzer manual actions state |       |           |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------|-------------------------------|-------|-----------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Register type  | Input                         |       |           |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Function code  | 4 (Read Input Registers)      |       |           |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Register       | Parameter                     | Bytes | Data Type | Access | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 9900           | MODE_CHANGE_STATE             | 1     | Unsigned8 | R      | <p>This parameter reads the status of the mode change. Allowed values:</p> <p>1: Waiting for Request:<br/>The analyzer is waiting for a request.<br/>2: Busy:<br/>Writing the parameter "Mode change request" was accepted. Mode change is in progress.<br/>3: Mode Change not allowed:<br/>The analyzer is in operation mode that the fieldbus is not allowed to change (like manual mode).</p>                                                                                                                                                                                                                 |
| 9901           | ACTION_REQUEST_STATE          | 1     | Unsigned8 | R      | <p>This parameter reads the status of processing the requested &lt;function&gt; (Measurement, Calibration or Cleaning). Allowed values:</p> <p>0: Ready to start action<br/>No procedure is running. This state is entered, if the analyzer enters fieldbus mode, while nothing is running that disturbs the start of any function via fieldbus.<br/>1: Action request accepted<br/>The request was accepted, but the requested function is not started yet.<br/>2: Fieldbus not active<br/>The analyzer is not in fieldbus mode and cannot accept action requests.<br/>32: Current action abort in progress</p> |

|  |  |  |  |  |                                                                                                                                                                                                                                                                                                |
|--|--|--|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  |  |  |  | 33: Measurement started<br>34: Calibration started<br>35: Cleaning started<br>64: Current activity aborted<br>65: Measurement finished<br>66: Calibration finished<br>67: Cleaning finished<br>97: Measurement not successful<br>98: Calibration not successful<br>99: Cleaning not successful |
|--|--|--|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 7 Tables

### 7.1 Unit codes

| Modbus unit code | Symbol                 | Name                           | Standard unit          |
|------------------|------------------------|--------------------------------|------------------------|
| 0                |                        | None                           |                        |
| 1                | 1/K                    | LfTempCompensation             | 1/K                    |
| 2                | nAs                    | NanoAmpereSeconds              | As                     |
| 3                | μAs                    | MicroAmpereSeconds             | As                     |
| 4                | As                     | AmpereSeconds                  | As                     |
| 5                | ppb                    | ppb                            | %                      |
| 6                | ppm                    | ppm                            | %                      |
| 7                | %                      | Percent                        | %                      |
| 8                | %SAT                   | PercentSaturation              | %                      |
| 9                | 1/mm                   | PerMilliMeter                  | 1/m                    |
| 10               | 1/cm                   | PerCentiMeter                  | 1/m                    |
| 11               | 1/m                    | PerMeter                       | 1/m                    |
| 12               | g/kg                   | GramPerKilogram                | g/kg                   |
| 13               | ppmVol                 | ppmVol                         | %Vol                   |
| 14               | %Vol                   | PercentVol                     | %Vol                   |
| 15               | %/K                    | PercentPerKelvin               | %/K                    |
| 16               | %/μV                   | PercentPerMicroVolt            | %/V                    |
| 17               | %/mV                   | PercentPerMilliVolt            | %/V                    |
| 18               | %/V                    | PercentPerVolt                 | %/V                    |
| 19               | μS                     | MicroSiemens                   | S                      |
| 20               | mS                     | MilliSiemens                   | S                      |
| 21               | S                      | Siemens                        | S                      |
| 22               | pA                     | PicoAmpere                     | A                      |
| 23               | nA                     | NanoAmpere                     | A                      |
| 24               | μA                     | MicroAmpere                    | A                      |
| 25               | mA                     | MilliAmpere                    | A                      |
| 26               | A                      | Ampere                         | A                      |
| 27               | nA/(mg/l)              | NanoAmperePerMilligramPerLiter | A/(kg/m <sup>3</sup> ) |
| 28               | A/(kg/m <sup>3</sup> ) | AmperePerKilogramPerCubicMeter | A/(kg/m <sup>3</sup> ) |
| 29               | A/Pa                   | AmperePerPascal                | A/Pa                   |
| 30               | pA/hPa                 | PicoAmperePerHektoPascal       | A/Pa                   |
| 31               | A/hPa                  | AmperePerHektoPascal           | A/Pa                   |
| 32               | °                      | Degree                         | °                      |
| 33               | FNU                    | Formazine_Nephelometric        | FNU                    |
| 34               | NTU                    | Nephelometric_Turbidity        | FNU                    |
| 35               | Hz                     | Hertz                          | Hz                     |
| 36               | 1/min                  | OnePerMinute                   | Hz                     |
| 37               | 1/h                    | OnePerHour                     | Hz                     |
| 38               | 1/d                    | OnePerDay                      | Hz                     |
| 39               | KByte                  | Kilobytes                      | KByte                  |
| 40               | mm                     | MilliMeter                     | m                      |

| Modbus unit code | Symbol            | Name                      | Standard unit     |
|------------------|-------------------|---------------------------|-------------------|
| 41               | cm                | CentiMeter                | m                 |
| 42               | dm                | DeciMeter                 | m                 |
| 43               | m                 | Meter                     | m                 |
| 44               | km                | KiloMeter                 | m                 |
| 45               | g/ml              | GramPerMilliLiter         | kg/m <sup>3</sup> |
| 46               | µg/l              | MicroGramPerLiter         | kg/m <sup>3</sup> |
| 47               | mg/l              | MilliGramPerLiter         | kg/m <sup>3</sup> |
| 48               | g/l               | GramPerLiter              | kg/m <sup>3</sup> |
| 49               | kg/l              | KiloGramPerLiter          | kg/m <sup>3</sup> |
| 50               | kg/m <sup>3</sup> | KiloGramPerCubicMeter     | kg/m <sup>3</sup> |
| 51               | ppb               | ppb_density1              | kg/m <sup>3</sup> |
| 52               | ppm               | ppm_density1              | kg/m <sup>3</sup> |
| 53               | pH                | PH                        | pH                |
| 54               | mm/s              | MilliMeterPerSecond       | m/s               |
| 55               | mm/min            | MilliMeterPerMinute       | m/s               |
| 56               | mm/h              | MilliMeterPerHour         | m/s               |
| 57               | mm/d              | MilliMeterPerDay          | m/s               |
| 58               | Pa                | Pascal                    | Pa                |
| 59               | hPa               | HectoPascal               | Pa                |
| 60               | mbar              | MilliBar                  | Pa                |
| 61               | Pa/A              | PascalPerAmpere           | Pa/A              |
| 62               | PSU               | PSU                       | PSU               |
| 63               | mΩ                | MilliOhm                  | Ω                 |
| 64               | Ω                 | Ohm                       | Ω                 |
| 65               | kΩ                | KiloOhm                   | Ω                 |
| 66               | MΩ                | MegaOhm                   | Ω                 |
| 67               | GΩ                | GigaOhm                   | Ω                 |
| 68               | rH                | rH                        | rH                |
| 69               | µS/mm             | MicroSiemensPerMilliMeter | S/m               |
| 70               | nS/cm             | NanoSiemensPerCentiMeter  | S/m               |
| 71               | µS/cm             | MicroSiemensPerCentiMeter | S/m               |
| 72               | mS/cm             | MilliSiemensPerCentiMeter | S/m               |
| 73               | S/cm              | SiemensPerCentiMeter      | S/m               |
| 74               | µS/m              | MicroSiemensPerMeter      | S/m               |
| 75               | mS/m              | MilliSiemensPerMeter      | S/m               |
| 76               | S/m               | SiemensPerMeter           | S/m               |
| 77               | kS/m              | KiloSiemensPerMeter       | S/m               |
| 78               | MS/m              | MegaSiemensPerMeter       | S/m               |
| 79               | nΩm               | NanoOhmMeter              | Ωm                |
| 80               | µΩm               | MicroOhmMeter             | Ωm                |
| 81               | mΩm               | MilliOhmMeter             | Ωm                |
| 82               | Ωm                | OhmMeter                  | Ωm                |
| 83               | kΩm               | KiloOhmMeter              | Ωm                |
| 84               | MΩm               | MegaOhmMeter              | Ωm                |
| 85               | GΩm               | GigaOhmMeter              | Ωm                |

| Modbus unit code | Symbol                    | Name                | Standard unit         |
|------------------|---------------------------|---------------------|-----------------------|
| 86               | $\Omega\text{cm}$         | OhmCentiMeter       | $\Omega\text{m}$      |
| 87               | $\text{k}\Omega\text{cm}$ | KiloOhmCentiMeter   | $\Omega\text{m}$      |
| 88               | $\text{M}\Omega\text{cm}$ | MegaOhmCentiMeter   | $\Omega\text{m}$      |
| 89               | $^{\circ}\text{C}$        | Celsius             | $^{\circ}\text{C}$    |
| 90               | K                         | Kelvin              | $^{\circ}\text{C}$    |
| 91               | $^{\circ}\text{C}$        | DeltaCelsius        | $^{\circ}\text{C}$    |
| 92               | K                         | DeltaKelvin         | $^{\circ}\text{C}$    |
| 93               | $\mu\text{s}$             | MicroSeconds        | s                     |
| 94               | ms                        | MilliSeconds        | s                     |
| 95               | s                         | Seconds             | s                     |
| 96               | min                       | Minutes             | s                     |
| 97               | h                         | Hours               | s                     |
| 98               | d                         | Days                | s                     |
| 99               | week(s)                   | Weeks               | s                     |
| 100              | month(s)                  | Month               | month(s)              |
| 101              | l/s                       | LiterPerSecond      | $\text{m}^3/\text{s}$ |
| 102              | $\text{m}^3/\text{s}$     | CubicMeterPerSecond | $\text{m}^3/\text{s}$ |
| 103              | l/min                     | LiterPerMinute      | $\text{m}^3/\text{s}$ |
| 104              | $\text{m}^3/\text{min}$   | CubicMeterPerMinute | $\text{m}^3/\text{s}$ |
| 105              | l/h                       | LiterPerHour        | $\text{m}^3/\text{s}$ |
| 106              | $\text{m}^3/\text{h}$     | CubicMeterPerHour   | $\text{m}^3/\text{s}$ |
| 107              | l/d                       | LiterPerDay         | $\text{m}^3/\text{s}$ |
| 108              | $\text{m}^3/\text{d}$     | CubicMeterPerDay    | $\text{m}^3/\text{s}$ |
| 109              | $\mu\text{V}$             | MicroVolt           | V                     |
| 110              | mV                        | MilliVolt           | V                     |
| 111              | V                         | Volt                | V                     |
| 112              | mV/%                      | MilliVoltPerPercent | V/%                   |
| 113              | V/%                       | VoltPerPercent      | V/%                   |
| 114              | mV/pH                     | MilliVoltPerPH      | V/pH                  |
| 115              | V/pH                      | VoltPerPH           | V/pH                  |
| 116              | ml                        | MilliLiter          | $\text{m}^3$          |
| 117              | l                         | Liter               | $\text{m}^3$          |
| 118              | $\text{m}^3$              | CubicMeter          | $\text{m}^3$          |
| 119              | inch                      | Inch                | m                     |
| 120              | ft                        | Feet                | m                     |
| 121              | yd                        | Yards               | m                     |
| 122              | mi                        | Miles               | m                     |
| 123              | in/s                      | InchPerSecond       | m/s                   |
| 124              | inch/min                  | InchPerMinute       | m/s                   |
| 125              | inch/h                    | InchPerHour         | m/s                   |
| 126              | inch/d                    | InchPerDay          | m/s                   |
| 127              | $^{\circ}\text{F}$        | Fahrenheit          | $^{\circ}\text{C}$    |
| 128              | $^{\circ}\text{F}$        | DeltaFahrenheit     | $^{\circ}\text{C}$    |
| 129              | gps                       | GallonPerSecond     | $\text{m}^3/\text{s}$ |
| 130              | cfs                       | CubicFeetPerSecond  | $\text{m}^3/\text{s}$ |

| Modbus unit code | Symbol             | Name                                 | Standard unit          |
|------------------|--------------------|--------------------------------------|------------------------|
| 131              | mgs                | MegaGallonPerSecond                  | m <sup>3</sup> /s      |
| 132              | gpm                | GallonPerMinute                      | m <sup>3</sup> /s      |
| 133              | cfm                | CubicFeetPerMinute                   | m <sup>3</sup> /s      |
| 134              | mgm                | MegaGallonPerMinute                  | m <sup>3</sup> /s      |
| 135              | gph                | GallonPerHour                        | m <sup>3</sup> /s      |
| 136              | cfh                | CubicFeetPerHour                     | m <sup>3</sup> /s      |
| 137              | mgh                | MegaGallonPerHour                    | m <sup>3</sup> /s      |
| 138              | gpd                | GallonPerDay                         | m <sup>3</sup> /s      |
| 139              | cfd                | CubicFeetPerDay                      | m <sup>3</sup> /s      |
| 140              | mgd                | MegaGallonPerDay                     | m <sup>3</sup> /s      |
| 141              | gal                | Gallons                              | m <sup>3</sup>         |
| 142              | cf                 | CubicFeet                            | m <sup>3</sup>         |
| 143              | mol/m <sup>3</sup> | MolPerCubicMeter                     | mol/m <sup>3</sup>     |
| 144              | mol/l              | MolPerLiter                          | mol/m <sup>3</sup>     |
| 145              | %TS                | PerCentTS                            | kg/m <sup>3</sup>      |
| 146              | bar                | Bar                                  | Pa                     |
| 147              | nm                 | NanoMeter                            | m                      |
| 148              | m/s                | MeterPerSecond                       | m/s                    |
| 149              | ft/s               | FeetPerSecond                        | m/s                    |
| 150              | MByte              | Megabytes                            | KByte                  |
| 151              | Byte               | Bytes                                | KByte                  |
| 152              | GByte              | Gigabytes                            | KByte                  |
| 153              | pA/(mg/l)          | PicoAmperePerMilligramPerLiter       | A/(kg/m <sup>3</sup> ) |
| 154              | kg/mol             | KiloGramPerMol                       | kg/mol                 |
| 155              | g/mol              | GramPerMol                           | kg/mol                 |
| 156              | FTU                | Formazine_Turbidity_Unit             | FNU                    |
| 157              | TE/F               | Turbidity_Formazine                  | FNU                    |
| 158              | ASBC               | American_Society_of_Brewing_Chemists | FNU                    |
| 159              | EBC                | European_Brewing_Convention          | FNU                    |
| 160              | â°I                | Dough                                | kg/m <sup>3</sup>      |
| 161              | mg/l               | MilliGramPerLiterPercent             | %                      |
| 162              | AU                 | AbsorbanceUnit                       | AU                     |
| 163              | %T                 | PercentTransmission                  | %T                     |
| 164              | OD                 | OpticalDensity                       | AU                     |
| 165              | ml/min             | MilliLiterPerMinute                  | m <sup>3</sup> /s      |
| 166              | eq                 | Equivalent                           | eq                     |
| 167              | eq/m <sup>3</sup>  | EquivalentPerCubicMeter              | eq/m <sup>3</sup>      |
| 168              | eq/l               | EquivalentPerLiter                   | eq/m <sup>3</sup>      |
| 169              | eq/gal             | EquivalentPerGallon                  | eq/m <sup>3</sup>      |
| 170              | °C/s               | CelsiusPerSecond                     | °C/s                   |
| 171              | °C/min             | CelsiusPerMinute                     | °C/s                   |
| 172              | FAU                | FormazineAttenuationUnit             | FNU                    |
| 173              | Ah                 | AmpereHours                          | As                     |
| 174              | m/h                | MeterPerHour                         | m/s                    |
| 175              | 1/Pa               | PerPascal                            | 1/Pa                   |

| Modbus unit code | Symbol | Name                      | Standard unit |
|------------------|--------|---------------------------|---------------|
| 176              | 1/hPa  | PerHectoPascal            | 1/Pa          |
| 177              | 1/MPa  | PerMegaPascal             | 1/Pa          |
| 254              |        | Used defined textual unit |               |

## 7.2 Legacy unit handling (Software version 1.06.06 and older)

Measuring devices with software prior to version 1.06.07 supported only fixed units for measurement values.

Deviating units on the device's onsite display are automatically converted to the corresponding Modbus unit and the converted process value is transmitted.

| Source of data | Selection            | Fixed Unit | Info                                |
|----------------|----------------------|------------|-------------------------------------|
| Current input  | Current              | mA         |                                     |
|                | Parameter            | mA         |                                     |
| Binary input   | PFM value            | none       |                                     |
| Controller     | Bipolar              | none       |                                     |
|                | Unipolar+            | none       |                                     |
|                | Unipolar-            | none       |                                     |
| pH Glass       | Raw value mV         | mV         |                                     |
|                | Temperature          | °C/°F/K    | depends on temperature unit setting |
|                | pH                   | pH         |                                     |
|                | Impedance glass      | MOhm       |                                     |
| Oxygen (amp.)  | Temperature          | °C/°F/K    | depends on temperature unit setting |
|                | Raw value nA         | mA         |                                     |
|                | Partial pressure     | hPa        |                                     |
|                | Liquid concentration | mg/l       |                                     |
|                | Saturation           | %          |                                     |
|                | Gas concentration    | %Vol       |                                     |
| Oxygen (opt.)  | Temperature          | °C/°F/K    | depends on temperature unit setting |
|                | Partial pressure     | hPa        |                                     |
|                | Liquid concentration | mg/l       |                                     |
|                | Saturation           | %          |                                     |
|                | Raw value µs         | S          |                                     |
|                | Gas concentration    | %Vol       |                                     |
| pH ISFET       | Raw value mV         | mV         |                                     |
|                | Temperature          | °C/°F/K    | depends on temperature unit setting |
|                | pH                   | pH         |                                     |
|                | Leak current         | mA         |                                     |
| ORP            | ORP mV               | mV         |                                     |
|                | ORP %                | %          |                                     |
|                | Temperature          | °C         |                                     |
| Conduct.cond.  | Temperature          | °C/°F/K    | depends on temperature unit setting |
|                | Conductivity         | mS/m       |                                     |
|                | Resistance           | Ωm         |                                     |
|                | TDS                  | mg/l       |                                     |

| Source of data       | Selection             | Fixed Unit   | Info                                |
|----------------------|-----------------------|--------------|-------------------------------------|
| Conduct.cond. 4-pol  | Temperature           | °C/°F/K      | depends on temperature unit setting |
|                      | Conductivity          | mS/m         |                                     |
|                      | Resistance            | Ωm           |                                     |
|                      | TDS                   | mg/l         |                                     |
| Induct.cond.         | Temperature           | °C/°F/K      | depends on temperature unit setting |
|                      | Conductivity          | mS/cm        |                                     |
|                      | Concentration         | %            |                                     |
|                      | TDS                   | mg/l         |                                     |
| TU/TS                | Turbidity FNU         | FNU          |                                     |
| TU                   | Turbidity FNU         | FNU          |                                     |
| Nitrate              | Temperature           | °C/°F/K      | depends on temperature unit setting |
|                      | NO3                   | mg/l         |                                     |
|                      | NO3-N                 | mg/l         |                                     |
| SAC                  | Temperature           | °C/°F/K      | depends on temperature unit setting |
|                      | SAC                   | 1/m          |                                     |
|                      | Transm.               | %            |                                     |
|                      | Tr. 10mm              | %            |                                     |
|                      | Absorption            | none         |                                     |
|                      | COD                   | mg/l         |                                     |
|                      | TOC                   | mg/l         |                                     |
|                      | DOC                   | mg/l         |                                     |
|                      | BOD                   | mg/l         |                                     |
| ISE                  | Temperature           | °C/°F/K      | depends on temperature unit setting |
|                      | Raw value (1...4)     | mV           |                                     |
|                      | Concentration (2...4) | mg/l         |                                     |
|                      | pH                    | pH           |                                     |
|                      | ORP mV                | mV           |                                     |
| Ultrasonic interface | Interface             | m            |                                     |
| Chlorine             | Temperature           | °C/°F/K      | depends on temperature unit setting |
|                      | Sensor current        | mA           |                                     |
|                      | Concentration         | mg/l         |                                     |
| Photometer (CM44P)   | Measurement value     | User defined | CM44P only                          |
|                      | 2nd meas. value       | User defined | CM44P only                          |
|                      | Raw meas. current     | mA           | CM44P only                          |
|                      | Raw ref. current      | mA           | CM44P only                          |
|                      | Lamp current          | mA           | CM44P only                          |
|                      | Lamp voltage          | mV           | CM44P only                          |
|                      | Raw meas. value       | User defined | CM44P only                          |
|                      | Raw 2nd meas. value   | User defined | CM44P only                          |
|                      | Raw ref. value        | User defined | CM44P only                          |
|                      | Reference value       | User defined | CM44P only                          |

## 7.3 Modbus register information

### 7.3.1 Numbering of Modbus-Registers

**i** The numbering of the Modbus registers starts with 0 as it is transmitted over the wire. In case your PLC is using Modicon addressing you must add 1 to the addresses as provided in the following tables.

### 7.3.2 Liquiline CM44x, Liquistation CSFxx and Liquiline CA80xx

#### 7.3.2.1 Identification (Input, FC: 04)

| Register | Parameter   | Data Type     | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                            |
|----------|-------------|---------------|-------|-----|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9000     | BUS_ADDRESS | UNSIGNED8     | 1     | R   | None | Modbus connection setting: bus address<br>Factory default: 247                                                                                                                                                                                                                                         |
| 9001     | DEVICE_TAG  | OCTETSTRING32 | 32    | R   | None | Device description / TAG                                                                                                                                                                                                                                                                               |
| 9017     | DEVICE_ID   | UNSIGNED8     | 1     | R   | None | Device ID<br><br>Selection:<br>0: Liquiline CM442<br>1: Liquiline CM448<br>2: Liquiport CSP44<br>3: Liquistation CSF48<br>4: Liquistation CSF22<br>5: Liquistation CSF33<br>6: Liquiline System CA80<br>7: Liquistation CSF34<br>8: Liquistation CSF39<br>9: Liquiline CM44P<br><br>Factory default: 0 |

#### 7.3.2.2 Process (Holding/Input, FC: 03, 16, 23, 04)

| Register | Parameter          | Data Type | Bytes | R/W | Unit | Description                                               |
|----------|--------------------|-----------|-------|-----|------|-----------------------------------------------------------|
| 0        | MODBUS_AI_1_VALUE  | FLOAT     | 4     | R   | None | Analog process value from device to control system: value |
| 2        | MODBUS_AI_1_STATUS | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: state |
| 3        | MODBUS_AI_1_UNIT   | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: unit  |
| 4        | MODBUS_AI_2_VALUE  | FLOAT     | 4     | R   | None | Analog process value from device to control system: value |
| 6        | MODBUS_AI_2_STATUS | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: state |
| 7        | MODBUS_AI_2_UNIT   | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: unit  |
| 8        | MODBUS_AI_3_VALUE  | FLOAT     | 4     | R   | None | Analog process value from device to control system: value |
| 10       | MODBUS_AI_3_STATUS | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: state |
| 11       | MODBUS_AI_3_UNIT   | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: unit  |
| 12       | MODBUS_AI_4_VALUE  | FLOAT     | 4     | R   | None | Analog process value from device to control system: value |
| 14       | MODBUS_AI_4_STATUS | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: state |
| 15       | MODBUS_AI_4_UNIT   | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: unit  |
| 16       | MODBUS_AI_5_VALUE  | FLOAT     | 4     | R   | None | Analog process value from device to control system: value |
| 18       | MODBUS_AI_5_STATUS | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: state |
| 19       | MODBUS_AI_5_UNIT   | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: unit  |
| 20       | MODBUS_AI_6_VALUE  | FLOAT     | 4     | R   | None | Analog process value from device to control system: value |
| 22       | MODBUS_AI_6_STATUS | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: state |
| 23       | MODBUS_AI_6_UNIT   | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: unit  |
| 24       | MODBUS_AI_7_VALUE  | FLOAT     | 4     | R   | None | Analog process value from device to control system: value |
| 26       | MODBUS_AI_7_STATUS | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: state |
| 27       | MODBUS_AI_7_UNIT   | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: unit  |
| 28       | MODBUS_AI_8_VALUE  | FLOAT     | 4     | R   | None | Analog process value from device to control system: value |
| 30       | MODBUS_AI_8_STATUS | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: state |
| 31       | MODBUS_AI_8_UNIT   | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: unit  |
| 32       | MODBUS_AI_9_VALUE  | FLOAT     | 4     | R   | None | Analog process value from device to control system: value |
| 34       | MODBUS_AI_9_STATUS | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: state |
| 35       | MODBUS_AI_9_UNIT   | UNSIGNED8 | 1     | R   | None | Analog process value from device to control system: unit  |
| 36       | MODBUS_AI_10_VALUE | FLOAT     | 4     | R   | None | Analog process value from device to control system: value |

[illegible]

|     |                     |           |   |     |      |                                                             |
|-----|---------------------|-----------|---|-----|------|-------------------------------------------------------------|
| 126 | MODBUS_DI_8_VALUE   | UNSIGNED8 | 1 | R   | None | Discrete process value from device to control system: value |
| 127 | MODBUS_DI_8_STATUS  | UNSIGNED8 | 1 | R   | None | Discrete process value from device to control system: state |
| 250 | MODBUS_DO_01_VALUE  | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: value |
| 251 | MODBUS_DO_01_STATUS | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: state |
| 252 | MODBUS_DO_02_VALUE  | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: value |
| 253 | MODBUS_DO_02_STATUS | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: state |
| 254 | MODBUS_DO_03_VALUE  | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: value |
| 255 | MODBUS_DO_03_STATUS | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: state |
| 256 | MODBUS_DO_04_VALUE  | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: value |
| 257 | MODBUS_DO_04_STATUS | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: state |
| 258 | MODBUS_DO_05_VALUE  | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: value |
| 259 | MODBUS_DO_05_STATUS | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: state |
| 260 | MODBUS_DO_06_VALUE  | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: value |
| 261 | MODBUS_DO_06_STATUS | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: state |
| 262 | MODBUS_DO_07_VALUE  | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: value |
| 263 | MODBUS_DO_07_STATUS | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: state |
| 264 | MODBUS_DO_08_VALUE  | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: value |
| 265 | MODBUS_DO_08_STATUS | UNSIGNED8 | 1 | R/W | None | Discrete process value from control system to device: state |
| 266 | MODBUS_AO_01_VALUE  | FLOAT     | 4 | R/W | None | Analog process value from control system to device: value   |
| 268 | MODBUS_AO_01_STATUS | UNSIGNED8 | 1 | R/W | None | Analog process value from control system to device: state   |
| 269 | MODBUS_AO_01_UNIT   | UNSIGNED8 | 1 | R/W | None | Analog process value from control system to device: unit    |
| 270 | MODBUS_AO_02_VALUE  | FLOAT     | 4 | R/W | None | Analog process value from control system to device: value   |
| 272 | MODBUS_AO_02_STATUS | UNSIGNED8 | 1 | R/W | None | Analog process value from control system to device: state   |
| 273 | MODBUS_AO_02_UNIT   | UNSIGNED8 | 1 | R/W | None | Analog process value from control system to device: unit    |
| 274 | MODBUS_AO_03_VALUE  | FLOAT     | 4 | R/W | None | Analog process value from control system to device: value   |
| 276 | MODBUS_AO_03_STATUS | UNSIGNED8 | 1 | R/W | None | Analog process value from control system to device: state   |
| 277 | MODBUS_AO_03_UNIT   | UNSIGNED8 | 1 | R/W | None | Analog process value from control system to device: unit    |
| 278 | MODBUS_AO_04_VALUE  | FLOAT     | 4 | R/W | None | Analog process value from control system to device: value   |
| 280 | MODBUS_AO_04_STATUS | UNSIGNED8 | 1 | R/W | None | Analog process value from control system to device: state   |
| 281 | MODBUS_AO_04_UNIT   | UNSIGNED8 | 1 | R/W | None | Analog process value from control system to device: unit    |

### 7.3.2.3 Diagnostics (Input, FC: 04)

| Register | Parameter                         | Data Type  | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                              |
|----------|-----------------------------------|------------|-------|-----|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 500      | MB_FC08_DIAGNOSE                  | UNSIGNED16 | 2     | R   | None | Content of Modbus function code FC08 (diagnostic)<br>Factory default: 0                                                                                                                                                                                  |
| 501      | DEVICE_HIGHEST_PRIOR_DIAG_CODE    | UNSIGNED16 | 2     | R   | None | Most important device-diagnosis: diagnosis code<br>Factory default: 0                                                                                                                                                                                    |
| 502      | DEVICE_HIGHEST_PRIOR_DIAG_CHANNEL | UNSIGNED8  | 1     | R   | None | Most important device-diagnosis: channel ID (0=device)<br>Factory default: 0                                                                                                                                                                             |
| 503      | DEVICE_HIGHEST_PRIOR_DIAG_STATUS  | UNSIGNED8  | 1     | R   | None | Most important device-diagnosis: status according to NAMUR NE107<br>Factory default: 0                                                                                                                                                                   |
| 504      | DEVICE_CURRENT_DIAG_MODUL         | UNSIGNED8  | 1     | R   | None | Most important device-related diagnosis: name of module<br><br>Selection:<br>0: Slot 1<br>1: Slot 1<br>2: Slot 2<br>3: Slot 3<br>4: Slot 4<br>5: Slot 5<br>6: Slot 6<br>7: Slot 7<br>8: Sampler<br>9: Software<br>10: Analyzer<br><br>Factory default: 0 |
| 505      | DEVICE_CURRENT_DIAG_PORT          | UNSIGNED8  | 1     | R   | None | Most important device-related diagnosis: connection ID<br>Factory default: 0                                                                                                                                                                             |
| 506      | DEVICE_CURRENT_DIAG_NE107_STATUS  | UNSIGNED8  | 1     | R   | None | Most important device-related                                                                                                                                                                                                                            |

| Register | Parameter                     | Data Type  | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                                                                                    |
|----------|-------------------------------|------------|-------|-----|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                               |            |       |     |      | diagnosis: status according to NAMUR NE107<br>Factory default: 0                                                                                                                                                                                                                                                                                                                               |
| 507      | DEVICE_CURRENT_DIAG_CODE      | UNSIGNED16 | 2     | R   | None | Most important device-related diagnosis: diagnosis code<br>Factory default: 0                                                                                                                                                                                                                                                                                                                  |
| 508      | DEVICE_CURRENT_DIAG_TIMESTAMP | UNSIGNED32 | 4     | R   | None | Most important device-related diagnosis: time of diagnosis appearance<br>Factory default: 0                                                                                                                                                                                                                                                                                                    |
| 510      | DEVICE_NUMBER_ADDITIONAL_DIAG | UNSIGNED8  | 1     | R   | None | Number of additional device-related diagnosis messages<br>Factory default: 0                                                                                                                                                                                                                                                                                                                   |
| 511      | DEVICE_LAST_DIAG_SOURCETYPE   | UNSIGNED8  | 1     | R   | None | Past device-diagnosis: component<br><br>Selection:<br>0: General<br>1: Temperature input<br>2: Binary input<br>3: Binary output<br>4: Current input<br>5: Current output<br>6: Relay<br>7: Memosens sensor<br>8: Controller<br>9: Cleaning<br>10: Limit switch<br>11: Mathematic function<br>12: Binary input module<br>13: Binary output module<br>14: Sample point<br><br>Factory default: 0 |
| 512      | DEVICE_LAST_DIAG_MODUL        | UNSIGNED8  | 1     | R   | None | Past device-diagnosis: name of module<br><br>Selection:<br>0: Slot 1<br>1: Slot 1<br>2: Slot 2<br>3: Slot 3<br>4: Slot 4<br>5: Slot 5<br>6: Slot 6<br>7: Slot 7<br>8: Sampler<br>9: Software<br>10: Analyzer<br><br>Factory default: 0                                                                                                                                                         |
| 513      | DEVICE_LAST_DIAG_PORT         | UNSIGNED8  | 1     | R   | None | Past device-diagnosis: port<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                              |
| 514      | DEVICE_LAST_DIAG_NE107_STATUS | UNSIGNED8  | 1     | R   | None | Past device-diagnosis: status according to NAMUR NE107<br>Factory default: 0                                                                                                                                                                                                                                                                                                                   |
| 515      | DEVICE_LAST_DIAG_CODE         | UNSIGNED16 | 2     | R   | None | Past device-diagnosis: diagnosis code<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                    |
| 516      | DEVICE_LAST_DIAG_TIMESTAMP    | UNSIGNED32 | 4     | R   | None | Past device-diagnosis: time of diagnosis appearance<br>Factory default: 0                                                                                                                                                                                                                                                                                                                      |
| 518      | MODBUS_VALID_FRAMES           | UNSIGNED32 | 4     | R   | None | Modbus statistics: Number of valid packets<br>Factory default: 0                                                                                                                                                                                                                                                                                                                               |
| 520      | MODBUS_INVALID_FRAMES         | UNSIGNED32 | 4     | R   | None | Modbus statistics: Number of invalid packets<br>Factory default: 0                                                                                                                                                                                                                                                                                                                             |
| 522      | MODBUS_FRAMING_ERRORS         | UNSIGNED32 | 4     | R   | None | Modbus statistics: Number of framing errors<br>Factory default: 0                                                                                                                                                                                                                                                                                                                              |
| 524      | MODBUS_CRC_ERRORS             | UNSIGNED32 | 4     | R   | None | Modbus statistics: Number of CRC errors                                                                                                                                                                                                                                                                                                                                                        |

| Register | Parameter                 | Data Type     | Bytes | R/W | Unit | Description                                                                     |
|----------|---------------------------|---------------|-------|-----|------|---------------------------------------------------------------------------------|
|          |                           |               |       |     |      | Factory default: 0                                                              |
| 526      | MODBUS_PARITY_ERRORS      | UNSIGNED32    | 4     | R   | None | Modbus statistics: Number of parity errors<br>Factory default: 0                |
| 528      | MODBUS_01_EXCEPTIONS      | UNSIGNED32    | 4     | R   | None | Modbus statistics: Number of exception code 01 exceptions<br>Factory default: 0 |
| 530      | MODBUS_02_EXCEPTIONS      | UNSIGNED32    | 4     | R   | None | Modbus statistics: Number of exception code 02 exceptions<br>Factory default: 0 |
| 532      | MODBUS_03_EXCEPTIONS      | UNSIGNED32    | 4     | R   | None | Modbus statistics: Number of exception code 03 exceptions<br>Factory default: 0 |
| 534      | MODBUS_04_EXCEPTIONS      | UNSIGNED32    | 4     | R   | None | Modbus statistics: Number of exception code 04 exceptions<br>Factory default: 0 |
| 536      | ETHERNET_RECEIVED_FRAMES  | UNSIGNED32    | 4     | R   | None | Ethernet statistics: Number of received packets<br>Factory default: 0           |
| 538      | ETHERNET_SEND_FRAMES      | UNSIGNED32    | 4     | R   | None | Ethernet statistics: Number of packets send<br>Factory default: 0               |
| 540      | ETHERNET_VALID_FRAMES     | UNSIGNED32    | 4     | R   | None | Ethernet statistics: Number of valid packets<br>Factory default: 0              |
| 542      | ETHERNET_INVALID_FRAMES   | UNSIGNED32    | 4     | R   | None | Ethernet statistics: Number of invalid packets<br>Factory default: 0            |
| 544      | ETHERNET_CRC_ERRORS       | UNSIGNED32    | 4     | R   | None | Ethernet statistics: Number of CRC errors<br>Factory default: 0                 |
| 546      | DEVICE_SW_VERSION         | OCTETSTRING16 | 16    | R   | None | Software version of the device<br>Factory default: 0                            |
| 554      | DEVICE_BOOTLOADER_VERSION | OCTETSTRING16 | 16    | R   | None | Software version of the bootloader<br>Factory default: 0                        |
| 562      | DEVICE_SERIAL             | OCTETSTRING32 | 32    | R   | None | Serial number of the device<br>Factory default: 0                               |
| 578      | DISPLAY_SER_NUM           | OCTETSTRING32 | 32    | R   | None | Serial number of the device display<br>Factory default: 0                       |
| 594      | BACKPLANE_SER_NUM         | OCTETSTRING32 | 32    | R   | None | Serial of sub-rack<br>Factory default: 0                                        |
| 610      | POWER_SUPPLY_SER_NUM      | OCTETSTRING32 | 32    | R   | None | Serial number of integrated power supply<br>Factory default: 0                  |
| 626      | BASE_MODUL_SER_NUM        | OCTETSTRING32 | 32    | R   | None | Serial of base module<br>Factory default: 0                                     |
| 642      | EXTENSION_MODUL_1_SER_NUM | OCTETSTRING32 | 32    | R   | None | Serial number of extension module<br>Factory default: 0                         |
| 658      | EXTENSION_MODUL_2_SER_NUM | OCTETSTRING32 | 32    | R   | None | Serial number of extension module<br>Factory default: 0                         |
| 674      | EXTENSION_MODUL_3_SER_NUM | OCTETSTRING32 | 32    | R   | None | Serial number of extension module<br>Factory default: 0                         |
| 690      | EXTENSION_MODUL_4_SER_NUM | OCTETSTRING32 | 32    | R   | None | Serial number of extension module<br>Factory default: 0                         |
| 706      | EXTENSION_MODUL_5_SER_NUM | OCTETSTRING32 | 32    | R   | None | Serial number of extension module<br>Factory default: 0                         |
| 722      | EXTENSION_MODUL_6_SER_NUM | OCTETSTRING32 | 32    | R   | None | Serial number of extension module<br>Factory default: 0                         |
| 738      | EXTENSION_MODUL_7_SER_NUM | OCTETSTRING32 | 32    | R   | None | Serial number of extension module<br>Factory default: 0                         |
| 754      | EXTENSION_MODUL_8_SER_NUM | OCTETSTRING32 | 32    | R   | None | Serial number of extension module<br>Factory default: 0                         |
| 770      | SENSOR_1_SER_NUM          | OCTETSTRING32 | 32    | R   | None | Serial number of the sensor<br>Factory default: 0                               |
| 786      | SENSOR_2_SER_NUM          | OCTETSTRING32 | 32    | R   | None | Serial number of the sensor<br>Factory default: 0                               |
| 802      | SENSOR_3_SER_NUM          | OCTETSTRING32 | 32    | R   | None | Serial number of the sensor                                                     |

| Register | Parameter               | Data Type     | Bytes | R/W | Unit | Description                                                                                                                                                                                                                            |
|----------|-------------------------|---------------|-------|-----|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                         |               |       |     |      | Factory default: 0                                                                                                                                                                                                                     |
| 818      | SENSOR_4_SER_NUM        | OCTETSTRING32 | 32    | R   | None | Serial number of the sensor<br>Factory default: 0                                                                                                                                                                                      |
| 834      | SENSOR_5_SER_NUM        | OCTETSTRING32 | 32    | R   | None | Serial number of the sensor<br>Factory default: 0                                                                                                                                                                                      |
| 850      | SENSOR_6_SER_NUM        | OCTETSTRING32 | 32    | R   | None | Serial number of the sensor<br>Factory default: 0                                                                                                                                                                                      |
| 866      | SENSOR_7_SER_NUM        | OCTETSTRING32 | 32    | R   | None | Serial number of the sensor<br>Factory default: 0                                                                                                                                                                                      |
| 882      | SENSOR_8_SER_NUM        | OCTETSTRING32 | 32    | R   | None | Serial number of the sensor<br>Factory default: 0                                                                                                                                                                                      |
| 898      | FMSY1_MODUL_SER_NUM     | OCTETSTRING32 | 32    | R   | None | Serial number of 'FXAB1' module<br>Factory default: 0                                                                                                                                                                                  |
| 941      | RS485_TERMINATION_STATE | UNSIGNED8     | 1     | R   | None | State of Modbus termination<br><br>Selection:<br>0: Off<br>1: On<br><br>Factory default: 0                                                                                                                                             |
| 942      | ETHERNET_MAC            | OCTETSTRING6  | 6     | R   | None | MAC address of the device<br>Factory default: 0                                                                                                                                                                                        |
| 945      | CLEANINGACTIONSTATE_1   | UNSIGNED8     | 1     | R   | None | Current state of the cleaning program.<br><br>Selection:<br>0: Off<br>1: Waiting<br>2: Waiting<br>3: Pre-rinse<br>4: Cleaning<br>5: Postrinsing<br>6: Failsafe<br>7: Manual mode<br>8: Waiting for execution<br><br>Factory default: 0 |
| 946      | CLEANINGACTIONSTATE_2   | UNSIGNED8     | 1     | R   | None | Current state of the cleaning program.<br><br>Selection:<br>0: Off<br>1: Waiting<br>2: Waiting<br>3: Pre-rinse<br>4: Cleaning<br>5: Postrinsing<br>6: Failsafe<br>7: Manual mode<br>8: Waiting for execution<br><br>Factory default: 0 |
| 947      | CLEANINGACTIONSTATE_3   | UNSIGNED8     | 1     | R   | None | Current state of the cleaning program.<br><br>Selection:<br>0: Off<br>1: Waiting<br>2: Waiting<br>3: Pre-rinse<br>4: Cleaning<br>5: Postrinsing<br>6: Failsafe<br>7: Manual mode<br>8: Waiting for execution<br><br>Factory default: 0 |
| 948      | CLEANINGACTIONSTATE_4   | UNSIGNED8     | 1     | R   | None | Current state of the cleaning program.<br><br>Selection:<br>0: Off                                                                                                                                                                     |

| Register | Parameter                         | Data Type | Bytes | R/W | Unit    | Description                                                                                                                                                      |
|----------|-----------------------------------|-----------|-------|-----|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                                   |           |       |     |         | 1: Waiting<br>2: Waiting<br>3: Pre-rinse<br>4: Cleaning<br>5: Postrinsing<br>6: Failsafe<br>7: Manual mode<br>8: Waiting for execution<br><br>Factory default: 0 |
| 949      | RTC_DATETIME                      | DATETIME  | 8     | R   | None    | Current date and time                                                                                                                                            |
| 953      | HEARTBEAT_DEVICE_STATUS           | FLOAT     | 4     | R   | None    | Heartbeat status device<br>Factory default: 0.0                                                                                                                  |
| 955      | HEARTBEAT_DEVICE_HEALTH_CONDITION | FLOAT     | 4     | R   | Percent | Heartbeat health device<br>Factory default: 0.0                                                                                                                  |
| 957      | MAINTENANCE_TIMER_VALUE           | FLOAT     | 4     | R   | None    | Heartbeat maintenance timer device<br>Factory default: 0.0                                                                                                       |
| 959      | HEARTBEAT_INDEX_DEVICE            | FLOAT     | 4     | R   | None    | Heartbeat index device<br>Factory default: 0.0                                                                                                                   |

### 7.3.2.4 Configuration (Holding, FC: 03, 16, 23)

| Register | Parameter          | Data Type | Bytes | R/W | Unit    | Description                                                                                                                                                        |
|----------|--------------------|-----------|-------|-----|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 500      | TEMPERATURE_UNIT   | UNSIGNED8 | 1     | R/W | None    | Temperature unit<br>Factory default: 0                                                                                                                             |
| 501      | RS485_BAUDRATE     | UNSIGNED8 | 1     | R/W | None    | Modbus setting: baud rate<br><br>Selection:<br>0: 1200<br>1: 2400<br>2: 4800<br>3: 9600<br>4: 19200<br>5: 38400<br>6: 57600<br>7: 115200<br><br>Factory default: 4 |
| 502      | RS485_ADDRESS_MODE | UNSIGNED8 | 1     | R/W | None    | Modbus setting: address mode<br>(1=Hardware, 0=Software)<br>Factory default: false                                                                                 |
| 503      | RS485_PARITY       | UNSIGNED8 | 1     | R/W | None    | Modbus setting: parity<br><br>Selection:<br>0: Even (1 Stopbit)<br>1: Odd (1 Stopbit)<br>2: None (2 Stopbit)<br>3: None (1 Stopbit)<br><br>Factory default: 0      |
| 504      | RS485_ENABLE       | UNSIGNED8 | 1     | R/W | None    | Activation of Modbus interface<br><br>Selection:<br>0: Off<br>1: On<br><br>Factory default: 1                                                                      |
| 505      | MODBUS_MODE        | UNSIGNED8 | 1     | R/W | None    | Modbus setting: operating mode<br><br>Selection:<br>0: RTU<br>1: ASCII<br><br>Factory default: 0                                                                   |
| 506      | MODBUS_WATCHDOG    | FLOAT     | 4     | R/W | Seconds | Timeout for Modbus communication<br>watchdog<br>Factory default: 5.0                                                                                               |

| Register | Parameter                | Data Type     | Bytes | R/W | Unit | Description                                                                                                                                                                                                 |
|----------|--------------------------|---------------|-------|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 508      | MODBUS_COMMAND           | UNSIGNED8     | 1     | R/W | None | Command for controlling Modbus statistics<br><br>Selection:<br>0: No operation<br>1: Retransmit error counters<br>2: Reset error counters<br><br>Factory default: 0                                         |
| 509      | ETHERNET_ENABLE          | UNSIGNED8     | 1     | R/W | None | Activation of ethernet interface<br><br>Selection:<br>0: Off<br>1: On<br><br>Factory default: 1                                                                                                             |
| 510      | ETHERNET_IP_ADDRESS      | UNSIGNED32    | 4     | R/W | None | Ethernet setting: IP address of the device<br>Factory default: 0                                                                                                                                            |
| 512      | ETHERNET_NETMASK         | UNSIGNED32    | 4     | R/W | None | Ethernet setting: Netmask<br>Factory default: 4294967040                                                                                                                                                    |
| 514      | ETHERNET_GATEWAY         | UNSIGNED32    | 4     | R/W | None | Ethernet setting: IP address of the gateway<br>Factory default: 0                                                                                                                                           |
| 516      | ETHERNET_AUTONEGOTIATION | UNSIGNED8     | 1     | R/W | None | Ethernet statistics: Link settings<br><br>Selection:<br>0: Auto negotiation<br>1: 10MBps Half duplex<br>2: 10MBps Full duplex<br>3: 100MBps Half duplex<br>4: 100MBps Full duplex<br><br>Factory default: 0 |
| 517      | ETHERNET_COMMAND         | UNSIGNED8     | 1     | R/W | None | Command for controlling ethernet statistics<br><br>Selection:<br>0: No operation<br>1: Retransmit error counters<br>2: Reset error counters<br><br>Factory default: 0                                       |
| 518      | DHCP_ENABLE              | UNSIGNED8     | 1     | R/W | None | Dynamic setting of device IP address (DHCP)<br><br>Selection:<br>0: Off<br>1: On<br><br>Factory default: 1                                                                                                  |
| 519      | WEBSERVER_ENABLE         | UNSIGNED8     | 1     | R/W | None | Webserver activation<br><br>Selection:<br>0: Off<br>1: On<br><br>Factory default: 1                                                                                                                         |
| 520      | DEVICE_RESET             | UNSIGNED16    | 2     | R/W | None | Device reset<br>Factory default: 0                                                                                                                                                                          |
| 521      | MODBUS_BYTE_ORDER        | UNSIGNED8     | 1     | R/W | None | Setting of byte transmission sequence<br><br>Selection:<br>0: 1-0-3-2<br>1: 0-1-2-3<br>2: 2-3-0-1<br>3: 3-2-1-0<br><br>Factory default: 0                                                                   |
| 600      | DEVICE_TAG               | OCTETSTRING32 | 32    | R/W | None | Device description / TAG<br>Factory default:<br>EH_[Product]_[Serial number]                                                                                                                                |

| Register | Parameter           | Data Type | Bytes | R/W | Unit    | Description                                                                  |
|----------|---------------------|-----------|-------|-----|---------|------------------------------------------------------------------------------|
| 700      | REGULATOR0_SETPOINT | FLOAT     | 4     | R/W | None    | Controller: set value for controller 0<br>Factory default: 0.0               |
| 702      | REGULATOR0_P_PART   | FLOAT     | 4     | R/W | None    | Controller: proportional band (Xp) for controller 0<br>Factory default: 10.0 |
| 704      | REGULATOR0_I_PART   | FLOAT     | 4     | R/W | Seconds | Controller: reset time (Tn) for controller 0<br>Factory default: 0.0         |
| 706      | REGULATOR0_D_PART   | FLOAT     | 4     | R/W | Seconds | Controller: rate time (Tv) for controller 0<br>Factory default: 0.0          |
| 708      | REGULATOR1_SETPOINT | FLOAT     | 4     | R/W | None    | Controller: set value for controller 1<br>Factory default: 0.0               |
| 710      | REGULATOR1_P_PART   | FLOAT     | 4     | R/W | None    | Controller: proportional band (Xp) for controller 1<br>Factory default: 10.0 |
| 712      | REGULATOR1_I_PART   | FLOAT     | 4     | R/W | Seconds | Controller: reset time (Tn) for controller 1<br>Factory default: 0.0         |
| 714      | REGULATOR1_D_PART   | FLOAT     | 4     | R/W | Seconds | Controller: rate time (Tv) for controller 1<br>Factory default: 0.0          |
| 716      | RTC_DATETIME_SET    | DATETIME  | 8     | R/W | None    | Real-Time Clock<br>Factory default: 2009-01-01T12:00:00                      |
| 720      | CONTROL_PANEL_LOCK  | UNSIGNED8 | 1     | R/W | None    | no description<br>Factory default: false                                     |

### 7.3.2.5 Sensor X (Input, FC: 04)

The X in the parameter list is a variable that describes the sensor number. See also the other Sensors respectively registers in the table below.

| Sensor   | Register  | X = |
|----------|-----------|-----|
| Sensor 1 | 1000-1999 | 1   |
| Sensor 2 | 2000-2999 | 2   |
| Sensor 3 | 3000-3999 | 3   |
| Sensor 4 | 4000-4999 | 4   |
| Sensor 5 | 5000-5999 | 5   |
| Sensor 6 | 6000-6999 | 6   |
| Sensor 7 | 7000-7999 | 7   |
| Sensor 8 | 8000-8999 | 8   |

| Register | Parameter              | Data Type | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                      |
|----------|------------------------|-----------|-------|-----|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| X000     | SENSOR_ENABLE_CHO      | UNSIGNED8 | 1     | R   | None | Activation of sensor channel<br><br>Selection:<br>0: On<br>1: Off<br><br>Factory default: 0                                                                                                                                                                                      |
| X001     | ACTIVE_SENSOR_TYPE_CHO | UNSIGNED8 | 1     | R   | None | Selected sensor type. The selected type has to match with the connected sensor type.<br><br>Selection:<br>0: None<br>1: Oxygen (amp.)<br>2: Oxygen (opt.)<br>3: pH Glass<br>4: pH Glass<br>5: pH ISFET<br>6: Cond c<br>7: Cond i<br>8: ORP<br>9: TU/TS<br>10: Nitrate<br>11: ISE |

| Register | Parameter                         | Data Type     | Bytes | R/W | Unit    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|-----------------------------------|---------------|-------|-----|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                                   |               |       |     |         | 12: SAC<br>13: Ultrasonic interface<br>14: Disinfection (CCS142D)<br>18: pH/ORP<br>19: Cond c 4-pol<br>20: Oxygen (opt.)<br>21: TU<br>22: Inline photometer<br>23: TU/AU<br>24: Disinfection<br>25: Spectrometer<br>27: ORP<br><br>Factory default: 0                                                                                                                                                                                                                      |
| X002     | CONNECTED_SENSOR_TYPE_CH0         | UNSIGNED8     | 1     | R   | None    | Connected sensor type<br><br>Selection:<br>0: None<br>1: Oxygen (amp.)<br>2: Oxygen (opt.)<br>3: pH Glass<br>4: pH Glass<br>5: pH ISFET<br>6: Cond c<br>7: Cond i<br>8: ORP<br>9: TU/TS<br>10: Nitrate<br>11: ISE<br>12: SAC<br>13: Ultrasonic interface<br>14: Disinfection (CCS142D)<br>18: pH/ORP<br>19: Cond c 4-pol<br>20: Oxygen (opt.)<br>21: TU<br>22: Inline photometer<br>23: TU/AU<br>24: Disinfection<br>25: Spectrometer<br>27: ORP<br><br>Factory default: 0 |
| X003     | SENSOR_TAG_CH0                    | OCTETSTRING32 | 32    | R   | None    | Sensor description/TAG<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                               |
| X019     | SENSOR_SERIAL_CH0                 | OCTETSTRING16 | 16    | R   | None    | Serial number of the sensor<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                          |
| X027     | SENSOR_HW_VERSION_CH0             | OCTETSTRING16 | 16    | R   | None    | Hardware version of connected sensor<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                 |
| X035     | SENSOR_SW_VERSION_CH0             | OCTETSTRING16 | 16    | R   | None    | Software version of connected sensor<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                 |
| X043     | SENSOR_MANUFACTURER_CH0           | OCTETSTRING32 | 32    | R   | None    | Manufacturer of the sensor<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                           |
| X059     | SENSOR_ORDERCODE_CH0              | OCTETSTRING32 | 32    | R   | None    | Order code of the sensor<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                             |
| X075     | SENSOR_MANUFACTURING_DATE_CH0     | DATETIME      | 8     | R   | None    | Manufacturing date of the sensor                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| X079     | SENSOR_INITIAL_OPERATION_DATE_CH0 | DATETIME      | 8     | R   | None    | Initial-operation date of sensor                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| X083     | SENSOR_EXTREME_SPECIFIC_MIN_CH0   | FLOAT         | 4     | R   | None    | Min. measured value<br>Factory default: 0.0                                                                                                                                                                                                                                                                                                                                                                                                                                |
| X085     | SENSOR_EXTREME_TEMP_MIN_CH0       | FLOAT         | 4     | R   | Celsius | Min. measured temperature value<br>Factory default: 0.0                                                                                                                                                                                                                                                                                                                                                                                                                    |
| X087     | SENSOR_EXTREME_SPECIFIC_MAX_CH0   | FLOAT         | 4     | R   | None    | Max. measured value<br>Factory default: 0.0                                                                                                                                                                                                                                                                                                                                                                                                                                |
| X089     | SENSOR_EXTREME_TEMP_MAX_CH0       | FLOAT         | 4     | R   | Celsius | Max. measured temperature                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Register | Parameter                            | Data Type  | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|--------------------------------------|------------|-------|-----|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                                      |            |       |     |      | value<br>Factory default: 0.0                                                                                                                                                                                                                                                                                                                                                                           |
| X091     | SENSOR_CURRENT_DIAG_SOURCETYPE_CH0   | UNSIGNED8  | 1     | R   | None | Current sensor-diagnosis: component<br><br>Selection:<br>0: General<br>1: Temperature Input<br>2: Binary Input<br>3: Binary Output<br>4: Current Input<br>5: Current Output<br>6: Relay<br>7: Memosens Sensor<br>8: PID Controller<br>9: Cleaning<br>10: Limit switch<br>11: Binary formula result<br>12: Binary Input Module<br>13: Binary Output Module<br>14: Sample point<br><br>Factory default: 0 |
| X092     | SENSOR_CURRENT_DIAG_MODUL_CH0        | UNSIGNED8  | 1     | R   | None | Current sensor-diagnosis: name of module<br><br>Selection:<br>0: Slot 1<br>1: Slot 1<br>2: Slot 2<br>3: Slot 3<br>4: Slot 4<br>5: Slot 5<br>6: Slot 6<br>7: Slot 7<br>8: Sampler<br>9: Software<br>10: Analyzer<br><br>Factory default: 0                                                                                                                                                               |
| X093     | SENSOR_CURRENT_DIAG_PORT_CH0         | UNSIGNED8  | 1     | R   | None | Current sensor-diagnosis: port<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                    |
| X094     | SENSOR_CURRENT_DIAG_NE107_STATUS_CH0 | UNSIGNED8  | 1     | R   | None | Current sensor-diagnosis: status according to NAMUR NE107<br>Factory default: 0                                                                                                                                                                                                                                                                                                                         |
| X095     | SENSOR_CURRENT_DIAG_CODE_CH0         | UNSIGNED16 | 2     | R   | None | Current sensor-diagnosis: diagnosis code<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                          |
| X096     | SENSOR_CURRENT_DIAG_TIMESTAMP_CH0    | UNSIGNED32 | 4     | R   | None | Current sensor-diagnosis: time of diagnosis appearance<br>Factory default: 0                                                                                                                                                                                                                                                                                                                            |
| X098     | SENSOR_NUMBER_ADDITIONAL_DIAG_CH0    | UNSIGNED8  | 1     | R   | None | Number of additional active sensor diagnosis<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                      |
| X099     | SENSOR_LAST_DIAG_SOURCETYPE_CH0      | UNSIGNED8  | 1     | R   | None | Past sensor-diagnosis : component<br><br>Selection:<br>0: General<br>1: Temperature Input<br>2: Binary Input<br>3: Binary Output<br>4: Current Input<br>5: Current Output<br>6: Relay<br>7: Memosens Sensor<br>8: PID Controller<br>9: Cleaning                                                                                                                                                         |

| Register | Parameter                         | Data Type  | Bytes | R/W | Unit    | Description                                                                                                                                                                                                                             |
|----------|-----------------------------------|------------|-------|-----|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                                   |            |       |     |         | 10: Limit switch<br>11: Binary formula result<br>12: Binary Input Module<br>13: Binary Output Module<br>14: Sample preparation<br><br>Factory default: 0                                                                                |
| X100     | SENSOR_LAST_DIAG_MODUL_CH0        | UNSIGNED8  | 1     | R   | None    | Past sensor-diagnosis : name of module<br><br>Selection:<br>0: Slot 1<br>1: Slot 1<br>2: Slot 2<br>3: Slot 3<br>4: Slot 4<br>5: Slot 5<br>6: Slot 6<br>7: Slot 7<br>8: Sampler<br>9: Software<br>10: Analyzer<br><br>Factory default: 0 |
| X101     | SENSOR_LAST_DIAG_PORT_CH0         | UNSIGNED8  | 1     | R   | None    | Past sensor-diagnosis: port<br>Factory default: 0                                                                                                                                                                                       |
| X102     | SENSOR_LAST_DIAG_NE107_STATUS_CH0 | UNSIGNED8  | 1     | R   | None    | Past sensor-diagnosis: status according to NAMUR NE107<br>Factory default: 0                                                                                                                                                            |
| X103     | SENSOR_LAST_DIAG_CODE_CH0         | UNSIGNED16 | 2     | R   | None    | Past sensor-diagnosis: diagnosis code<br>Factory default: 0                                                                                                                                                                             |
| X104     | SENSOR_LAST_DIAG_TIMESTAMP_CH0    | UNSIGNED32 | 4     | R   | None    | Past sensor-diagnosis: time of diagnosis appearance<br>Factory default: 0                                                                                                                                                               |
| X106     | OP_TIME_TOTAL_CH0                 | FLOAT      | 4     | R   | Seconds | Operating hours of connected sensor<br>Factory default: 0.0                                                                                                                                                                             |
| X108     | OP_TIME_ABOVE_SPEC_TEMP_CH0       | FLOAT      | 4     | R   | Seconds | Operating hours above maximal operating temperature<br>Factory default: 0.0                                                                                                                                                             |
| X110     | OP_TIME_BELOW_SPEC_TEMP_CH0       | FLOAT      | 4     | R   | Seconds | Operating hours below minimal operating temperature<br>Factory default: 0.0                                                                                                                                                             |
| X112     | OP_TIME_LAMP_LIFE_CH0             | FLOAT      | 4     | R   | None    | Operating hours of lamp, unit seconds [s]<br>Factory default: 0.0                                                                                                                                                                       |
| X114     | OP_TIME_STERILISATIONS_CH0        | UNSIGNED16 | 2     | R   | None    | Number of sterilization cycles<br>Factory default: 0                                                                                                                                                                                    |
| X115     | OP_TIME_CIP_CYCLES_CH0            | UNSIGNED16 | 2     | R   | None    | Number of clean in place cycles<br>Factory default: 0                                                                                                                                                                                   |
| X116     | OP_TIME_CAP_CALIBRATIONS_CH0      | UNSIGNED16 | 2     | R   | None    | Number of sensor-cap calibrations<br>Factory default: 0                                                                                                                                                                                 |
| X117     | OP_TIME_CAP_CALIB_TIMER_CH0       | FLOAT      | 4     | R   | Seconds | Calibration timer of sensor cap<br>Factory default: 0.0                                                                                                                                                                                 |
| X119     | OP_TIME_CAP_STERILISATIONS_CH0    | UNSIGNED16 | 2     | R   | None    | Number of sensor-cap sterilizations<br>Factory default: 0                                                                                                                                                                               |
| X120     | OP_TIME_CAP_FILTER_CHANGED_CH0    | FLOAT      | 4     | R   | Seconds | Number of filter changes<br>Factory default: 0.0                                                                                                                                                                                        |
| X122     | CAL_COUNT_0_CH0                   | UNSIGNED16 | 2     | R   | None    | Number of calibrations<br>Factory default: 0                                                                                                                                                                                            |
| X123     | CAL_COUNT_1_CH0                   | UNSIGNED16 | 2     | R   | None    | Number of calibrations, 2nd parameter of multiparameter sensor<br>Factory default: 0                                                                                                                                                    |

| Register | Parameter          | Data Type  | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------|--------------------|------------|-------|-----|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| X124     | CAL_COUNT_2_CH0    | UNSIGNED16 | 2     | R   | None | Number of calibrations, 3rd parameter of multiparameter sensor<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| X125     | CAL_COUNT_3_CH0    | UNSIGNED16 | 2     | R   | None | Number of calibrations, 4th parameter of multiparameter sensor<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| X126     | CAL_DATETIME_0_CH0 | DATETIME   | 8     | R   | None | Time stamp of last calibration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| X130     | CAL_DATETIME_1_CH0 | DATETIME   | 8     | R   | None | Time stamp of last calibration, 2nd parameter of multiparameter sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| X134     | CAL_DATETIME_2_CH0 | DATETIME   | 8     | R   | None | Time stamp of last calibration, 3rd parameter of multiparameter sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| X138     | CAL_DATETIME_3_CH0 | DATETIME   | 8     | R   | None | Time stamp of last calibration, 4th parameter of multiparameter sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| X142     | CAL_METHOD_0_CH0   | UNSIGNED8  | 1     | R   | None | Calibration method of last calibration<br><br>Selection:<br>0: None<br>1: Numeric input<br>2: 1-point calibration<br>3: 2-point calibration<br>4: Multipoint Calibration<br>5: Table<br>6: Grab sample<br>7: Zero point<br>8: Air 100%% rh<br>9: H2O air-saturated<br>10: Air variable<br>11: Zero point sample<br>12: Slope sample<br>13: Offset<br>14: Slope<br>15: with temp. comp<br>16: without temp. comp<br>17: Standard addition<br>18: Numeric input<br>19: Numeric input zero point<br>20: Numeric input<br>21: Factory calib.<br>22: Test gas calibration<br>23: Value acquisition<br>24: 3-point calibration<br>25: Ext. Reference<br>26: Int. Reference<br>27: in water<br>28: in air<br><br>Factory default: 0 |
| X143     | CAL_METHOD_1_CH0   | UNSIGNED8  | 1     | R   | None | Calibration method of last calibration<br><br>Selection:<br>0: None<br>1: Numeric input<br>2: 1-point calibration<br>3: 2-point calibration<br>4: Multipoint Calibration<br>5: Table<br>6: Grab sample<br>7: Zero point<br>8: Air 100%% rh<br>9: H2O air-saturated<br>10: Air variable                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| Register | Parameter        | Data Type | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------|------------------|-----------|-------|-----|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                  |           |       |     |      | 11: Zero point sample<br>12: Slope sample<br>13: Offset<br>14: Slope<br>15: with temp. comp<br>16: without temp. comp<br>17: Standard addition<br>18: Numeric input<br>19: Numeric input zero point<br>20: Numeric input<br>21: Factory calib.<br>22: Test gas calibration<br>23: Value acquisition<br>24: 3-point calibration<br>25: Ext. Reference<br>26: Int. Reference<br>27: in water<br>28: in air<br><br>Factory default: 0                                                                                                                                                                                                                                                                                           |
| X144     | CAL_METHOD_2_CH0 | UNSIGNED8 | 1     | R   | None | Calibration method of last calibration<br><br>Selection:<br>0: None<br>1: Numeric input<br>2: 1-point calibration<br>3: 2-point calibration<br>4: Multipoint Calibration<br>5: Table<br>6: Grab sample<br>7: Zero point<br>8: Air 100%% rh<br>9: H2O air-saturated<br>10: Air variable<br>11: Zero point sample<br>12: Slope sample<br>13: Offset<br>14: Slope<br>15: with temp. comp<br>16: without temp. comp<br>17: Standard addition<br>18: Numeric input<br>19: Numeric input zero point<br>20: Numeric input<br>21: Factory calib.<br>22: Test gas calibration<br>23: Value acquisition<br>24: 3-point calibration<br>25: Ext. Reference<br>26: Int. Reference<br>27: in water<br>28: in air<br><br>Factory default: 0 |
| X145     | CAL_METHOD_3_CH0 | UNSIGNED8 | 1     | R   | None | Calibration method of last calibration<br><br>Selection:<br>0: None<br>1: Numeric input<br>2: 1-point calibration<br>3: 2-point calibration<br>4: Multipoint Calibration<br>5: Table<br>6: Grab sample<br>7: Zero point<br>8: Air 100%% rh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| Register | Parameter             | Data Type  | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------|-----------------------|------------|-------|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                       |            |       |     |      | 9: H2O air-saturated<br>10: Air variable<br>11: Zero point sample<br>12: Slope sample<br>13: Offset<br>14: Slope<br>15: with temp. comp<br>16: without temp. comp<br>17: Standard addition<br>18: Numeric input<br>19: Numeric input zero point<br>20: Numeric input<br>21: Factory calib.<br>22: Test gas calibration<br>23: Value acquisition<br>24: 3-point calibration<br>25: Ext. Reference<br>26: Int. Reference<br>27: in water<br>28: in air<br><br>Factory default: 0                                                                                                                                                                                                                                                                  |
| X146     | CAL_COUNT_ZERO_CH0    | UNSIGNED16 | 2     | R   | None | Number of zero-point calibrations<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| X147     | CAL_DATETIME_ZERO_CH0 | DATETIME   | 8     | R   | None | Time stamp of last zero-point calibration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| X151     | CAL_METHOD_ZERO_CH0   | UNSIGNED8  | 1     | R   | None | Calibration method of last zero point calibration<br><br>Selection:<br>0: None<br>1: Numeric input<br>2: 1-point calibration<br>3: 2-point calibration<br>4: Multipoint Calibration<br>5: Table<br>6: Grab sample<br>7: Zero point<br>8: Air 100%% rh<br>9: H2O air-saturated<br>10: Air variable<br>11: Zero point sample<br>12: Slope sample<br>13: Offset<br>14: Slope<br>15: with temp. comp<br>16: without temp. comp<br>17: Standard addition<br>18: Numeric input<br>19: Numeric input zero point<br>20: Numeric input 2-point<br>21: Factory calib.<br>22: Test gas calibration<br>23: Value acquisition<br>24: 3-point calibration<br>25: Ext. Reference<br>26: Int. Reference<br>27: in water<br>28: in air<br><br>Factory default: 0 |
| X152     | CAL_COUNT_TEMP_CH0    | UNSIGNED16 | 2     | R   | None | Number of temperature calibrations<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| X153     | CAL_DATETIME_TEMP_CH0 | DATETIME   | 8     | R   | None | Time stamp of last temperature calibration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| X157     | CAL_METHOD_TEMP_CH0   | UNSIGNED8  | 1     | R   | None | Calibration method of last                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

| Register | Parameter                             | Data Type | Bytes | R/W | Unit    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------|---------------------------------------|-----------|-------|-----|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                                       |           |       |     |         | temperature calibration<br><br>Selection:<br>0: None<br>1: Numeric input<br>2: 1-point calibration<br>3: 2-point calibration<br>4: Multipoint Calibration<br>5: Table<br>6: Grab sample<br>7: Zero point<br>8: Air 100%% rh<br>9: H2O air-saturated<br>10: Air variable<br>11: Zero point sample<br>12: Slope sample<br>13: Offset<br>14: Slope<br>15: with temp. comp<br>16: without temp. comp<br>17: Standard addition<br>18: Numeric input<br>19: Numeric input zero point<br>20: Numeric input<br>21: Factory calib.<br>22: Test gas calibration<br>23: Value acquisition<br>24: 3-point calibration<br>25: Ext. Reference<br>26: Int. Reference<br>27: in water<br>28: in air<br><br>Factory default: 0 |
| X158     | HEARTBEAT_SENSOR_STATUS_CH0           | FLOAT     | 4     | R   | Percent | Heartbeat status sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| X160     | HEARTBEAT_SENSOR_HEALTH_CONDITION_CH0 | FLOAT     | 4     | R   | Percent | Heartbeat health sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| X162     | MAINTENANCE_TIMER_VALUE_CH0           | FLOAT     | 4     | R   | Percent | Heartbeat maintenance timer sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| X164     | HEARTBEAT_INDEX_SENSOR_CH0            | FLOAT     | 4     | R   | Percent | Heartbeat index sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

### 7.3.2.6 Sensor X Setup (Holding, FC: 03, 16, 23)

The X in the parameter list is a variable that describes the sensor number. See also the other Sensors respectively registers in the table below.

| Sensor   | Register  | X = |
|----------|-----------|-----|
| Sensor 1 | 1000-1999 | 1   |
| Sensor 2 | 2000-2999 | 2   |
| Sensor 3 | 3000-3999 | 3   |
| Sensor 4 | 4000-4999 | 4   |
| Sensor 5 | 5000-5999 | 5   |
| Sensor 6 | 6000-6999 | 6   |
| Sensor 7 | 7000-7999 | 7   |
| Sensor 8 | 8000-8999 | 8   |

| Register | Parameter                          | Data Type | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|------------------------------------|-----------|-------|-----|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| X000     | SENSOR_SAC_SWITCHDATASET_CHX       | UNSIGNED8 | 1     | R/W | None | Dataset switch for SAK<br><br>0: Factory calib.<br>1: Dataset1<br>2: Dataset2<br>3: Dataset3<br>4: Dataset4<br>5: Dataset5<br>6: Dataset6<br>7: undefined<br><br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| X001     | SENSOR_NITRATE_SWITCHDATASET_CHX   | UNSIGNED8 | 1     | R/W | None | Dataset switch for nitrate<br><br>Selection:<br>0: Factory calib.<br>1: Dataset1<br>2: Dataset2<br>3: Dataset3<br>4: Dataset4<br>5: Dataset5<br>6: Dataset6<br>7: undefined<br><br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| X002     | SENSOR_TURBIDITY_SWITCHDATASET_CHX | UNSIGNED8 | 1     | R/W | None | Dataset switch for turbidity<br><br>Selection:<br>0: Formazine<br>1: Kaolin<br>2: SiO2<br>3: TiO2<br>4: Excess sludge<br>5: Digested sludge<br>6: Activated sludge<br>7: Dataset1<br>8: Dataset2<br>9: Dataset3<br>10: Dataset4<br>11: Dataset5<br>13: Thin sludge<br>14: PSL<br>15: Diatomite<br>16: Dataset6<br>17: Absorbance<br>18: ThinSludge<br>19: EBC<br>20: Milk<br>21: Apha<br>22: EBCColor<br>23: OEM Dataset 1<br>24: OEM Dataset 2<br>25: OEM Dataset 3<br>26: OEM Dataset 4<br>27: OEM Dataset 5<br>28: OEM Dataset 6<br>29: Product loss<br>30: Sludge<br>31: Auto sludge<br>32: Dataset7<br>33: Dataset8<br>34: Sludge, general<br><br>Factory default: 0 |

|      |                                              |           |   |     |      |                                                                                                                                                                  |
|------|----------------------------------------------|-----------|---|-----|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| X003 | SENSOR_INLINEPHOTOMETER_SWITCHDATASET_MC_CHX | UNSIGNED8 | 1 | R/W | None | Dataset switch for Inline Photometer<br><br>Selection:<br>0: Dataset 1<br>1: Dataset 2<br>2: Dataset 3<br>3: Dataset 4<br>4: Dataset<br><br>Factory default: 0   |
| X004 | SENSOR_INLINEPHOTOMETER_SWITCHDATASET_RC_CHX | UNSIGNED8 | 1 | R/W | None | Dataset switch for Inline Photometer<br><br>Selection:<br>0: Dataset 1<br>1: Dataset 2<br>2: Dataset 3<br>3: Dataset 4<br>4: Dataset 5<br><br>Factory default: 0 |

### 7.3.3 Liquistation CSFxx

#### 7.3.3.1 Sampler Info (Input, FC: 04)

| Register | Parameter                 | Data Type     | Bytes | R/W | Unit       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|---------------------------|---------------|-------|-----|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1500     | RUNNING_PROGRAM_NAME      | OCTETSTRING16 | 16    | R   | None       | Program name<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1508     | PROGRAM_BOTTLE_POSITION   | UNSIGNED8     | 1     | R   | None       | Current bottle position<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 1509     | PROGRAM_SAMPLING_MODE     | UNSIGNED8     | 1     | R   | None       | Mode of sampling<br><br>Selection:<br>0: Time paced CTCV<br>1: Flow paced VTCV<br>2: Time/flow paced CTV<br>3: Single sample<br>4: Sampling table<br>5: External signal<br>6: Manual<br>7: %OV<br><br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 1510     | DATETIME_NEXT_SAMPLING    | DATETIME      | 8     | R   | None       | Date and time of next sampling<br>Factory default: 2000-01-01T00:00:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1514     | FLOW_NEXT_SAMPLING        | FLOAT         | 4     | R   | None       | Dosing volume of last sample taking<br>Factory default: 0.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 1516     | PROGRAM_NAME              | OCTETSTRING16 | 16    | R   | None       | Name of current active program<br>Factory default: [Program]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 1524     | PROGRAM_STATE             | UNSIGNED8     | 1     | R   | None       | Program state<br><br>Selection:<br>0: Inactive<br>1: Active<br>2: Pause<br>3: Waiting for pause<br><br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1525     | BOTTLE_CONFIGURATION      | UNSIGNED8     | 1     | R   | None       | Bottle assignment<br><br>Selection:<br>0: 1x - PE Direct distribution<br>1: 2x - PE Direct distribution<br>2: 4x - PE Direct distribution<br>3: 4x - Glass Direct distribution<br>4: 12x - PE Direct distribution<br>5: 12x - PE/Glass Plate distribution<br>6: 24x - PE Direct distribution<br>7: 24x - PE/Glass Plate distribution<br>8: 6x+1x - PE/Glass Plate distribution<br>9: 6x+2x - PE+PE Plate distribution<br>10: 6x+2x - PE+Glass Plate distribution<br>11: 12x+1x - PE/Glass Plate distribution<br>12: 12x+2x - PE+PE Plate distribution<br>13: 12x+2x - PE+Glass Plate distribution<br>14: 12x+6x - PE Direct distribution<br>15: 12x+6x - PE/Glass Plate distribution<br>16: 4x - Glass Schott GLS80 Direct distribution<br><br>Factory default: 0 |
| 1526     | BOTTLE_VOLUME_LEFT        | FLOAT         | 4     | R   | CubicMeter | Bottle volume<br>Factory default: 0.03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1528     | BOTTLE_VOLUME_RIGHT       | FLOAT         | 4     | R   | CubicMeter | Bottle volume of the right bottle box<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 1530     | CURRENT_BOTTLE_FILL_LEVEL | FLOAT         | 4     | R   | CubicMeter | Liquid level of selected bottle<br>Factory default: 0.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

|      |                           |            |   |   |            |                                                                                                                                                                               |
|------|---------------------------|------------|---|---|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1532 | SAMPLING_TECHNIQUE        | UNSIGNED8  | 1 | R | None       | Sampling mode<br><br>Selection:<br>0: Peristaltic<br>1: Vacuum<br>2: Inline<br><br>Factory default: 0                                                                         |
| 1533 | SAMPLING_VOLUME_VACUUM    | FLOAT      | 4 | R | CubicMeter | Dosing volume of vacuum- or inline-sampler<br>Factory default: 0.0002                                                                                                         |
| 1535 | LAST_SAMPLING_START_TIME  | DATETIME   | 8 | R | None       | Start time of last sampling<br>Factory default: 1970-01-01T00:00:00                                                                                                           |
| 1539 | CAL_COUNT_DISTLEVER       | UNSIGNED32 | 4 | R | None       | Number of distribution lever calibrations<br>Factory default: 0                                                                                                               |
| 1541 | CAL_DATETIME_DISTLEVER    | DATETIME   | 8 | R | None       | Time stamp of last distribution lever calibration<br>Factory default: 1970-01-01T00:00:00                                                                                     |
| 1545 | CAL_COUNT_PERISTVOLUME    | UNSIGNED32 | 4 | R | None       | Number of peristaltic sampling volume calibrations<br>Factory default: 0                                                                                                      |
| 1547 | CAL_DATETIME_PERISTVOLUME | DATETIME   | 8 | R | None       | Time stamp of last peristaltic sampling volume calibration<br>Factory default: 1970-01-01T00:00:00                                                                            |
| 1551 | CAL_METHOD_PERISTVOLUME   | UNSIGNED8  | 1 | R | None       | Calibration method of last peristaltic sampling volume calibration<br><br>Selection:<br>0: None<br>1: 1-point calibration<br>2: 2-point calibration<br><br>Factory default: 0 |
| 1552 | CAL_COUNT_TEMP2           | UNSIGNED32 | 4 | R | None       | Number of calibrations of temperature sensor 2<br>Factory default: 0                                                                                                          |
| 1554 | CAL_DATETIME_TEMP2        | DATETIME   | 8 | R | None       | Time stamp of last calibration of temperature sensor 2<br>Factory default: 1970-01-01T00:00:00                                                                                |
| 1558 | CAL_COUNT_TEMP3           | UNSIGNED32 | 4 | R | None       | Number of calibrations of temperature sensor 3<br>Factory default: 0                                                                                                          |
| 1560 | CAL_DATETIME_TEMP3        | DATETIME   | 8 | R | None       | Time stamp of last calibration of temperature sensor 3<br>Factory default: 1970-01-01T00:00:00                                                                                |

### 7.3.3.2 Sampler Setup (Holding, FC: 03, 16, 23)

| Register | Parameter      | Data Type | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------|----------------|-----------|-------|-----|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1500     | SAMPLING_STATE | UNSIGNED8 | 1     | R/W | None | Sampling progress<br><br>Selection:<br>0: Waiting<br>1: Reference run<br>2: Dist. arm positioned<br>3: Purge process<br>4: Suction process<br>5: Medium detected<br>6: Dose process<br>7: sampling Ok<br>8: sampling nOk<br>9: Sampling delay<br>10: Sampling<br>11: Pre rinsing<br>12: Post rinsing<br>13: Launch bottle<br>14: Sample bottling<br>15: Emptying bottle<br>16: Rinsing bottle<br>17: Draining bottle<br><br>Factory default: 0 |

| Register | Parameter                  | Data Type | Bytes | R/W | Unit       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|----------------------------|-----------|-------|-----|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1501     | MAN_SAMPLING_VOLUME_PERIST | FLOAT     | 4     | R/W | CubicMeter | Sample volume of manual sampling with peristaltic pump<br>Factory default: 0.0001                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1503     | MAN_SAMPLING_BOTTLE_POS    | UNSIGNED8 | 1     | R/W | None       | Manual sampling bottle position<br><br>Selection:<br>0: Front<br>1: Bottle 1<br>2: Bottle 2<br>3: Bottle 3<br>4: Bottle 4<br>5: Bottle 5<br>6: Bottle 6<br>7: Bottle 7<br>8: Bottle 8<br>9: Bottle 9<br>10: Bottle 10<br>11: Bottle 11<br>12: Bottle 12<br>13: Bottle 13<br>14: Bottle 14<br>15: Bottle 15<br>16: Bottle 16<br>17: Bottle 17<br>18: Bottle 18<br>19: Bottle 19<br>20: Bottle 20<br>21: Bottle 21<br>22: Bottle 22<br>23: Bottle 23<br>24: Bottle 24<br>25: Back<br><br>Factory default: 0 |
| 1504     | MAN_SAMPLING_COMMAND       | UNSIGNED8 | 1     | R/W | None       | Manual sampling command<br><br>Selection:<br>0: None<br>1: Start<br>2: Stop<br><br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                     |
| 1505     | MAN_SAMPLING_PARK_POS      | UNSIGNED8 | 1     | R/W | None       | Distribution arm park position<br><br>Selection:<br>0: None<br>1: Back<br><br>Factory default: 1                                                                                                                                                                                                                                                                                                                                                                                                          |

### 7.3.4 Liquiline CA80xx

#### 7.3.4.1 Analyzer SP 1 Info (Input, FC: 04)

| Register | Parameter                | Data Type     | Bytes | R/W | Unit    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|--------------------------|---------------|-------|-----|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8500     | ORDERCODE_SP1            | OCTETSTRING32 | 32    | R   | None    | Order code of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 8516     | ORDERCODE_EXT_SP1        | OCTETSTRING32 | 32    | R   | None    | Extended order code of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 8532     | SERIAL_SP1               | OCTETSTRING16 | 16    | R   | None    | Serial number of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 8540     | HW_VERSION_SP1           | OCTETSTRING16 | 16    | R   | None    | Hardware version of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 8548     | SW_VERSION_SP1           | OCTETSTRING16 | 16    | R   | None    | Software version of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 8556     | TYPE_SP1                 | OCTETSTRING16 | 16    | R   | None    | Type of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 8564     | CONTROL_MODE_SP1         | UNSIGNED8     | 1     | R   | None    | Operating mode<br><br>Selection:<br>0: Local control<br>1: Remote control<br><br>Factory default: 1                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 8565     | STATE_SP1                | UNSIGNED8     | 1     | R   | None    | Current state of sample preparation<br><br>Selection:<br>0: Inactive<br>1: Sampling<br>2: Cleaning<br>3: Flush with air<br>4: Flush with cleaner<br>5: Flush filter<br>6: Flush with air<br>7: Flush with cleaner<br>8: Flush with air<br>9: Flush with cleaner<br>10: Cleaning up<br>11: Cleaning up<br>12: Cleaning up<br>13: Cleaning up<br>14: Flush with air<br>15: Flush with cleaner<br>16: Flush with air<br>17: Flush with cleaner<br>18: Flush filter<br>19: Sampling<br>20: Pump backward<br>21: Cleaning up<br><br>Factory default: 0 |
| 8566     | OP_TIME_FILTER_SP1       | UNSIGNED32    | 4     | R   | None    | Operating hours of sample preparation filter<br>Factory default: 1970-01-01T00:00:00                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 8568     | OP_TIME_HOSE_SP1         | UNSIGNED32    | 4     | R   | None    | Operating hours of sample preparation hose<br>Factory default: 1970-01-01T00:00:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 8570     | OP_TIME_MEMBRANEPUMP_SP1 | UNSIGNED32    | 4     | R   | None    | Operating hours of sample preparation membrane pump<br>Factory default: 1970-01-01T00:00:00                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 8572     | AMBIENT_TEMPERATURE_SP1  | FLOAT         | 4     | R   | Celsius | Ambient temperature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 8574     | HOUSING_TEMPERATURE_SP1  | FLOAT         | 4     | R   | Celsius | Cabinet temperature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 8576     | OPERATING_MODE_SP1       | UNSIGNED8     | 1     | R   | None    | Operating mode<br><br>Selection:<br>0: Independent<br>1: Controlled<br><br>Factory default: 1                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| Register | Parameter                                | Data Type | Bytes | R/W | Unit | Description                                                                                                                            |
|----------|------------------------------------------|-----------|-------|-----|------|----------------------------------------------------------------------------------------------------------------------------------------|
| 8577     | SAMPLE_PREPARATION_TYPE_SP1              | UNSIGNED8 | 1     | R   | None | Type of sample preparation<br><br>Selection:<br>0: 3rd party<br>1: Inlet<br>2: Aeration/Outlet<br>3: Unknown<br><br>Factory default: 0 |
| 8578     | PRESSURIZED_AIR_AVAILABLE_SP1            | UNSIGNED8 | 1     | R   | None | Pressurized air available<br><br>Selection:<br>0: Available<br>1: Not available<br><br>Factory default: 0                              |
| 8579     | PPSCLEANING_VALVE_INSTALLED_SP1          | UNSIGNED8 | 1     | R   | None | Cleaning valve<br><br>Selection:<br>0: Not available<br>1: Available<br><br>Factory default: 0                                         |
| 8580     | HOUSING_HEATING_AVAILABLE_SP1            | UNSIGNED8 | 1     | R   | None | Cabinet heating<br><br>Selection:<br>0: Available<br>1: Not available<br><br>Factory default: 1                                        |
| 8581     | FILTERTUBE_HEATING_AVAILABLE_SP1         | UNSIGNED8 | 1     | R   | None | Hose heating filter<br><br>Selection:<br>0: Available<br>1: Not available<br><br>Factory default: 1                                    |
| 8582     | ANALYZERTUBE_HEATING_AVAILABLE_SP1       | UNSIGNED8 | 1     | R   | None | Hose heating analyzer<br><br>Selection:<br>0: Available<br>1: Not available<br><br>Factory default: 1                                  |
| 8583     | AMBIENT_TEMPERATURE_SENSOR_AVAILABLE_SP1 | UNSIGNED8 | 1     | R   | None | Ambient temperature sensor<br><br>Selection:<br>0: Available<br>1: Not available<br><br>Factory default: 1                             |

### 7.3.4.2 Analyzer SP 1 setup (Holding, FC: 03, 16, 23)

| Register | Parameter              | Data Type | Bytes | R/W | Unit | Description                                                                                                                                     |
|----------|------------------------|-----------|-------|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 8500     | CLEANING_TRIGGER_SP1   | UNSIGNED8 | 1     | R/W | None | Start condition of first sample preparation cleaning<br><br>Selection:<br>0: Immediate<br>1: Date/time<br>2: Disabled<br><br>Factory default: 0 |
| 8501     | CLEANING_STARTDATE_SP1 | DATETIME  | 8     | R/W | None | Date of first sample preparation cleaning<br>Factory default: 1970-01-01T00:00:00                                                               |
| 8505     | CLEANING_STARTTIME_SP1 | DATETIME  | 8     | R/W | None | Time of first sample preparation                                                                                                                |

| Register | Parameter                             | Data Type  | Bytes | R/W | Unit    | Description                                                                                 |
|----------|---------------------------------------|------------|-------|-----|---------|---------------------------------------------------------------------------------------------|
|          |                                       |            |       |     |         | cleaning<br>Factory default: 1970-01-01T00:00:00                                            |
| 8509     | CLEANING_INTERVAL_SP1                 | UNSIGNED32 | 4     | R/W | None    | Interval for sample preparation cleaning<br>Factory default: 1970-01-02T00:00:00            |
| 8511     | CLEANING_DURATION_SP1                 | UNSIGNED32 | 4     | R/W | None    | Duration of sample preparation cleaning<br>Factory default: 1970-01-01T00:01:00             |
| 8513     | TRANSPORT_TIME_MAX_SP1                | UNSIGNED32 | 4     | R/W | None    | Max. transport time of sample preparation<br>Factory default: 1970-01-01T00:15:00           |
| 8515     | HEATING_TUBE_SETPOINT_SP1             | FLOAT      | 4     | R/W | Celsius | Switch on temperature for sample preparation hose heating<br>Factory default: 5.0           |
| 8517     | HEATING_HOUSING_SETPOINT_SP1          | FLOAT      | 4     | R/W | Celsius | Switch on temperature for outlet sample preparation cabinet heating<br>Factory default: 5.0 |
| 8519     | HEATING_HOUSING_SETPOINT_INLET_SP1    | FLOAT      | 4     | R/W | Celsius | Switch on temperature for inlet sample preparation cabinet heating<br>Factory default: 10.0 |
| 8521     | FILTERCHANGE_WARNLEVEL_SP1            | UNSIGNED32 | 4     | R/W | None    | Warn level for sample preparation filter change<br>Factory default: 1970-03-02T00:00:00     |
| 8523     | HOSECHANGE_WARNLEVEL_SP1              | UNSIGNED32 | 4     | R/W | None    | Warn level for sample preparation hose change<br>Factory default: 1970-03-02T00:00:00       |
| 8525     | MEASUREMENT_ITERATIONS_SP1            | UNSIGNED8  | 1     | R/W | None    | Number of consecutive measurements for one channel<br>Factory default: 1                    |
| 8526     | FILTER_CHANGE_ACTIVATION_SP1          | UNSIGNED8  | 1     | R/W | None    | Limit change filter<br><br>Selection:<br>0: Off<br>1: On<br><br>Factory default: 0          |
| 8527     | HOSE_CHANGE_ACTIVATION_SP1            | UNSIGNED8  | 1     | R/W | None    | Limit change hose<br><br>Selection:<br>0: Off<br>1: On<br><br>Factory default: 1            |
| 8528     | TIMEOUT_SAMPLING_SP1                  | UNSIGNED32 | 4     | R/W | None    | Timeout no sample<br>Factory default: 1970-01-01T00:05:00                                   |
| 8530     | TIMEOUT_SAMPLING_PPS_SP1              | UNSIGNED32 | 4     | R/W | None    | Timeout no sample (pressurized pipe)<br>Factory default: 1970-01-01T00:01:00                |
| 8532     | FILTER_AIRCLEANING_DURATION_SP1       | FLOAT      | 4     | R/W | Seconds | Filter air cleaning duration<br>Factory default: 30.0                                       |
| 8534     | FILTER_AIRCLEANING_INTERVAL_SP1       | UNSIGNED32 | 4     | R/W | None    | Filter air cleaning interval<br>Factory default: 1970-01-01T02:00:00                        |
| 8536     | FILTER_AIRCLEANING_MODE_SP1           | UNSIGNED8  | 1     | R/W | None    | Filter air cleaning mode<br><br>Selection:<br>0: On<br>1: Off<br><br>Factory default: 0     |
| 8537     | CLEANING_DETERGENT_RESIDENCE_TIME_SP1 | UNSIGNED32 | 4     | R/W | None    | Cleaner residence time<br>Factory default: 1970-01-01T00:01:00                              |
| 8539     | CLEANING_DISCARD_TIME_SP1             | UNSIGNED32 | 4     | R/W | None    | Cleaning discard time<br>Factory default: 1970-01-01T00:01:30                               |
| 8541     | CLEANING_DURATION_PPS_SP1             | FLOAT      | 4     | R/W | Seconds | Pressurized pipe cleaning duration<br>Factory default: 10.0                                 |
| 8543     | CLEANING_DISCARD_TIME_PPS_SP1         | FLOAT      | 4     | R/W | Seconds | Pressurized pipe cleaning discard time<br>Factory default: 180.0                            |
| 8545     | CLEANING_TRIGGER_PPS_SP1              | UNSIGNED8  | 1     | R/W | None    | Start condition of first pressurized pipe cleaning                                          |

| Register | Parameter                 | Data Type  | Bytes | R/W | Unit | Description                                                                    |
|----------|---------------------------|------------|-------|-----|------|--------------------------------------------------------------------------------|
|          |                           |            |       |     |      | Selection:<br>0: On<br>1: Date/time<br>2: Off<br><br>Factory default: 0        |
| 8546     | CLEANING_INTERVAL_PPS_SP1 | UNSIGNED32 | 4     | R/W | None | Interval for pressurized pipe cleaning<br>Factory default: 1970-01-01T00:30:00 |

### 7.3.4.3 Analyzer SP 2 Info (Input, FC: 04)

| Register | Parameter                | Data Type     | Bytes | R/W | Unit    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|--------------------------|---------------|-------|-----|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8700     | ORDERCODE_SP2            | OCTETSTRING32 | 32    | R   | None    | Order code of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 8716     | ORDERCODE_EXT_SP2        | OCTETSTRING32 | 32    | R   | None    | Extended order code of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 8732     | SERIAL_SP2               | OCTETSTRING16 | 16    | R   | None    | Serial number of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 8740     | HW_VERSION_SP2           | OCTETSTRING16 | 16    | R   | None    | Hardware version of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 8748     | SW_VERSION_SP2           | OCTETSTRING16 | 16    | R   | None    | Software version of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 8756     | TYPE_SP2                 | OCTETSTRING16 | 16    | R   | None    | Type of sample preparation<br>Factory default: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 8764     | CONTROL_MODE_SP2         | UNSIGNED8     | 1     | R   | None    | Operating mode<br><br>Selection:<br>0: Local control<br>1: Remote control<br><br>Factory default: 1                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 8765     | STATE_SP2                | UNSIGNED8     | 1     | R   | None    | Current state of sample preparation<br><br>Selection:<br>0: Inactive<br>1: Sampling<br>2: Cleaning<br>3: Flush with air<br>4: Flush with cleaner<br>5: Flush filter<br>6: Flush with air<br>7: Flush with cleaner<br>8: Flush with air<br>9: Flush with cleaner<br>10: Cleaning up<br>11: Cleaning up<br>12: Cleaning up<br>13: Cleaning up<br>14: Flush with air<br>15: Flush with cleaner<br>16: Flush with air<br>17: Flush with cleaner<br>18: Flush filter<br>19: Sampling<br>20: Pump backward<br>21: Cleaning up<br><br>Factory default: 0 |
| 8766     | OP_TIME_FILTER_SP2       | UNSIGNED32    | 4     | R   | None    | Operating hours of sample preparation filter<br>Factory default: 1970-01-01T00:00:00                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 8768     | OP_TIME_HOSE_SP2         | UNSIGNED32    | 4     | R   | None    | Operating hours of sample preparation hose<br>Factory default: 1970-01-01T00:00:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 8770     | OP_TIME_MEMBRANEPUMP_SP2 | UNSIGNED32    | 4     | R   | None    | Operating hours of sample preparation membrane pump<br>Factory default: 1970-01-01T00:00:00                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 8772     | AMBIENT_TEMPERATURE_SP2  | FLOAT         | 4     | R   | Celsius | Ambient temperature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 8774     | HOUSING_TEMPERATURE_SP2  | FLOAT         | 4     | R   | Celsius | Cabinet temperature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

| Register | Parameter                                | Data Type | Bytes | R/W | Unit | Description                                                                                                                            |
|----------|------------------------------------------|-----------|-------|-----|------|----------------------------------------------------------------------------------------------------------------------------------------|
| 8776     | OPERATING_MODE_SP2                       | UNSIGNED8 | 1     | R   | None | Operating mode<br><br>Selection:<br>0: Independent<br>1: Controlled<br><br>Factory default: 1                                          |
| 8777     | SAMPLE_PREPARATION_TYPE_SP2              | UNSIGNED8 | 1     | R   | None | Type of sample preparation<br><br>Selection:<br>0: 3rd party<br>1: Inlet<br>2: Aeration/Outlet<br>3: Unknown<br><br>Factory default: 0 |
| 8778     | PRESSURIZED_AIR_AVAILABLE_SP2            | UNSIGNED8 | 1     | R   | None | Pressurized air available<br><br>Selection:<br>0: Available<br>1: Not available<br><br>Factory default: 0                              |
| 8779     | PPSCLEANING_VALVE_INSTALLED_SP2          | UNSIGNED8 | 1     | R   | None | Cleaning valve<br><br>Selection:<br>0: Not available<br>1: Available<br><br>Factory default: 0                                         |
| 8780     | HOUSING_HEATING_AVAILABLE_SP2            | UNSIGNED8 | 1     | R   | None | Cabinet heating<br><br>Selection:<br>0: Available<br>1: Not available<br><br>Factory default: 1                                        |
| 8781     | FILTERTUBE_HEATING_AVAILABLE_SP2         | UNSIGNED8 | 1     | R   | None | Hose heating filter<br><br>Selection:<br>0: Available<br>1: Not available<br><br>Factory default: 1                                    |
| 8782     | ANALYZERTUBE_HEATING_AVAILABLE_SP2       | UNSIGNED8 | 1     | R   | None | Hose heating analyzer<br><br>Selection:<br>0: Available<br>1: Not available<br><br>Factory default: 1                                  |
| 8783     | AMBIENT_TEMPERATURE_SENSOR_AVAILABLE_SP2 | UNSIGNED8 | 1     | R   | None | Ambient temperature sensor<br><br>Selection:<br>0: Available<br>1: Not available<br><br>Factory default: 1                             |

#### 7.3.4.4 Analyzer SP 2 setup (Holding, FC: 03, 16, 23)

| Register | Parameter            | Data Type | Bytes | R/W | Unit | Description                                                                            |
|----------|----------------------|-----------|-------|-----|------|----------------------------------------------------------------------------------------|
| 8700     | CLEANING_TRIGGER_SP2 | UNSIGNED8 | 1     | R/W | None | Start condition of first sample preparation cleaning<br><br>Selection:<br>0: Immediate |

|      |                                       |            |   |     |         |                                                                                             |
|------|---------------------------------------|------------|---|-----|---------|---------------------------------------------------------------------------------------------|
|      |                                       |            |   |     |         | 1: Date/time<br>2: Disabled<br><br>Factory default: 0                                       |
| 8701 | CLEANING_STARTDATE_SP2                | DATETIME   | 8 | R/W | None    | Date of first sample preparation cleaning<br>Factory default: 1970-01-01T00:00:00           |
| 8705 | CLEANING_STARTTIME_SP2                | DATETIME   | 8 | R/W | None    | Time of first sample preparation cleaning<br>Factory default: 1970-01-01T00:00:00           |
| 8709 | CLEANING_INTERVAL_SP2                 | UNSIGNED32 | 4 | R/W | None    | Interval for sample preparation cleaning<br>Factory default: 1970-01-02T00:00:00            |
| 8711 | CLEANING_DURATION_SP2                 | UNSIGNED32 | 4 | R/W | None    | Duration of sample preparation cleaning<br>Factory default: 1970-01-01T00:01:00             |
| 8713 | TRANSPORT_TIME_MAX_SP2                | UNSIGNED32 | 4 | R/W | None    | Max. transport time of sample preparation<br>Factory default: 1970-01-01T00:15:00           |
| 8715 | HEATING_TUBE_SETPOINT_SP2             | FLOAT      | 4 | R/W | Celsius | Switch on temperature for sample preparation hose heating<br>Factory default: 5.0           |
| 8717 | HEATING_HOUSING_SETPOINT_SP2          | FLOAT      | 4 | R/W | Celsius | Switch on temperature for outlet sample preparation cabinet heating<br>Factory default: 5.0 |
| 8719 | HEATING_HOUSING_SETPOINT_INLET_SP2    | FLOAT      | 4 | R/W | Celsius | Switch on temperature for inlet sample preparation cabinet heating<br>Factory default: 10.0 |
| 8721 | FILTERCHANGE_WARNLEVEL_SP2            | UNSIGNED32 | 4 | R/W | None    | Warn level for sample preparation filter change<br>Factory default: 1970-03-02T00:00:00     |
| 8723 | HOSECHANGE_WARNLEVEL_SP2              | UNSIGNED32 | 4 | R/W | None    | Warn level for sample preparation hose change<br>Factory default: 1970-03-02T00:00:00       |
| 8725 | MEASUREMENT_ITERATIONS_SP2            | UNSIGNED8  | 1 | R/W | None    | Number of consecutive measurements for one channel<br>Factory default: 1                    |
| 8726 | FILTER_CHANGE_ACTIVATION_SP2          | UNSIGNED8  | 1 | R/W | None    | Limit change filter<br><br>Selection:<br>0: Off<br>1: On<br><br>Factory default: 0          |
| 8727 | HOSE_CHANGE_ACTIVATION_SP2            | UNSIGNED8  | 1 | R/W | None    | Limit change hose<br><br>Selection:<br>0: Off<br>1: On<br><br>Factory default: 1            |
| 8728 | TIMEOUT_SAMPLING_SP2                  | UNSIGNED32 | 4 | R/W | None    | Timeout no sample<br>Factory default: 1970-01-01T00:05:00                                   |
| 8730 | TIMEOUT_SAMPLING_PPS_SP2              | UNSIGNED32 | 4 | R/W | None    | Timeout no sample (pressurized pipe)<br>Factory default: 1970-01-01T00:01:00                |
| 8732 | FILTER_AIRCLEANING_DURATION_SP2       | FLOAT      | 4 | R/W | Seconds | Filter air cleaning duration<br>Factory default: 30.0                                       |
| 8734 | FILTER_AIRCLEANING_INTERVAL_SP2       | UNSIGNED32 | 4 | R/W | None    | Filter air cleaning interval<br>Factory default: 1970-01-01T02:00:00                        |
| 8736 | FILTER_AIRCLEANING_MODE_SP2           | UNSIGNED8  | 1 | R/W | None    | Filter air cleaning mode<br><br>Selection:<br>0: On<br>1: Off<br><br>Factory default: 0     |
| 8737 | CLEANING_DETERGENT_RESIDENCE_TIME_SP2 | UNSIGNED32 | 4 | R/W | None    | Cleaner residence time<br>Factory default: 1970-01-01T00:01:00                              |
| 8739 | CLEANING_DISCARD_TIME_SP2             | UNSIGNED32 | 4 | R/W | None    | Cleaning discard time<br>Factory default: 1970-01-01T00:01:30                               |
| 8741 | CLEANING_DURATION_PPS_SP2             | FLOAT      | 4 | R/W | Seconds | Pressurized pipe cleaning duration<br>Factory default: 10.0                                 |
| 8743 | CLEANING_DISCARD_TIME_PPS_SP2         | FLOAT      | 4 | R/W | Seconds | Pressurized pipe cleaning discard time<br>Factory default: 180.0                            |
| 8745 | CLEANING_TRIGGER_PPS_SP2              | UNSIGNED8  | 1 | R/W | None    | Start condition of first pressurized pipe                                                   |

|      |                           |            |   |     |      |                                                                                         |
|------|---------------------------|------------|---|-----|------|-----------------------------------------------------------------------------------------|
|      |                           |            |   |     |      | cleaning<br><br>Selection:<br>0: On<br>1: Date/time<br>2: Off<br><br>Factory default: 0 |
| 8746 | CLEANING_INTERVAL_PPS_SP2 | UNSIGNED32 | 4 | R/W | None | Interval for pressurized pipe cleaning<br>Factory default: 1970-01-01T00:30:00          |

### 7.3.4.5 Analyzer Config (Holding, FC: 03, 16, 23)

| Register | Parameter                   | Data Type     | Bytes | R/W | Unit                    | Description                                                                                       |
|----------|-----------------------------|---------------|-------|-----|-------------------------|---------------------------------------------------------------------------------------------------|
| 9000     | ORDERCODE_EXT_CURRENT       | OCTETSTRING64 | 64    | R/W | None                    | Current extended order code of the device<br>Factory default: 0                                   |
| 9032     | MEAS_VALUE_INDEX            | UNSIGNED8     | 1     | R/W | None                    | Index of selected measurement value in measurement value list<br>Factory default: 0               |
| 9033     | MEAS_VALUE_UNIT             | UNSIGNED8     | 1     | R/W | None                    | User selectable measurand unit<br>Factory default: 1                                              |
| 9034     | POWERFAIL_REACTION          | UNSIGNED8     | 1     | R/W | None                    | Power fail reaction<br><br>Selection:<br>0: Last mode<br>1: Manual mode<br><br>Factory default: 0 |
| 9035     | CALIBRATION_RETRIES         | UNSIGNED8     | 1     | R/W | None                    | Number of retries in case of failed calibration<br>Factory default: 2                             |
| 9036     | CALIBRATION_FACTOR          | FLOAT         | 4     | R   | None                    | Calibration factor of the photometer<br>Factory default: 1.00                                     |
| 9038     | CALIBRATION_FACTOR_DELTA    | FLOAT         | 4     | R/W | Percent                 | Max. allowed deviation of calibration factor for calibration<br>Factory default: 10               |
| 9040     | CALIBRATION_FACTOR_MIN      | FLOAT         | 4     | R/W | None                    | Min. allowed calibration factor<br>Factory default: 0.5                                           |
| 9042     | CALIBRATION_FACTOR_MAX      | FLOAT         | 4     | R/W | None                    | Max. allowed calibration factor<br>Factory default: 2.0                                           |
| 9044     | CALIBRATION_CONCENTRATION   | FLOAT         | 4     | R/W | KiloGram PerCubic Meter | Concentration of the calibration standard<br>Factory default: 0.0                                 |
| 9046     | MEASUREMENT_OFFSET          | FLOAT         | 4     | R   | KiloGram PerCubic Meter | Concentration offset for concentration value calculation<br>Factory default: 0.0                  |
| 9048     | MEASUREMENT_DILUTION_FACTOR | FLOAT         | 4     | R/W | None                    | Dilution factor for concentration value calculation<br>Factory default: 1.0                       |
| 9050     | CALIBRATION_ZEROPOINT_DELTA | FLOAT         | 4     | R/W | KiloGram PerCubic Meter | Max. allowed deviation of zero point for calibration<br>Factory default: 0.0                      |
| 9052     | CALIBRATION_ZEROPOINT_MIN   | FLOAT         | 4     | R/W | KiloGram PerCubic Meter | Min. allowed calibration zero point<br>Factory default: 0.0                                       |
| 9054     | CALIBRATION_ZEROPOINT_MAX   | FLOAT         | 4     | R/W | KiloGram PerCubic Meter | Max. allowed calibration zero point<br>Factory default: 0.0                                       |
| 9056     | MULTIPLE_CALIBRATIONS_COUNT | UNSIGNED8     | 1     | R/W | None                    | Calibration: Number determinations<br>Factory default: 1                                          |
| 9057     | MULTIPLE_MEASUREMENTS_COUNT | UNSIGNED8     | 1     | R/W | None                    | Number measurements<br>Factory default: 1                                                         |
| 9058     | SP_FOR_FIELDBUS_ACTIVITIES  | UNSIGNED8     | 1     | R/W | None                    | Sampling point for fieldbus activities<br><br>Selection:<br>0: Sequence of measurements<br>1: SP1 |

| Register | Parameter | Data Type | Bytes | R/W | Unit | Description                                                              |
|----------|-----------|-----------|-------|-----|------|--------------------------------------------------------------------------|
|          |           |           |       |     |      | 2: SP2<br>3: SP3<br>4: SP4<br>5: SP5<br>6: SP6<br><br>Factory default: 0 |

### 7.3.4.6 Analyzer Info (Input, FC: 04)

| Register | Parameter                      | Data Type     | Bytes | R/W | Unit | Description                                                                                            |
|----------|--------------------------------|---------------|-------|-----|------|--------------------------------------------------------------------------------------------------------|
| 9100     | ANALYZER_ORDERCODE             | OCTETSTRING64 | 64    | R   | None | Order code of the device<br>Factory default: 0                                                         |
| 9132     | ANALYZER_ORDERCODE_EXT         | OCTETSTRING64 | 64    | R   | None | Extended order code of the device<br>Factory default: 0                                                |
| 9164     | ANALYZER_ORDERCODE_EXT_CURRENT | OCTETSTRING64 | 64    | R   | None | Current extended order code of the device<br>Factory default: 0                                        |
| 9196     | ANALYZER_HW_VERSION            | OCTETSTRING16 | 16    | R   | None | Hardware version of the device<br>Factory default: 0                                                   |
| 9204     | ANALYZER_SW_VERSION            | OCTETSTRING16 | 16    | R   | None | Software version of the device<br>Factory default: 0                                                   |
| 9212     | ANALYZER_MODE                  | UNSIGNED8     | 1     | R   | None | Operation mode<br><br>Selection:<br>0: Manual<br>1: Automatic<br>2: Fieldbus<br><br>Factory default: 0 |

|      |                                |            |   |   |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|--------------------------------|------------|---|---|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9213 | ANALYZER_ACTIVITY              | UNSIGNED8  | 1 | R | None    | <p>Current activity</p> <p>Selection:</p> <p>0: None</p> <p>1: Measurement %OV</p> <p>2: Calibration</p> <p>3: Cleaning</p> <p>4: ---</p> <p>5: ---</p> <p>6: Emptying SC</p> <p>7: ---</p> <p>8: ---</p> <p>9: Empty hoses</p> <p>10: Initializing</p> <p>11: Cleaning up</p> <p>12: Cleaning sample preparation</p> <p>13: Dispenser replacem.</p> <p>14: Dispenser replacem.</p> <p>15: Testing liquidmanager actuator</p> <p>16: Bottle insertion</p> <p>17: Bottle removal</p> <p>18: Open valves</p> <p>19: Close valves</p> <p>20: Rinse reagents</p> <p>21: Rinse with water</p> <p>22: Commissioning</p> <p>23: Empty reactor</p> <p>24: Empty dosing unit</p> <p>25: Empty dilution module</p> <p>26: Rinse analyzer</p> <p>27: Reactor heating test</p> <p>28: Reactor pressure test</p> <p>29: Custom</p> <p>30: Rinsing</p> <p>31: Rinsing</p> <p>32: Rinsing</p> <p>33: Rinsing</p> <p>34: Preparing</p> <p>35: Service function 1</p> <p>36: Service function 2</p> <p>37: Service function 3</p> <p>38: Service function 4</p> <p>39: Service function 5</p> <p>40: Dispenser test</p> <p>41: Dispenser test</p> <p>42: Grab sample meas.</p> <p>Factory default: 0</p> |
| 9214 | ANALYZER_ACTIVITY_TIME         | UNSIGNED32 | 4 | R | None    | Remaining time of current activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 9216 | ANALYZER_OP_TIME_FILTERMAT     | FLOAT      | 4 | R | Seconds | <p>Operating time of filter mat</p> <p>Factory default: 0.0</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 9218 | ANALYZER_OP_TIME_PELTIER       | FLOAT      | 4 | R | Seconds | <p>Operating time of peltier element</p> <p>Factory default: 0.0</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 9220 | ANALYZER_SAMPLE_COLLECTOR_TYPE | UNSIGNED8  | 1 | R | None    | <p>Type of sample preparation</p> <p>Selection:</p> <p>0: None</p> <p>1: Conductive</p> <p>2: Capacitive</p> <p>3: Flow rate</p> <p>Factory default: 0</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

|      |                                |               |    |   |                       |                                                                                                                                                                                                                                                                                        |
|------|--------------------------------|---------------|----|---|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9221 | ANALYZER_ACTIVE_SAMPLINGPOINT  | UNSIGNED8     | 1  | R | None                  | Active channel<br><br>Selection:<br>0: SP1<br>1: SP2<br>2: SP3<br>3: SP4<br>4: SP5<br>5: SP6<br>6: None<br><br>Factory default: 0                                                                                                                                                      |
| 9222 | ANALYZER_SP_INSTALLATION_TYPE  | UNSIGNED8     | 1  | R | None                  | SP Installation Type<br><br>Selection:<br>0: Others<br>1: Pressurized pipe sampling<br><br>Factory default: 0                                                                                                                                                                          |
| 9223 | ANALYZER_MEAS_PARAM_ACTIVETEXT | OCTETSTRING32 | 32 | R | None                  | Measuring parameter<br>Factory default: 0                                                                                                                                                                                                                                              |
| 9239 | CAL_COUNT                      | UNSIGNED32    | 4  | R | None                  | Number of calibrations<br>Factory default: 0                                                                                                                                                                                                                                           |
| 9241 | CAL_DATETIME                   | DATETIME      | 8  | R | None                  | Time stamp of last calibration<br>Factory default: 1970-01-01T00:00:00                                                                                                                                                                                                                 |
| 9245 | CAL_METHOD                     | UNSIGNED8     | 1  | R | None                  | Calibration method of last calibration<br><br>Selection:<br>0: None<br>1: Zero point<br>2: Cal. factor<br>3: 2-point calibration<br>4: Application calibration<br>5: Numeric input zero point<br>6: Numeric input cal. factor<br>7: Numeric input appl. cal.<br><br>Factory default: 0 |
| 9246 | RAW_VALUE_OTIS                 | FLOAT         | 4  | R | None                  | Raw value                                                                                                                                                                                                                                                                              |
| 9248 | RAW_VALUE_STATE_OTIS           | UNSIGNED8     | 1  | R | None                  | Raw value state                                                                                                                                                                                                                                                                        |
| 9249 | ZEROPOINT_CAL                  | FLOAT         | 4  | R | KiloGramPerCubicMeter | Zero point<br>Factory default: 0.0                                                                                                                                                                                                                                                     |
| 9251 | ZEROPOINT_CAL_DATE             | UNSIGNED32    | 4  | R | None                  | Date of last zero-point calibration                                                                                                                                                                                                                                                    |
| 9253 | CALIBRATION_FACTOR             | FLOAT         | 4  | R | None                  | Calibration factor of the photometer<br>Factory default: 1.00                                                                                                                                                                                                                          |
| 9255 | CALIBRATION_FACTOR_DATE        | UNSIGNED32    | 4  | R | None                  | Date of last calibration factor determination                                                                                                                                                                                                                                          |
| 9257 | APPLICATION_CAL_ACTIVE         | UNSIGNED8     | 1  | R | None                  | Application calibration active<br>Factory default: 0                                                                                                                                                                                                                                   |
| 9258 | INTERNAL_DILUTION              | UNSIGNED8     | 1  | R | None                  | Internal dilution factor<br>Factory default: 1                                                                                                                                                                                                                                         |
| 9259 | EXTERNAL_SAMPLE_DILUTION       | FLOAT         | 4  | R | None                  | External dilution factor<br>Factory default: 1.0                                                                                                                                                                                                                                       |
| 9261 | CONCENTRATION_OFFSET           | FLOAT         | 4  | R | KiloGramPerCubicMeter | Offset<br>Factory default: 0.0                                                                                                                                                                                                                                                         |
| 9263 | SP1_MEAS_VALUE                 | FLOAT         | 4  | R | KiloGramPerCubicMeter | SP1: Measured value                                                                                                                                                                                                                                                                    |
| 9265 | SP1_MEAS_STATE                 | UNSIGNED8     | 1  | R | KiloGramPerCubicMeter | SP1: Measured value state                                                                                                                                                                                                                                                              |
| 9266 | SP1_MEAS_DATE                  | UNSIGNED32    | 4  | R | None                  | SP1: Date of last measured value<br>Factory default: 1970-01-01T00:00:00                                                                                                                                                                                                               |

|      |                             |               |    |   |                       |                                                                                                                            |
|------|-----------------------------|---------------|----|---|-----------------------|----------------------------------------------------------------------------------------------------------------------------|
| 9268 | SP1_MEAS_TIME               | UNSIGNED32    | 4  | R | None                  | SP1: Time of last measured value<br>Factory default: 1970-01-01T00:00:00                                                   |
| 9270 | SP2_MEAS_VALUE              | FLOAT         | 4  | R | KiloGramPerCubicMeter | SP2: Measured value                                                                                                        |
| 9272 | SP2_MEAS_STATE              | UNSIGNED8     | 1  | R | KiloGramPerCubicMeter | SP2: Measured value state                                                                                                  |
| 9273 | SP2_MEAS_DATE               | UNSIGNED32    | 4  | R | None                  | SP2: Date of last measured value<br>Factory default: 1970-01-01T00:00:00                                                   |
| 9275 | SP2_MEAS_TIME               | UNSIGNED32    | 4  | R | None                  | SP2: Time of last measured value<br>Factory default: 1970-01-01T00:00:00                                                   |
| 9277 | INFO_MEASRANGE_ACTIVETEXT   | OCTETSTRING32 | 32 | R | None                  | Measuring range<br>Factory default: 0                                                                                      |
| 9293 | DIGESTION_TIME              | UNSIGNED32    | 4  | R | None                  | Digestion time                                                                                                             |
| 9295 | DIGESTION_TEMPERATURE       | FLOAT         | 4  | R | Celsius               | Digestion temperature<br>Factory default: 0.0                                                                              |
| 9297 | TURBID_SAMPLE_MODE          | UNSIGNED8     | 1  | R | None                  | Turbid sample mode<br><br>Selection:<br>0: Off<br>1: On<br>2: Automatic<br><br>Factory default: 1                          |
| 9298 | CALIBRATION_CONCENTRATION   | FLOAT         | 4  | R | KiloGramPerCubicMeter | Concentration of the calibration standard<br>Factory default: 0.0                                                          |
| 9300 | PROGRAM_CAL_TRIGGER         | UNSIGNED8     | 1  | R | None                  | Start condition for calibration<br><br>Selection:<br>0: Immediate<br>1: Date/time<br>2: Disabled<br><br>Factory default: 2 |
| 9301 | PROGRAM_CAL_INTERVAL        | UNSIGNED32    | 4  | R | None                  | Interval for calibration<br>Factory default: 1970-01-03T00:00:00                                                           |
| 9303 | PROGRAM_CLEAN_TRIGGER       | UNSIGNED8     | 1  | R | None                  | Start condition for cleaning<br><br>Selection:<br>0: Immediate<br>1: Date/time<br>2: Disabled<br><br>Factory default: 2    |
| 9304 | PROGRAM_CLEAN_INTERVAL      | UNSIGNED32    | 4  | R | None                  | Interval for cleaning<br>Factory default: 1970-01-03T00:00:00                                                              |
| 9306 | MULTIPLE_CALIBRATIONS_COUNT | UNSIGNED8     | 1  | R | None                  | Calibration: Number determinations<br>Factory default: 1                                                                   |
| 9307 | MULTIPLE_MEASUREMENTS_COUNT | UNSIGNED8     | 1  | R | None                  | Number measurements<br>Factory default: 1                                                                                  |
| 9308 | BLANK_VALUE                 | FLOAT         | 4  | R | None                  | Blank value<br>Factory default: 0.0                                                                                        |
| 9310 | SAMPLE_VALUE                | FLOAT         | 4  | R | None                  | Sample value<br>Factory default: 0.0                                                                                       |
| 9312 | SLOPE                       | FLOAT         | 4  | R | KiloGramPerCubicMeter | Slope<br>Factory default: 0.001                                                                                            |
| 9314 | SP1_TIME_OF_SAMPLE          | UNSIGNED32    | 4  | R | None                  | no description<br>Factory default: 1970-01-01T00:00:00                                                                     |
| 9316 | SP2_TIME_OF_SAMPLE          | UNSIGNED32    | 4  | R | None                  | no description<br>Factory default: 1970-01-01T00:00:00                                                                     |

|      |                              |            |   |   |                       |                                                                          |
|------|------------------------------|------------|---|---|-----------------------|--------------------------------------------------------------------------|
| 9318 | SP3_MEAS_VALUE               | FLOAT      | 4 | R | KiloGramPerCubicMeter | SP3: Measured value                                                      |
| 9320 | SP3_MEAS_STATE               | UNSIGNED8  | 1 | R | KiloGramPerCubicMeter | SP3: Measured value state                                                |
| 9321 | SP3_MEAS_DATE                | UNSIGNED32 | 4 | R | None                  | SP3: Date of last measured value<br>Factory default: 1970-01-01T00:00:00 |
| 9323 | SP3_MEAS_TIME                | UNSIGNED32 | 4 | R | None                  | SP3: Time of last measured value<br>Factory default: 1970-01-01T00:00:00 |
| 9325 | SP3_TIME_OF_SAMPLE           | UNSIGNED32 | 4 | R | None                  | no description<br>Factory default: 1970-01-01T00:00:00                   |
| 9327 | SP4_MEAS_VALUE               | FLOAT      | 4 | R | KiloGramPerCubicMeter | SP4: Measured value                                                      |
| 9329 | SP4_MEAS_STATE               | UNSIGNED8  | 1 | R | KiloGramPerCubicMeter | SP4: Measured value state                                                |
| 9330 | SP4_MEAS_DATE                | UNSIGNED32 | 4 | R | None                  | SP4: Date of last measured value<br>Factory default: 1970-01-01T00:00:00 |
| 9332 | SP4_MEAS_TIME                | UNSIGNED32 | 4 | R | None                  | SP4: Time of last measured value<br>Factory default: 1970-01-01T00:00:00 |
| 9334 | SP4_TIME_OF_SAMPLE           | UNSIGNED32 | 4 | R | None                  | no description<br>Factory default: 1970-01-01T00:00:00                   |
| 9336 | SP5_MEAS_VALUE               | FLOAT      | 4 | R | KiloGramPerCubicMeter | SP5: Measured value                                                      |
| 9338 | SP5_MEAS_STATE               | UNSIGNED8  | 1 | R | KiloGramPerCubicMeter | SP5: Measured value state                                                |
| 9339 | SP5_MEAS_DATE                | UNSIGNED32 | 4 | R | None                  | SP5: Date of last measured value<br>Factory default: 1970-01-01T00:00:00 |
| 9341 | SP5_MEAS_TIME                | UNSIGNED32 | 4 | R | None                  | SP5: Time of last measured value<br>Factory default: 1970-01-01T00:00:00 |
| 9343 | SP5_TIME_OF_SAMPLE           | UNSIGNED32 | 4 | R | None                  | no description<br>Factory default: 1970-01-01T00:00:00                   |
| 9345 | SP6_MEAS_VALUE               | FLOAT      | 4 | R | KiloGramPerCubicMeter | SP6: Measured value                                                      |
| 9347 | SP6_MEAS_STATE               | UNSIGNED8  | 1 | R | KiloGramPerCubicMeter | SP6: Measured value state                                                |
| 9348 | SP6_MEAS_DATE                | UNSIGNED32 | 4 | R | None                  | SP6: Date of last measured value<br>Factory default: 1970-01-01T00:00:00 |
| 9350 | SP6_MEAS_TIME                | UNSIGNED32 | 4 | R | None                  | SP6: Time of last measured value<br>Factory default: 1970-01-01T00:00:00 |
| 9352 | SP6_TIME_OF_SAMPLE           | UNSIGNED32 | 4 | R | None                  | no description<br>Factory default: 1970-01-01T00:00:00                   |
| 9354 | ZEROPOINT_CAL_TIME_UTCO      | UNSIGNED32 | 4 | R | None                  | Date of last zero-point calibration                                      |
| 9356 | CALIBRATION_FACTOR_TIME_UTCO | UNSIGNED32 | 4 | R | None                  | Date of last calibration factor determination                            |
| 9358 | SP1_MEAS_TIME_UTCO           | UNSIGNED32 | 4 | R | None                  | SP1: Time of last measured value                                         |
| 9360 | SP1_TIME_OF_SAMPLE_UTCO      | UNSIGNED32 | 4 | R | None                  | SP1: Time of last measured value                                         |
| 9362 | SP2_MEAS_TIME_UTCO           | UNSIGNED32 | 4 | R | None                  | SP2: Time of last measured value                                         |
| 9364 | SP2_TIME_OF_SAMPLE_UTCO      | UNSIGNED32 | 4 | R | None                  | SP1: Time of last measured value                                         |
| 9366 | SP3_MEAS_TIME_UTCO           | UNSIGNED32 | 4 | R | None                  | SP3: Time of last measured value                                         |
| 9368 | SP3_TIME_OF_SAMPLE_UTCO      | UNSIGNED32 | 4 | R | None                  | SP1: Time of last measured value                                         |
| 9370 | SP4_MEAS_TIME_UTCO           | UNSIGNED32 | 4 | R | None                  | SP4: Time of last measured value                                         |
| 9372 | SP4_TIME_OF_SAMPLE_UTCO      | UNSIGNED32 | 4 | R | None                  | SP1: Time of last measured value                                         |
| 9374 | SP5_MEAS_TIME_UTCO           | UNSIGNED32 | 4 | R | None                  | SP5: Time of last measured value                                         |

|      |                         |            |   |   |      |                                  |
|------|-------------------------|------------|---|---|------|----------------------------------|
| 9376 | SP5_TIME_OF_SAMPLE_UTCO | UNSIGNED32 | 4 | R | None | SP1: Time of last measured value |
| 9378 | SP6_MEAS_TIME_UTCO      | UNSIGNED32 | 4 | R | None | SP6: Time of last measured value |
| 9380 | SP6_TIME_OF_SAMPLE_UTCO | UNSIGNED32 | 4 | R | None | SP1: Time of last measured value |

### 7.3.4.7 Analyzer Program (Holding, FC: 03, 16, 23)

| Register | Parameter                | Data Type  | Bytes | R/W | Unit | Description                                                                                                                  |
|----------|--------------------------|------------|-------|-----|------|------------------------------------------------------------------------------------------------------------------------------|
| 9200     | PROGRAM_MEAS_TRIGGER     | UNSIGNED8  | 1     | R/W | None | Start condition for measurement<br><br>Selection:<br>0: Immediate<br>1: Date/time<br>2: Continuous<br><br>Factory default: 0 |
| 9201     | PROGRAM_MEAS_START_DATE  | DATETIME   | 8     | R/W | None | Start of first measurement: date<br>Factory default: 1970-01-01T00:00:00                                                     |
| 9205     | PROGRAM_MEAS_START_TIME  | DATETIME   | 8     | R/W | None | Start of first measurement: time<br>Factory default: 1970-01-01T00:00:00                                                     |
| 9209     | PROGRAM_MEAS_INTERVAL    | UNSIGNED32 | 4     | R/W | None | Interval for measurement<br>Factory default: 1970-01-01T00:30:00                                                             |
| 9211     | PROGRAM_CAL_TRIGGER      | UNSIGNED8  | 1     | R/W | None | Start condition for calibration<br><br>Selection:<br>0: Immediate<br>1: Date/time<br>2: Disabled<br><br>Factory default: 2   |
| 9212     | PROGRAM_CAL_START_DATE   | DATETIME   | 8     | R/W | None | Start of first calibration: date<br>Factory default: 1970-01-01T00:00:00                                                     |
| 9216     | PROGRAM_CAL_START_TIME   | DATETIME   | 8     | R/W | None | Start of first calibration: time<br>Factory default: 1970-01-01T00:00:00                                                     |
| 9220     | PROGRAM_CAL_INTERVAL     | UNSIGNED32 | 4     | R/W | None | Interval for calibration<br>Factory default: 1970-01-03T00:00:00                                                             |
| 9222     | PROGRAM_CLEAN_TRIGGER    | UNSIGNED8  | 1     | R/W | None | Start condition for cleaning<br><br>Selection:<br>0: Immediate<br>1: Date/time<br>2: Disabled<br><br>Factory default: 2      |
| 9223     | PROGRAM_CLEAN_START_DATE | DATETIME   | 8     | R/W | None | Start of first cleaning: date<br>Factory default: 1970-01-01T00:00:00                                                        |
| 9227     | PROGRAM_CLEAN_START_TIME | DATETIME   | 8     | R/W | None | Start of first cleaning: time<br>Factory default: 1970-01-01T00:00:00                                                        |
| 9231     | PROGRAM_CLEAN_INTERVAL   | UNSIGNED32 | 4     | R/W | None | Interval for cleaning<br>Factory default: 1970-01-03T00:00:00                                                                |

### 7.3.4.8 Analyzer Manual actions (Holding, FC: 03, 16, 23)

| Register | Parameter            | Data Type | Bytes | R/W | Unit | Description                                                                                                                                                     |
|----------|----------------------|-----------|-------|-----|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9400     | MODE_CHANGE_REQUEST  | UNSIGNED8 | 1     | R/W | None | Mode change request<br><br>Selection:<br>0: None<br>1: Enter fieldbus mode<br>2: Continue automatic mode<br>3: Restart automatic mode<br><br>Factory default: 0 |
| 9401     | ABORT_ACTION_REQUEST | UNSIGNED8 | 1     | R/W | None | Abort current activity<br><br>Selection:<br>0: None<br>1: Abort current action                                                                                  |

| Register | Parameter             | Data Type | Bytes | R/W | Unit | Description                                                                                                                                         |
|----------|-----------------------|-----------|-------|-----|------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                       |           |       |     |      | Factory default: 0                                                                                                                                  |
| 9402     | MANUAL_ACTION_REQUEST | UNSIGNED8 | 1     | R/W | None | Manual activity request<br><br>Selection:<br>0: None<br>1: Start measurement<br>2: Start calibration<br>3: Start cleaning<br><br>Factory default: 0 |

#### 7.3.4.9 Analyzer Photometer Info (Input, FC: 04)

| Register | Parameter                 | Data Type     | Bytes | R/W | Unit    | Description                                              |
|----------|---------------------------|---------------|-------|-----|---------|----------------------------------------------------------|
| 9600     | PHOTOMETER_HW_VERSION     | OCTETSTRING16 | 16    | R   | None    | Hardware version of photometer<br>Factory default: 0     |
| 9608     | PHOTOMETER_SW_VERSION     | OCTETSTRING16 | 16    | R   | None    | Software version of photometer<br>Factory default: 0     |
| 9616     | PHOTOMETER_OP_TIME        | FLOAT         | 4     | R   | Seconds | Operating hours of photometer<br>Factory default: 0.0    |
| 9618     | PHOTOMETER_TEMPERATURE    | FLOAT         | 4     | R   | Celsius | Temperature of photometer cuvette<br>Factory default: 25 |
| 9620     | PHOTOMETER_RAW_MEAS_VALUE | FLOAT         | 4     | R   | None    | Raw value of photometer                                  |

#### 7.3.4.10 Analyzer Measurement data (Input, FC: 04)

| Register | Parameter                 | Data Type     | Bytes | R/W | Unit | Description                                                                                     |
|----------|---------------------------|---------------|-------|-----|------|-------------------------------------------------------------------------------------------------|
| 9700     | DATA_MEAS_LISTSIZE        | UNSIGNED8     | 1     | R   | None | Amount of available/selectable measurands<br>Factory default: 0                                 |
| 9701     | DATA_MEAS_LIST1           | OCTETSTRING16 | 16    | R   | None | Descriptor of available/selectable measurand<br>Factory default: 0                              |
| 9709     | DATA_MEAS_LIST2           | OCTETSTRING16 | 16    | R   | None | Descriptor of available/selectable measurand<br>Factory default: 0                              |
| 9717     | DATA_MEAS_LIST3           | OCTETSTRING16 | 16    | R   | None | Descriptor of available/selectable measurand<br>Factory default: 0                              |
| 9725     | DATA_MEAS_LIST4           | OCTETSTRING16 | 16    | R   | None | Descriptor of available/selectable measurand<br>Factory default: 0                              |
| 9733     | DATA_MEAS_LIST5           | OCTETSTRING16 | 16    | R   | None | Descriptor of available/selectable measurand<br>Factory default: 0                              |
| 9741     | DATA_MEAS_LIST6           | OCTETSTRING16 | 16    | R   | None | Descriptor of available/selectable measurand<br>Factory default: 0                              |
| 9749     | DATA_MEAS_LIST7           | OCTETSTRING16 | 16    | R   | None | Descriptor of available/selectable measurand<br>Factory default: 0                              |
| 9757     | DATA_MEAS_LIST8           | OCTETSTRING16 | 16    | R   | None | Descriptor of available/selectable measurand<br>Factory default: 0                              |
| 9765     | DATA_MEASRANGE_ACTIVETEXT | OCTETSTRING32 | 32    | R   | None | Measuring range<br>Factory default: 0                                                           |
| 9781     | DATA_AUTOMEASRANGECHANGE  | UNSIGNED8     | 1     | R   | None | Automatic range switch<br><br>Selection:<br>0: Manual<br>1: Automatic<br><br>Factory default: 0 |

#### 7.3.4.11 Analyzer manual actions state (Input, FC: 04)

| Register | Parameter            | Data Type | Bytes | R/W | Unit | Description                                                            |
|----------|----------------------|-----------|-------|-----|------|------------------------------------------------------------------------|
| 9900     | MODE_CHANGE_STATE    | UNSIGNED8 | 1     | R   | None | State of mode change request interface (0=ready)<br>Factory default: 0 |
| 9901     | ACTION_REQUEST_STATE | UNSIGNED8 | 1     | R   | None | Manual action request state. 0 = ready.<br>Factory default: 0          |

### 7.3.5 Heartbeat Monitoring (requires activation code)

Without activation code these registers read back with the value 0.

The Heartbeat Monitoring registers are mapped to deliver additional status information about the sensor in addition to the parameters available in the standard registers. For each sensor channel and sensor type a register block is defined, which can be read with one Modbus request.

Each register block has a length of 200 registers. The following table contains that start register of each block depending on sensor channel and sensor type.

| Channel  | Sensor Type |              |              |        |       |       |       |         |
|----------|-------------|--------------|--------------|--------|-------|-------|-------|---------|
|          | pH          | Conductivity | Disinfection | Oxygen | SAK   | CUS   | ISE   | Nitrate |
| Sensor 1 | 10000       | 11600        | 13200        | 14800  | 16400 | 18000 | 19600 | 21200   |
| Sensor 2 | 10200       | 11800        | 13400        | 15000  | 16600 | 18200 | 19800 | 21400   |
| Sensor 3 | 10400       | 12000        | 13600        | 15200  | 16800 | 18400 | 20000 | 21600   |
| Sensor 4 | 10600       | 12200        | 13800        | 15400  | 17000 | 18600 | 20200 | 21800   |
| Sensor 5 | 10800       | 12400        | 14000        | 15600  | 17200 | 18800 | 20400 | 22000   |
| Sensor 6 | 11000       | 12600        | 14200        | 15800  | 17400 | 19000 | 20600 | 22200   |
| Sensor 7 | 11200       | 12800        | 14400        | 16000  | 17600 | 19200 | 20800 | 22400   |
| Sensor 8 | 11400       | 13000        | 14600        | 16200  | 17800 | 19400 | 21000 | 22600   |

The subsequent chapters contain the offset to add to the start register to read a specific parameter for a given sensor type.



The parameter

- Heartbeat\_sensor\_status
- Heartbeat\_sensor\_health
- Maintenance\_timer (hours until next recommended maintenance)

for each sensor can be mapped individually to any AI device variable. Via Modbus they can be read out at the registers of the AI device variables.

#### 7.3.5.1 Sensor pH (Input, FC: 04)

| Offset | Data Type  | Bytes | R/W | Unit         | Description                                                             |
|--------|------------|-------|-----|--------------|-------------------------------------------------------------------------|
| 0      | DATETIME   | 8     | R   | None         | Current sensor-diagnosis: time of diagnosis appearance                  |
| 4      | DATETIME   | 8     | R   | None         | Manufacturing date of the sensor                                        |
| 8      | DATETIME   | 8     | R   | None         | Initial-operation date of sensor                                        |
| 12     | DATETIME   | 8     | R   | None         | Date of the last successful calibration of the sensor                   |
| 16     | FLOAT      | 4     | R   | None         | Slope                                                                   |
| 18     | FLOAT      | 4     | R   | None         | Difference of slope between current and last calibration                |
| 20     | FLOAT      | 4     | R   | None         | Zero point                                                              |
| 22     | FLOAT      | 4     | R   | None         | Difference of zero point between current and last calibration           |
| 24     | FLOAT      | 4     | R   | Ohm          | Glass impedance                                                         |
| 26     | FLOAT      | 4     | R   | Ohm          | Reference impedance                                                     |
| 28     | FLOAT      | 4     | R   | DeltaCelsius | Temperature offset                                                      |
| 30     | FLOAT      | 4     | R   | Ampere       | Leakage current                                                         |
| 32     | FLOAT      | 4     | R   | None         | Min. measured value                                                     |
| 34     | FLOAT      | 4     | R   | Celsius      | Min. measured temperature value                                         |
| 36     | FLOAT      | 4     | R   | None         | Max. measured value                                                     |
| 38     | FLOAT      | 4     | R   | Celsius      | Max. measured temperature value                                         |
| 40     | FLOAT      | 4     | R   | Seconds      | Operating hours of connected sensor                                     |
| 42     | FLOAT      | 4     | R   | Seconds      | Operating time >80°C                                                    |
| 44     | FLOAT      | 4     | R   | Seconds      | Operating time >100°C                                                   |
| 46     | FLOAT      | 4     | R   | Seconds      | Operating time <-300mV (pH)                                             |
| 48     | FLOAT      | 4     | R   | Seconds      | Operating time >300mV (pH)                                              |
| 50     | UNSIGNED16 | 2     | R   | None         | Number of sterilization cycles                                          |
| 51     | UNSIGNED16 | 2     | R   | None         | Number of clean in place cycles                                         |
| 52     | UNSIGNED16 | 2     | R   | None         | Current sensor-diagnosis: diagnosis code                                |
| 53     | UNSIGNED8  | 1     | R   | None         | Current sensor-diagnosis: status according to NAMUR NE107               |
| 54     | UNSIGNED8  | 1     | R   | None         | Selected sensor type. The selected type has to match with the connected |

| Offset | Data Type | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                                                                                     |
|--------|-----------|-------|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |           |       |     |      | sensor type.<br><br>Selection:<br>0: None (default)<br>1: Oxygen (amp.)<br>2: Oxygen (opt. fixed cable)<br>3: pH Glass<br>4: pH/ORP<br>5: pH ISFET<br>6: Cond c<br>7: Cond i<br>8: ORP<br>9: TU/TS<br>10: Nitrate<br>11: ISE<br>12: SAC<br>13: Ultrasonic interface<br>14: Chlorine<br>18: pH/ORP<br>19: Cond c 4-pol<br>20: Oxygen (opt. Memosens coupling)<br>21: TU<br>22: Inline photometer |

### 7.3.5.2 Sensor Conductivity (Input, FC: 04)

| Register | Data Type  | Bytes | R/W | Unit         | Description                                                                                                                                                                                                                                                                               |
|----------|------------|-------|-----|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | DATETIME   | 8     | R   | None         | Current sensor-diagnosis: time of diagnosis appearance                                                                                                                                                                                                                                    |
| 4        | DATETIME   | 8     | R   | None         | Manufacturing date of the sensor                                                                                                                                                                                                                                                          |
| 8        | DATETIME   | 8     | R   | None         | Initial-operation date of sensor                                                                                                                                                                                                                                                          |
| 12       | DATETIME   | 8     | R   | None         | Date of the last successful slope calibration of the sensor                                                                                                                                                                                                                               |
| 16       | FLOAT      | 4     | R   | None         | Cell constant                                                                                                                                                                                                                                                                             |
| 18       | FLOAT      | 4     | R   | None         | Difference of cell constant between current and last calibration                                                                                                                                                                                                                          |
| 20       | FLOAT      | 4     | R   | DeltaCelsius | Temperature offset                                                                                                                                                                                                                                                                        |
| 22       | FLOAT      | 4     | R   | None         | Min. measured value                                                                                                                                                                                                                                                                       |
| 24       | FLOAT      | 4     | R   | Celsius      | Min. measured temperature value                                                                                                                                                                                                                                                           |
| 26       | FLOAT      | 4     | R   | None         | Max. measured value                                                                                                                                                                                                                                                                       |
| 28       | FLOAT      | 4     | R   | Celsius      | Max. measured temperature value                                                                                                                                                                                                                                                           |
| 30       | FLOAT      | 4     | R   | Seconds      | Operating hours of connected sensor                                                                                                                                                                                                                                                       |
| 32       | FLOAT      | 4     | R   | Seconds      | Raw value                                                                                                                                                                                                                                                                                 |
| 34       | FLOAT      | 4     | R   | Seconds      | Operating time >80°C                                                                                                                                                                                                                                                                      |
| 36       | FLOAT      | 4     | R   | Seconds      | Operating time >100°C (Cond 4pol)                                                                                                                                                                                                                                                         |
| 38       | FLOAT      | 4     | R   | Seconds      | Operating time >120°C (cond.)                                                                                                                                                                                                                                                             |
| 40       | FLOAT      | 4     | R   | Seconds      | Operating time >125°C (ind.)                                                                                                                                                                                                                                                              |
| 42       | FLOAT      | 4     | R   | Seconds      | Operating time >140°C (Cond 2pol)                                                                                                                                                                                                                                                         |
| 44       | FLOAT      | 4     | R   | Seconds      | Operating time >150°C (Cond i, Cond 4pol)                                                                                                                                                                                                                                                 |
| 46       | FLOAT      | 4     | R   | Seconds      | Operating time <100nS (cond.)                                                                                                                                                                                                                                                             |
| 48       | UNSIGNED16 | 2     | R   | None         | Number of sterilization cycles                                                                                                                                                                                                                                                            |
| 49       | UNSIGNED16 | 2     | R   | None         | Number of clean in place cycles                                                                                                                                                                                                                                                           |
| 50       | UNSIGNED16 | 2     | R   | None         | Current sensor-diagnosis: diagnosis code                                                                                                                                                                                                                                                  |
| 51       | UNSIGNED8  | 1     | R   | None         | Current sensor-diagnosis: status according to NAMUR NE107                                                                                                                                                                                                                                 |
| 52       | UNSIGNED8  | 1     | R   | None         | Selected sensor type. The selected type has to match with the connected sensor type.<br><br>Selection:<br>0: None (default)<br>1: Oxygen (amp.)<br>2: Oxygen (opt. fixed cable)<br>3: pH Glass<br>4: pH/ORP<br>5: pH ISFET<br>6: Cond c<br>7: Cond i<br>8: ORP<br>9: TU/TS<br>10: Nitrate |

| Register | Data Type | Bytes | R/W | Unit | Description                                                                                                                                                                |
|----------|-----------|-------|-----|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |           |       |     |      | 11: ISE<br>12: SAC<br>13: Ultrasonic interface<br>14: Chlorine<br>18: pH/ORP<br>19: Cond c 4-pol<br>20: Oxygen (opt. Memosens coupling)<br>21: TU<br>22: Inline photometer |

### 7.3.5.3 Sensor Disinfection (Input, FC: 04)

| Register | Data Type  | Bytes | R/W | Unit          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|------------|-------|-----|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | DATETIME   | 8     | R   | None          | Current sensor-diagnosis: time of diagnosis appearance                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4        | DATETIME   | 8     | R   | None          | Manufacturing date of the sensor                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 8        | DATETIME   | 8     | R   | None          | Initial-operation date of sensor                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 12       | DATETIME   | 8     | R   | None          | Date of the last successful slope calibration of the sensor                                                                                                                                                                                                                                                                                                                                                                                                             |
| 16       | DATETIME   | 8     | R   | None          | Date of the last successful zero-point calibration of the sensor                                                                                                                                                                                                                                                                                                                                                                                                        |
| 20       | FLOAT      | 4     | R   | None          | Slope                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 22       | FLOAT      | 4     | R   | None          | Difference of slope between current and last calibration                                                                                                                                                                                                                                                                                                                                                                                                                |
| 24       | FLOAT      | 4     | R   | None          | Zero point                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 26       | FLOAT      | 4     | R   | None          | Difference of zero point between current and last calibration                                                                                                                                                                                                                                                                                                                                                                                                           |
| 28       | FLOAT      | 4     | R   | DeltaCelsius  | Temperature offset                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 30       | FLOAT      | 4     | R   | AmpereSeconds | Charge (electrical)                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 32       | FLOAT      | 4     | R   | None          | Min. measured value                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 34       | FLOAT      | 4     | R   | Celsius       | Min. measured temperature value                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 36       | FLOAT      | 4     | R   | None          | Max. measured value                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 38       | FLOAT      | 4     | R   | Celsius       | Max. measured temperature value                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 40       | FLOAT      | 4     | R   | Seconds       | Operating hours of connected sensor                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 42       | FLOAT      | 4     | R   | Seconds       | Operating time >15°C                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 44       | FLOAT      | 4     | R   | Seconds       | Operating time >30°C                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 46       | FLOAT      | 4     | R   | Seconds       | Operating time <-20 nA                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 48       | FLOAT      | 4     | R   | Seconds       | Operating time <-100 nA                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 50       | UNSIGNED16 | 2     | R   | None          | Number of sensor-cap calibrations                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 51       | UNSIGNED16 | 2     | R   | None          | Current sensor-diagnosis: diagnosis code                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 52       | UNSIGNED8  | 1     | R   | None          | Current sensor-diagnosis: status according to NAMUR NE107                                                                                                                                                                                                                                                                                                                                                                                                               |
| 53       | UNSIGNED8  | 1     | R   | None          | Selected sensor type. The selected type has to match with the connected sensor type.<br><br>Selection:<br>0: None (default)<br>1: Oxygen (amp.)<br>2: Oxygen (opt. fixed cable)<br>3: pH Glass<br>4: pH/ORP<br>5: pH ISFET<br>6: Cond c<br>7: Cond i<br>8: ORP<br>9: TU/TS<br>10: Nitrate<br>11: ISE<br>12: SAC<br>13: Ultrasonic interface<br>14: Chlorine<br>18: pH/ORP<br>19: Cond c 4-pol<br>20: Oxygen (opt. Memosens coupling)<br>21: TU<br>22: Inline photometer |
| 54       | UNSIGNED16 | 2     | R   | None          | Number of calibrations                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 55       | UNSIGNED16 | 2     | R   | None          | Number of sterilizations                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 56       | UNSIGNED16 | 2     | R   | None          | Number of clean in place cycles                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 57       | UNSIGNED16 | 2     | R   | None          | Number of autoclavings                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 58       | UNSIGNED8  | 1     | R   | None          | Number of sterilization cycles for cap                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 59       | UNSIGNED16 | 2     | R   | None          | Number of clean in place cycles for cap                                                                                                                                                                                                                                                                                                                                                                                                                                 |

| Register | Data Type  | Bytes | R/W | Unit          | Description                                          |
|----------|------------|-------|-----|---------------|------------------------------------------------------|
| 60       | UNSIGNED16 | 2     | R   | None          | Number of autoclavings for cap                       |
| 61       | FLOAT      | 4     | R   | AmpereSeconds | Electrolyte capacity                                 |
| 63       | FLOAT      | 4     | R   | Seconds       | Operating hours above a temperature of T3            |
| 65       | FLOAT      | 4     | R   | Seconds       | Cap operating hours of connected sensor              |
| 67       | FLOAT      | 4     | R   | Seconds       | Cap operating hours above a temperature of T1        |
| 69       | FLOAT      | 4     | R   | Seconds       | Cap operating hours above a temperature of T2        |
| 71       | FLOAT      | 4     | R   | Seconds       | Cap operating hours above a temperature of T3        |
| 73       | FLOAT      | 4     | R   | Seconds       | Cap operating hours raw value above T4               |
| 75       | FLOAT      | 4     | R   | Seconds       | Cap operating hours raw value above T5               |
| 77       | UNSIGNED8  | 1     | R   | None          | Sensor element                                       |
| 78       | UNSIGNED8  | 1     | R   | None          | Temperature threshold T1 for operating hours counter |
| 79       | UNSIGNED8  | 1     | R   | None          | Temperature threshold T2 for operating hours counter |
| 80       | UNSIGNED8  | 1     | R   | None          | Temperature threshold T3 for operating hours counter |
| 81       | FLOAT      | 4     | R   | Ampere        | Current threshold T4 for operating hours counter     |
| 83       | FLOAT      | 4     | R   | Ampere        | Current threshold T5 for operating hours counter     |

### 7.3.5.4 Sensor Oxygen (Input, FC: 04)

| Register | Data Type  | Bytes | R/W | Unit          | Description                                                                                                                                                                                                                             |
|----------|------------|-------|-----|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | DATETIME   | 8     | R   | None          | Current sensor-diagnosis: time of diagnosis appearance                                                                                                                                                                                  |
| 4        | DATETIME   | 8     | R   | None          | Manufacturing date of the sensor                                                                                                                                                                                                        |
| 8        | DATETIME   | 8     | R   | None          | Initial-operation date of sensor                                                                                                                                                                                                        |
| 12       | DATETIME   | 8     | R   | None          | Date of the last successful calibration of the sensor                                                                                                                                                                                   |
| 16       | DATETIME   | 8     | R   | None          | Date of the last successful zero-point calibration of the sensor                                                                                                                                                                        |
| 20       | FLOAT      | 4     | R   | None          | Slope                                                                                                                                                                                                                                   |
| 22       | FLOAT      | 4     | R   | None          | Difference of slope between current and last calibration                                                                                                                                                                                |
| 24       | FLOAT      | 4     | R   | None          | Zero point                                                                                                                                                                                                                              |
| 26       | FLOAT      | 4     | R   | None          | Difference of slope between current and last calibration                                                                                                                                                                                |
| 28       | FLOAT      | 4     | R   | DeltaCelsius  | Temperature offset                                                                                                                                                                                                                      |
| 30       | FLOAT      | 4     | R   | AmpereSeconds | Charge (electrical)                                                                                                                                                                                                                     |
| 32       | FLOAT      | 4     | R   | Celsius       | Min. measured temperature value                                                                                                                                                                                                         |
| 34       | FLOAT      | 4     | R   | Celsius       | Max. measured temperature value                                                                                                                                                                                                         |
| 36       | FLOAT      | 4     | R   | Seconds       | Operating hours of connected sensor                                                                                                                                                                                                     |
| 38       | FLOAT      | 4     | R   | Seconds       | Operating time <5°C (COS61D, COS81D)                                                                                                                                                                                                    |
| 40       | FLOAT      | 4     | R   | Seconds       | Operating time >25°C (COS61D), >40°C (COS21D), >5°C(COS51D), >T1 (COS81D)                                                                                                                                                               |
| 42       | FLOAT      | 4     | R   | Seconds       | Operating time >40°C (COS21D), >80°C (COS51D), >30°C (COS51D), >T2 (COS81D)                                                                                                                                                             |
| 44       | FLOAT      | 4     | R   | Seconds       | Operating time >40°C (COS21D), >80°C (COS51D), >30°C (COS51D), >T2 (COS81D)                                                                                                                                                             |
| 46       | FLOAT      | 4     | R   | Seconds       | Operating time >T3 (COS81D), >15nA (COS21D), > 30nA (COS51D)                                                                                                                                                                            |
| 48       | FLOAT      | 4     | R   | Seconds       | Operating time >T3 (COS81D), >15nA (COS21D), > 30nA (COS51D)                                                                                                                                                                            |
| 50       | FLOAT      | 4     | R   | Seconds       | Operating time >50nA (COS21D), > 160nA (COS51D), <5°C (COS21D), <="">                                                                                                                                                                   |
| 52       | FLOAT      | 4     | R   | Seconds       | Operating time >50nA (COS21D), > 160nA (COS51D), <5°C (COS21D), <="">                                                                                                                                                                   |
| 54       | FLOAT      | 4     | R   | Seconds       | Operating time <25µs (COS61D)                                                                                                                                                                                                           |
| 56       | FLOAT      | 4     | R   | Seconds       | Operating time >40µs (COS61D)                                                                                                                                                                                                           |
| 58       | UNSIGNED16 | 2     | R   | None          | Number of sterilization cycles                                                                                                                                                                                                          |
| 59       | UNSIGNED16 | 2     | R   | None          | Number of clean in place cycles                                                                                                                                                                                                         |
| 60       | UNSIGNED16 | 2     | R   | None          | Number of calibrations                                                                                                                                                                                                                  |
| 61       | UNSIGNED16 | 2     | R   | None          | Number of sensor-cap calibrations                                                                                                                                                                                                       |
| 62       | UNSIGNED16 | 2     | R   | None          | Current sensor-diagnosis: diagnosis code                                                                                                                                                                                                |
| 63       | UNSIGNED8  | 1     | R   | None          | Current sensor-diagnosis: status according to NAMUR NE107                                                                                                                                                                               |
| 64       | UNSIGNED8  | 1     | R   | None          | Selected sensor type. The selected type has to match with the connected sensor type.<br><br>Selection:<br>0: None (default)<br>1: Oxygen (amp.)<br>2: Oxygen (opt. fixed cable)<br>3: pH Glass<br>4: pH/ORP<br>5: pH ISFET<br>6: Cond c |

| Register | Data Type | Bytes | R/W | Unit | Description                                                                                                                                                                                                                  |
|----------|-----------|-------|-----|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |           |       |     |      | 7: Cond i<br>8: ORP<br>9: TU/TS<br>10: Nitrate<br>11: ISE<br>12: SAC<br>13: Ultrasonic interface<br>14: Chlorine<br>18: pH/ORP<br>19: Cond c 4-pol<br>20: Oxygen (opt. Memosens coupling)<br>21: TU<br>22: Inline photometer |

### 7.3.5.5 Sensor SAC (Input, FC: 04)

| Register | Data Type  | Bytes | R/W | Unit     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------|------------|-------|-----|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | FLOAT      | 4     | R   | None     | Calibration offset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 2        | FLOAT      | 4     | R   | PerMeter | ExtendedSAC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 4        | FLOAT      | 4     | R   | Celsius  | Min. measured temperature value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 6        | FLOAT      | 4     | R   | Celsius  | Max. measured temperature value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 8        | FLOAT      | 4     | R   | Seconds  | Operating hours of connected sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 10       | FLOAT      | 4     | R   | Seconds  | Operating time of filter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 12       | UNSIGNED32 | 4     | R   | None     | Flash lamp counter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 14       | DATETIME   | 8     | R   | None     | Current sensor-diagnosis: time of diagnosis appearance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 18       | DATETIME   | 8     | R   | None     | Manufacturing date of the sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 22       | DATETIME   | 8     | R   | None     | Initial-operation date of sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 26       | DATETIME   | 8     | R   | None     | Date of the last successful calibration of the sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 30       | UNSIGNED8  | 1     | R   | None     | Dataset switch for SAK<br><br>Selection:<br>0: Factory calib. (default)<br>1: Dataset1<br>2: Dataset2<br>3: Dataset3<br>4: Dataset4<br>5: Dataset5<br>6: Dataset6<br>7: undefined                                                                                                                                                                                                                                                                                                                                                                                      |
| 31       | UNSIGNED8  | 1     | R   | None     | Calibration method<br><br>Selection:<br>0: None (default)<br>1: Numeric input<br>2: 1-point calibration<br>3: 2-point calibration<br>4: Multipoint Calibration<br>5: Table<br>7: Zero point<br>8: Slope air<br>9: Slope H2O<br>10: Slope variable<br>11: Zero point reference<br>12: Slope reference<br>13: Offset<br>14: Slope<br>15: with temp. comp<br>16: without temp. comp<br>17: Standard addition<br>18: Numeric input slope<br>19: Numeric input zero point<br>20: Numeric input 2-point<br>21: Factory calib.<br>22: Slope test gas<br>23: Value acquisition |
| 32       | UNSIGNED16 | 2     | R   | None     | Number of calibrations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 33       | UNSIGNED16 | 2     | R   | None     | Current sensor-diagnosis: diagnosis code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

| Register | Data Type | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|-----------|-------|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 34       | UNSIGNED8 | 1     | R   | None | Current sensor-diagnosis: status according to NAMUR NE107                                                                                                                                                                                                                                                                                                                                                                                                               |
| 35       | UNSIGNED8 | 1     | R   | None | Selected sensor type. The selected type has to match with the connected sensor type.<br><br>Selection:<br>0: None (default)<br>1: Oxygen (amp.)<br>2: Oxygen (opt. fixed cable)<br>3: pH Glass<br>4: pH/ORP<br>5: pH ISFET<br>6: Cond c<br>7: Cond i<br>8: ORP<br>9: TU/TS<br>10: Nitrate<br>11: ISE<br>12: SAC<br>13: Ultrasonic interface<br>14: Chlorine<br>18: pH/ORP<br>19: Cond c 4-pol<br>20: Oxygen (opt. Memosens coupling)<br>21: TU<br>22: Inline photometer |
| 36       | FLOAT     | 4     | R   | None | Raw value                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

### 7.3.5.6 Sensor CUS (Input, FC: 04)

| Register | Data Type  | Bytes | R/W | Unit    | Description                                                                                                                                                                                                                                                                                                              |
|----------|------------|-------|-----|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | FLOAT      | 4     | R   | None    | Calibration offset                                                                                                                                                                                                                                                                                                       |
| 2        | FLOAT      | 4     | R   | Celsius | Min. measured temperature value                                                                                                                                                                                                                                                                                          |
| 4        | FLOAT      | 4     | R   | Celsius | Max. measured temperature value                                                                                                                                                                                                                                                                                          |
| 6        | FLOAT      | 4     | R   | Seconds | Operating hours of connected sensor                                                                                                                                                                                                                                                                                      |
| 8        | FLOAT      | 4     | R   | Seconds | Operating hours of connected sensor                                                                                                                                                                                                                                                                                      |
| 10       | FLOAT      | 4     | R   | Seconds | Operating hours of connected sensor                                                                                                                                                                                                                                                                                      |
| 12       | DATETIME   | 8     | R   | None    | Current sensor-diagnosis: time of diagnosis appearance                                                                                                                                                                                                                                                                   |
| 16       | DATETIME   | 8     | R   | None    | Manufacturing date of the sensor                                                                                                                                                                                                                                                                                         |
| 20       | DATETIME   | 8     | R   | None    | Initial-operation date of sensor                                                                                                                                                                                                                                                                                         |
| 24       | DATETIME   | 8     | R   | None    | Date of the last successful calibration of the sensor                                                                                                                                                                                                                                                                    |
| 28       | UNSIGNED8  | 1     | R   | None    | Dataset switch for turbidity<br><br>Selection:<br>0: Formazine (default)<br>1: Kaolin<br>2: SiO2<br>3: TiO2<br>4: Excess sludge<br>5: Digested sludge<br>6: Activated sludge<br>7: Dataset1<br>8: Dataset2<br>9: Dataset3<br>10: Dataset4<br>11: Dataset5<br>13: Thin sludge<br>14: PSL<br>15: Diatomite<br>16: Dataset6 |
| 29       | UNSIGNED16 | 2     | R   | None    | Number of calibrations                                                                                                                                                                                                                                                                                                   |
| 30       | UNSIGNED8  | 1     | R   | None    | Current sensor-diagnosis: status according to NAMUR NE107                                                                                                                                                                                                                                                                |
| 31       | UNSIGNED16 | 2     | R   | None    | Current sensor-diagnosis: diagnosis code                                                                                                                                                                                                                                                                                 |
| 32       | UNSIGNED8  | 1     | R   | None    | Selected sensor type. The selected type has to match with the connected sensor type.<br><br>Selection:<br>0: None (default)                                                                                                                                                                                              |

| Register | Data Type | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                              |
|----------|-----------|-------|-----|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |           |       |     |      | 1: Oxygen (amp.)<br>2: Oxygen (opt. fixed cable)<br>3: pH Glass<br>4: pH/ORP<br>5: pH ISFET<br>6: Cond c<br>7: Cond i<br>8: ORP<br>9: TU/TS<br>10: Nitrate<br>11: ISE<br>12: SAC<br>13: Ultrasonic interface<br>14: Chlorine<br>18: pH/ORP<br>19: Cond c 4-pol<br>20: Oxygen (opt. Memosens coupling)<br>21: TU<br>22: Inline photometer |
| 33       | FLOAT     | 4     | R   | None | Calibration factor                                                                                                                                                                                                                                                                                                                       |

### 7.3.5.7 Sensor ISE (Input, FC: 04)

| Register | Data Type  | Bytes | R/W | Unit    | Description                                                                                                                                       |
|----------|------------|-------|-----|---------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | FLOAT      | 4     | R   | None    | Min. measured value                                                                                                                               |
| 2        | FLOAT      | 4     | R   | Celsius | Min. measured temperature value                                                                                                                   |
| 4        | FLOAT      | 4     | R   | None    | Max. measured value                                                                                                                               |
| 6        | FLOAT      | 4     | R   | Celsius | Max. measured temperature value                                                                                                                   |
| 8        | FLOAT      | 4     | R   | None    | Slope reference slot                                                                                                                              |
| 10       | FLOAT      | 4     | R   | None    | Difference of slope between current and last calibration reference slot                                                                           |
| 12       | FLOAT      | 4     | R   | None    | Zero-point reference slot                                                                                                                         |
| 14       | FLOAT      | 4     | R   | None    | Delta zero-point reference slot                                                                                                                   |
| 16       | FLOAT      | 4     | R   | None    | Slope slot 1                                                                                                                                      |
| 18       | FLOAT      | 4     | R   | None    | Difference of slope between current and last calibration slot 1                                                                                   |
| 20       | FLOAT      | 4     | R   | None    | Zero-point slot 1                                                                                                                                 |
| 22       | FLOAT      | 4     | R   | None    | Delta zero-point slot 1                                                                                                                           |
| 24       | FLOAT      | 4     | R   | None    | Slope slot 2                                                                                                                                      |
| 26       | FLOAT      | 4     | R   | None    | Difference of slope between current and last calibration slot 2                                                                                   |
| 28       | FLOAT      | 4     | R   | None    | Zero-point slot 2                                                                                                                                 |
| 30       | FLOAT      | 4     | R   | None    | Delta zero-point slot 2                                                                                                                           |
| 32       | FLOAT      | 4     | R   | None    | Slope slot 3                                                                                                                                      |
| 34       | FLOAT      | 4     | R   | None    | Difference of slope between current and last calibration slot 3                                                                                   |
| 36       | FLOAT      | 4     | R   | None    | Zero-point slot 3                                                                                                                                 |
| 38       | FLOAT      | 4     | R   | None    | Delta zero-point slot 3                                                                                                                           |
| 40       | FLOAT      | 4     | R   | Seconds | Operating hours of connected sensor                                                                                                               |
| 42       | DATETIME   | 8     | R   | None    | Current sensor-diagnosis: time of diagnosis appearance                                                                                            |
| 46       | DATETIME   | 8     | R   | None    | Manufacturing date of the sensor                                                                                                                  |
| 50       | DATETIME   | 8     | R   | None    | Initial-operation date of sensor                                                                                                                  |
| 54       | DATETIME   | 8     | R   | None    | Date of the last successful calibration of the sensor reference slot                                                                              |
| 58       | DATETIME   | 8     | R   | None    | Date of the last successful calibration of the sensor slot 1                                                                                      |
| 62       | DATETIME   | 8     | R   | None    | Date of the last successful calibration of the sensor slot 2                                                                                      |
| 66       | DATETIME   | 8     | R   | None    | Date of the last successful calibration of the sensor slot 3                                                                                      |
| 70       | UNSIGNED8  | 1     | R   | None    | Electrode type reference slot (measured parameter)<br><br>Selection:<br>0: disabled (default)<br>5: pH                                            |
| 71       | UNSIGNED16 | 2     | R   | None    | Number of calibrations reference slot                                                                                                             |
| 72       | UNSIGNED8  | 1     | R   | None    | Electrode type slot 1 (measured parameter)<br><br>Selection:<br>0: disabled (default)<br>1: Nitrate<br>2: Ammonium<br>3: Potassium<br>4: Chloride |

| Register | Data Type  | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|------------|-------|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |            |       |     |      | 5: pH<br>6: ORP<br>7: user defined name                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 73       | UNSIGNED16 | 2     | R   | None | Number of calibrations slot 1                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 74       | UNSIGNED8  | 1     | R   | None | Electrode type slot 2 (measured parameter)<br><br>Selection:<br>0: disabled (default)<br>1: Nitrate<br>2: Ammonium<br>3: Potassium<br>4: Chloride<br>5: pH<br>6: ORP<br>7: user defined name                                                                                                                                                                                                                                                                            |
| 75       | UNSIGNED16 | 2     | R   | None | Number of calibrations slot 2                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 76       | UNSIGNED8  | 1     | R   | None | Electrode type slot 3 (measured parameter)<br><br>Selection:<br>0: disabled (default)<br>1: Nitrate<br>2: Ammonium<br>3: Potassium<br>4: Chloride<br>5: pH<br>6: ORP<br>7: user defined name                                                                                                                                                                                                                                                                            |
| 77       | UNSIGNED16 | 2     | R   | None | Number of calibrations slot 3                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 78       | UNSIGNED16 | 2     | R   | None | Current sensor-diagnosis: diagnosis code                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 79       | UNSIGNED8  | 1     | R   | None | Current sensor-diagnosis: status according to NAMUR NE107                                                                                                                                                                                                                                                                                                                                                                                                               |
| 80       | UNSIGNED8  | 1     | R   | None | Selected sensor type. The selected type has to match with the connected sensor type.<br><br>Selection:<br>0: None (default)<br>1: Oxygen (amp.)<br>2: Oxygen (opt. fixed cable)<br>3: pH Glass<br>4: pH/ORP<br>5: pH ISFET<br>6: Cond c<br>7: Cond i<br>8: ORP<br>9: TU/TS<br>10: Nitrate<br>11: ISE<br>12: SAC<br>13: Ultrasonic interface<br>14: Chlorine<br>18: pH/ORP<br>19: Cond c 4-pol<br>20: Oxygen (opt. Memosens coupling)<br>21: TU<br>22: Inline photometer |

### 7.3.5.8 Sensor Nitrate (Input, FC: 04)

| Register | Data Type  | Bytes | R/W | Unit    | Description                                            |
|----------|------------|-------|-----|---------|--------------------------------------------------------|
| 0        | FLOAT      | 4     | R   | None    | Calibration offset                                     |
| 2        | FLOAT      | 4     | R   | Celsius | Min. measured temperature value                        |
| 4        | FLOAT      | 4     | R   | Celsius | Max. measured temperature value                        |
| 6        | FLOAT      | 4     | R   | Seconds | Operating hours of connected sensor                    |
| 8        | FLOAT      | 4     | R   | Seconds | Operating time of filter                               |
| 10       | UNSIGNED32 | 4     | R   | None    | Flash lamp counter                                     |
| 12       | DATETIME   | 8     | R   | None    | Current sensor-diagnosis: time of diagnosis appearance |
| 16       | DATETIME   | 8     | R   | None    | Manufacturing date of the sensor                       |
| 20       | DATETIME   | 8     | R   | None    | Initial-operation date of sensor                       |

| Register | Data Type  | Bytes | R/W | Unit | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------|------------|-------|-----|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24       | DATETIME   | 8     | R   | None | Date of the last successful calibration of the sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 28       | UNSIGNED8  | 1     | R   | None | Dataset switch for nitrate<br><br>Selection:<br>0: Factory calib. (default)<br>1: Dataset1<br>2: Dataset2<br>3: Dataset3<br>4: Dataset4<br>5: Dataset5<br>6: Dataset6<br>7: undefined                                                                                                                                                                                                                                                                                                                                                                                  |
| 29       | UNSIGNED8  | 1     | R   | None | Calibration method<br><br>Selection:<br>0: None (default)<br>1: Numeric input<br>2: 1-point calibration<br>3: 2-point calibration<br>4: Multipoint Calibration<br>5: Table<br>7: Zero point<br>8: Slope air<br>9: Slope H2O<br>10: Slope variable<br>11: Zero point reference<br>12: Slope reference<br>13: Offset<br>14: Slope<br>15: with temp. comp<br>16: without temp. comp<br>17: Standard addition<br>18: Numeric input slope<br>19: Numeric input zero point<br>20: Numeric input 2-point<br>21: Factory calib.<br>22: Slope test gas<br>23: Value acquisition |
| 30       | UNSIGNED16 | 2     | R   | None | Number of calibrations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 31       | UNSIGNED16 | 2     | R   | None | Current sensor-diagnosis: diagnosis code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 32       | UNSIGNED8  | 1     | R   | None | Current sensor-diagnosis: status according to NAMUR NE107                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 33       | UNSIGNED8  | 1     | R   | None | Selected sensor type. The selected type has to match with the connected sensor type.<br><br>Selection:<br>0: None (default)<br>1: Oxygen (amp.)<br>2: Oxygen (opt. fixed cable)<br>3: pH Glass<br>4: pH/ORP<br>5: pH ISFET<br>6: Cond c<br>7: Cond i<br>8: ORP<br>9: TU/TS<br>10: Nitrate<br>11: ISE<br>12: SAC<br>13: Ultrasonic interface<br>14: Chlorine<br>18: pH/ORP<br>19: Cond c 4-pol<br>20: Oxygen (opt. Memosens coupling)<br>21: TU<br>22: Inline photometer                                                                                                |
| 34       | FLOAT      | 4     | R   | None | Raw value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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