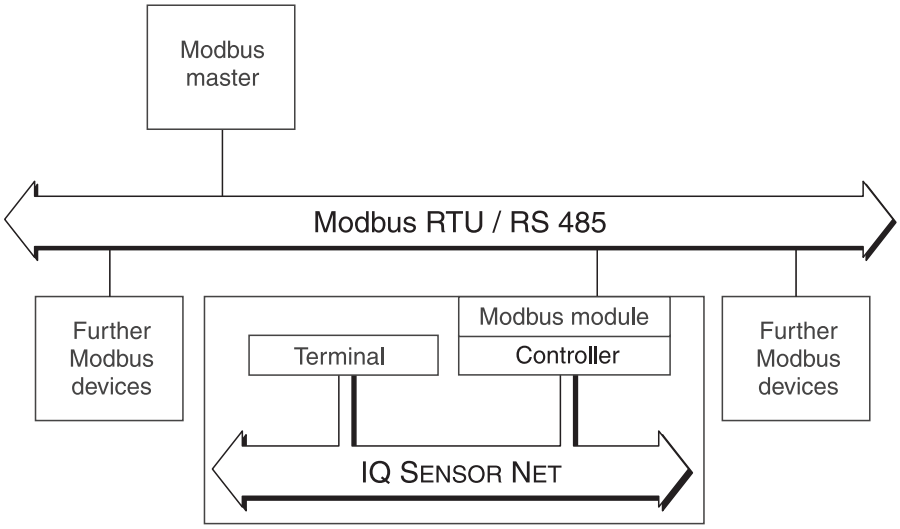
Operating Manual

IQ SENSOR NET
MIQ/MC(-A)-MOD



Modbus RTU and RS 485 connection for the IQ SENSOR NET 2020 system

ba75423e02 03/2006

Accuracy when going to press

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Note
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Modbus RTU and RS 485 connection for the IQ SENSOR NET System 2020

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1 Overview

1.1 How to use this component operating manual

The present operating manual complements the system operating manual for the IQ SENSOR NET system 2020. It contains the description of the MOD option of the MIQ/MC(-A)-MOD controller.

File this operating manual directly behind the system operating manual.

Structure of the IQ SENSOR NET operating manual

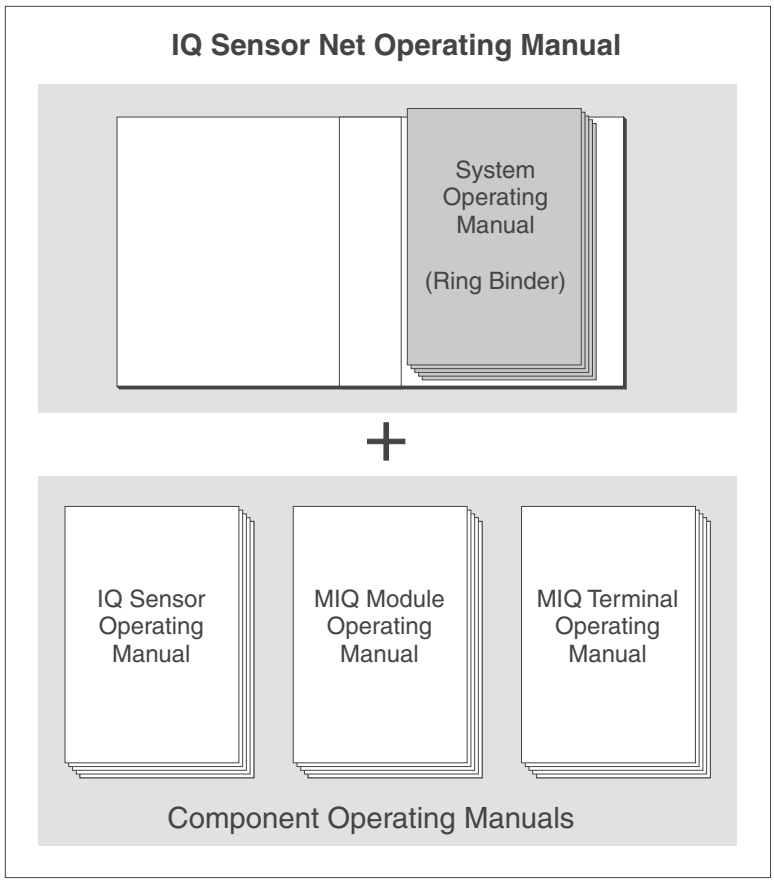


Fig. 1-1 Structure of the IQ SENSOR NET operating manual

The IQ SENSOR NET operating manual has a modular structure like the IQ SENSOR NET system itself. It consists of the system operating manual and the operating manuals of all the components used.

The space in the ring binder behind the system operating manual is intended for filing the component operating manuals. Please file all component operating manuals here so that all information is quickly available in one location.

1.2 Modbus and IQ SENSOR NET system 2020

System communication

The functional units of the IQ SENSOR NET are connected with one another via a common line (Fig. 1-2). The line consists of two wires and a shield. It transports digital information between the controller and the other modules. At the same time, the line is used to supply all modules with electrical voltage from a power supply unit. The power supply unit is only required for power supply and is not used in the system communication.

The -MOD option of the MIQ/MC(-A)-MOD controller expands the system communication by a Modbus interface. Via this interface, sensor data can be queried with the Modbus RTU protocol. The Modbus interface (RS 485) also enables a direct point-to-point connection from an IQ SENSOR NET system to a Modbus master (e.g. PC or PLC).

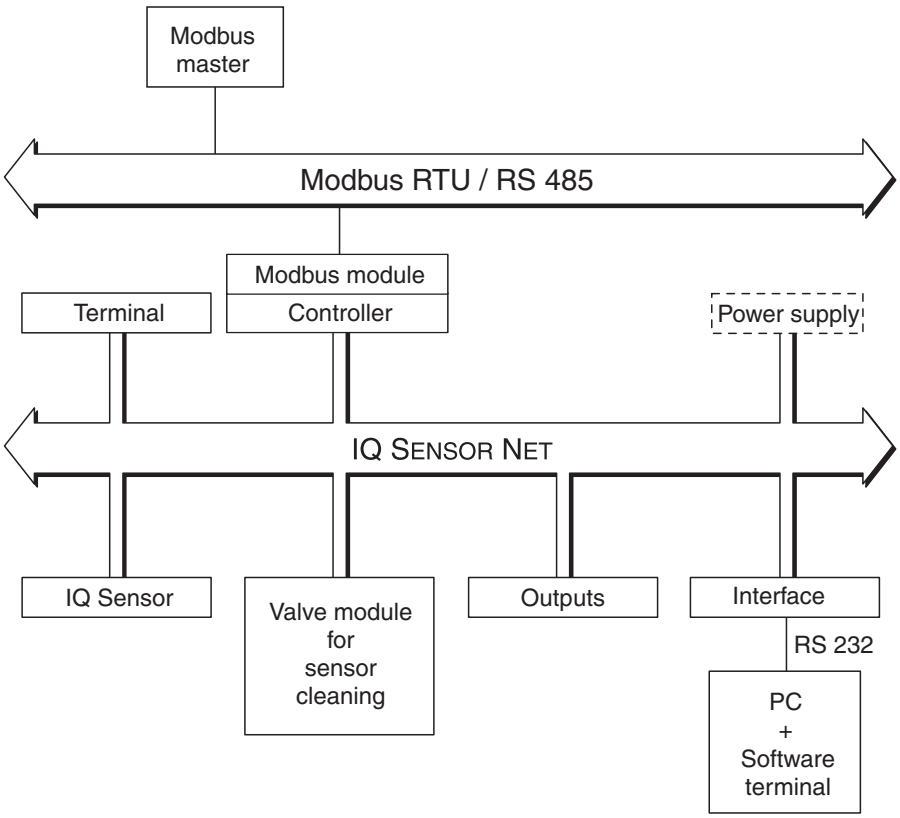


Fig. 1-2 Functional units of the IQ SENSOR NET with connection to the Modbus

Note
All other general information on components, functions and operation of the IQ SENSOR NET 2020 system is given in the system operating manual.

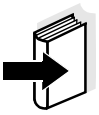
2 Safety instructions

Essential instructions that must be followed during the commissioning, operation and maintenance of the IQ SENSOR NET system are given in the system operating manual. It is essential for the operator to read this system operating manual before carrying out any work with the system.

Notes in this operating manual



Note
indicates notes that draw your attention to special features.

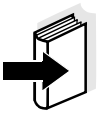


Note
indicates cross-references to other documents, e.g. component operating manuals.

3 Interface for the Modbus RTU

The Modbus module in the MIQ/MC(-A)-MOD controller enables to connect the IQ SENSOR NET together with all connected sensors to the digital connection of a higher process control system.

The connection to a Modbus system is supported in the MIQ/MC(-A)-MOD controller. The *AnyBus-S Modbus RTU* Modbus module of the HMS INDUSTRIAL NETWORKS AB company is used for this.



Note
Further instructions for the installation and operation of a Modbus network are given on the Internet under www.modbus.org. Especially recommendable is the "Aufbaurichtlinie PROFIBUS/FMS" (installation guideline) issued by the PNO PROFIBUS user organization, (PNO order number 2.111) with many practical installation tips that apply to Modbus systems as well.

3.1 Scope of delivery

In addition to the scope of delivery of the MIQ/MC(-A), the scope of delivery of the MIQ/MC(-A)-MOD module contains:

- *AnyBus-S Modbus RTU* modbus module, mounted in the MIQ/MC(-A)-MOD controller
- Screw for shielding terminal
- 2 x washer for shielding terminal
- Insulating part of the shielding terminal
- Operating manual for the Modbus module

3.2 The Modbus module

The Modbus module (*AnyBus-S Modbus RTU)* is mounted on the main circuit board of the MIQ/MC(-A)-MOD controller.

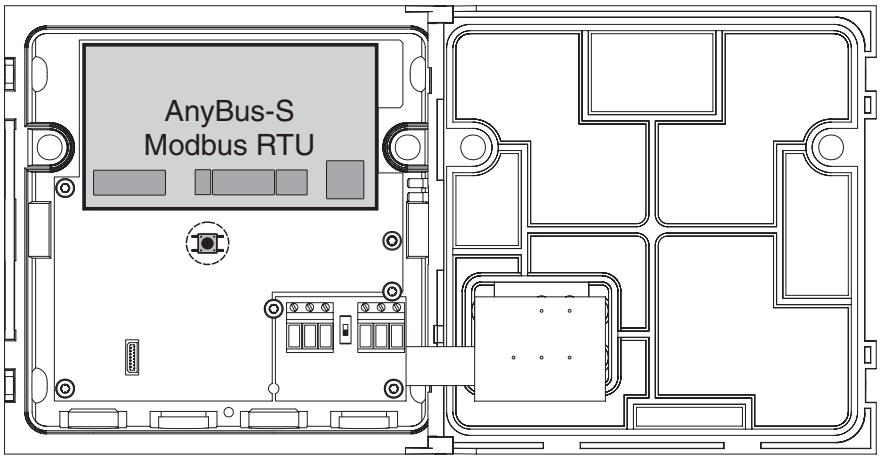


Fig. 3-1 AnyBus-S Modbus RTU in the MIQ/MC(-A)-MOD

The *AnyBus-S Modbus RTU* is an interface that can be used to query sensor data with the Modbus RTU protocol.

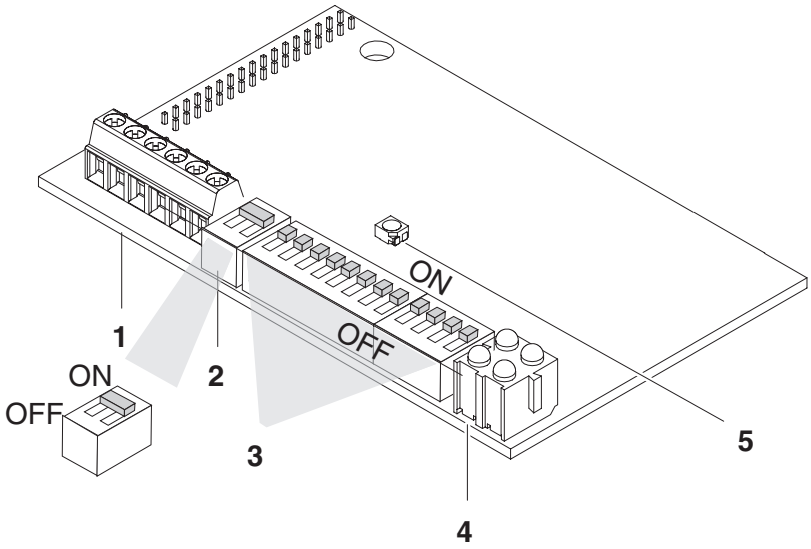


Fig. 3-2 Elements of the AnyBus-S Modbus RTU

1	Modbus RTU terminal strip
2	Modbus terminator switch
3	Dip switches to set the address, baud rate and parity (see section 3.2.3)
4	LEDs for Modbus diagnosis
5	LED for module diagnosis

3.2.1 Terminal connections

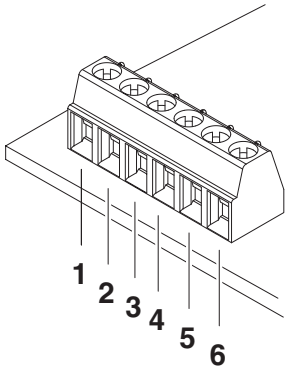


Fig. 3-3 Terminal connections

Pin	Name	Function
1	-	-
2	-	-
3	A line	Negative RxD/TxD according to RS 485 specification
4	B line	Positive RxD/TxD according to RS 485 specification
5	-	-
6	Shield	BUS cable screen, connected with PE

3.2.2 Connecting the Modbus cable

The MIQ/MC(-A)-MOD component can be connected at the end of the Modbus (A) or by looping through (B).

An RS 485 point-to-point connection has to be installed as a component at the end of the Modbus (A).

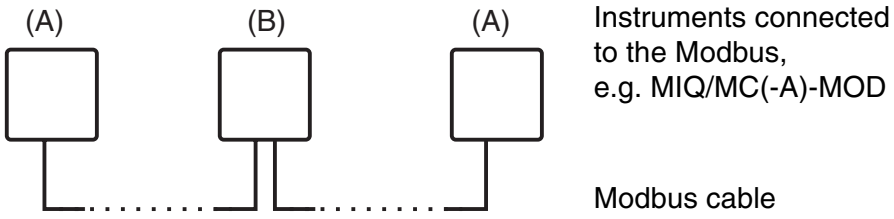


Fig. 3-4 Options of connecting the MIQ/MC(-A)-MOD to the Modbus cable (A) at the end or (B) by looping through

Note
All cables with electrical characteristics according to EN 50170 are suitable as a Modbus cable (e.g. all Profibus cables).

(A) Connecting the MIQ/MC(-A)-MOD component to the Modbus end

1	Carefully strip the Modbus cable insulation for approx. 20 mm.
2	Bare the Modbus wires from the shielding braid and strip them for approx. 5 mm.
3	Twist the shielding braid and cover it with approx. 15 mm insulating tube.
4	Insert the Modbus cable into the module housing of the MIQ/MC(-A)-MOD through the screwed cable gland.
5	Additionally insulate the transition between cable sheath and insulating tube of the shielding braid (e.g. with insulating tape or shrinkable tubing), so that no shielding braid is uncovered.

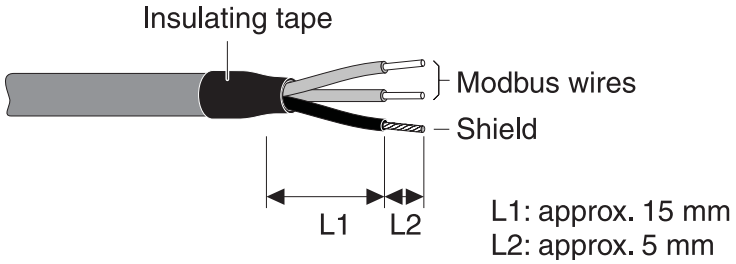


Fig. 3-5 Modbus cable with insulating tape

6	Connect the Modbus wires and shield to the terminal connections of the Modbus module (connections *ALine*, *BLine* and *Shield*, see section 3.2.1).

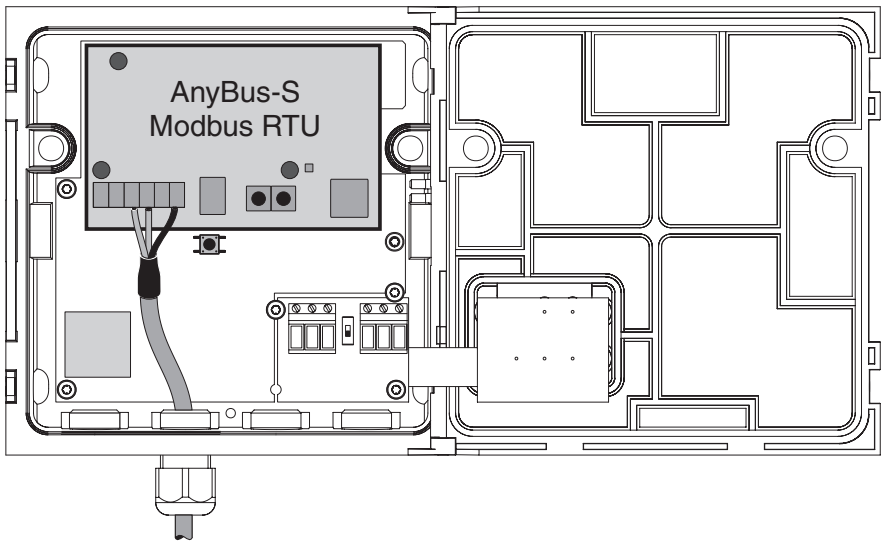


Fig. 3-6 Connection of the MIQ/MC(-A)-MOD as the Modbus termination

7	Fasten the cap nut of the screwed cable gland.
8	Check and if necessary correct the position of the Modbus terminator switch. The switch must be in the ON position.
9	Perform the check: ● Check whether the wires and cables are screwed on tightly. ● Insulate open wires. ● Remove cable rests from the MIQ/MC(-A)-MOD module.
10	Close the MIQ/MC(-A)-MOD module.

Note
Using a shielding terminal, connect the shield of the Modbus cable to the potential equalization or grounding system of the plant in the vicinity but outside of the MIQ module housing.

(B) Connecting the MIQ/MC(-A)-MOD component to the Modbus by looping through

For looping through the Modbus cable via the MIQ/MC(-A)-MOD component, a shielding terminal is contained in the scope of delivery.

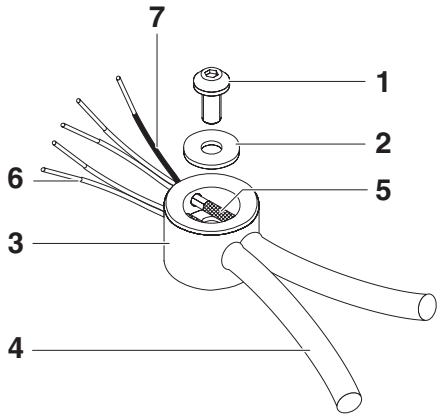


Fig. 3-7 Shielding terminal with Modbus cable and shield connection cable

1	Screw
2	Washer
3	Insulating part of the shielding terminal
4	Cable insulation of the Modbus cable
5	Shielding braid of the Modbus cable
6	Wires of the Modbus cable
7	Shield connection wire

1	Carefully strip the cable insulation of both Modbus cables for approx. 35 mm.
2	Shorten the exposed shielding braid to approx. 15 mm.
3	Bare the Modbus wires for approx. 5 mm.
4	Insert both cables in the module housing of the MIQ/MC(-A)-MOD through the free cable glands.
5	Create a shield connection wire (7). To do so, strip a wire on both ends for approx. 5 mm and 10 mm.
6	Insert a washer in the insulating part (3) of the shielding terminal.
7	Feed both Modbus cables into the insulating part (3) and lead them through the insulating part.
8	Feed the long stripped end of the shield connection wire (7) into the insulating part (3) of the shielding terminal.

9	Position the second washer and screw it tight.

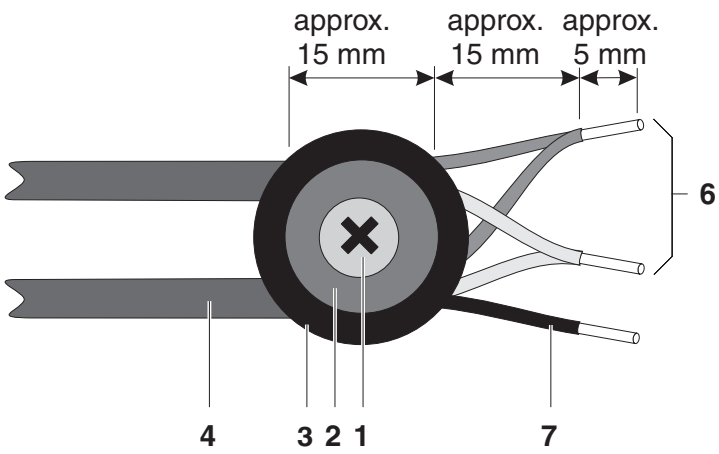


Fig. 3-8 Shielding terminal with Modbus cable (view from above)

10	Shorten the wires of the shielding braid if they protrude over the shielding terminal.
11	Put the Modbus wires together in pairs.
12	Connect the Modbus wires and shield to the terminal connections of the Modbus module (connections *A Line*, *BLine* and *Shield*, see section 3.2.1).

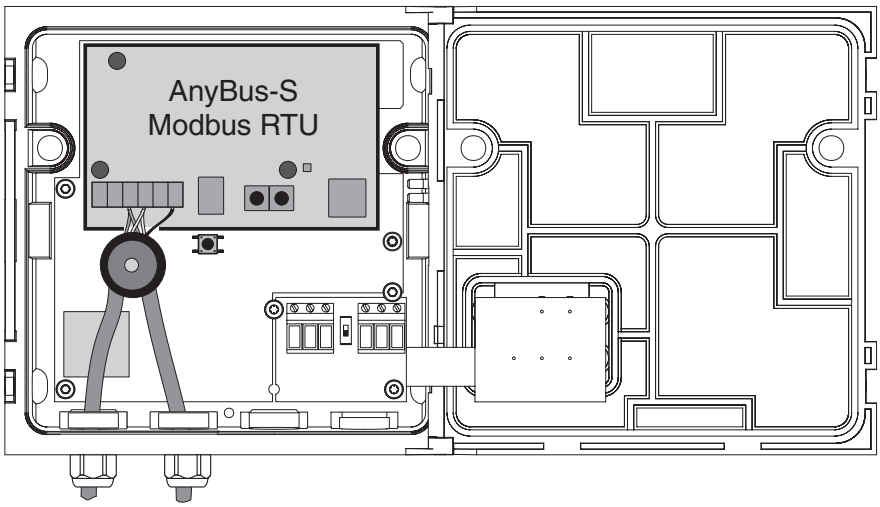


Fig. 3-9 Looping through of the Modbus cable via a MIQ/MC(-A)-MOD

13	Fasten the cap nut of the screwed cable gland.

14	Check and if necessary correct the position of the Modbus terminator switch. The switch must be in the OFF position.
15	Perform the check: ● Check whether the wires and cables are screwed on tightly. ● Insulate open wires. ● Remove cable rests from the MIQ/MC(-A)-MOD module.
16	Close the MIQ/MC(-A)-MOD module.

Note
Using a shielding terminal, connect the shield of the Modbus cable to the potential equalization or grounding system of the plant in the vicinity but outside of the MIQ module housing.

3.2.3 Setting/Changing the Addresse, Baud rate and Parity

Note
Address, Baud rate or Parity cannot be changed during operation. Any change becomes only effective after the system was reset by pressing the reset button on the MIQ/MC circuit board (see system-operating manual).

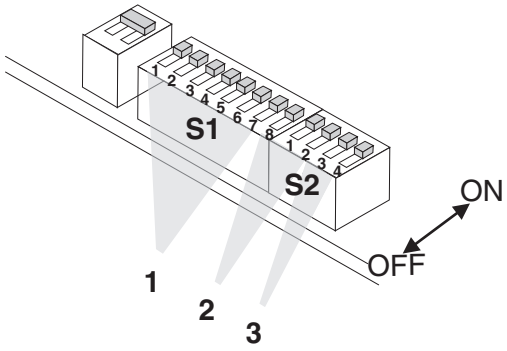


Fig. 3-10 Dip switches

3	Dip switches to set the address S1: Dip 1-7
4	Dip switches to set the baud rate S1: Dip 8 and S2: Dip 1-2
5	Dip switches to set the parity S2: Dip 3-4

Address

A prerequisite for the configuration of the *AnyBus-S Modbus RTU* Modbus module is the setting of its address. The setting of the address is carried out with the dip switches, 1-7 (**3**). Each switch sets the value 0 or 1 for one digit of the seven-digit binary number. This enables addresses of 0-127 to be set.

Examples:

Address	Setting on S1, dip switches 1-7
invalid	0000000
1	**0000001**
30	0011110
127	1111111

Baud rate

A prerequisite for the configuration of the *AnyBus-S Modbus RTU* Modbus module is the setting of the baud rate. The setting of the baud rate is carried out with the dip switches, 8,1,2 (**4**). Each switch sets the value 0 or 1 for one digit of the three-digit binary number. This makes seven valid settings possible.

Baud rate	Setting on S1, dip switch 8 and S2, dip switches 1-2
invalid	000
1200	001
2400	010
4800	011
9600	100
19200	**101**
38400	110
57600	111

Parity

A prerequisite for the configuration of the *AnyBus-S Modbus RTU* Modbus module is the setting of the parity. The setting of the parity is carried out with the parity dip switches, 3,4 (**5**). Each switch sets the value 0 or 1 for one digit of the two-digit binary number. This makes three valid settings possible.

Parity	Setting on S2, dip switches 3-4
invalid	00
None (2 stop bits)	**01**
Even (1 stop bit)	10
Odd (1 stop bit)	11

3.2.4 Bus and module monitoring

The Modbus module has 4 LEDs for monitoring the bus and one LED for monitoring the Modbus module. These 5 LEDs are important aids for the monitoring and diagnosis of faults.

Bus monitoring

The LEDs have the following meaning:

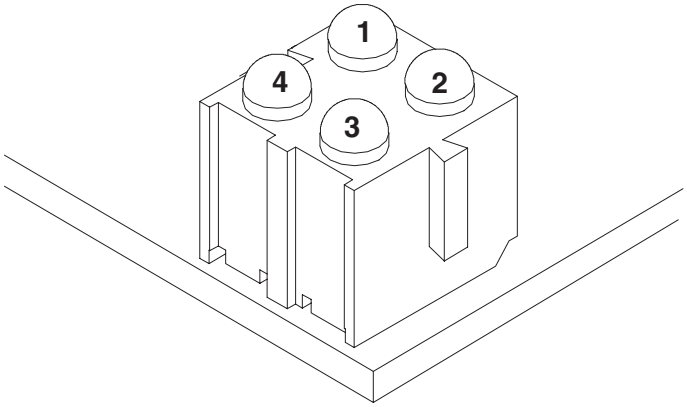


Fig. 3-11 LEDs for bus monitoring

LED	Color	Meaning
1	Flashes green	Data exchange (the module receives or transmits data.)
	Off	No data exchange
2	Red	Bus error (more than 10% of the received telegrams have wrong CRC values.)
	Off	The module is operating or not initialized
3	Green	Modbus is ready for operation
	Off	The module is not correctly initialized
4	Red	The dip switches are set to invalid values (all dip switches are set to Off or to invalid values.)
	Off	The dip switches are set to valid values

Module monitoring

A two-color LED (for position of the LED, see section 3.2) is used for monitoring the Modbus module.

Monitoring function	Color	Flash frequency
ASIC and FLASH ROM error	Red	2 Hz
Module not initialized	Green	2 Hz
Module initialized and in operation	Green	1 Hz
RAM error	Red	1 Hz
DPRAM error	Red	4 Hz

3.3 Commissioning

To connect the IQ SENSOR NET to the Modbus, preparations are required on the Modbus module, on the Modbus master and possibly on the IQ SENSOR NET as well.

Preparing the Modbus module

1	Open the MIQ/MC (-A)-MOD module (see System operating manual).
2	Set the address with the 7 dip switches at the Modbus module (S1: dip switches 1-7) (see section 3.2.3).
3	Set the baud rate with the 3 dip switches at the Modbus module (S1: dip switch 8 and S2: dip switches 1-2) (see section 3.2.3).
4	Set the parity using the two dip switches on the Modbus module (S2: dip switches 3-4) (see section 3.2.3).
5	Connect the cable to the Modbus on the terminals of the Modbus module (see section 3.2.1).
6	Check and if necessary correct the position of the Modbus terminator switch (see section 3.2.2).

Configuring the Modbus master

7	Configure the Modbus master for the new component (see Modbus documentation).

Preparing the IQ SENSOR NET

Preparations on the IQ SENSOR NET may be necessary if the system should transmit the data of the sensors to the Modbus with a specific assignment of the sensors to sensor numbers (S01 ... S20) (see section 3.5).



Note
The sensor numbers are automatically assigned by the IQ SENSOR NET in the order in which sensors are recognized by the system. The current assignment of sensor numbers to the sensors can be seen in the *List of sensors* (see System operating manual, chapter *List of sensors*).

3.4 Modbus checklist

The following checklist supports you when planning, projecting and installing a Modbus plant with the IQ SENSOR NET. For smooth operation, you should be able to answer all questions with "Yes".

- Is the [bus system] (bus segment) installed without branch lines?
- Was the correct Modbus cable used (cord type A according to EN 50170)?
- Are the poles of the signal lines A line and B line correctly connected at all bus connections?
- Is it guaranteed that there is no short-circuit between A line, B line and cable shielding?
- Is the shielding installed free of interruptions?
- Are the guidelines for shielding and grounding being observed, and doesn't any unallowed potential equalization current flow via the shielding?
- Is the maximum cable length (per bus segment) observed for the corresponding baud rate?
- Do all devices support the required baud rate?
- Are exactly two terminators switched on at the ends of the [bus system] (bus segment)?
- Are the terminators supplied with voltage so the following applies: $U_{B\ line} - U_{A\ line} > + 500$ mV?
- Do all devices have individual bus addresses?
- After changing the bus address, Baud rate or parity, have the devices been restarted (switched off and on again, or reset button of the MIQ/MC pressed)?
- Do the addresses projected in the master correspond to the actual addresses?
- After commissioning:
  Do all devices signal error-free behavior?
- Is it guaranteed that the Modbus master has consistent access to the 16 byte sensor data structure?

3.5 Sensor administration under Modbus

Preparation of the IQ SENSOR NET for communication with the Modbus may require, e.g. the following:

- Creating a IQ SENSOR NET system with specific assignment of sensor numbers to sensors (see section 3.5.1)
- Creating several IQ SENSOR NET systems with the identical assignment of sensor numbers to sensors (see section 3.5.2)
- Changing the order of the sensors in an already installed system (see section 3.5.3)

3.5.1 Creating the assignment of sensor numbers

You want to install an IQ SENSOR NET system and, at the same time, to create a specific sequence of sensor number assignments to the sensors.

1	Carry out a system start without any sensors (see System operating manual, chapter Installation).
2	Connect the sensors to the system in the required order. For each sensor, wait until the sensor is recognized by the system (see System operating manual, chapter Installation).

3.5.2 Creating the identical assignment of sensor numbers in several systems

You want to install several identical IQ SENSOR NET systems and, at the same time, to create the same sequence of sensor number assignments to the sensors in all systems.

1	Carry out a system start without any sensors (see System operating manual, chapter Installation).
2	Connect the sensors to the system in the required order. For each sensor, wait until the sensor is recognized by the system (see System operating manual, chapter Installation).
3	Repeat steps 1 and 2 for all other systems and, while doing so, keep to exactly the same order when connecting the sensors.

3.5.3 Changing the assignment of sensor numbers

You want to change the assignment of sensor numbers to the sensors in an already running IQ SENSOR NET system.

1	Unplug all sensors from the IQ SENSOR NET.



Note
When the inactive datasets are deleted, all settings for the sensors are deleted as well.

2	Delete all inactive datasets in the list of sensors (see System operating manual, chapter *Deleting inactive datasets of sensors*).
3	Connect the sensors to the system in the required order. For each sensor, wait until the sensor is recognized by the system (see System operating manual, chapter Installation).

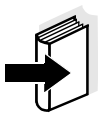
4 Data transmission

4.1 Overview

Data transmission is carried out via the RS 485 interface with the Modbus RTU protocol.

The following sensor data is transmitted:

- Sensor number (Sxx)
- Sensor status
- Sensor model
- Status info of sensors
- Measuring mode
- Measured value status (main and secondary measured value)
- Main measured value
- Secondary measured value



Note
The transmitted data of all IQ SENSOR NET sensors is given in the WTW document, "IQ SENSOR NET sensors: coded data for field bus communication" (ba75560de). It is permanently updated when new sensors are available and when the sensor software is modified (if the modifications are relevant for the transmitted sensor data). The latest version is available on the Internet, in the download area for operating manuals. Use the search function for the download and search for "ba75560de".

4.2 Modbus query

With each query of sensor data via the Modbus protocol, a block of consecutive registers is read (up to all of the 240 registers).
For a query of sensor data, determine the first register and the number of registers to be read (1 ... 240).

Determining the first register to be read

The first register to be read depends on the sensor number (Sxx) [1 ... 30] and the number of the sensor register (R) [1 ... 8]:

$[(Sxx - 1)] * 8 + R.$

Example: Determine the first register with data for the sensor S10:
$[(10 - 1) * 8] + 1 = 73$

Determining the number of registers to be read

The maximum number of registers to be read is 240.

Example: Read all data of X sensors

Number of sensors (X)	Number of registers
1	8
2	16
3	24
⋮	⋮
30	240

Example of a Modbus query and Modbus response

Query of all sensor information of the sensor with the sensor number S02:

Modbus query			
Byte	**Value**	**Information**	**Meaning of the value**
1	01h	Modbus address of the MIQ/MC-MOD	01h --> **1**
2	04h	Function	04h --> 4 **Read Input Register** (see section 4.3)
3	00h	Start address HI	0008h --> 8 **Start with register 9** (Modbus counting method)
4	08h	Start address LO	
5	00h	Number of HI registers	0008h --> 8 **8 registers**
6	08h	Number of LO registers	
7	70h	CRC (HI)	Checksum (CRC)
8	0Eh	CRC (LO)	

Response with all sensor information of the sensor with the sensor number S02:

Modbus response			
Byte	**Value**	**Information**	**Meaning of the value**
1	01h	Modbus address of the MIQ/MC-MOD	01h --> **1**
2	04h	Function	04h --> 4 **Read Input Register**
3	10h	Number of bytes	10h --> **16** 16 Byte (8 registers)
4	02h	Contents of register 9 (HI) = sensor number	02h (Int 8) --> 2 Sensor number **S02**
5	02h	Contents of register 9 (LO) = sensor status	02h (Int 8) --> **MEASURE**
6	04h	Contents of register 10 (HI) = sensor model	0401h (Int 16) --> **VisoTurb 700 IQ**
7	01h	Contents of register 10 (LO) = sensor model	
8	00h	Contents of register 11 (HI) = status info	0000h (Int 16) --> **no errors**
9	00h	Contents of register 11 (LO) = status info	
10	00h	Contents of register 12 (HI) = measuring mode	00h (Int 8) --> **FNU** *Trüb*
11	14h	Contents of register 12 (LO) = measured value status	14h (Int 8) Main measured value (bits 7-4): 1h --> **VALID** Secondary measured value (bits 3-0): 4h --> **MISSING**
12	42h	Contents of register 13 (HI) = main measured value	429E46C2h (Float 32) --> **79,1382** Measured parameter and unit, see byte 10 (measuring mode)
13	9Eh	Contents of register 13 (LO) = main measured value	
14	46h	Contents of register 14 (HI) = main measured value	
15	C2h	Contents of register 14 (LO) = main measured value	

Modbus response			
Byte	**Value**	**Information**	**Meaning of the value**
16	00h	Contents of register 15 (HI) = secondary measured value	00000000h (Float 32) --> **0** but measured value invalid (MISSING), see Byte 11 (measured value status)
17	00h	Contents of register 15 (LO) = secondary measured value	
18	00h	Contents of register 16 (HI) = secondary measured value	
19	00h	Contents of register 16 (LO) = secondary measured value	
20	23h	CRC (HI)	Checksum (CRC)
21	5Eh	CRC (LO)	

4.3 Structure of the information

Sensor data block

The datasets of up to 30 sensors (20 IQ SENSOR NET sensors and 10 differential sensors) of the IQ SENSOR NET are made available to the Modbus in a sensor data block in the controller of the IQ SENSOR NET.

Query and response telegram

Data transmission takes place via query and response telegrams. The form of the telegrams is determined by the Modbus RTU protocol. The Modbus master transmits a query telegram with a Modbus command to a Modbus slave. The Modbus slave transmits a response telegram with the requested data from the sensor data block or an error message.

Supported Modbus commands

The IQ SENSOR NET provides the data block for read access only. Writing Modbus commands are not carried out.

Modbus commands	Command code
Read Input Register	04h
Read Discrete Inputs	02h
Read Holding Register	03h
Read Coils	01h

4.4 Sensor data block

The data block contains the data of up to 30 sensors in the order of registering on the IQ SENSOR NET (Sxx number).

The data of a sensor are stored in 8 registers each.
Thus, the sensor data block consists of altogether 240 registers. Each register contains 2 bytes. The bytes 0 and 1 form register 0001, the bytes 2 and 3 form register 0002, etc.

	Modbus		Information	Data format	
	Register	Bit		Data type	Bit
Sensor S01	0001	1-8	1 [= sensor number (S01)]	(Int 8)	7-0
	0001	9-16	Sensor status	(Int 8)	7-0
	0002	1-16	Sensor model	(Int 16)	15-0
	0003	1-16	Status info	(Int 16)	15-0
	0004	1-8	Measuring mode	(Int 8)	7-0
	0004	9-16	Measured value status	(Int 8)	7-0
	0005	1-16	Main meas. value (IEEE-754 floating point, 32-bit)	(Float 32)	31-16
	0006	1-16	Main meas. value (IEEE-754 floating point, 32-bit)	(Float 32)	15-0
	0007	1-16	Secondary measured value (IEEE-754 floating point, 32-bit)	(Float 32)	31-16
	0008	1-16	Secondary measured value (IEEE-754 floating point, 32-bit)	(Float 32)	15-0
Sensor S02	0009	1-8	2 [= sensor number (S02)]	(Int 8)	7-0
	0009	9-16	Sensor status	(Int 8)	7-0
	0010	1-16	Sensor model	(Int 16)	15-0
	0011	1-16	Status info	(Int 16)	15-0
	0012	1-8	Measuring mode	(Int 8)	7-0
	0012	9-16	Measured value status	(Int 8)	7-0
	0013	1-16	Main measured value (IEEE-754 floating point, 32-bit)	(Float 32)	31-16
	0014	1-16	Main measured value (IEEE-754 floating point, 32-bit)	(Float 32)	15-0
	0015	1-16	Secondary measured value (IEEE-754 floating point, 32-bit)	(Float 32)	31-16
	0016	1-16	Secondary measured value (IEEE-754 floating point, 32-bit)	(Float 32)	15-0

	Modbus		Information	Data format	
	Register	Bit		Data type	Bit
Sensors S03 ... S29	0017 ... 0232				
	⋮		⋮	⋮	⋮
Sensor S30	0233	1-8	30 [= sensor number (S30)]	(Int 8)	7-0
	0233	9-16	Sensor status	(Int 8)	7-0
	0234	1-16	Sensor model	(Int 16)	15-0
	0235	1-16	Status info	(Int 16)	15-0
	0236	1-8	Measuring mode	(Int 8)	7-0
	0236	9-16	Measured value status	(Int 8)	7-0
	0237	1-16	Main meas. value (IEEE-754 floating point, 32-bit)	(Float 32)	31-16
	0238	1-16	Main meas. value (IEEE-754 floating point, 32-bit)	(Float 32)	15-0
	0239	1-16	Secondary measured value (IEEE-754 floating point, 32-bit)	(Float 32)	31-16
	0240	1-16	Secondary measured value (IEEE-754 floating point, 32-bit)	(Float 32)	15-0



Note
The counting method of the Modbus registers and Modbus bits and the allocation of MSB and LSB is different from the usual method of most programming languages.

	Modbus	Usually
Counting start of the register	1	0
MSB* allocation of the register	Bit 1	Bit 15
LSB* allocation of the register	Bit 16	Bit 0

* MSB = Most significant bit, LSB = Least significant bit

4.5 Data formats

The sensor data in the sensor data block (see section 4.4) are available in the Float 32, INT16 and INT8 data formats.

Float 32

The data for the main and secondary measured values are transmitted in the IEE-754 standard 32-bit floating point format.

Bit representation	Byte	Bit	
MSB* LSB*			
S E E E E E E E	4	31 - 24	S = sign (bit 31)
E M M M M M M M	3	23 - 16	E = Exponent (Bit 30-23)
M M M M M M M M	2	15 - 08	M = mantissa (bits 22-0)
M M M M M M M M	1	07 - 00	

* MSB = Most significant bit, LSB = Least significant bit

If not all of the bits of the exponent are 0, the value is calculated according to:

$$V = -1^{S} \cdot 2^{E-127} \cdot (1 + M_{b22} \cdot 2^{-1} + M_{b21} \cdot 2^{-2} + M_{b20} \cdot 2^{-3} + ... + M_{b0} \cdot 2^{-23})$$

If all of the bits of the exponent are 0, the value is calculated according to:

$$V = -1^{S} \cdot 2^{-126} \cdot (M_{b22} \cdot 2^{-1} + M_{b21} \cdot 2^{-2} + M_{b20} \cdot 2^{-3} + ... + M_{b0} \cdot 2^{-23})$$

A value is 0 if all the bits of both the exponent as well as the mantissa are 0.

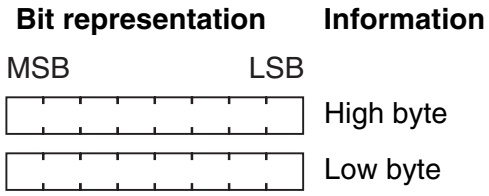
Note
If the measured value is equal to 0, check the measured value status. If the measured value status is not equal to 1, an error has occurred and the measured value is invalid.

Note
The Modbus protocol does not define how the bytes of 32-Bit-IEEE-754 floating point numbers should be ordered.

Apart from the byte order described in the bit representation, another order of the bytes is also possible.
Opposite to the order described, the two lower bytes have been exchanged with the two upper bytes in this order (b4 b3 b2 b1 - b2 b1 b4 b3).

For Modbus applications that can independently interpret floating point numbers (or allow to select a data format for certain registers), the byte order the data interpretation is based on should be checked.

INT16 In the INT16 format, the data for the sensor model and status info is transmitted. The data consists of two bytes. The assignment is carried out in Motorola format ("big-endian", the higher value byte first).



INT8 All other data are transmitted in the INT8 format. This data consists of one byte.

The data for the measured value status of the main and secondary measured values are encoded jointly into a single byte. Bits 7-4 encode the status of the main measured value, bits 3-0 encode the status of the secondary measured value.

5 What to do if ...

5.1 Fault diagnosis

A simple diagnosis of the operability of the Modbus module and communication with the Modbus is possible via the LEDs on the Modbus module in the MIQ/MC (-A)-MOD (see section 3.2.4).

5.2 Error elimination

Data transmission between the Modbus master and IQ SENSOR NET system is faulty

Cause	Remedy
– Incorrect wiring of the connections on the terminal strip	– Check/change the connections on the terminal strip (see section 3.2.1)
– Incorrect setting of address, baud rate, parity	– Check/change the settings (see section 3.2.3)
– Incorrect protocol	– Adapt the protocol
– Modbus module defective	– Send MIQ/MC(-A)-MOD module to WTW

The Modbus master does not receive any plausible input data

Cause	Remedy
– The data interpretation is not correct	– Observe data formats of the MIQ/MC(-A)-MOD (see also section 4.5).

6 Technical data

6.1 IQ SENSOR NET MIQ/MC(-A)-MOD component

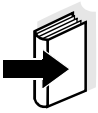
General technical data for the IQ SENSOR NET and the MIQ/MC component are given in the System operating manual for the 2020 system.

Electrical data

Power consumption	
MIQ/MC with "MOD" option	3 W

6.2 Modbus module

Information on the technical data of the *AnyBus-S Modbus RTU* module from the HMS INDUSTRIAL NETWORKS AB company is given in the documentation of the HMS INDUSTRIAL NETWORKS AB company.



Note
Further information on the technical data of the Modbus module is given on the Internet under the address of the manufacturer

HMS INDUSTRIAL NETWORKS AB
(www.hms-networks.com)

in the following documents:

- FIELDBUS APPENDIX
  ANYBUS-S Modbus RTU
- AnyBus Slave Design Guide
  ANYBUS-S Parallel Interface