MemoRail Modbus

Modbus Command Specification

Document Revision 1.12

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Content

1 General Information

This document is valid for MemoRail Modbus from Version 1.1.0.

1.1 LED Signals

LED green, red		
green	steady light	Power o.k.
red	steady light	Device error, repair required
	flashing	Sensor failure or communication fault
	Blinking	Sensor parameter error

1.2 Installation

MemoRail is delivered with a Modbus baud rate of 19200. To change the baud rate, connect to MemoRail and use register command 212 to set the appropriate value. The other link parameters can be changed by DIP switches.

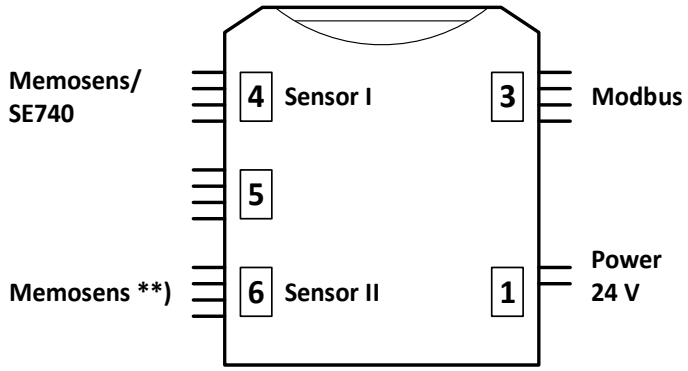
Setting the Modbus parameters

DIP Switch 1…5: setting the address
DIP Switch 6 + 7: setting the link parameters
DIP Switch 8: sensor on/off

DIP Switches								Setting
1	2	3	4	5	6	7	8	
Off	Off	Off	Off	Off				Not allowed
On	**Off**	**Off**	**Off**	**Off**				**Bus address 1**
Off	On	Off	Off	Off				Bus address 2
								Bus addresses 3 to 30 in binary coding
On	On	On	On	On				Bus address 31
					Off	**Off**		**1 start bit / 8 data bits / parity even / 1 stop bit**
					On	Off		1 start bit / 8 data bits / parity odd / 1 stop bit
					Off	On		1 start bit / 8 data bits / no parity / 2 stop bit
					On	On		1 start bit / 8 data bits / no parity / 1 stop bit
							Off	**Sensor II *)**
							On	Sensor II

bold = default
*) Suppress fault indication, if there is no sensor connected to channel II

Sensor wiring



Sensor I: Memosens
cable CA/MS-xxxNAA

Terminal**)	Color	Signal
4.1	BN	3 V
4.2	GN	RS485 A
4.3	YE	RS485 B
4.4	WH	GND
5.1	-	-
5.2	-	-
5.3	Clear	Shield
5.4	-	-

Sensor I: SE 740
cable CA/M12-xxxN485

Terminal	Color	Signal
4.1	-	-
4.2	GY	RS485 A
4.3	PK	RS485 B
4.4	BN	GND
5.1	WH	12 V
5.2	-	-
5.3	Clear	Shield
5.4	-	-

**) 2-channel version only:

Sensor II: Memosens
cable CA/MS-xxxNAA

Terminal	Color	Signal
6.1	BN	3V
6.2	GN	RS485A
6.3	YE	RE485B
6.4	WH	GND
5.1	-	-
5.2	-	-
5.3	-	-
5.4	Clear	Shield

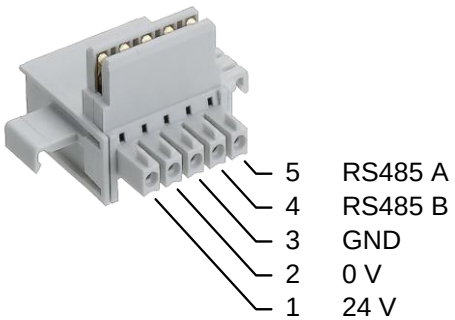
Modbus

Terminal	Signal
3.1	Shield
3.2	RS485 A
3.3	RS485 B
3.4	GND

Power

Terminal	Signal
1.1	Power + (24 V)
1.2	Power – (0 V)
1.3	-

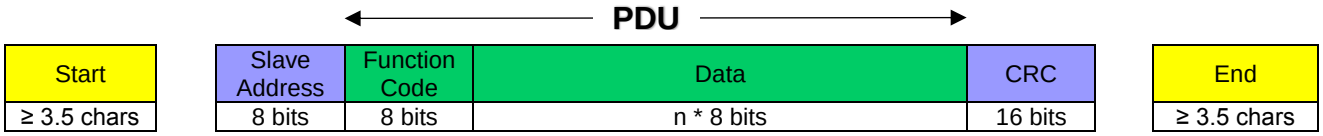
TBUS connector



1.3 Modbus RTU Protocol Usage

Message framing

The MODBUS application protocol defines a simple **P**rotocol **D**ata **U**nit (**PDU**) independent of the underlying communication layers. On MODBUS serial line the client that initiates the MODBUS transaction will add the slave address field and the error-checking field (Cyclic Redundancy Check). In RTU (Remote Terminal Unit, binary) mode, message frames are separated by a silent interval of at least 3.5 character times.



MODBUS distinguishes 2 object types: bit-addresable and word-addressable (register) data items.

Function Codes

The function code indicates to the server what kind of action to perform. MemoRail uses only 2 MODBUS function codes:

3: Read Holding Registers
16: Write Multiple Registers

Slave Addressing

Individual MODBUS slave devices are assigned addresses in the range of 1 – 247 where MemoRail uses only addresses from 1-31. A master addresses a slave by placing the slave address in the address field of the message. When the slave returns its response, it places its own address in the response address field to let the master know which slave is responding. The Address 0 is reserved as the broadcast address. Note that MemoRail does not recognize broadcasts.

Register Adressing

In this manual the register counting starts per definition at address 1. Usually, the MODBUS master software translates the addressing. Thus, the register address of 2088 will be translated by MODBUS master software to 2087 which is sent to the sensor (MODBUS slave). This must be observed during programming.

MemoRail devices can be equipped with one ore two sensor channels. This document describes the register set for the 1st sensor channel. To address the 2nd channel add an offset of 10 000 to the individual register of 1st channel.

Data Encoding

MODBUS doesn't define exactly how the data is transmitted when data type uses more than one register (e.g. float → 4 bytes → 2 registers). When MemoRail transmits data, the following order is used: **low register** first - **high byte** first.

Example of reading “2923517522” UInt32 value from registers 3300 – 3301.

0x 01	Slave address (decimal “1”)
0x 03	Function code (“Read Holding Registers”)
0x 0CE3	Starting register address (decimal “3299”)
0x 0002	Number of rgisters (=Quantity, decimal “2”)
0x 04	Byte count (decimal “4”)
0x AE41 5652	Response value (unsigned integer “2 923 517 522”)
0x nnnn	CRC

Request send to MemoRail	
	Hex
Slave address	01
Function code	03
Starting address Hi	**0C**
Starting address Lo	**E3**
Quantity Hi	00
Qantity Lo	02

0x 01 03 **0C E3** 00 02 nn nn

Respone received from MemoRail	
	Hex
Slave address	01
Funtion code	03
Byte count	04
Register 3300 Hi	**56**
Register 3300 Lo	**52**
Register 3301 Hi	**AE**
Register 3301 Lo	**41**

0x 01 03 04 **56 52 AE 41** nn nn

Example of reading -30.52 float value from registers 3310 – 3311.

0x 01	Slave address (decimal “1”)
0x 03	Function code (“Read Holding Registers”)
0x 0CED	Starting register address (decimal “3309”)
0x 0002	Number of rgisters (=Quantity, decimal “2”)
0x 04	Byte count (decimal “4”)
0x C1F4 28F6	Response value (float -30.52“”)
0x nnnn	CRC

Request send to MemoRail	
	Hex
Slave address	01
Function code	03
Starting address Hi	**0C**
Starting address Lo	**ED**
Quantity Hi	00
Qantity Lo	02

0x 01 03 **0C ED** 00 02 nn nn

Respone received from MemoRail	
	Hex
Slave address	01
Funtion code	03
Byte count	04
Register 3310 Hi	**28**
Register 3310 Lo	**F6**
Register 3311 Hi	**C1**
Register 3311 Lo	**F4**

0x 01 03 04 **28 F6 C1 F4** nn nn

Example of reading “abcd” ASCII string from registers 3320 – 3322.

0x 01	Slave address (decimal “1”)
0x 03	Function code (“Read Holding Registers”)
0x 0CF7	Starting register address (decimal “3319”)
0x 0003	Number of rgisters (=Quantity, decimal “3”)
0x 06	Byte count (decimal “6”)
0x 61 62 63 64 20 20	Response value (6-byte ASCII character filled with blanks “abcd “)
0x nnnn	CRC

Request send to MemoRail	
	Hex
Slave address	01
Function code	03
Starting address Hi	**0C**
Starting address Lo	**F7**
Quantity Hi	00
Qantity Lo	02

0x 01 03 **0C F7** 00 02 nn nn

Respone received from MemoRail	
	Hex
Slave address	01
Funtion code	03
Byte count	06
Register 3320 Hi	**62**
Register 3320 Lo	**61**
Register 3321 Hi	**64**
Register 3321 Lo	**63**
Register 3322 Hi	**20**
Register 3322 Lo	**20**

0x 01 03 06 **62 61 64 63 20 20** nn nn

Data types used by MemoRail

Data Type	Quantity (registers)	Bytes	Description
Float	2	4	floating point according to IEEE 754 (Single Precision)
HEX	variable	variable	hexadecimal representation
UInt8	½	1	unsigned 8-bit integer
UInt16	1	2	unsigned 16-bit integer
UInt32	2	4	unsigned 32-bit integer
ASCII	variable	variable	Numeric representation of characters is defined in 8-Bit ASCII-Code-Table (ANSI X3.4-1986). Important: ASCII-strings must be padded to the specified length

Modbus Exception Codes used by MemoRail

Code	Description	Details
0x01	Illegal Function	Function code received in the query is not recognized or allowed by slave
0x02	Illegal Data Address	Data address of some or all the required entities are not allowed or do not exist in slave
0x03	Illegal Data Value	Value is not accepted by slave
0x04	Slave Device Failure	Unrecoverable error occurred while slave was attempting to perform requested action
0x05	Acknowledge	Slave has accepted request and is processing it, but a long duration of time is required. This response is returned to prevent a timeout error from occurring in the master. Master can next issue a Poll Program Complete message to determine whether processing is completed

0x06	Slave Device Busy	Slave is engaged in processing a long-duration command. Master should retry later
0x07	Negative Acknowledge	Slave cannot perform the programming functions. Master should request diagnostic or error information from slave
0x08	Memory Parity Error	Slave detected a parity error in memory. Master can retry the request, but service may be required on the slave device

1.4 MemoRail Sensor Handling Scenarios

Important:
Many registers are dependent on the connected sensor type and not readable/writeable if they do not apply for the according sensor type. Unavailable register commands return with Modbus exception code 4.

First connection of MemoRail to Modbus

MemoRail is delivered with Modbus baud rate of 19200. To change the baud rate connect to MemoRail and use register command 212 to set the appropriate value. Other link parameter can be changed by DIP switches.

Accessing 2nd Sensor Channel

This document describes all commands for 1st sensor channel. To read from or write to 2nd sensor channel an address offset of **10 000** has to be added to the StartRegister. For instance to read pH-Value:

- from sensor 1: register= 2066, Quantity=3
- from sensor 2: register=12066, Quantity=3

PH/ORP - Calibration via data entry

1. adjust MemoRail device time
   1200 - set time

2. write calibration data to register address
   - standard pH sensor (glass)
     2512 - zero point [pH]
     2516 - slope [mv/pH]
   - ISFET pH sensor
     2508 - asymmetry potential [mV]
     2516 - slope [mv/pH]
   - ORP sensor
     2524 - ORP offset [mV]

3. commit data to sensor by running sensor action
   800 - set action code=2000 (standard pH and ISFET), 2010 (ORP)

4. monitor action progress by reading status from same register
   800 - action status

PH - Product calibration

1. adjust MemoRail device time
   1200 - set time

2. take a sample and store the latest measurement value in MemoRail
   800 - set action code=2001 to store the according measurement value
   2552 - stored value

3. process the lab value

2556 - write the lab value to MemoRail
800 - set action code=2002 to execute the calibration

4. monitor action progress by reading status from same register
   800 - action status

PH - Zero point calibration

1. adjust MemoRail device time
   1200 - set time

2. write buffer value
   2528 - pH buffer value [pH]
   (initial value after reset)

3. execute calibration
   800 - set action code=2003 to run calibration

4. to read the stored measured values
   2532 - measured pH voltage [mV]
   2536 - measured temperature [°C]

5. monitor action progress by reading status from same register
   800 - action status

PH – Slope and zero point calibration

1. adjust MemoRail device time
   1200 - set time

2. write 1st buffer value to device
   2528 - pH buffer value [pH]
   (initial value after reset)

3. execute 1st calibration step
   800 - set action code=2004 to run calibration

4. to read the stored measured values

   2532 - 1st buffer measured pH voltage [mV]
   2536 - 1st buffer measured temperature [°C]

5. write 2nd buffer value to device
   2540 - pH buffer value [pH]
   (initial value after reset)

6. execute calibration
   800 - set action code=2005 to run calibration

7. to read the stored measured values

   2544 - 2nd buffer measured pH voltage [mV]
   2548 - 2nd buffer measured temperature [°C]

8. monitor action progress by reading status from same register
   800 - action status

PH ISFET - asymmetry potential calibration

This calibration method can be used for new sensors before first operation and should be followed-up by a product or 1/2 –point calibration. Important: 7.0 pH-buffer has to be used for an asymmetry potential calibration.

1. adjust MemoRail device time
   1200 - set time

2. write buffer value
   2528 - pH buffer value [pH]
   (initial value after reset)

3. execute calibration
   800 - set action code=2006 to run calibration

4. to read the stored measured values
   2532 - measured pH voltage [mV]
   2526 - measured temperature [°C]

5. monitor action progress by reading status from same register
   800 - action status

ORP redox buffer calibration

1. adjust MemoRail device time
   1200 - set time

2. write buffer value
   2560 - redox buffer value [mV]
   (initial value after reset)

3. execute calibration
   800 - set action code=2014 to run calibration

4. monitor action progress by reading status from same register
   800 - action status

OXY – Product calibration (Memosens)

1. adjust MemoRail device time
   1200 - set time

2. sensor is measuring during calibration, for value calculation the following input has to be written to MemoRail
   3204 - process pressure [mbar]
   3208 - relative humidty [%]
   3212 - salinity [g/kg]
   3240 - medium (0 = liquid, 1 = air)
   3244 - measurement type
   liquid: 0 = saturation [%Air], 1 = concentration [mg/l]
   air: 0 = saturation [Air], 1 = concentration [ppm]

3. take a sample and store the latest measurement value in MemoRail
   800 - set action code=3001 to store the according measurement value
   3536 - to read the stored value

4. process the lab value
   3540 - write the lab value to MemoRail
   800 - set action code=3002 to execute the calibration

5. monitor action progress by reading status from same register
   800 - action status

OXY – Zero point calibration (Memosens)

1. adjust MemoRail device time
   1200 - set time

2. execute calibration (Note: calibration will be done for 0% saturation)
   800 - set action code=3004 to run calibration

3. monitor action progress by reading status from same register
   800 - action status

OXY – Slope calibration (Memosens)

1. adjust MemoRail device time
   1200 - set time

2. calibration will be done for 100% saturation. sensor is measuring during calibration, for value calculation the following input has to be written to MemoRail
   3204 - process pressure [mbar]
   3208 - relative humidty [%]
   3212 - salinity [g/kg]
   3240 - medium (0 = liquid, 1 = air)
   3244 - measurement type
   liquid: 0 = saturation [%Air], 1 = concentration [mg/l]
   air: 0 = saturation [Air], 1 = concentration [ppm]

3. execute calibration
   800 - set action code=3005 to run calibration

4. monitor action progress by reading status from same register
   800 - action status

OXY – Zero point calibration (LDO SE 740)

1. adjust MemoRail device time
   1200 - set time

2. calibration will be done for 0% saturation. sensor is measuring during calibration, for value calculation the following input has to be written to MemoRail
   3200 - refrerence temperature [°C]
   3204 - process pressure [mbar]
   3208 - relative humidty [%]
   3212 - salinity [g/kg]
   3240 - medium (0 = liquid, 1 = air)
   3244 - measurement type
   liquid: 0 = saturation [%Air], 1 = concentration [mg/l]
   air: 0 = saturation [Air], 1 = concentration [ppm]

3. execute calibration
   800 - set action code=3014 to run calibration

4. monitor action progress by reading status from same register
   800 - action status

OXY – Slope calibration (LDO SE 740)

1. adjust MemoRail device time
   1200 - set time

2. calibration will be done for 100% saturation. sensor is measuring during calibration, for value calculation the following input has to be written to MemoRail
   3200 - refrerence temperature [°C]
   3204 - process pressure [mbar]
   3208 - relative humidty [%]
   3212 - salinity [g/kg]
   3240 - medium (0 = liquid, 1 = air)
   3244 - measurement type
   liquid: 0 = saturation [%Air], 1 = concentration [mg/l]
   air: 0 = saturation [Air], 1 = concentration [ppm]

3. execute calibration
   800 - set action code=3015 to run calibration

4. monitor action progress by reading status from same register
   800 - action status

OXY – Product calibration (LDO SE 740)

1. adjust MemoRail device time
   1200 - set time

2. sensor is measuring during calibration, for value calculation the following input has to be written to MemoRail
   3200 - refrerence temperature [°C]
   3204 - process pressure [mbar]
   3208 - relative humidty [%]
   3212 - salinity [g/kg]
   3240 - medium (0 = liquid, 1 = air)
   3244 - measurement type
   liquid: 0 = saturation [%Air], 1 = concentration [mg/l]
   air: 0 = saturation [Air], 1 = concentration [ppm]

3. take a sample and store the latest measurement value in MemoRail
   800 - set action code=3011 to store the according measurement value
   3536 - to read the stored value

4. process the lab value
   3540 - write the lab value to MemoRail
   800 - set action code=3012 to execute the calibration

5. monitor action progress by reading status from same register
   800 - action status

COND - Calibration via data entry

1. adjust MemoRail device time
   1200 - set time

2. write calibration data to register address
   4508 - new cell constant [1/cm]

3. commit data to sensor by running sensor action
   800 - set action code=4000 to store the new cell constant

4. monitor action progress by reading status from same register
   800 - action status

COND – Product calibration

1. adjust MemoRail device time
   1200 - set time

2. take a sample and store the latest measurement value in MemoRail
   800 - set action code=4001 to store the according measurement value
   4520 - to read the stored value [µS/cm]

3. process the lab value
   4524 - write the lab value to MemoRail
   800 - set action code=4002 to execute the calibration

4. monitor action progress by reading status from same register
   800 - action status

COND – Installation factor correction

1. adjust MemoRail device timse
   1200 - set time

2. write calibration data to register address
   4528 - new installation factor []

3. commit data to sensor by running sensor action
   800 - set action code=4006 to store the new installation factor

4. monitor action progress by reading status from same register
   800 - action status

CONDI - Calibration via data entry

1. adjust MemoRail device time
   1200 - set time

2. write calibration data to register address
   5508 - new cell factor []

3. commit data to sensor by running sensor action
   800 - set action code=5000 to store the new cell factor

4. monitor action progress by reading status from same register
   800 - action status

CONDI – Product calibration

1. adjust MemoRail device time

1200 - set time

2. take a sample and store the latest measurement value in MemoRail
   800 - set action code=5001 to store the according measurement value
   5520 - to read the stored value [µS/cm]

3. process the lab value
   5524 - write the lab value to MemoRail
   800 - set action code=5002 to execute the calibration

4. monitor action progress by reading status from same register
   800 - action status

CONDI – Zero point correction

1. adjust MemoRail device time
   1200 - set time

2. correction will be processed automatically by sensor, preconditioned sensor is on air and dry. To start the correction
   800 - set action code=5004 to store the according measurement value

3. monitor action progress by reading status from same register
   800 - action status

CONDI – Installation factor correction

1. write calibration data to register address
   5528 - new installation factor []

2. commit data to sensor by running sensor action
   800 - set action code=5006 to store the new installation factor

3. monitor action progress by reading status from same register
   800 - action status

1.5 Common Tables

Measurement value status codes

Status Code (hex value)	Status	Description
0x10	BAD	bad value
0x11	BAD_LOW	bad value, lower limit
0x12	BAD_HIGH	bad value, higher limit
0x1F	BAD_CONST_INITIAL	bad value, constant initial value
0x58	UNC	uncertain
0x59	UNC_LOW	uncertain, lower limit
0x5A	UNC_HIGH	uncertain, higher limit
0x80	OK	good value
0x83	OK_CONST	good value, constant

Calibration status codes (LDO SE 740)

Bit #	Status Code (hex value)	Description
0	0x00000001	CP1: Oxygen value to be calibrated at is too low
1	0x00000002	CP1: Oxygen value to be calibrated at is too high
2	0x00000004	CP1: current temperature reading is too low
3	0x00000008	CP1: current temperature reading is too high
4	0x00000010	CP1: temperature reading during calibration is not stable
5	0x00000020	CP1: Phase is too low for the oxygen value to be calibrated at
6	0x00000040	CP1: Phase too high for the oxygen value to be calibrated at
7	0x00000080	CP1: Phase reading during calibration is not stable
8	0x00000100	CP2: Oxygen value to be calibrated at is too low
9	0x00000200	CP2: Oxygen value to be calibrated at is too high
10	0x00000400	CP2: current temperature reading is too low
11	0x00000800	CP2: current temperature reading is too high
12	0x00001000	CP2: temperature reading during calibration is not stable
13	0x00002000	CP2: Phase is too low for the oxygen value to be calibrated at
14	0x00004000	CP2: Phase too high for the oxygen value to be calibrated at
15	0x00008000	CP2: Phase reading during calibration is not stable
16..23	…	not available
24	0x01000000	CP6: out of calibration range
25	0x02000000	CP6: out of range
26	0x04000000	CP6: active
27	0x08000000	CP6: initial measurement
28	0x10000000	CP6: assigned

Persistency

Some parameter values written to MemoRail will be stored on EEPROM, others will be kept in RAM only and will be initialized on restart. Persistency column of command table specifies if parameters are peristent or volatile.

- p: parameter value is persistent stored on EEPROM
- v: parameter value is volatile and disappears when power out
- -: not relevant for the specific parameter

2 Commands

2.1 MemoRail Information

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
1000	r	12	3	-	-	**Device firmware** Register Parameter Type Bytes 1..12 MemoRail firmware version string ASCII 24
1024	r	12	3	-	-	**Device manufacturer** Register Parameter Type Bytes 1..12 MemoRail manufacturer ASCII 24
1048	r	12	3	-	-	**Device name** Register Parameter Type Bytes 1..12 MemoRail device name ASCII 24
1072	r	12	3	-	-	**Device order code** Register Parameter Type Bytes 1..12 MemoRail order number ASCII 24
1096	r	12	3	-	-	**Device serial number** Register Parameter Type Bytes 1..12 MemoRail serial number ASCII 24
1200	rw	2	3	16	v	**Device time** Register Parameter Type Bytes 1..2 Seconds since 1.1.2000 (used to store calibration time stamp into sensor, must be set to current time when device restarted) UInt32 4

2.2 MemoRail Networking

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
212	rw	1	3	16	p	**Modbus Baudrate (persistent)** Register Parameter Type Bytes 1 Baud rate at startup (stored on device) UInt16 2 0 = 1200 1 = 2400 2 = 4800 3 = 9600 4 = 19200 5 = 38400 6 = 57600 7 = 115200
1212	rw	1	3	16	v	**Modbus Baudrate (volatile)** Register Parameter Type Bytes 1 Baud rate (after restart reset to value in register 212) UInt16 2 0 = 1200 1 = 2400 2 = 4800 3 = 9600 4 = 19200 5 = 38400 6 = 57600 7 = 115200
220	rw	1	3	16	v	**MODBUS transmission byte order** Register Parameter Type Bytes 1 Sequential order of bytes (since MemoRail 1.1.1) UInt16 2 0 = little-endian 1 = big-endian
222	r	2	3	-	p	**Device Capabilities** Register Parameter Type Bytes 1..2 List of device capabilities (since MemoRail 1.1.1) UInt32 4 0x0001: device time adjustment by master required 0x0002: Baudrate configurable

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
292	rw	2	3	16	v	**Network access status information** Register: 1..2 — Parameter: Register to notify the MemoRail about network access status (since MemoRail 1.1.1) e.g. a Profinet-Gateway has established connection between MemoRail and Profinet host. — Type: UInt32 — Bytes: 4
296	rw	3	3	16	v	**MAC address of device** Register: 1..3 — Parameter: Register to notify MemoRail about the physical device address (MAC address) of the Profinet-Gateway — Type: HEX — Bytes: 6
302	rw	2	3	16	v	**Assigned IP address of gateway** Register: 1..2 — Parameter: Register to notify MemoRail about the IPv4 address of the Profinet-Gateway — Type: HEX — Bytes: 4
306	rw	2	3	16	v	**Assigned subnet mask of gateway** Register: 1..2 — Parameter: Register to notify MemoRail about the IPv4 subnet mask of the Profinet-Gateway — Type: HEX — Bytes: 4
310	rw	2	3	16	v	**Assigned gateway address** Register: 1..2 — Parameter: Register to notify MemoRail about the IPv4 gateway address of the Profinet-Gateway — Type: HEX — Bytes: 4
314	rw	1	3	16	p	**Ethernet/IP: Network configuration mode** Register: 1 — Parameter: IPv4 Addresses Configuration Mode x: DHCP x: BootP x Custom configuration of module — Type: UInt16 — Bytes: 2
316	rw	2	3	16	p	**Ethernet/IP: Custom IP address of gateway** Register: 1..2 — Parameter: IPv4 address of the Profinet-Gateway — Type: HEX — Bytes: 4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
320	rw	2	3	16	p	**Ethernet/IP: Custom subnet mask of gateway** Register Parameter Type Bytes 1..2 IPv4 subnet mask of the Profinet-Gateway HEX 4
324	rw	2	3	16	p	**Ethernet/IP: Custom gateway address** Register Parameter Type Bytes 1..2 IPv4 gateway address of the Profinet-Gateway HEX 4
328	rw	1	3	16	v	**Network gateway LED status** Register Parameter Type Bytes 1 Register to notify MemoRail about the state of gateway multicolor LED HEX 2 First LED ---------- Bits 0-1: LED-status: 00 = off 01 = blink 11 = permanent Bits 2-4: Color 000 = off 001 = red 010 = yellow 011 = green 100 = red/green (Ethernet/IP only) Second LED ---------- Bits 8-9: LED-status: ... Bits 10-12: Color: ...

2.3 Sensor Information

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
500	r	12	3	-	-	**Sensor manufacturer** Register Parameter Type Bytes 1..12 Sensor manufacturer ASCII 24
524	r	12	3	-	-	**Sensor order code** Register Parameter Type Bytes 1..12 Sensor order code ASCII 24
548	r	12	3	-	-	**Sensor serial number** Register Parameter Type Bytes 1..12 Sensor serial number ASCII 24
572	r	12	3	-	-	**Sensor name** Register Parameter Type Bytes 1..12 Sensor name ASCII 24
596	r	12	3	-	-	**Sensor software version** Register Parameter Type Bytes 1..12 Sensor software version ASCII 24
620	r	12	3	-	-	**Sensor hardware version** Register Parameter Type Bytes 1..12 Sensor hardware version ASCII 24
678	r	1	3	-	-	**Sensor channel information** Register Parameter Type Bytes 1 Channel error bits HEX 2 0x0000 = no error 0x0001 = no sensor 0x0002 = unknown sensor 0x0004 = invalid calibration parameter

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
680	r	1	3	-	-	**Sensor measured value type** Register Parameter Type Bytes 1 Sensor measured value type HEX 2 0x0000 = not defined 0x0001 = PH 0x0002 = OXY 0x0003 = COND 0x0004 = CONDI

2.4 Initial Values

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
400	rw	1	3	16	p	**Sensor detection mode** Register Parameter Type Bytes 1 Mode, determines whether sensor family is detected automatically or is set manually UInt16 2 0 = automatic (default) 1 = manual (sensor family to be set in command Sensor family)
402	rw	1	3	16	p	**Sensor family** Register Parameter Type Bytes 1 Family (if sensor detection mode is manual) UInt16 2 6 = Memosens 11 = LDO SE 740
434	rw	2	3	16	p	**PH - Default pH buffer 1** Register Parameter Type Bytes 1..2 Initial pH-Buffer 1 [pH] (7.0) Float 4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
438	rw	2	3	16	p	**PH - Default pH buffer 2** Register Parameter Type Bytes 1..2 Initial pH-Buffer 2 [pH] (4.01) Float 4
442	rw	2	3	16	p	**ORP - Default ORP buffer** Register Parameter Type Bytes 1..2 Initial Redox-Buffer [mV] (465.0) Float 4
404	rw	1	3	16	p	**OXY - Default measurement medium** Register Parameter Type Bytes 1 Measurement medium (0) UInt16 2 0 = liquid 1 = air
406	rw	1	3	16	p	**OXY - Default cal-medium of product calibration** Register Parameter Type Bytes 1 Initial calibration medium (1) UInt16 2 0 = liquid 1 = air
408	rw	1	3	16	p	**OXY - Default cal-meastype of product calibration** Register Parameter Type Bytes 1 Initial measurement type for product calibration (0) UInt16 2 0 = Saturation [%Air] 1 = Concentration [mg/l] 2 = Partial pressure [mbar] (only LDO SE 740)
414	rw	2	3	16	p	**OXY - Default process pressure** Register Parameter Type Bytes 1..2 Pressure [mbar] (1013.0) Float 4
418	rw	2	3	16	p	**OXY - Default relative humidity** Register Parameter Type Bytes 1..2 Humidity [%] (50.0) Float 4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
422	rw	2	3	16	p	**OXY - Default salinity** Register Parameter Type Bytes 1..2 Salinity [g/kg] (0.0) Float 4
430	rw	2	3	16	p	**CONDI - Default installation factor** Register Parameter Type Bytes 1..2 Installation factor (1.0) Float 4

2.5 PH - Measurement Values

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
2066	r	2	3	-	-	**pH value (without status)** Register Parameter Type Bytes 1 pH value [pH] Float 4
2066	r	3	3	-	-	**pH value** Register Parameter Type Bytes 1..2 pH value [pH] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
2024	r	2	3	-	-	**pH voltage (without status)** Register Parameter Type Bytes 1..2 pH Voltage [mV] Float 4
2024	r	3	3	-	-	**pH voltage** Register Parameter Type Bytes 1..2 pH Voltage [mV] Float 4 3 lo Measurement status HEX 1 3 hi Measurement counter UInt8 1

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
2012	r	2	3	-	-	**Temperature (without status)** Register Parameter Type Bytes 1 Temperature value [°C] Float 4
2012	r	3	3	-	-	**Temperature** Register Parameter Type Bytes 1..2 Temperature value [°C] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
2036	r	2	3	-	-	**Resistance (glass) (without status)** Register Parameter Type Bytes 1..2 Resistance of glass electrode value [Ω] Float 4
2036	r	3	3	-	-	**Resistance (glass)** Register Parameter Type Bytes 1..2 Resistance of glass electrode value [Ω] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
2048	r	2	3	-	-	**ORP voltage (without status)** Register Parameter Type Bytes 1..2 Redox voltage value [mV] Float 4
2048	r	3	3	-	-	**ORP voltage** Register Parameter Type Bytes 1..2 Redox voltage value [mV] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
2060	r	2	3	-	-	**ORP-Resistance (without status)** Register Parameter Type Bytes 1..2 ORP-Resistance of electrode value [Ω] Float 4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
2060	r	3	3	-	-	**ORP-Resistance** Register Parameter Type Bytes 1..2 ORP-Resistance of electrode value [Ω] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
2084	r	3	3	-	-	**Leakage current** Register Parameter Type Bytes 1..2 Leakage current [nA] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1

2.6 PH - Calibration

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
2404	r	10	3	-	-	**PH - Latest calibration** Register Parameter Type Bytes 1..2 Timestamp of latest calibration (seconds since 1.1.2000 00:00) UInt32 4 3..4 ISFET asymmetry potential [mV] (const. 0 mV if not ISFET sensor) Float 4 5..6 Zero point [pH] (const. pH 7.0 if ISFET sensor) Float 4 7..8 Slope [mV/pH] Float 4 9..10 Isotherm intersection [pH] Float 4
2424	r	4	3	-	-	**ORP - Latest calibration** Register Parameter Type Bytes 1..2 Timestamp of latest calibration (seconds since 1.1.2000 00:00) UInt32 4 2..4 ORP offset [mV] Float 4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
800	r	1	3	-	-	**Sensor action status** Register Parameter Type Bytes 1 Sensor action status UInt16 2 0 = no active action, last action successful 254 = invalid action 255 = completed action failed other = number of pending action
800	w	1	3	16	v	**Run sensor action** Register Parameter Type Bytes 1 Action code to be performed UInt16 2 PH: 2000 = data entry calibration 2001 = product calibration: step - snap sample value 2002 = product calibration: step - apply lab value 2004 = 1 point zero buffer calibration 2005 = 2 point slope buffer calibration ORP: 2010 = data entry calibration 2014 = 1 point redox-buffer calibration
2508	rw	2	3	16	v	**Data calibration: ISFET asymmetry potential** Register Parameter Type Bytes 1..2 ISFET asymmetry potential [mV] Float 4
2512	rw	2	3	16	v	**Data calibration: zero point** Register Parameter Type Bytes 1..2 Zero point [pH] Float 4
2516	rw	2	3	16	v	**Data calibration: slope** Register Parameter Type Bytes 1..2 Slope [mV/pH] Float 4
2520	rw	2	3	16	v	**Data calibration: Isotherm intersection** Register Parameter Type Bytes 1..2 Isotherm intersection [pH] Float 4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
2528	rw	2	3	16	v	**Calibration: pH buffer 1** Register Parameter Type Bytes 1..2 pH value of buffer 1 (temperature compensated) Float 4
2532	r	2	3	-	-	**pH buffer1: Sensor voltage (Cal)** Register Parameter Type Bytes 1..2 Voltage [mV] Float 4
2536	r	2	3	-	-	**pH buffer1: Temperature (Cal)** Register Parameter Type Bytes 1..2 Temperature [°C] Float 4
2540	rw	2	3	16	v	**Calibration: pH buffer 2** Register Parameter Type Bytes 1..2 pH value of buffer 2 (temperature compensated) Float 4
2544	r	2	3	-	-	**pH buffer2: Sensor voltage (Cal)** Register Parameter Type Bytes 1..2 Voltage [mV] Float 4
2548	r	2	3	-	-	**pH buffer2: Temperature (Cal)** Register Parameter Type Bytes 1..2 Temperature [°C] Float 4
2552	r	2	3	16	-	**Product calibration: sample value** Register Parameter Type Bytes 1..2 Sample value [pH] Float 4
2556	rw	2	3	16	v	**Product calibration: lab value** Register Parameter Type Bytes 1..2 Lab value [pH] Float 4
2524	rw	2	3	16	v	**Data calibration: ORP offset** Register Parameter Type Bytes 1..2 ORP offset [mV] Float 4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
2560	rw	2	3	16	v	**ORP - Redox buffer**

Register	Parameter	Type	Bytes
1..2	-	Float	4

2.7 PH - Sensor wear

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
2600	r	10	3	-	-	**Sensor wear**

Register	Parameter	Type	Bytes
1..2	Operating time [h]	Float	4
3..4	Sensor wear [%]	Float	4
5..6	Autoclave count	UInt32	4
7..8	CIP cycles	UInt32	4
9..10	SIP cycles	UInt32	4

2.8 OXY - Measurement Values

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
3240	rw	1	3	16	v	**Input: Measurement medium**

Register	Parameter	Type	Bytes
1..2	Measurement medium 0 = liquid 1 = air	UInt16	2

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
3200	rw	2	3	16	v	**Input: Reference temperature** Register Parameter Type Bytes 1..2 Temperature value [°C] Float 4
3204	rw	2	3	16	v	**Input: Process pressure** Register Parameter Type Bytes 1..2 Process pressure [mbar] Float 4
3208	rw	2	3	16	v	**Input: Relative humidity** Register Parameter Type Bytes 1..2 Relative humidity [%] Float 4
3212	rw	2	3	16	v	**Input: Salinity** Register Parameter Type Bytes 1..2 Salinity [mg/l] Float 4
3012	r	2	3	-	-	**Temperature (without status)** Register Parameter Type Bytes 1..2 Temperature value [°C] Float 4
3012	r	3	3	-	-	**Temperature** Register Parameter Type Bytes 1..2 Temperature value [°C] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
3024	r	3	3	-	-	**Current (raw)** Register Parameter Type Bytes 1..2 Sensor current raw value [nA] Float 4 EDO: Current of cathode [nA] 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
3030	r	2	3	-	-	**Current (without status)** Register Parameter Type Bytes 1..2 Sensor current value [nA] Float 4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
3030	r	3	3	-	-	**Current** Register Parameter Type Bytes 1..2 Sensor current value [nA] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
3036	r	3	3	-	-	**Leakage current** Register Parameter Type Bytes 1..2 Leakage current value [nA] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
3048	r	2	3	-	-	**Partial pressure (without status)** Register Parameter Type Bytes 1..2 Partial pressure value [mbar] Float 4
3048	r	3	3	-	-	**Partial pressure** Register Parameter Type Bytes 1..2 Partial pressure value [mbar] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
3060	r	2	3	-	-	**Saturation index O_2 (without status)** Register Parameter Type Bytes 1..2 Saturation index value [%O_2] Float 4
3060	r	3	3	-	-	**Saturation index O_2** Register Parameter Type Bytes 1..2 Saturation index value [%O_2] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
3066	r	2	3	-	-	**Saturation index air (without status)** Register Parameter Type Bytes 1..2 Saturation index on air value [%Air] Float 4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
3066	r	3	3	-	-	**Saturation index air** Register Parameter Type Bytes 1..2 Saturation index on air value [%Air] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
3072	r	2	3	-	-	**Concentration liquid (without status)** Register Parameter Type Bytes 1..2 Concentration liquid value [mg/l] Float 4
3072	r	3	3	-	-	**Concentration liquid** Register Parameter Type Bytes 1..2 Concentration liquid value [mg/l] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
3084	r	2	3	-	-	**Concentration air [Vol%] (without status)** Register Parameter Type Bytes 1..2 Concentration air [Vol%] Float 4
3084	r	3	3	-	-	**Concentration air [Vol%]** Register Parameter Type Bytes 1..2 Concentration air [Vol%] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1

2.9 OXY - Calibration

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
3404	r	9	3	-	-	**Latest calibration - Memosens**

Register	Parameter	Type	Bytes
1..2	Timestamp of zero point calibration (second since 01.01.2000 00:00)	UInt32	4
3..4	Zero point [nA]	Float	4
5..6	Timestamp of slope calibration (seconds since 1.1.2000 00:00)	UInt32	4
7..8	Slope [nA]	Float	4
9	Membrane calibration counter	UInt16	2

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
3454	r	8	3	-	-	**Latest calibration - LDO SE 740**

Register	Parameter	Type	Bytes
1..2	Timestamp of latest calibration (seconds since 1.1.2000 00:00)	UInt32	4
3..4	Phase[°]	Float	4
5..6	Stern-Volmer coefficient	Float	4
7..8	Calibration status (see ch. [Calibration status (LDO SE 740)])	HEX	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
3700	r	14	3	-	-	**Calibration statistics CP1 - LDO SE 740**

Register	Parameter	Type	Bytes
1..2	Partial pressure [mbar]	Float	4
3..4	Phase[°] / Sensor current [nA]	Float	4
5..6	Temperature [°C]	Float	4
7..8	Process pressure [mbar]	Float	4
9..10	Timestamp of CP1 calibration (seconds since 1.1.2000 00:00)	UInt32	4
11..12	Number of calibrataions	UInt32	4
13..14	Calibration status (see ch. [Calibration status (LDO SE 740)])	HEX	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
3728	r	14	3	-	-	**Calibration statistics CP2 - LDO SE 740**

Register	Parameter	Type	Bytes
1..2	Partial pressure [mbar]	Float	4
3..4	Phase[°] / Sensor current [nA]	Float	4
5..6	Temperature [°C]	Float	4
7..8	Process pressure [mbar]	Float	4
9..10	Timestamp of CP2 calibration (seconds since 1.1.2000 00:00)	UInt32	4
11..12	Number of calibrataions	UInt32	4
13..14	Calibration status (see ch. [Calibration status (LDO SE 740)])	HEX	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
3756	r	14	3	-	-	**Calibration statistics CP6 - LDO SE 740** Register Parameter Type Bytes 1..2 Partial pressure [mbar] Float 4 3..4 Phase[°] / Sensor current [nA] Float 4 5..6 Temperature [°C] Float 4 7..8 Process pressure [mbar] Float 4 9..10 Timestamp of CP6 calibration (seconds since 1.1.2000 00:00) UInt32 4 11..12 Number of calibrataions UInt32 4 13..14 Calibration status (see ch. [Calibration status (LDO SE 740)]) HEX 4
800	r	1	3	-	-	**Sensor action status** Register Parameter Type Bytes 1 Sensor action status UInt16 2 0 = no active action, last action successful 254 = invalid action 255 = completed action failed other = number of pending action
800	w	1	3	16	v	**Run sensor action** Register Parameter Type Bytes 1 Action code to be performed UInt16 2 Memosens: 3000 = data entry calibration 3001 = product calibration: step - snap sample value 3002 = product calibration: step - apply lab value 3004 = zero point calibration 3005 = slope calibration LDO SE 740 3011 = CP6 product calibration: step - snap sample value 3012 = CP6 product calibration: step - apply lab value 3013 = CP6 product calibration: remove calibration 3014 = CP1 zero point calibration 3015 = CP2 slope calibration
3508	rw	2	3	16	v	**Data calibration: zero point (Memosens)** Register Parameter Type Bytes 1..2 Zero point [nA] Float 4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
3512	rw	2	3	16	v	**Data calibration: slope (Memosens)** Register Parameter Type Bytes 1..2 Slope [nA] Float 4
3520	r	2	3	-	-	**Process pressure (Calibration)** Register Parameter Type Bytes 1..2 Process pressure [mbar] Float 4
3524	rw	2	3	16	v	**Relative humidity (Calibration)** Register Parameter Type Bytes 1..2 Relative humidity [%] Float 4
3242	rw	1	3	16	v	**Measurement medium (Calibration)** Register Parameter Type Bytes 1..2 Measurement medium UInt16 2 0 = liquid 1 = air
3244	rw	1	3	16	v	**Product calibration: measurement type** Register Parameter Type Bytes 1..2 Measurement type UInt16 2 0 = Saturation [%Air] 1 = Concentration liquid [mg/l], Concentration air [Vol%] 2 = Partial pressure [mbar] - only LDO SE 740
3536	r	2	3	-	-	**Product calibration: sample value** Register Parameter Type Bytes 1..2 Sample value (unit: depends on measurement type) Float 4
3540	rw	2	3	16	v	**Product calibration: lab value** Register Parameter Type Bytes 1..2 Reference value (unit: depends on measurement type) Float 4

2.10 OXY - Sensor wear

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
3600	r	12	3	-	-	**Sensor wear**

Register	Parameter	Type	Bytes
1..2	Operating time [h]	Float	4
3..4	Sensor wear [%]	Float	4
5..6	Autoclave count	UInt32	4
7..8	CIP cycles	UInt32	4
9..10	SIP cycles (membrane cap)	UInt32	4
11.12	SIP cycles (sensor total)	UInt32	4

2.11 COND - Measurement Values

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
4012	r	2	3	-	-	**Temperature (without status)**

Register	Parameter	Type	Bytes
1..2	Temperature [°C]	Float	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
4012	r	3	3	-	-	**Temperature**

Register	Parameter	Type	Bytes
1..2	Temperature [°C]	Float	4
3 hi	Measurement status	HEX	1
3 lo	Measurement counter	UInt8	1

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
4024	r	2	3	-	-	**Conductance (without status)**

Register	Parameter	Type	Bytes
1..2	Conductance [µS]	Float	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
4024	r	3	3	-	-	**Conductance**

Register	Parameter	Type	Bytes
1..2	Conductance [µS]	Float	4
3 hi	Measurement status	HEX	1
3 lo	Measurement counter	UInt8	1

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
4030	r	2	3	-	-	**Conductivity (without status)**

Register	Parameter	Type	Bytes
1..2	Conductivity [µS/cm]	Float	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
4030	r	3	3	-	-	**Conductivity**

Register	Parameter	Type	Bytes
1..2	Conductivity [µS/cm]	Float	4
3 hi	Measurement status	HEX	1
3 lo	Measurement counter	UInt8	1

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
4036	r	2	3	-	-	**Specific Resistance (without status)**

Register	Parameter	Type	Bytes
1..2	Specific Resistance [Ω*m]	Float	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
4036	r	3	3	-	-	**Specific Resistance**

Register	Parameter	Type	Bytes
1..2	Specific Resistance [Ω*m]	Float	4
3 hi	Measurement status	HEX	1
3 lo	Measurement counter	UInt8	1

2.12 COND - Calibration

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
4404	r	4	3	-	-	**Latest calibration**

Register	Parameter	Type	Bytes
1..2	Timestamp of latest calibration (seconds since 1.1.2000 00:00)	UInt32	4
3..4	Cell constant [1/cm]	Float	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
4428	r	2	3	-	-	**Installation factor**

Register	Parameter	Type	Bytes
1..2	Installation factor (KSLC5 only)	Float	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
800	r	1	3	-	-	**Read sensor action** Register Parameter Type Bytes 1 Sensor action status UInt16 2 0 = no active action, last action successful 254 = invalid action 255 = completed action failed other = number of pending action
800	w	1	3	16	v	**Submit sensor action** Register Parameter Type Bytes 1 Action code to be performed UInt16 2 4000 = data entry calibration 4001 = product calibration: step - snap sample value 4002 = product calibration: step - apply lab value 4006 = installation factor correction (KSLC5 only)
4508	rw	2	3	16	v	**Data calibration: cell constant** Register Parameter Type Bytes 1..2 Cell constant [1/cm] Float 4
4528	rw	2	3	16	v	**Data calibration: installation factor** Register Parameter Type Bytes 1..2 Installation factor (KSLC5 only) Float 4
4520	r	2	3	-	-	**Product calibration: sample value** Register Parameter Type Bytes 1..2 Sample value [...] Float 4
4524	rw	2	3	16	v	**Product calibration: lab value** Register Parameter Type Bytes 1..2 Lab value [...] Float 4

2.13 COND - Sensor wear

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
4600	r	10	3	-	-	**Sensor wear**

Register	Parameter	Type	Bytes
1..2	Operating time [h]	Float	4
3..4	Sensor wear [%]	Float	4
5..6	Autoclave count	UInt32	4
7..8	CIP cycles	UInt32	4
9..10	SIP cycles	UInt32	4

2.14 CONDI - Measurement Values

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
5204	rw	2	3	16	v	**Input: Installation factor**

Register	Parameter	Type	Bytes
1..2	Installation factor	Float	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
5012	r	2	3	-	-	**Temperature (without status)**

Register	Parameter	Type	Bytes
1..2	Temperature [°C]	Float	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
5012	r	3	3	-	-	**Temperature**

Register	Parameter	Type	Bytes
1..2	Temperature [°C]	Float	4
3 hi	Measurement status	HEX	1
3 lo	Measurement counter	UInt8	1

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
5024	r	2	3	-	-	**Conductance (without status)**

Register	Parameter	Type	Bytes
1..2	Conductance [µS]	Float	4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
5024	r	3	3	-	-	**Conductance** Register Parameter Type Bytes 1..2 Conductance [µS] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
5036	r	2	3	-	-	**Conductivity (without status)** Register Parameter Type Bytes 1..2 Conductivity [µS/cm] Float 4
5036	r	3	3	-	-	**Conductivity** Register Parameter Type Bytes 1..2 Conductivity [µS/cm] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1
5042	r	2	3	-	-	**Specific Resistance (without status)** Register Parameter Type Bytes 1..2 Specific Resistance [Ω*m] Float 4
5042	r	3	3	-	-	**Specific Resistance** Register Parameter Type Bytes 1..2 Specific Resistance [Ω*m] Float 4 3 hi Measurement status HEX 1 3 lo Measurement counter UInt8 1

2.15 CONDI - Calibration

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
5420	r	4	3	-	-	**Latest zero calibration** Register Parameter Type Bytes 1..2 Resistance zero point [Ω] Float 4 3..4 Phase zero [°] Float 4
5404	r	4	3	-	-	**Latest cell factor calibration** Register Parameter Type Bytes 1..2 Timestamp of latest calibration (seconds since 1.1.2000 00:00) UInt32 4 3..4 Cell constant [1/cm] Float 4
5428	r	2	3	-	-	**Installation factor** Register Parameter Type Bytes 1..2 Installation factor Float 4
800	r	1	3	-	-	**Sensor action status** Register Parameter Type Bytes 1 Sensor action status UInt16 2 0 = no active action, last action successful 254 = invalid action 255 = completed action failed other = number of pending action
800	w	1	3	16	v	**Run sensor action** Register Parameter Type Bytes 1 Action code to be performed UInt16 2 5000 = data entry calibration 5001 = product calibration: step - snap sample value 5002 = product calibration: step - apply lab value 5004 = zero point correction 5006 = installation factor correction
5508	rw	2	3	16	v	**Data calibration: cell constant** Register Parameter Type Bytes 1..2 Cell constant [1/cm] Float 4
5528	rw	2	3	16	v	**Data calibration: installation factor** Register Parameter Type Bytes 1..2 Installation factor Float 4

Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
5520	r	2	3	-	-	**Product calibration: sample value** Register Parameter Type Bytes 1..2 Sample value [...] Float 4
5524	rw	2	3	16	v	**Product calibration: lab value** Register Parameter Type Bytes 1..2 Lab value [...] Float 4

2.16 CONDI - Sensor wear

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Start register	Access	Quantity	Read Function	Write Function	Persistency	Command Description
5600	r	10	3	-	-	**Sensor wear** Register Parameter Type Bytes 1..2 Operating time [h] Float 4 3..4 Sensor wear [%] Float 4 5..6 Autoclave count UInt32 4 7..8 CIP cycles UInt32 4 9..10 SIP cycles UInt32 4

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