



RS485, Modbus and BACnet

Basics & Practical Applications

Frederik Riedel & Martin Speer | 16.09.26



Frederik Riedel

- Head and Trainer in Technical Service at Elsner Elektronik GmbH
- Support, Product Advice

» We are
your
speakers
today



Martin Speer

- Product manager at Elsner Elektronik GmbH
- Practical experience as a KNX system integrator and in sales

A person is walking away from the camera in a modern office hallway. The floor is polished and reflects the person and the surrounding environment. A large white arrow is painted on the floor, pointing in the direction the person is walking. The background shows office desks, chairs, and large windows. The text "What has been our starting point so far?" is overlaid on the image, with a blue circle behind the word "What".

| What has been our
starting point so far?

AGENDA

1. Differences RS485 & Modbus & BACnet
2. Applications
3. Weather stations compared
4. Installation & accessories
5. Different wind measurement methods
6. More Elsner Modbus devices
7. BACeye/SC data evaluation
8. Commissioning
9. Faults & troubleshooting



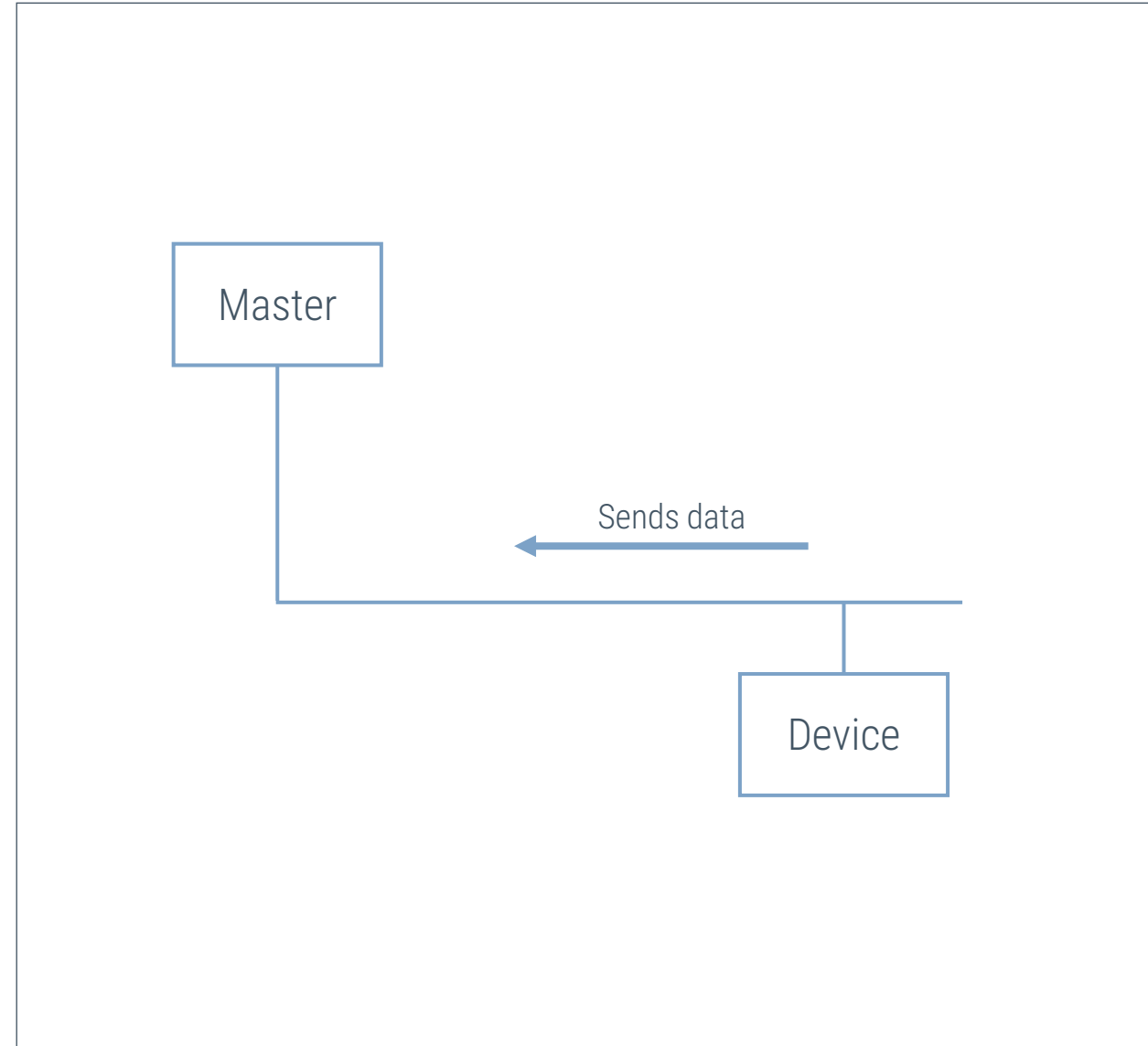
01 | Differences RS485, Modbus and BACnet



RS485

| Communication overview

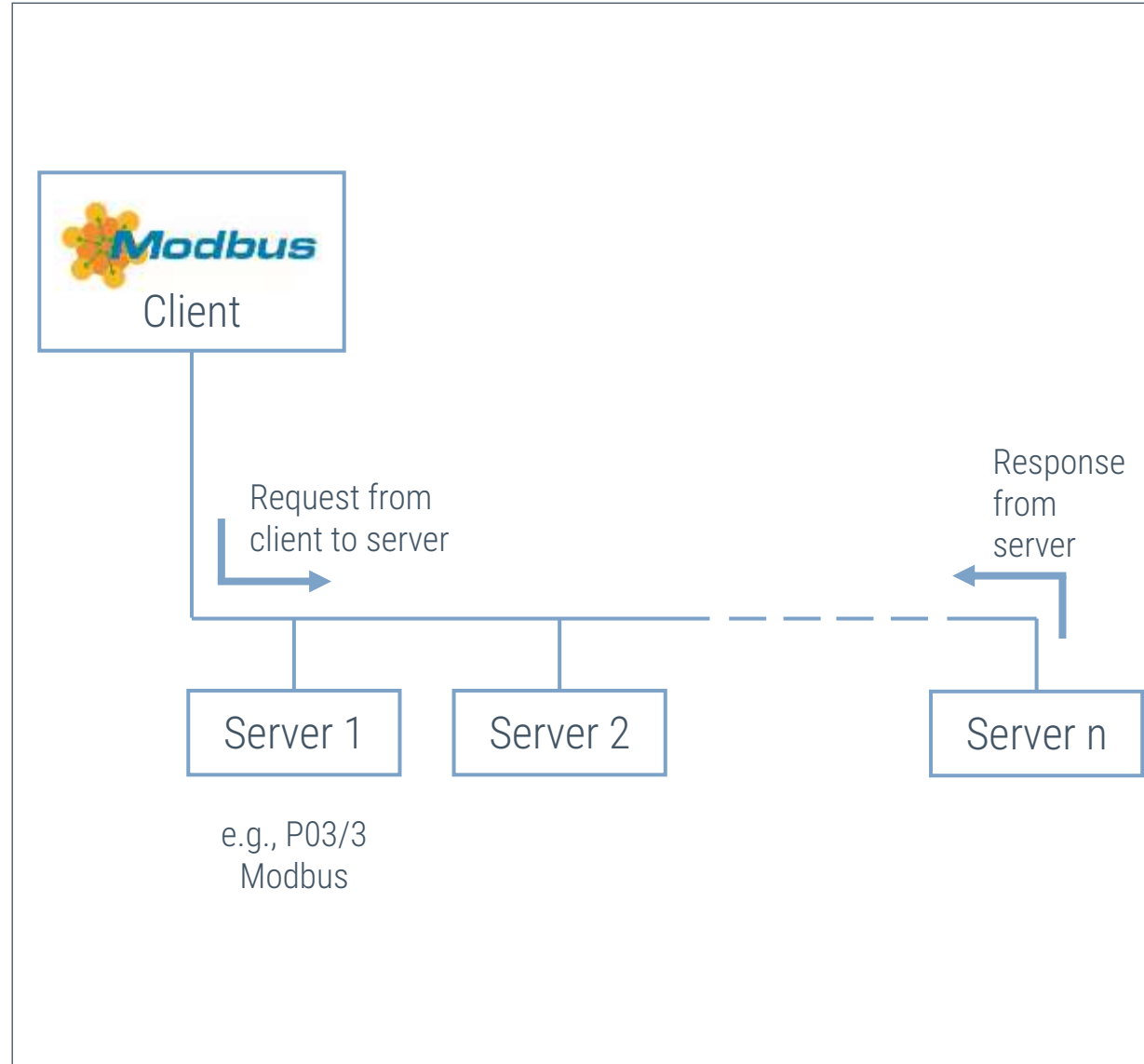
- 1-to-1 connection (1 device sends data to the receiver without a request)
- Data transfer rate and parity fixed in the device.



Modbus-RTU

| Communication overview

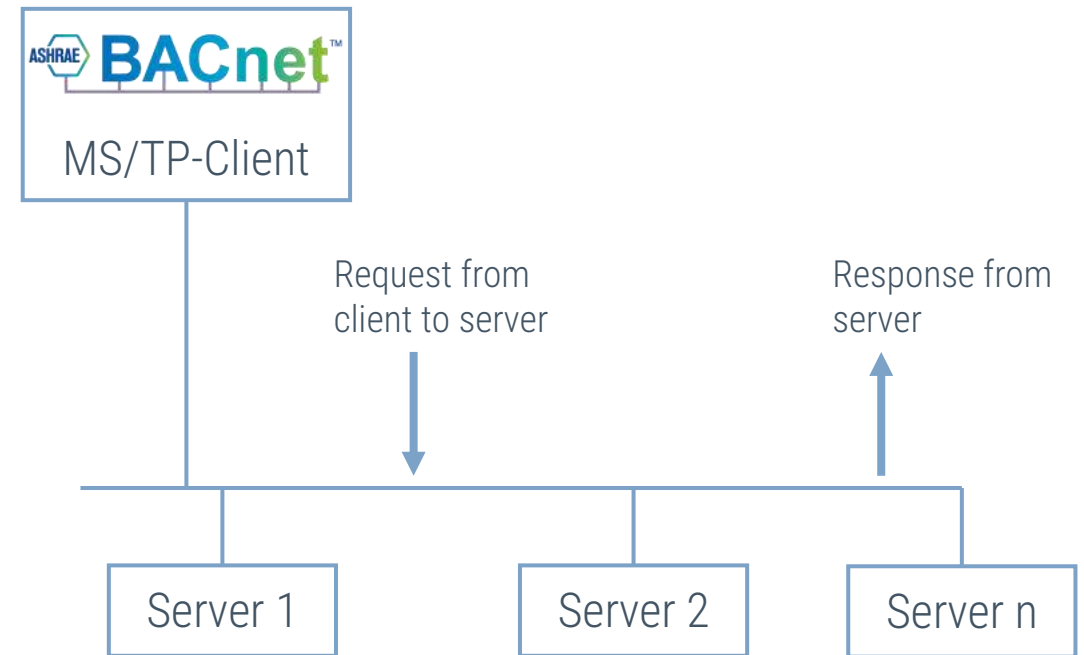
- Client/server communication
- Addresses 1–247 = valid range for server devices
- Address can be set on the device
- Data transfer rate adjustable
- Bus termination required
- RS485 and Modbus devices are not compatible with each other.



BACnet

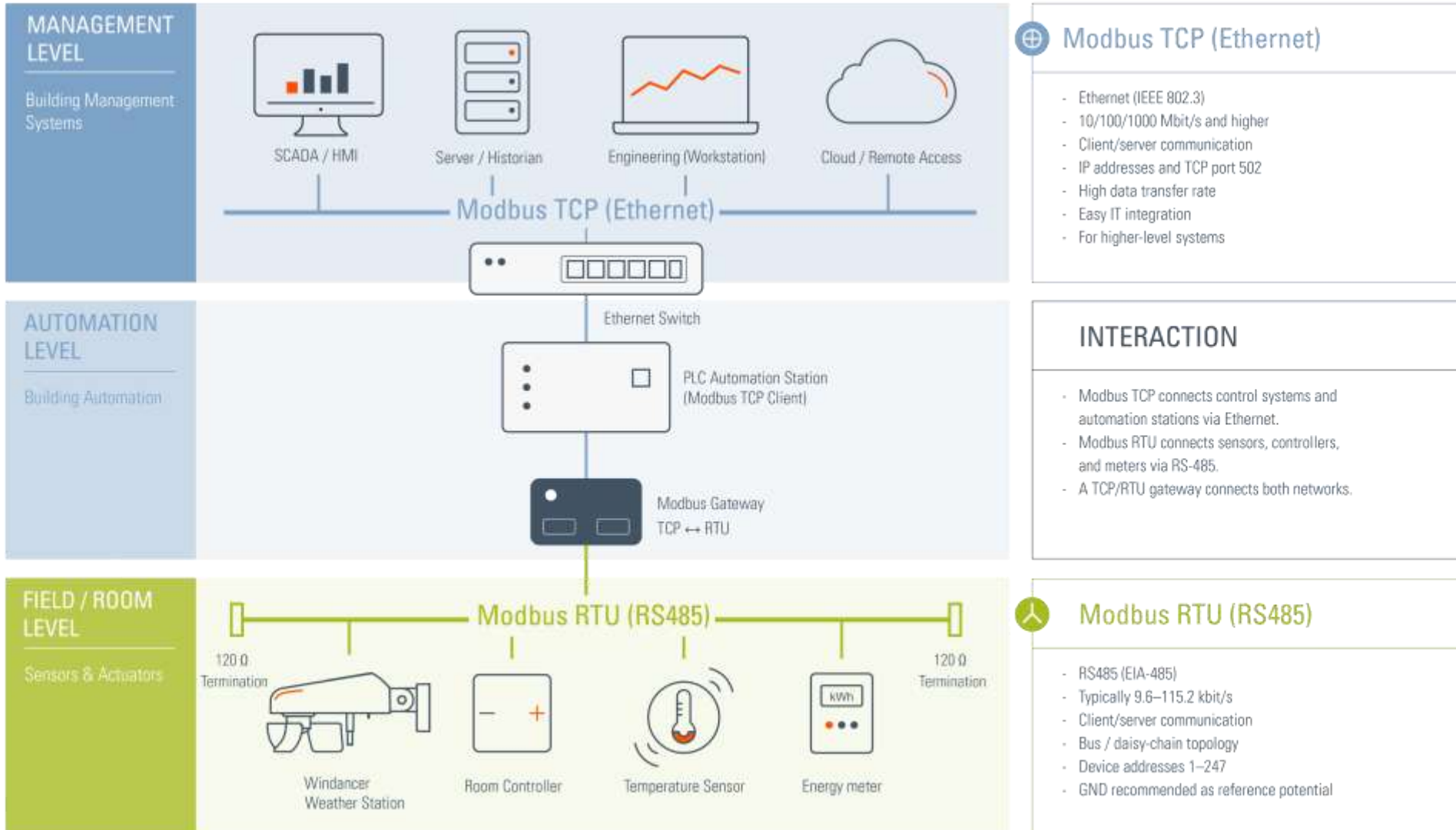
| Communication overview

- Client-server communication
- Up to 128 devices per bus segment can be integrated on the bus via address
- Address can be set on the device
- Data transfer rate adjustable
- Bus termination required



Differences

| Modbus-RTU & Modbus-TCP



Differences

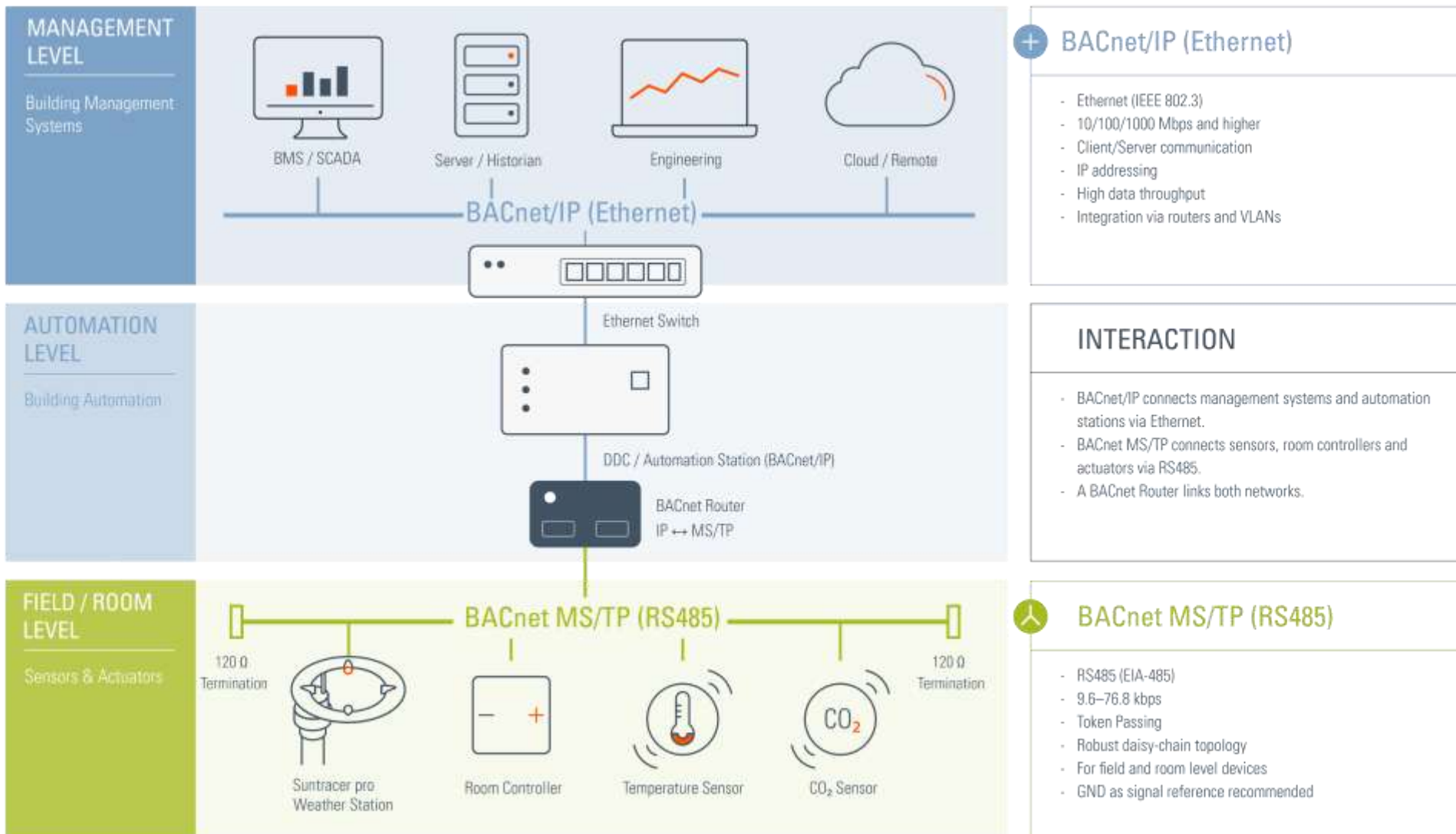
| Modbus-RTU & Modbus-TCP

- **Transmission medium:**
RTU = serial (RS-485), TCP = Ethernet
- **Protocol format:**
RTU = binary, TCP = embedded in TCP/IP
- **Addressing:**
RTU = server ID, TCP = IP address
- **Speed/range:**
RTU = slower & limited, TCP = faster & flexible

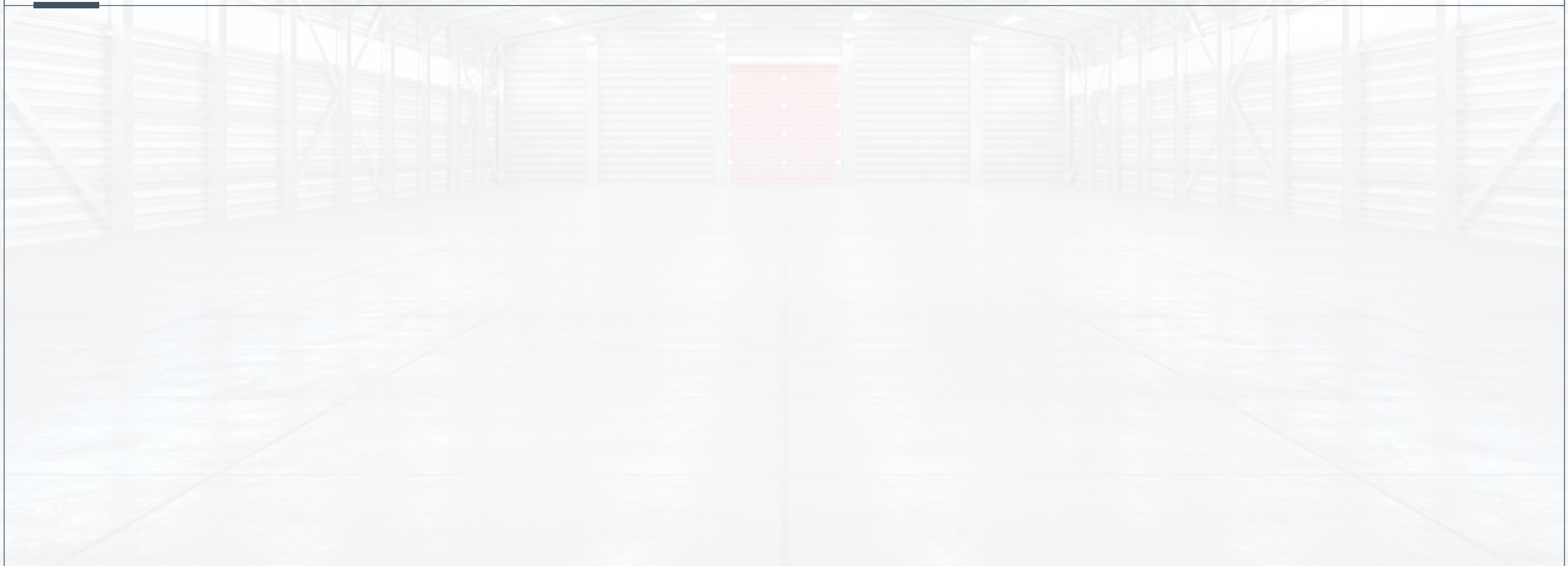


BACnet/IP and BACnet MS/TP

| Network architecture: wired integration via a BACnet-Router



02 Applications



Applications

| Common areas of application

- **Modbus**
PV systems, heat pumps, PLC controls,
room sensors
- **RS485**
PLC controls, data loggers
- **BACnet**
BMS, HVAC, server applications



03| Weather stations compared

Weather stations

| Overview



P03/3-Modbus (-GPS)

- Measures temperature, 3× brightness, wind speed, precipitation.
- Optionally with GPS receiver



P03-RS485 basic/-GPS/-CET

- Measures temperature, 3× brightness, wind speed, precipitation.
- Optionally with GPS receiver
- Functional & proven



P04/3-RS485 basic/-GPS/-CET

- Measures temperature, 3× brightness, wind speed, precipitation.
- Optionally with GPS receiver
- Design oriented



Suntracer pro RS485

- Measures brightness, wind (speed, direction), precipitation, temperature, humidity, air pressure.
- GPS reception (time, position, sun position)

Weather stations

| Overview



Suntracer pro BACnet

- Measures brightness, wind direction, wind speed, precipitation, temperature, humidity, air pressure
- GPS reception for date/ time, position, sun position
- Shading control via BACeye plug-in integrated

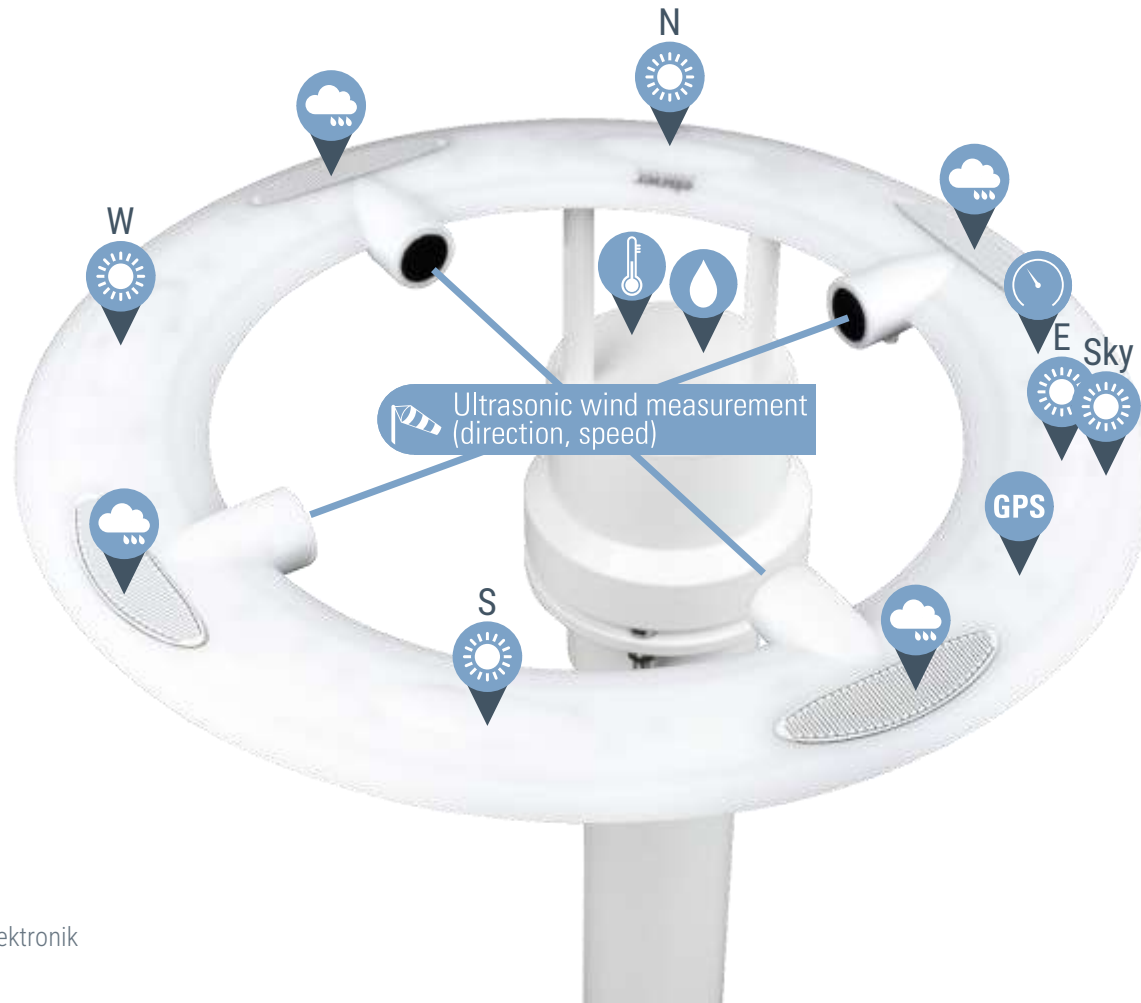


Windancer (GPS) Modbus

- Mechanical wind sensor
- Measures temperature, 3× brightness, wind speed, precipitation
- Optionally with GPS receiver

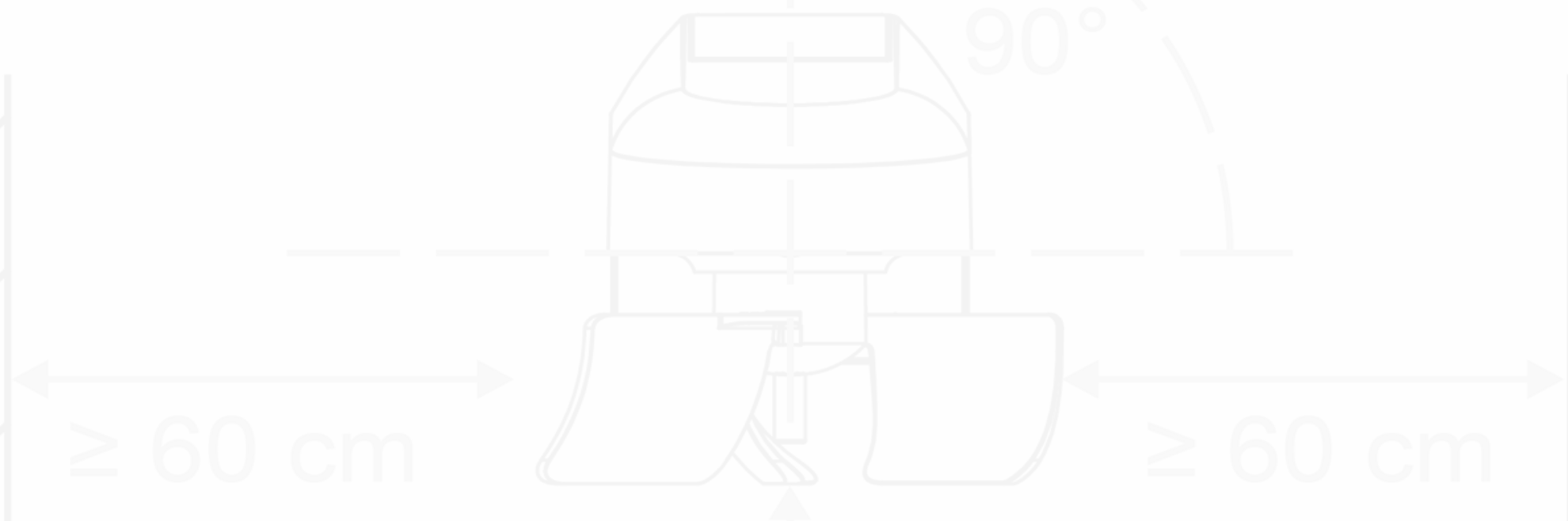
Functions Suntracer pro RS485/BACNet

| Sensors



- Temperature 🌡️
- Wind speed and direction (ultrasonic measurement)
- Brightness (5 sensors in total) ☀️
- Precipitation ☁️
- Air humidity 💧
- Air pressure 🕒
- GPS reception (location, time), 📶
sun position calculation

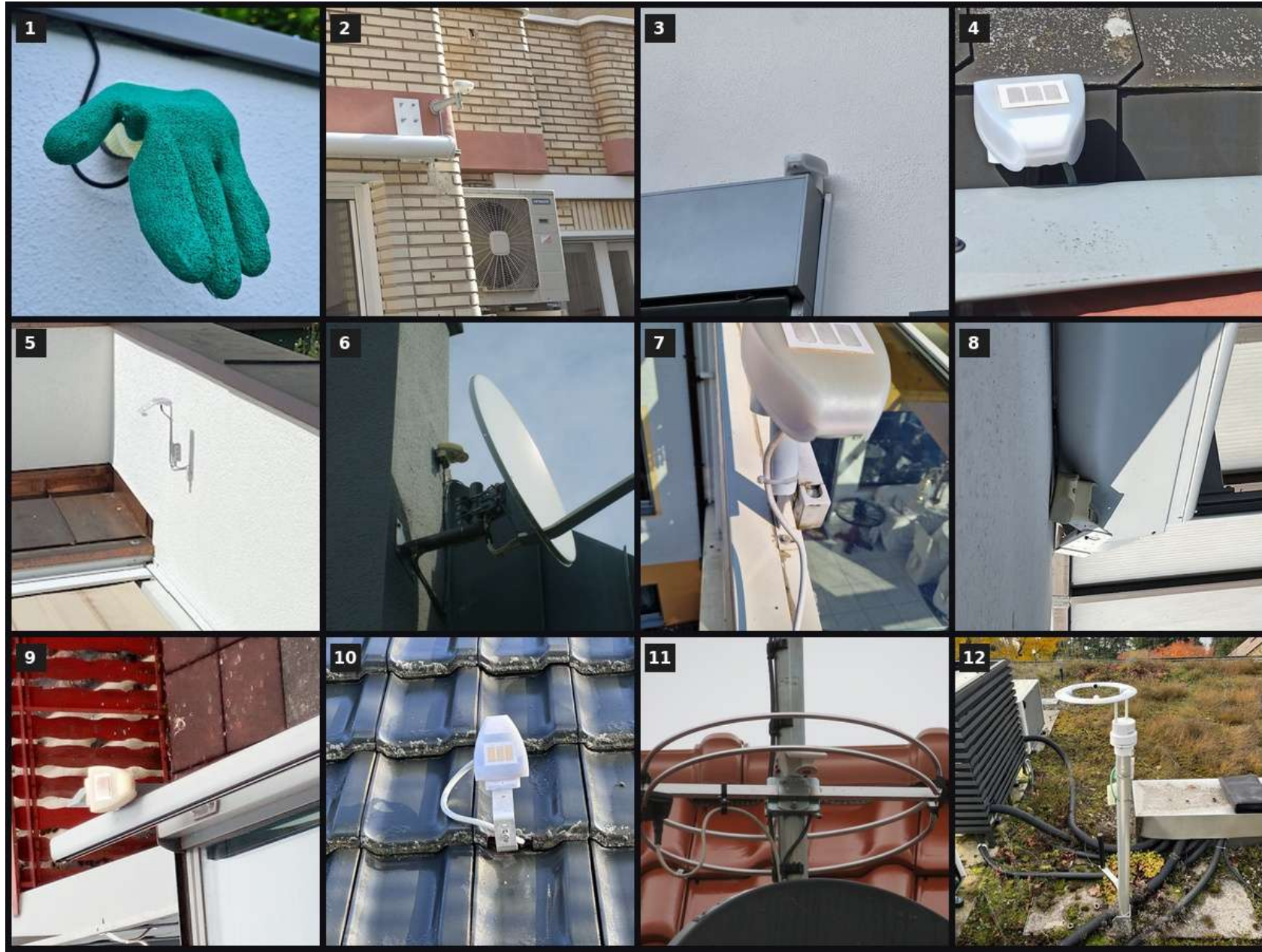
04 | Installation and accessories



Which weather station is correctly installed?

| Overview of common installation errors

➤ No image shows a correct installation



Installing the P03

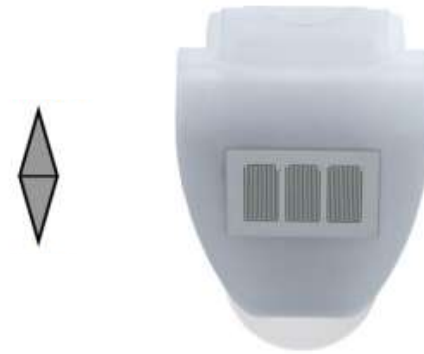
| Correct installation of the weather station



Mount on a vertical wall (or a mast).



Leave at least 60 cm distance below, to the sides and in front of other elements (building structure, construction parts, etc.).



Northern hemisphere: align to the south. Southern hemisphere: align to the north.

Installing the P04

| Correct installation of the weather station



Leave at least 60 cm distance below, to the sides and in front of other elements (building structure, construction parts, etc.).



Northern hemisphere: align to the south. Southern hemisphere: align to the north.



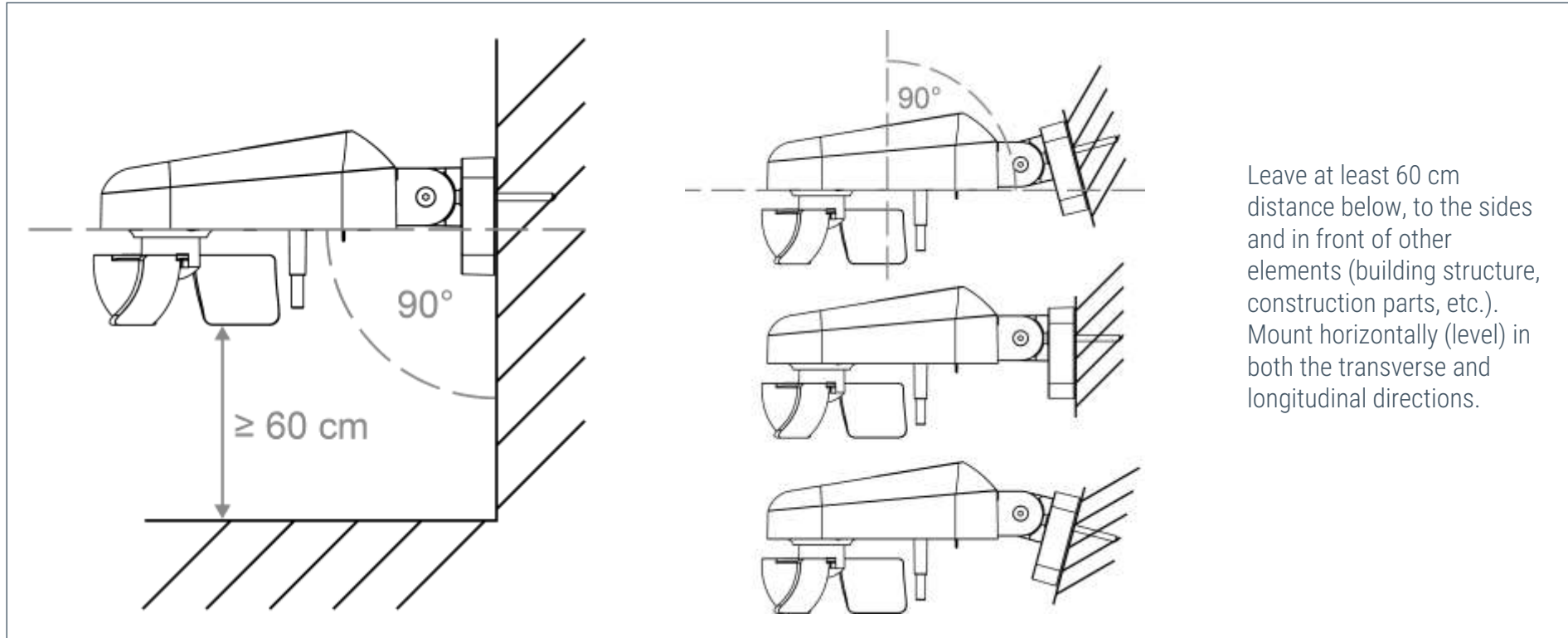
Mount on a vertical wall (or a mast). Route the supply cable in a loop before it enters the wall or junction box. Mount horizontally (level) in the transverse direction.

Installing Suntracer KNX pro



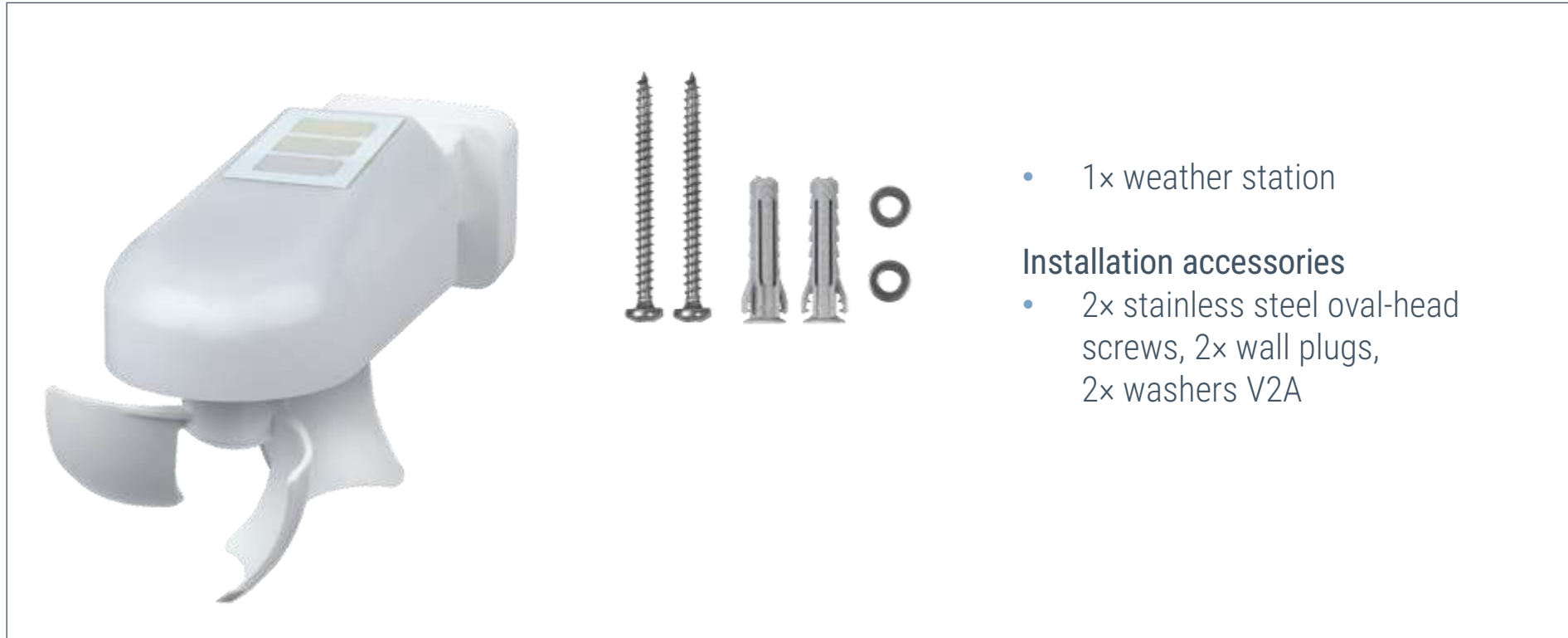
Installing Windancer

| Correct installation of the weather station



Installation accessories for Windancer

| Scope of delivery



- 1x weather station

Installation accessories

- 2x stainless steel oval-head screws, 2x wall plugs, 2x washers V2A

Installation accessories

| Optional accessories



Optional accessories

- Mounting Fix
- Arm L
- Fix P

05| Different wind measurement methods

Wind measurement

| Overview



Anemometer

- Only with [Windancer](#) available
- Mechanical wind sensor
- Measures horizontal winds only



Electronic

- [P03](#) and [P04](#) models
- Measures horizontal and rising winds
- Sensitive to wind changes
- Wear-free



Ultrasonic

- [Suntracer pro](#)
- Measures wind speed and wind direction
- Wear-free

06| More Elsner Modbus devices

The background image is a photograph of a modern office interior. It shows a long, bright hallway with large windows on the left side. Several potted plants are placed along the windowsill. The ceiling is a grid of white acoustic tiles. The floor is a light-colored, polished surface. The overall atmosphere is clean and professional.

Modbus devices

| Overview



eTR 101 Modbus

- Temperature measurement
- Displays actual temperature, setpoint or base setpoint shift
- 2 touch buttons (+/-) to change the target temperature or the base setpoint shift



TH-AP Modbus

- Measures temperature, humidity
- Calculates the dew point temperature
- Suitable for indoor or outdoor use



Sewi Modbus (AQS-)TH

- Measures temperature, humidity
- Calculates the dew point temperature
- Optionally with CO2 sensor

A person wearing a white shirt is sitting at a desk, using a pen to point at a laptop screen. The laptop screen displays a bar chart with green bars and a line graph with blue lines. The person's right hand is holding the pen, and their left hand is resting on the laptop keyboard. The background is a blurred office setting.

07| BACeye/SC data evaluation

BACeye/SC

| Available devices

- 12 façades can already be mapped via the weather station without requiring a BMS to intervene
- If the BMS fails, the weather-dependent functions still work when communication runs directly via BACnet
- Fewer gateways = fewer points of failure & less latency
- Cost savings through fewer gateways
- Commissioning typically by I&C/HVAC technicians



BE BACeye/SC. Professional device control 3.1.1.1 - MBS GmbH - Standard Project

File Edit Data transfer Window View Diagnostics Elsner weather station Help

All networks >> Devices

Devices			
3 devices found			
Network	Inst. no.	Device name	Description
1	52	BACeye/SC	BACeye/SC MBS GmbH
2	1	UBR-1	UBR BACnet router
2	50	Suntracer Pro BACnet	Light and Building 2026

BACeye/SC

| Plug-in

BE

BACeye/SC. Professional device control 3.1.1.1 - MBS GmbH - Standard Project

FileEditData transferWindowViewDiagnosticsElsner weather stationHelp

Elsner weather station

Network

Notes

Properties

• ○ ○ ○ ○

Weather station identification

Device selection

Device ID	Name	Description	MAC address	Model name	Firmware rev.
50	Suntracer Pro BAC	Light and Building 2026	32 => 50	30310 Suntracer B.	Base: 0.1.1; B

BACeye/SC

Data points

- Highly specific data points/values and their processing (azimuth/elevation...) already take place in the weather station

BACeye/SC. Professional device control 3.1.1.1 - MBS GmbH - Standard Project
File Edit Data transfer Window View Diagnostics Elsner weather station Help

← ○○○○ → BACnet server

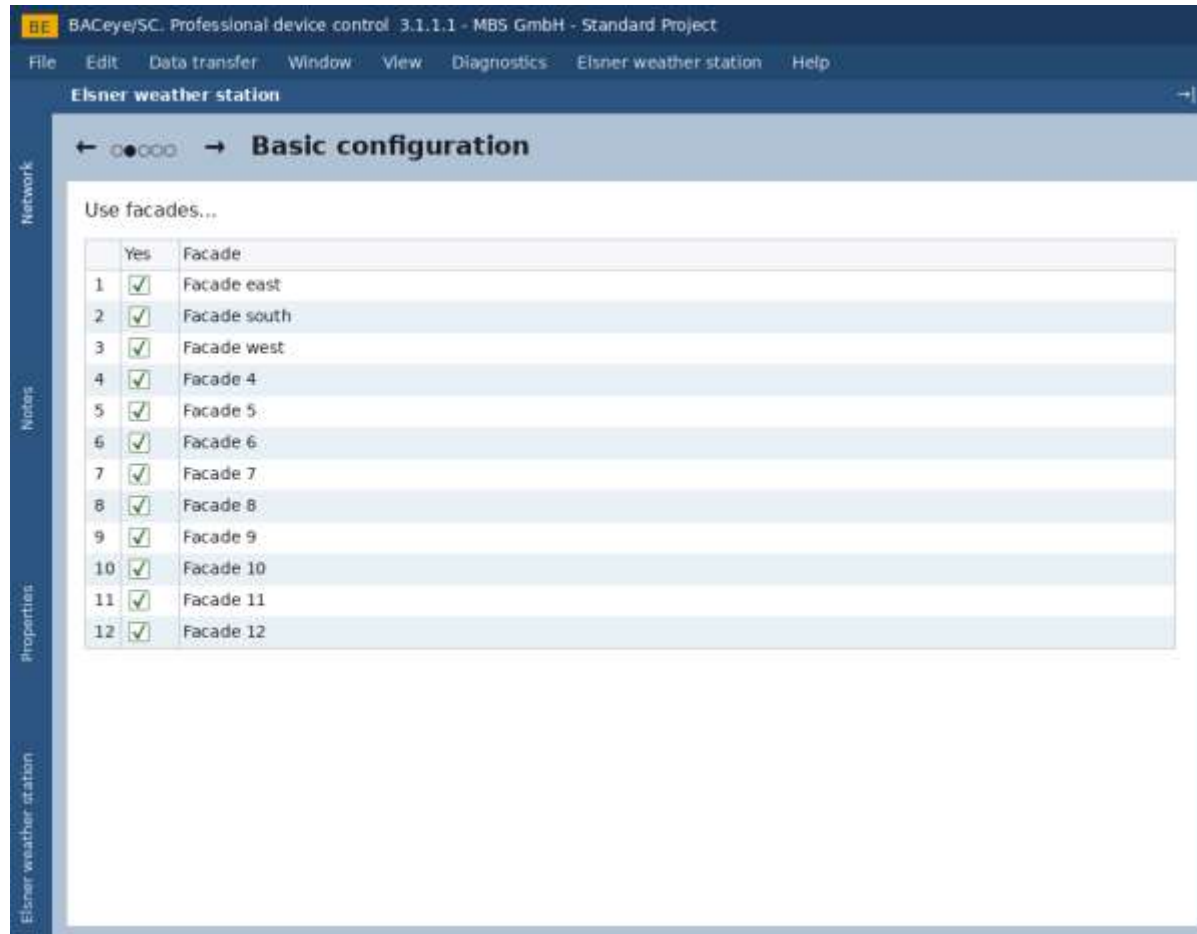
Objects
Search ▼ Filter 106 / 106

Active	Parameter	Obj. type	Inst. no.	Object name
☒		DEV	50	Name BACnet Suntracer Pro
☒		FIL	10	File object firmware
☒		MV	10	Firmware control
☒		MV	11	Firmware response
☐		NP	1	Object name NP1
☐		NC	1	Object name NC1
☐		NC	2	Object name NC2
☐		NC	3	Object name NC3
☐		NC	4	Object name NC4
☐		NC	5	Object name NC5
☐		NC	6	Object name NC6
☐		NC	7	Object name NC7
☐		NC	8	Object name NC8
☐		NC	9	Object name NC9
☐		NC	10	Object name NC10
☒		FIL	20	File object configuration
☒		MV	20	Configuration control
☒		MV	21	Configuration response
☒		FIL	30	File object persistence data
☒		MV	30	Persistence data control
☒		MV	31	Persistence data response
☒	Outside temperature weather stat	AI	1	Temperature
☒	Wind speed weather stat	AI	2	Wind speed
☒	Wind direction weather station	AI	3	Wind direction
☒	Humidity weather station	AI	4	Relative humidity
☒	Brightness weather station	AI	5	Light intensity
☒	Air pressure weather station	AI	6	Air pressure
☒	Central rain alarm	BI	1	Rain warning
☒	Sun elevation	AV	1	Sun position elevation
☒	Sun azimuth	AV	2	Sun position direction
☒		IV	1	First position coordinate
☒		IV	2	Second position coordinate
☒		IV	3	Third position coordinate
☒		IV	4	Fourth position coordinate
☒		BV	100	Rain warning for facade #1
☒		BV	101	Wind warning for facade #1
☒		AV	100	Current position for facade #1
☒		AV	101	Current slat position for facade #1
☒		SV	100	All objects for facade #1
☒		SV	101	All external objects for facade 1
☒		BV	200	Rain warning for facade #2
☒		BV	201	Wind warning for facade #2
☒		AV	200	Current position for facade #2
☒		AV	201	Current slat position for facade 2

Time values
Passwords
MSTP

BACeye/SC

| Façade plug-in



BACeye/SC

| Façade settings

BACeye/SC. Professional device control 3.1.1.1 - MBS GmbH - Standard Project

File Edit Data transfer Window View Diagnostics Elsner weather station Help

Elsner weather station

← ○○○●○ → **BACnet client**

Network

Facades

Name

Facade east

Facade south

Facade west

Facade 4

Facade 5

Facade 6

Facade 7

Facade 8

Facade 9

Facade 10

Facade 11

Facade 12

Notes

Properties

Elsner weather station

Facade

Name: Facade east

▲ **Wind alarm**

+ -

Device ID	Obj. type	Obj. inst.	Property	Array index	Priority
50	Binary value	101	EventDetectionEn	-	-

▲ **Rain alarm**

+ -

Device ID	Obj. type	Obj. inst.	Property	Array index	Priority
50	Binary input	1	EventDetectionEn	-	-

▲ **Position**

+ -

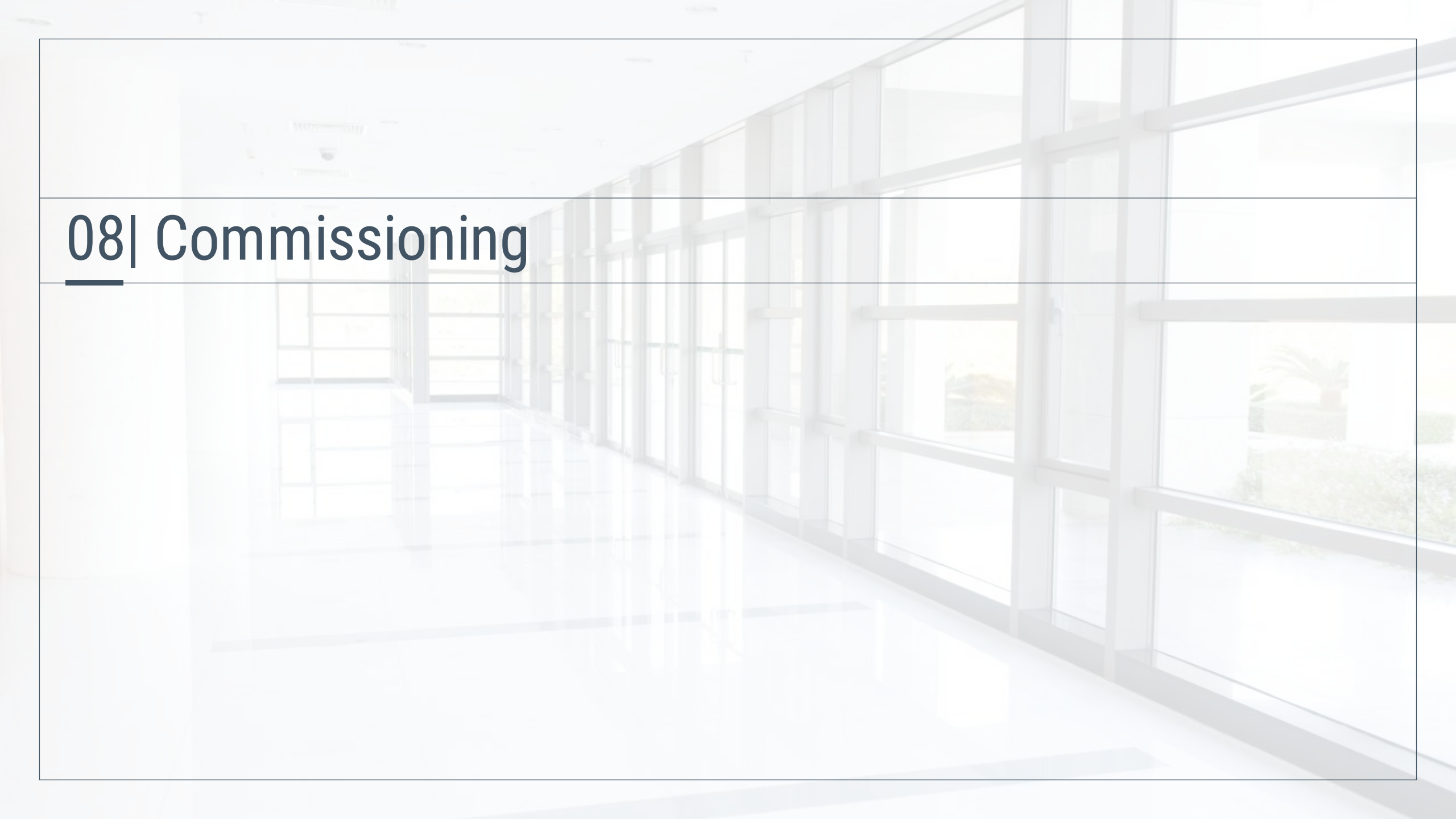
Device ID	Obj. type	Obj. inst.	Property	Array index	Priority
50	Analog value	100	PresentValue	-	-

▲ **Slat angle**

+ -

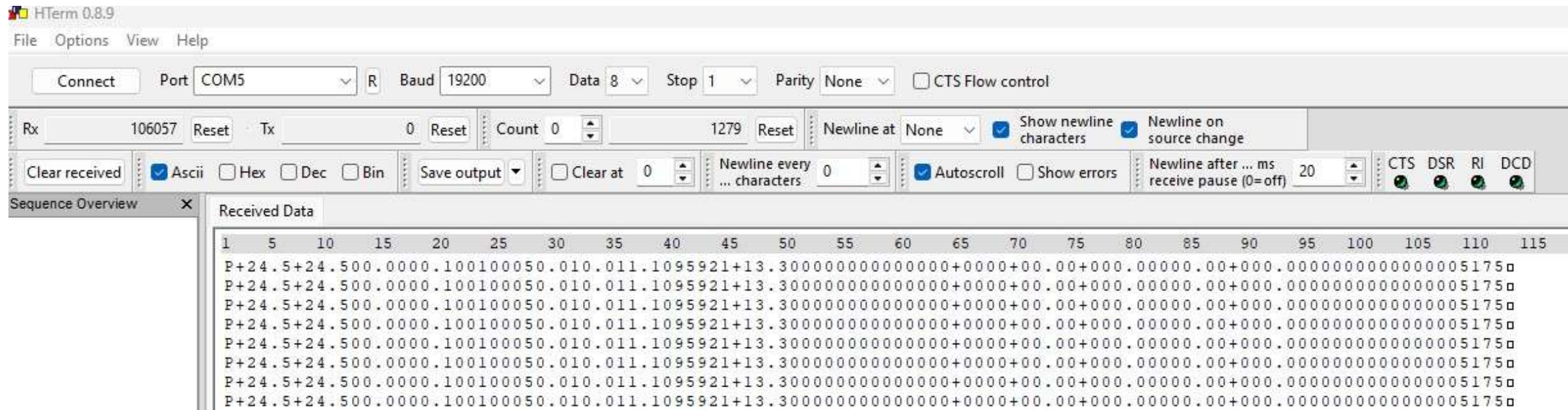
Device ID	Obj. type	Obj. inst.	Property	Array index	Priority
50	Analog value	101	PresentValue	-	-

08| Commissioning

A photograph of a modern office hallway with large windows and a reflective floor. The hallway is empty, and the windows look out onto a bright, sunny day. The floor is highly reflective, showing the windows and the sky. The walls are white, and the ceiling has recessed lighting. The overall atmosphere is clean, bright, and professional.

RS-485 data string

| Evaluation



RS485-Register

Overview

- Technical data sheet/reference table
- Encoding of temperature, wind, rain, humidity
- String format with fixed byte assignment (0-37)

Byte No	Char	Description
0	p = 80	Start of string
1	+ / -	Outdoor temperature in °C, sign
2	0 ... 9	Outdoor temperature in °C, tens digit
3	0 ... 9	Outdoor temperature in °C, units digit
4	.	Outdoor temperature in °C, decimal point
5	0 ... 9	Outdoor temperature in °C, tenths digit
6	+ / -	Felt temperature in °C, sign
7	0 ... 9	Felt temperature in °C, tens digit
8	0 ... 9	Felt temperature in °C, units digit
9	.	Felt temperature in °C, decimal point
10	0 ... 9	Felt temperature in °C, tenths digit
11	0 ... 3	Wind in m/s, tens digit
12	0 ... 9	Wind in m/s, units digit
13	.	Wind in m/s, decimal point
14	0 ... 9	Wind in m/s, tenths digit
15	0 ... 1	Wind in km/h, hundreds digit
16	0 ... 9	Wind in km/h, tens digit
17	0 ... 9	Wind in km/h, units digit
18	.	Wind in km/h, decimal point
19	0 ... 9	Wind in km/h, tenths digit
20	0 ... 1	Beaufort, tens digit
21	0 ... 9	Beaufort, units digit
22	0 ... 3	Wind angle, hundreds digit
23	0 ... 9	Wind angle, tens digit
24	0 ... 9	Wind angle, units digit
25	0 ... 1	Rain
26	0 ... 9	Air humidity in % rH, tens digit
27	0 ... 9	Air humidity in % rF, units digit
28	.	Air humidity in % rF, decimal point
29	0 ... 9	Air humidity in % rF, tenths digit
30	0 ... 9	Air humidity in g/kg, tens digit
31	0 ... 9	Air humidity in g/kg, units digit
32	.	Air humidity in g/kg, decimal point
33	0 ... 9	Air humidity in g/kg, tenths digit
34	0 ... 9	Air humidity in g/m³, tens digit
35	0 ... 9	Air humidity in g/m³, units digit
36	.	Air humidity in g/m³, decimal point
37	0 ... 9	Air humidity in g/m³, tenths digit

RS485-Register

| Example



Byte No	Char	Description
0	p = 80	Start of string
1	+ / -	Outdoor temperature in °C, sign
2	0 ... 9	Outdoor temperature in °C, tens digit
3	0 ... 9	Outdoor temperature in °C, units digit
4	.	Outdoor temperature in °C, decimal point
5	0 ... 9	Outdoor temperature in °C, tenths digit
6	+ / -	Felt temperature in °C, sign
7	0 ... 9	Felt temperature in °C, tens digit
8	0 ... 9	Felt temperature in °C, units digit
9	.	Felt temperature in °C, decimal point
10	0 ... 9	Felt temperature in °C, tenths digit

p +23.5 +22.4

Modbus communication

| Required settings in the slave

- Transfer rate
- Parity
- Termination
- Address

Fig. 13

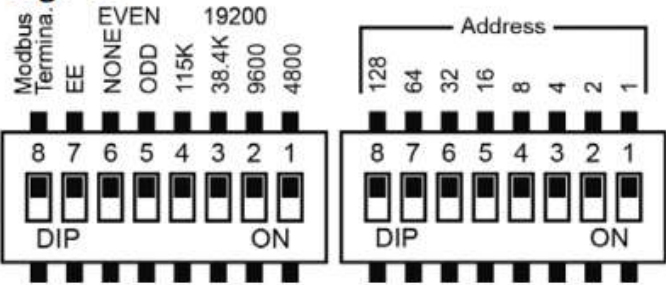


Fig. 14 Baud rate

115K	38.4K	9600	4800	baud
OFF	OFF	OFF	OFF	19200
ON	OFF	OFF	OFF	115000
OFF	ON	OFF	OFF	38400
OFF	OFF	ON	OFF	9600
OFF	OFF	OFF	ON	4800

Fig. 15 Parity

7 NONE	6 ODD	Parity
OFF	OFF	EVEN
ON	OFF	NONE
OFF	ON	ODD

Modbus-Register

| Example eTR101 MB



Byte no.	Variable		Explanation
0	Server address	xx	
1	Command	04H	Read input registers
2	Start address high byte	xx	Register start address
3	Start address low byte	xx	
4	Word count high byte	xx	Number of registers to be read
5	Word count low byte	xx	
6	CRC low byte	xx	
7	CRC high byte	xx	

Sample query string for reading all data for server address 1:

01H, 04H, 00H, 00H, 00H, 0DH, 31H, CFH

Modbus communication

| eTR Modbus



QModMaster

File Options Commands View Help

Modbus Mode

RTU

Slave Addr

1

Scan Rate (ms)

1000

Function Code

Read Input Registers (0x04)

Start Address

1

Dec

Number of Registers

12

Data Format

Dec

Signed

☐

266	0	0	80	1	1	10	1	1	30
30	20	x	x	x	x	x	x	x	x

Modbus-Register

Overview

4.1. Function 04H read input registers

Query from client

Byte no.	Variable		Explanation
0	Server address	xx	
1	Command	04H	Read input registers
2	Start address high byte	xx	Register start address
3	Start address low byte	xx	
4	Word count high byte	xx	Number of registers to be read
5	Word count low byte	xx	
6	CRC low byte	xx	
7	CRC high byte	xx	

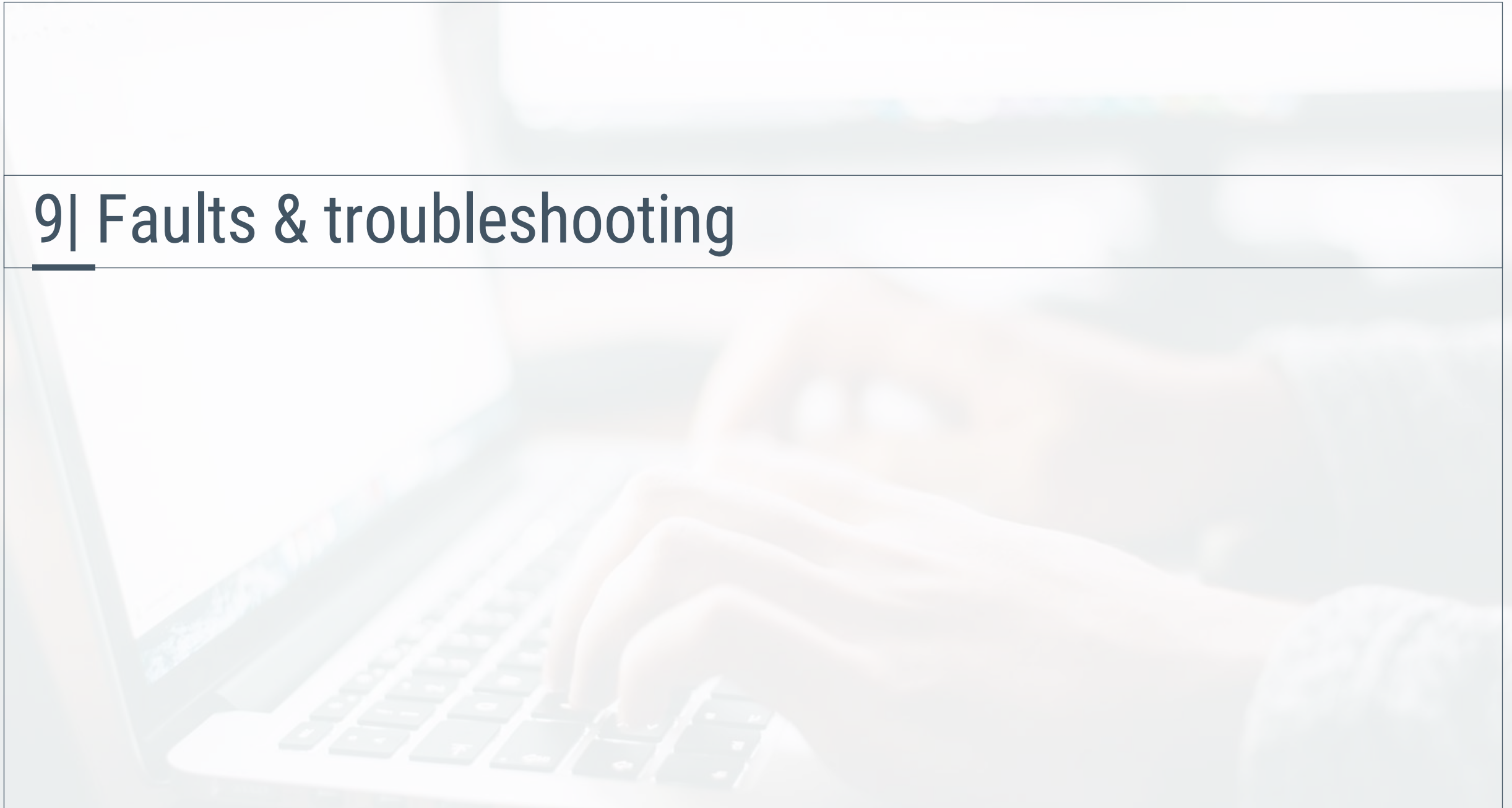
Sample query string for reading all data for server address 1:
01H, 04H, 00H, 00H, 00H, 0DH, 31H, CFH

Response from server

Before the first measurement, and if there is a defective sensor, register 0 (temp. sensor measurement value) is "-32768".

Byte no.	Register Address	Variable		Explanation
0		Server address	xx	
1		Command	04H	Read input register
2		Number of bytes	xx	
3	0	Actual temperature high byte	xx	
4		Actual temperature low byte	xx	
5	1	Sensor Fault high byte	xx	
6		Sensor Fault low byte	xx	
7	2	Actual temperature offset high byte	xx	
8		Actual temperature offset low byte	xx	
9	3	LED brightness % high byte	xx	
10		LED brightness % low byte	xx	
11	4	LED On Off high byte	xx	
12		LED On Off low byte	xx	
13	5	LED Auto Off Activation high byte	xx	
14		LED Auto Off Activation low byte	xx	
15	6	LED Auto Off Time high byte	xx	
16		LED Auto Off Time low byte	xx	
17	7	LED display high byte	xx	
18		LED display low byte	xx	
19	8	Substations Type high byte	xx	
20		Substations Type low byte	xx	
21	9a	Basic setpoint shift PLUS Max high byte	xx	
22		Basic setpoint shift PLUS Max low byte	xx	
23	10a	Basic setpoint shift MINUS Max high byte	xx	
24		Basic setpoint shift MINUS Max low byte	xx	
25	11a	Basic setpoint shift high byte	xx	
26		Basic setpoint shift low byte	xx	
27	12a	Basic setpoint shift step high byte	xx	
28		Basic setpoint shift step low byte	xx	
21	9b	Target value max high byte	xx	
22		Target value max low byte	xx	
23	10b	Target value min high byte	xx	
24		Target value min low byte	xx	
25	11b	Target value high byte	xx	
26		Target value low byte	xx	
27	12b	Target value step high byte	xx	
28		Target value step low byte	xx	
29		CRC low byte	xx	
30		CRC high byte	xx	

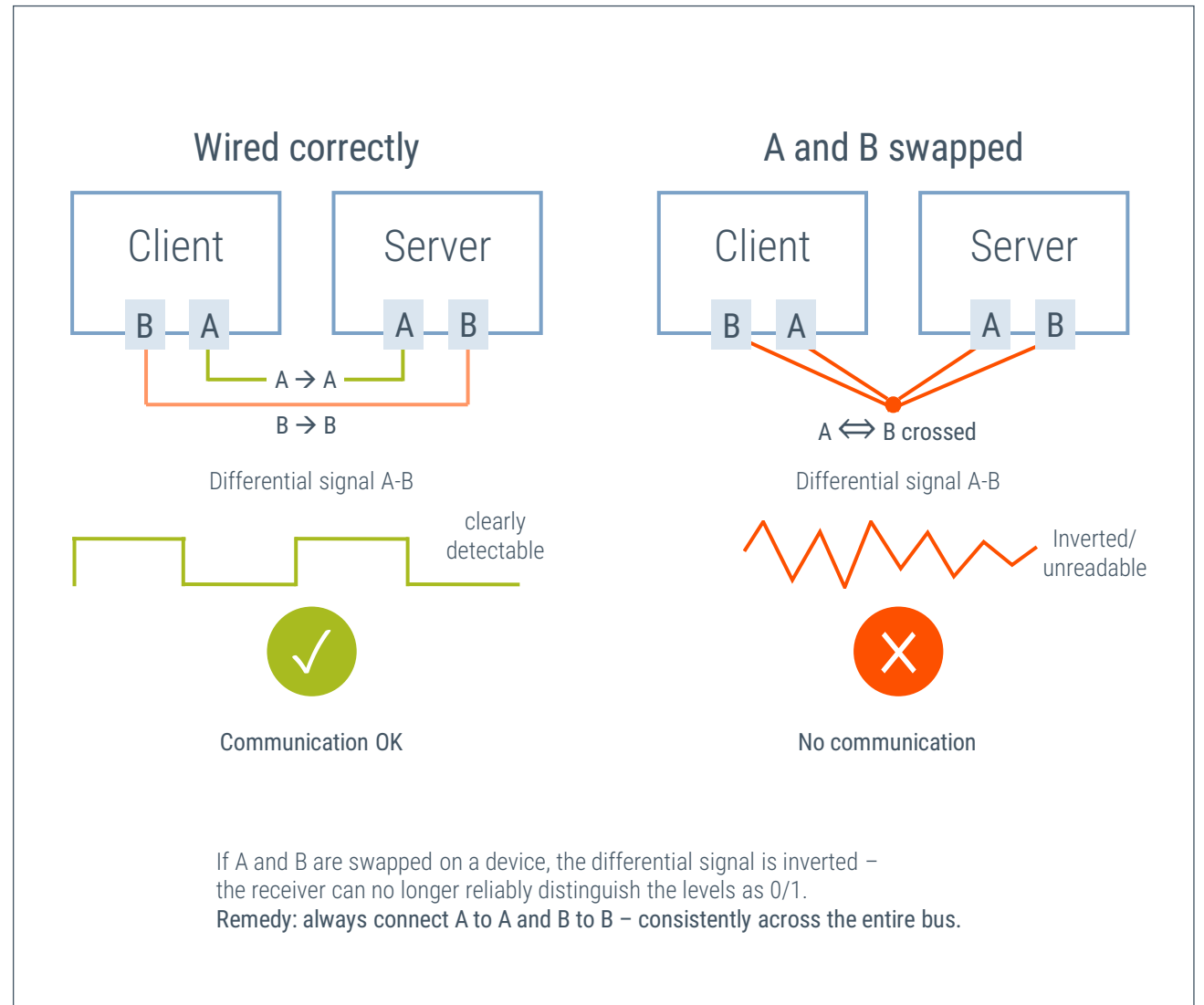
9| Faults & troubleshooting



Faults

| No bus communication

- Check the communication LED (Modbus only)
- Check whether A & B are swapped
- Is voltage applied correctly?
- Check the baud rate

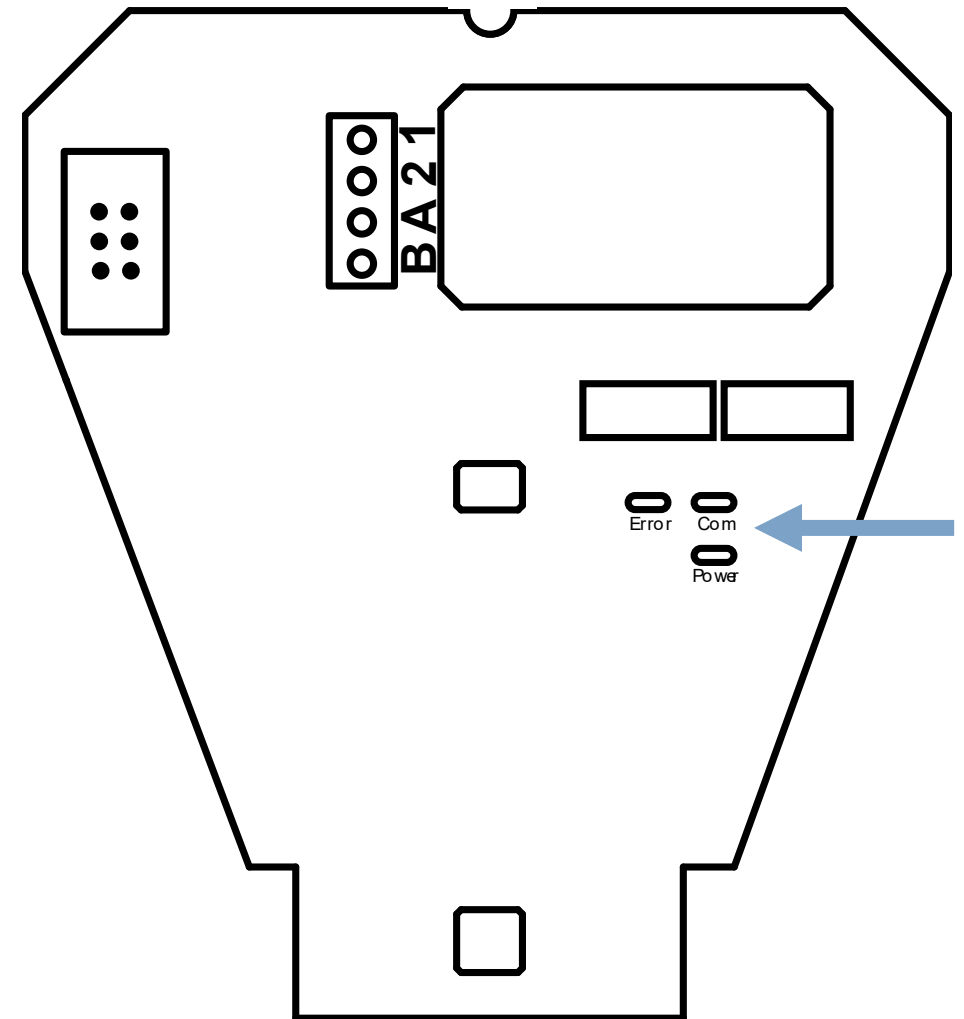


Faults

| Diagnostic tips for Modbus

Status-LEDs

- "Power": supply voltage
- "Error": sensor fault or faulty data
- "Com": bus communication



Elsner Diagnostic Tool

Overview

WetterstationCOM

Datei Einstellungen Hilfe

Wetterstation: P03/3-RS485 basic Verbinden

☒ Ascii ☐ Hex ☐ Dez

Licht

Sonne (kLux)

Ost

Süd

West

Dämmerung

Tageslicht (in Lux)

Zeit

Datum

Uhrzeit

Wochentag

Sommerzeit

Tagesminuten

Tage seit 2000

Klima

Außentemperatur

Wind (in m/s)

Regen

GPS

Azimuth (in Grad)

Elevation (in Grad)

Länge (in Grad)

Breite (in Grad)

GPS-Status

elsner
elektronik

☒ Ascii ☐ Hex ☐ Dez

Sende-Frame Senden

☐ Automatisch senden

Nach 1 Sekunden senden

Löschen

Port: COM3 Baud: 19200 Data: 8 Parity: None Stop: One

Overview of applications

| Common areas of application



Modbus

- PV systems
- Heat pumps
- PLC controls
- Room sensors

RS485

RS485

- PLC controls
- Data loggers



BACnet

- BMS
- HVAC
- Server applications

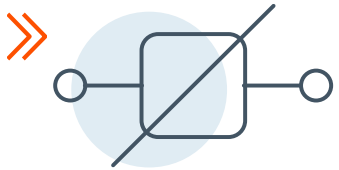


KNX

- Room sensors
- Lighting control
- HVAC
- Remote access

Benefits

| Advantages at a Glance



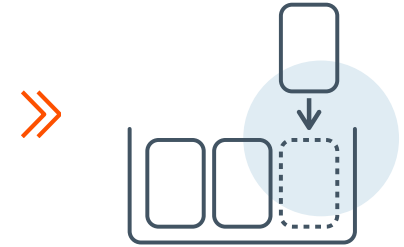
No separate gateway required



Less administrative work for hardware and software



Cost savings for the operator



Flexible retrofitting options for existing installations



| Get your
web shop
discount
now!



for all items in the
RS485, Modbus and
BACnet categories.

5% discount with code
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Frederik Riedel

f.riedel@elsner-elektronik.de

Martin Speer

m.speer@elsner-elektronik.de



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