IV PRODUKT

Air handling with focus on LCC
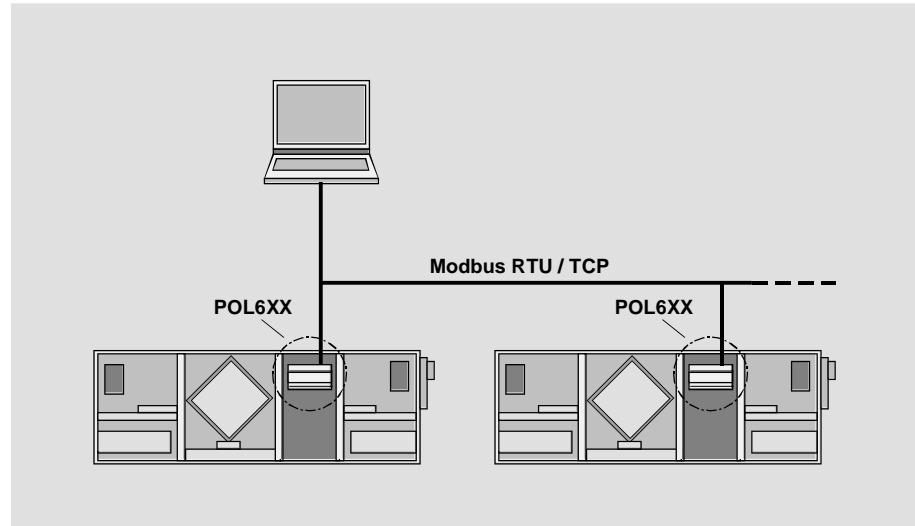
Climatix™
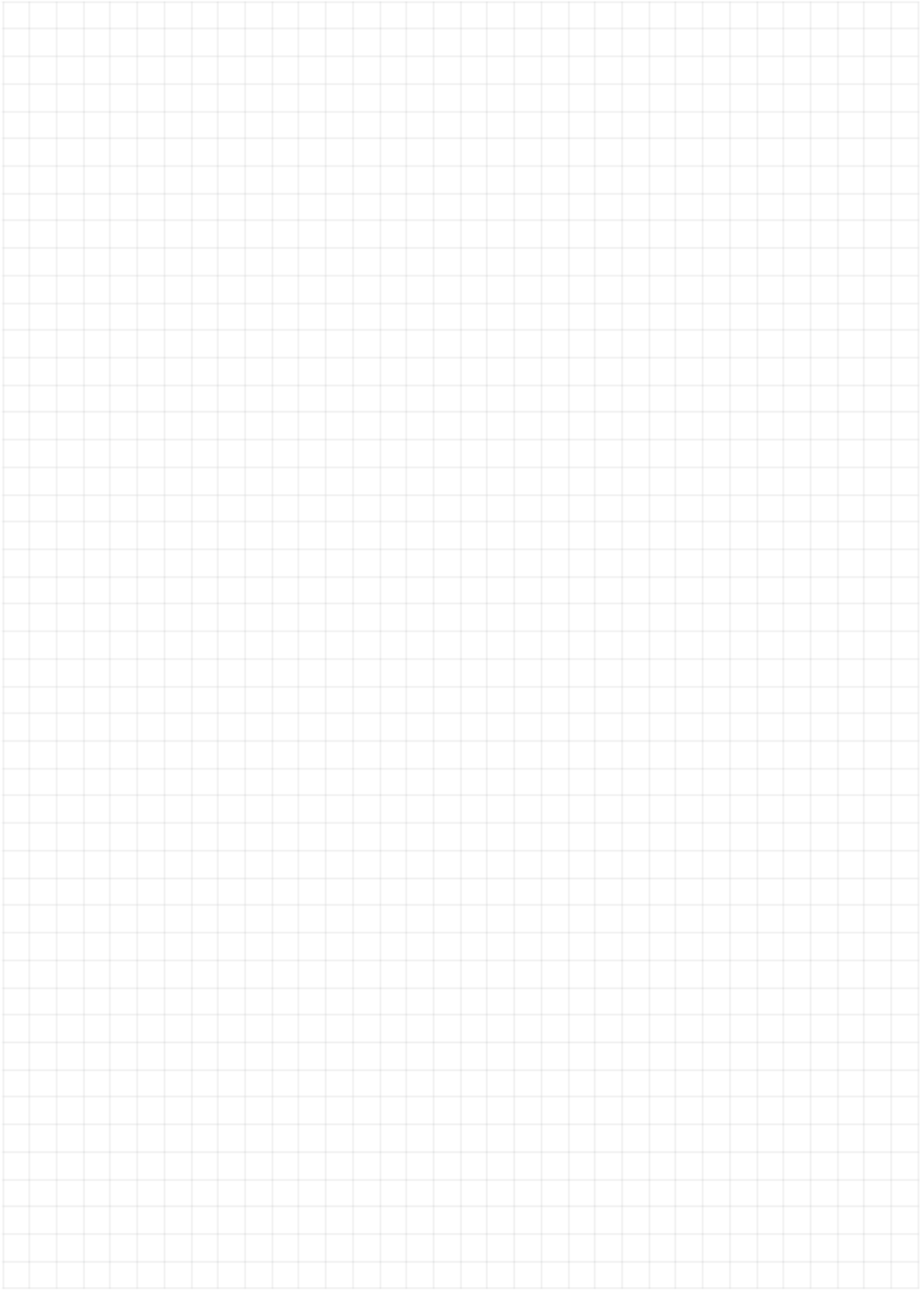
Modbus communication, slave mode

Integration guide

Table of contents

Modbus/IP Communication with POL902.00

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1 About this document

1.1 Revision history

Date	Changes	Section
2023-06-07	New integration guide for Modbus	all
2024-04-17	Minor enhancements	

1.2 Before you start

Validity

The documentation applies to the products with one or more Modbus interfaces (A+, B-, REF) respectively with an internal Modbus TCP interface.

Target audience

This document is intended for the following audience:

- Modbus system integrators
- Measuring and control engineering staff
- Sales and commissioning staff

Requirements

The above target audience:

- Has general professional knowledge on planning and commissioning measuring and control solutions.
- Has basic knowledge of Modbus.
- Has the additional reference address documentation for the specific product.

1.3 Further documentation

Further information

The following documents contain additional information on the products described in this manual

Document
Modbus communication module, product datasheet
Climatix Modbus communication, Reference addresses AHU
Modbus addresses for AHU in general, examples
Basic documentation "Climatix AHU"
Basic documentation, "Climatix Basic Document"
Modbus communication, Reference addresses EcoHeater
Reference Modbus addresses EHP
Modbus addresses for EcoHeater in general, examples

1.4 Document conventions

Symbols used

Below is an overview of all symbols used in this document denoting risks or important information.

This symbol draws your attention to special safety notes and warnings.
Failing to observe these notes may results in injury and/or serious damages.

Notes with this symbol provides important information that requires appropriate attention.

The following abbreviations are used in text and illustrations:

Addreviations

Abbreviation	Meaning
BSP	**B**oard **S**upport **P**ackage (operating system)
Climatix	Siemens controller range with common tools
Gateway	A device for transfer data between different kind of networks
HVAC	**H**eating **V**entilation **AC**
HMI	**H**uman **M**achine **I**nterface, e.g Operator unit
RTU	**R**emote **T**erminal **U**nit
SELV	**S**afety **E**xtra **L**ow **V**oltage
TCP/IP	**T**ransmission **C**ontrol **P**rotocol, e.g. Ethernet/Internet

1.5 Important information on electrical installation

⚠	**⚠ CAUTION**
	Electrical shock
	• Fuses, switches, wiring and grounding must comply with local safety regulations for electrical installations.
	• When wiring, strictly separate AC 230 V mains voltage from AC 24 V safety extra-low voltage (SELV) to protect against electrical shock.
	• Only qualified staff trained accordingly may prepare for use, commission, and maintain Modbus communication modules.
	• Only authorized staff may diagnose and correct faults and recommission the plant. This applies to working within the panel as well.

1.6 Trademarks and copyrights

Trademarks, legal owners

The table below lists the third-party trademarks used in this document and their legal owners. The use of trademarks is subject to international and domestic provisions of the law.

Trademarks	Legal owner
Modbus®	The Modbus Organization, Hopkinton, MA, USA

All product names listed in the table are registered (®) or not registered (™) trademarks of the owner listed in the table. We forgo the labeling (e.g. using the symbols ® and ™) of trademarks for the purposes of legibility based on the reference in this section.

Copyright

This document may be duplicated and distributed only with the express permission of Siemens, and may be passed on only to authorized persons or companies with the required technical knowledge.

1.7 Quality assurance

Document contents

These documents were prepared with great care.
- The contents of all documents are checked at regular intervals.
- All necessary corrections are included in subsequent versions.
- Documents are automatically amended as a consequence of modifications and corrections to the products described.

Please make sure that you are aware of the latest document revision date.

1.8 Document use/request to the reader

Request to the reader

Before using our products, it is important that you read the documents supplied with or ordered at the same time as the products (equipment, applications, tools etc.) carefully and in full.

We assume that persons using our products and documents are authorized and properly trained and have the requisite technical knowledge to use our products as intended.

Exemption from liability

IV Produkt assumes no liability to the extent allowed under the law for any losses resulting from a failure to comply with the aforementioned points or for the improper compliance of the same.
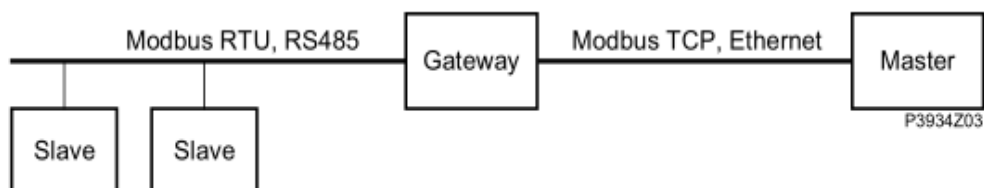
2 Modbus overview

2.1 Modbus protocol

Modbus, General information

This section provides a brief overview of the Modbus protocol.

For the full specification, see "Modicon Modbus Protocol Reference Guide PI MBUS 300 Rev. J".

Master/slave protocol

The Modbus is a master/slave protocol. This, by definition, means that a Modbus network contains only one master and at least one slave.

Transactions on Modbus

The Modbus master uses a slave query to start transmitting data on the network. The slave either responds positively with the requested service (response) or transmits an "exception message".

Function codes

The type of transaction is defined by the function code transmitted in the Modbus telegrams.

A function code defines the following:

- Structure of the telegram, query and response.
- Direction of data transmission (master → slave or slave → master).
- Data format of data point.

Transmission modes

The Modbus protocol defines two alternative serial transmission modes, via RS485: These modes have the following characteristics:

RTU (Remote Terminal Unit) mode (Supported by Climatix)

- Binary-coded data.
- The individual telegrams are marked by send pauses ("silent intervals").
- CRC (cyclical redundancy check) identify data faults.

ASCII mode (Not supported by Climatix)

- Hexadecimal data as ASCII code.
- Beginning and end of telegrams marked by start and end characters.
- LRC (longitudinal redundancy check) identifies data faults.

Telegrams with multiple data points

Certain types of Modbus transactions allow for transmission of a variable number of Modbus data points in a single telegram.

Modbus TCP Ethernet

The Climatix C600 controllers supports also Modbus TCP via the internal TCP/IP port onboard. A Modbus TCP/RTU gateway can also be used to connect a Modbus/TCP master to one or several Climatix controllers (slaves):

648 uses T14(RS485) for internal Modbus(slave) while T6(RS485) is for external Modbus(master).

638 uses T9(RS485) for internal modbus and then you will need POL 902.00 Modbus module for TCP(master). If its older then ~2014 you can use T9(RS485) for TCP(master).

The Modbus TCP/RTU gateway acts as a Modbus/TCP slave on an Ethernet network and transforms the queries to the serial Modbus network and back.

For more information on Modbus: See www.modbus.org

Modbus/IP Communication with POL902.00

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2.2 RS485 bus standard

RS485 definition

RS485 is a balanced line, half-duplex transmission system that meets the requirements for a truly multi-point communications network. The standard specifies up to 32 drivers and 32 receivers on a single (3-wire) bus.

Half-duplex data transmission means that data can be transmitted in both directions on a signal carrier, but not at the same time.
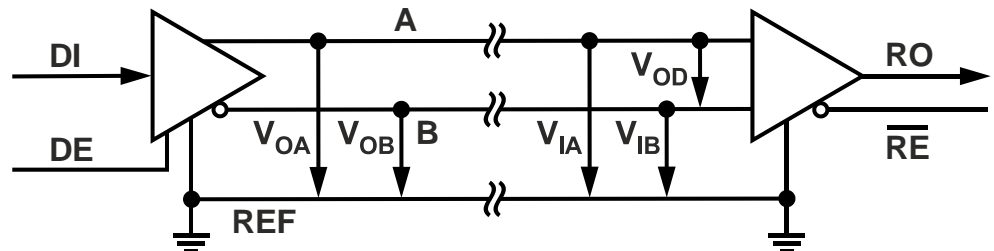
| DI | data input | RO | receiver output |
| DE | data enable | RE | receiver enable |

- The RS485 uses differential data transmission.
- And therefore has two differential lines (A+ and B-).
- Both lines (A+ and B-) are referred to REF.
- Normal voltage level of lines (A+ and B-) to REF is 5V.
- Maximum receiver input voltage (VIA, VIB) is limited to -7V….+12V.

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i

For communication between all devices a reliable reference is required on the RS485 bus.

More than 32 devices on one RS485 trunk

This is possible using a repeater. A repeater is not always necessary, however:
- Although based on just 32 full load devices, most RS485 chips now require less than the specified unit load since initial development.
- Today, some devices on the market require only half or a quarter of the load units.

Refer to the associated data sheets and count the required load to determine how many devices you can install. This data is located in "UL" ("Unit Load").

Isolated RS485 interface

Some RS485 interfaces are isolated from system ground.

For example the controller POL6x8 and the communication modules POL902 have an isolated RS485 interface.

This isolation is more expensive but has the following advantages:
- Greater EMC immunity
- Increased robustness against potential differences between the device nodes
- No risk of equalizing current on the REF line

Non-isolated RS485 interface

Some RS485 interfaces are not isolated from system ground.

For example one of the interfaces of the controller POL6x8 have a non-isolated RS485 interfaces.

This is less expensive but the following restrictions to panel design must be considered:

- Maintain the REF potential differences between all bus devices within ±5V
- Avoid higher equalizing current on REF line (risk of burning cable
- Avoid current loops

Recommendation Use non-isolated RS485 interfaces only on local devices in close proximity to the machine. Always use isolated interface on longer distances outside the machine.

Product name	Interface	Modbus protocol	Unit load	Isolated RS485 common
Controllers				
POL64x	Interface:1	Master (or Slave)	1	no
	Interface:2	Slave (or Master)	1	yes
POL63x	Interface:1	Master (or Slave)	0.25 (1/4)	no
Communication module				
POL902	Interface:1	Slave	1	Yes
	Interface:2	Slave	1	Yes

Topology An RS485-MODBUS configuration without repeater has one trunk cable, along which devices are connected, either directly (daisy chaining) or by short derivation cables.

2.3 TCP/IP networks

Modbus IP port

The onboard IP port is used as the Modbus IP port. Furthermore, the WEB@HMI (web browser) and other clients can be used for simultaneous remote service.

IP address

The IP address is assigned either dynamically via the DHCP server or set manually via HMI. A fixed IP address is normally used.

Modbus TCP port

Modbus TCP in Climatix uses TCP port 502 but can normally be changed.

2.4 Tools

Modbus master simulation tools

Modbus slave devices, e.g. Climatix controllers, can be tested with several Modbus master simulation tools, such as "Modbus Poll" or "Modicon". "Modbus Poll" can be downloaded at www.modbustools.com.

A RS485/RS232 converter or a Modbus RTU/TCP gateway may be required to connect to a computer.

3 Installation RS485 / Modbus networks

3.1 RS485, cable installation

Background

Task of the third wire

The Climatix Modbus network interface is a 3-wire RS-485 interface with a common reference (REF) signal to improve noise immunity and ensure high data security.

Naming

The name of the third wire on a 3-wire network interface varies by manufacturer (for example: Common, Ground, Com. SC (Signal Common), R (for Reference), GND, SG (Signal Ground) or REF (e.g. in Climatix)).

Function

This connection is for a common reference signal. Voltage on lines Tx/Rx (or +/-) is measured relative to the voltage level on the reference signal.

Grounding the REF terminal

- Connect the "REF" (common signal) to the protective ground, at only **one** point on the bus. Generally this point is on the master device or its connection.
- Test the wire with a DMM before connecting the "REF" (common signal) to the protective ground (this ensures that it is not already connected to the ground). Correct the fault condition if the wire is connected to protective ground before terminating the wire to the protective ground.
- You do not need to connect the "REF" (common signal) to the protective ground if it is already connected internally to a protective ground for a Modbus node.

Further tips

Risks due to missing third wire

Not using a third wire may:
- Destroy RS485 inputs.
- Result in unstable operation.
- Require a new installation.

The risks are greater:
- The higher the number of feeds to supply devices.
- The greater the physical separation.
- If fewer well grounded devices and feeds are used.

Screening not required   Screening is not required. The twisted cable for Tx and Rx suppresses interference more effectively than a screen.

!	**NOTICE**
	Wrong installation
	Do not use the shield as the "third wire"!

i	Shielding foil and drain wire provide additional noise protection.

Observe cabling   Observe the following when running the bus cable:

- Do not wind the bus cable around other cables or electric/magnetic sources (e.g. around a motor cable).
- Do not run the bus cable next to DC load switches (e.g. relay); the represent the main sources of induced interference.
- Caution around frequency-controlled actuators!
- Protect bus cable against unwanted movement (e.g. due to vibrations).

Cable length and baud rates   RS485 cable installation does not specify max cable length. It depends largely on transmission rates:

The greater the transmission rate, the shorter the possible cable length.

Rule of thumb for AWG cable:

Cable length [m] x data rate [bps] < 10^8

The following guide values result:

Baud rate	Cable length [m]
9,600	10,400
19,200	5,200
38,400	2,600

Additionally, note the following:

The higher the baud rate, the more important the cable installation quality. Issues such as twisted pair cable unfolded at each resistor gain importance.

Observe the following when running the bus cable

Cable type

Use a single twisted pair cable with third wire (1.5-pair) as the network cable on a 3-wire (isolated RS-485 common) connection; it keeps the RS-485 reference (communication common) together for all nodes on the network.
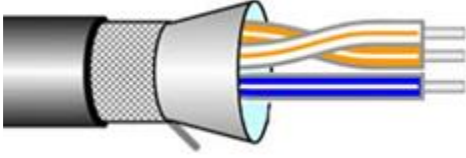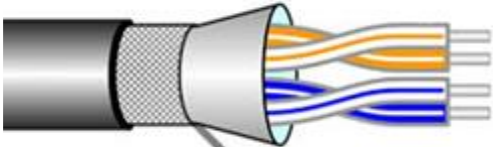
Impedance

Each cable has its own impedance. We recommend using cables with impedance that is relatively independent of length. Refer to the nominal impedance as a starting point:

- A cable is well suited if a number, e.g. 100 Ohm, is indicated.
- Do not use cables if impedance is indicated by meter/foot: The cables must be measured and calculated to determine the terminating resistance.
- • Select a cable with the lowest possible capacity.

Cat5 cables?

Cat5 cables are well suited: Use a twisted pair for Tx/Rx and a wire (1.5-pair) or the other pair (2-pair) for the reference signal (REF).

We recommend the following cables:

Manufacture/Type	Specification
Belden 3106A	Multi-Conductor - EIA Industrial RS-485 PLTC/CM • 22 AWG stranded (7×30) tinned copper conductors, • Datalene® insulation, • twisted pairs, • overall Beldfoil® shield (100% coverage) plus a tinned copper braid (90% coverage), • drain wire, • UV resistant PVC jacket.
Belden 3107A	Multi-Conductor - EIA Industrial RS-485 PLTC/CM • 22 AWG stranded (7×30) tinned copper conductors, • Datalene® insulation, • twisted pairs, • overall Beldfoil® shield (100% coverage) plus a tinned copper braid (90% coverage), • drain wire, • UV resistant PVC jacket.

Cable length and baud rates

The end-to-end length of the trunk cable (Bus) is limited. The maximum length is based on the baud rate, cable (Gauge, Capacitance or Characteristic Impedance), number of loads on the daisy chain, and network configuration.

Note the following:

- For a 9600 baud rate and AWG26 (or wider) gauge, the maximum length is 1000m.
- Stub lines must be short, never longer than 20m.
  For a multi-port tap with n stub lines, limit each stub length to 40 m divided by n to determine the maximum length.
- The higher the baud rate, the more sensitive the cable reacts to installation quality. Quality here refers, for example, to the number of twisted pairs that are wrapped around each connection.

3.2 Topologies

Introduction

The RS485 standard is simple and well-proven, but choosing the right topology is important. This starts with the selection of the topology.

Best: Individual line

The best topology is a single line (line topology), with the bus cable connected directly to the individual devices. This type of connection has the least problems.
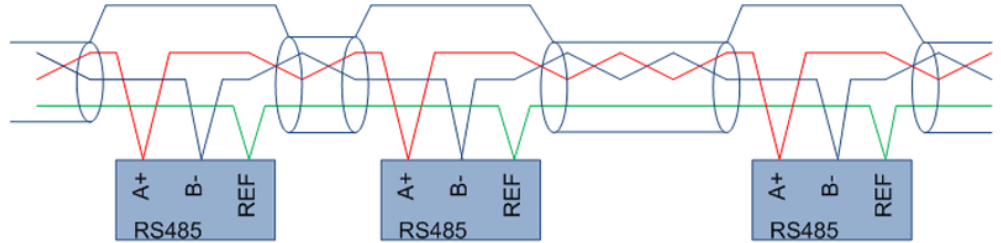
Disadvantages of intermediate terminals

Connecting network devices via intermediate terminals can result in reflections and harmonics of electrical signals. Long, untwisted intermediate lines increase the risk of interference.
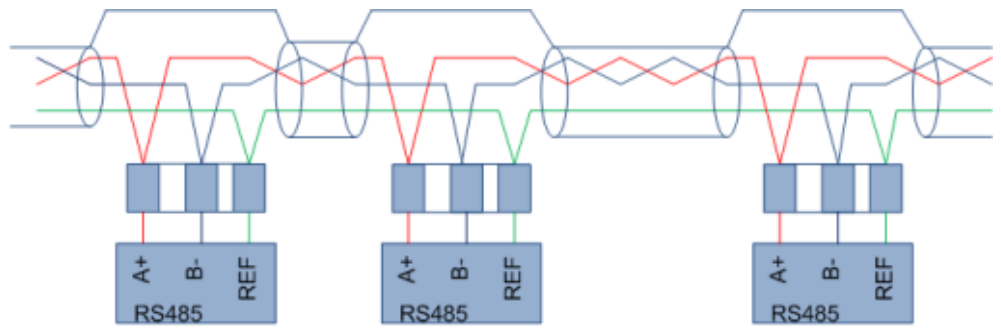
Error-prone: Star

Do not use star topologies!

They are prone to errors and troubleshooting is difficult to localize and correct.
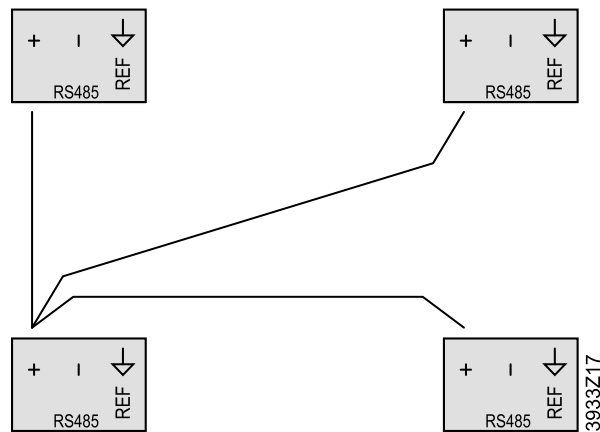
Note on figure: Only one line + (A+) is shown in this example.

3.3 Line termination/polarization

Line termination

Terminate each end of the line to minimize reflections from the end of the RS485-cable.

Polarization

Wires are not controlled if there is no data activity on an RS-485 bus and are therefore susceptible to external noise or interference.

Some devices require line polarization resistors (pull up/pull down) to bias the network to ensure the receiver stays in a constant state. The Modbus master normally does this, but should however only be activated by one device.

Climatix POL6x8 and POL902

The line termination can be switched on for the slave interfaces and polarization can be switched on for master interfaces. The termination must be set externally if the Climatix controller is at the end and at the same time is used as a Master.

Example for Climatix POL6x8 and POL902:
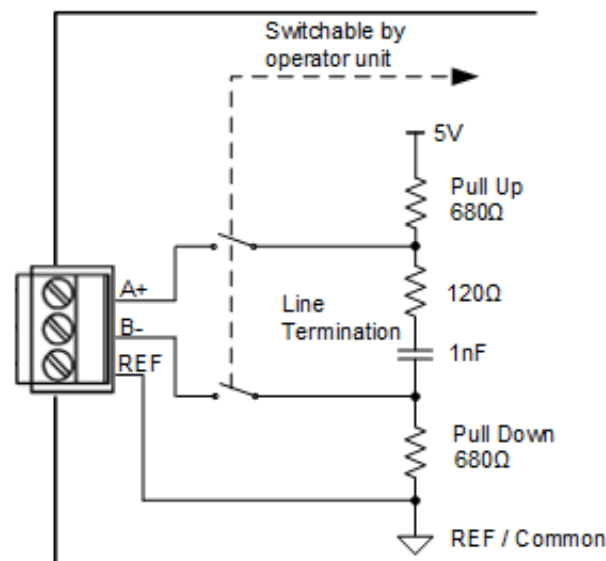
3.4 Wiring examples

Three isolated nodes
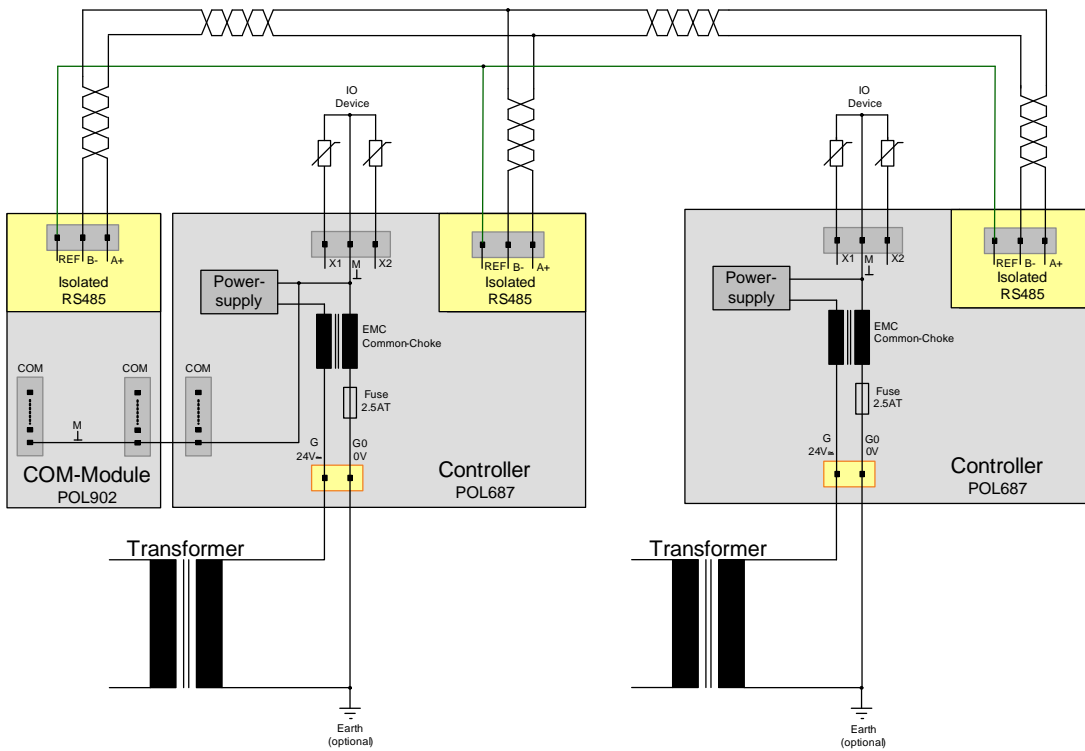
Wiring example: Two isolated nodes and one non-isolated node
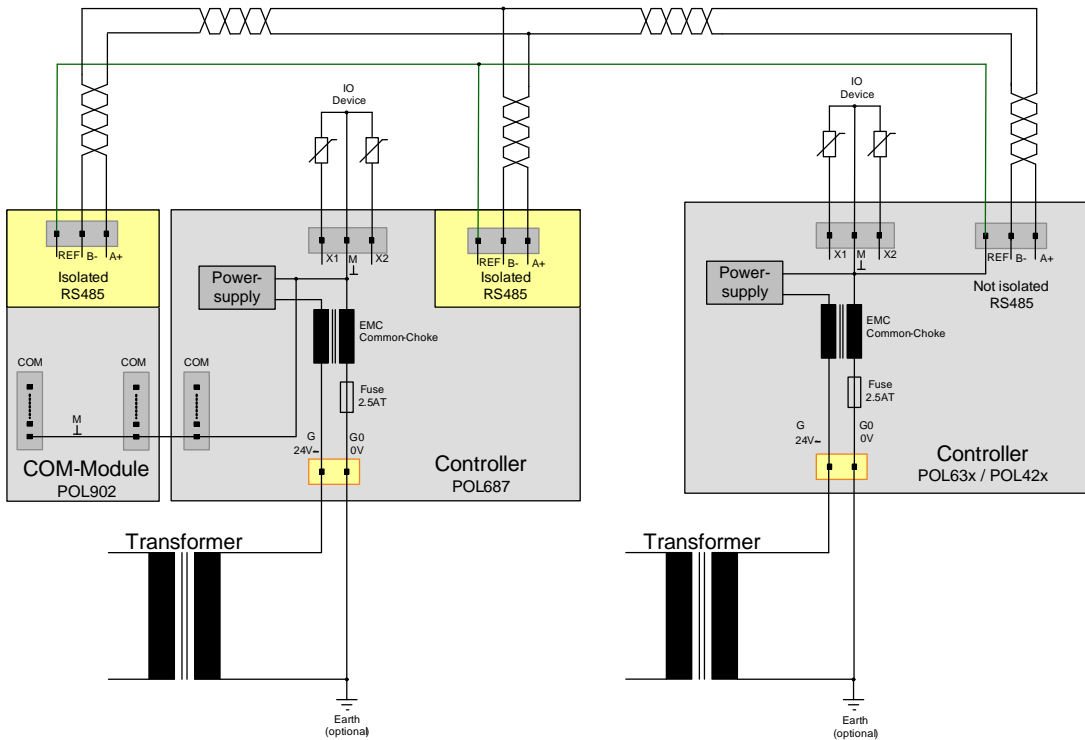
Note	Some restrictions must be considered (see next pages) if more than one non-isolated node is connected to the RS485 bus.

Modbus/IP Communication with POL902.00

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Two controllers with own isolated supply sources
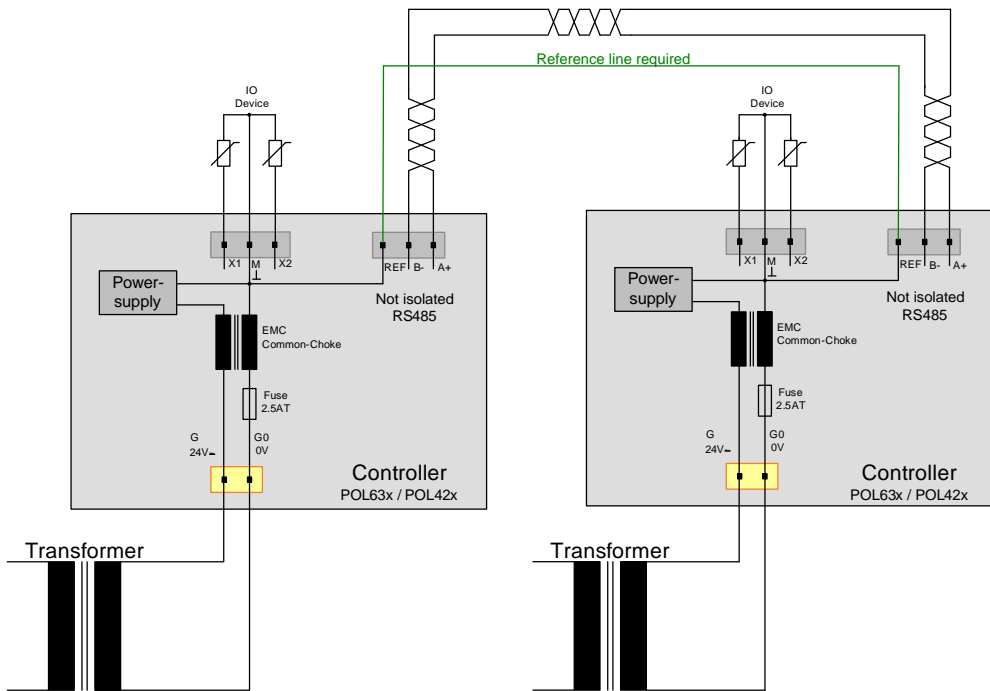
Use the REF line for proper operation of the RS485 bus if each RS485 node has a separate, isolated power supply.

Two controllers with same supply source
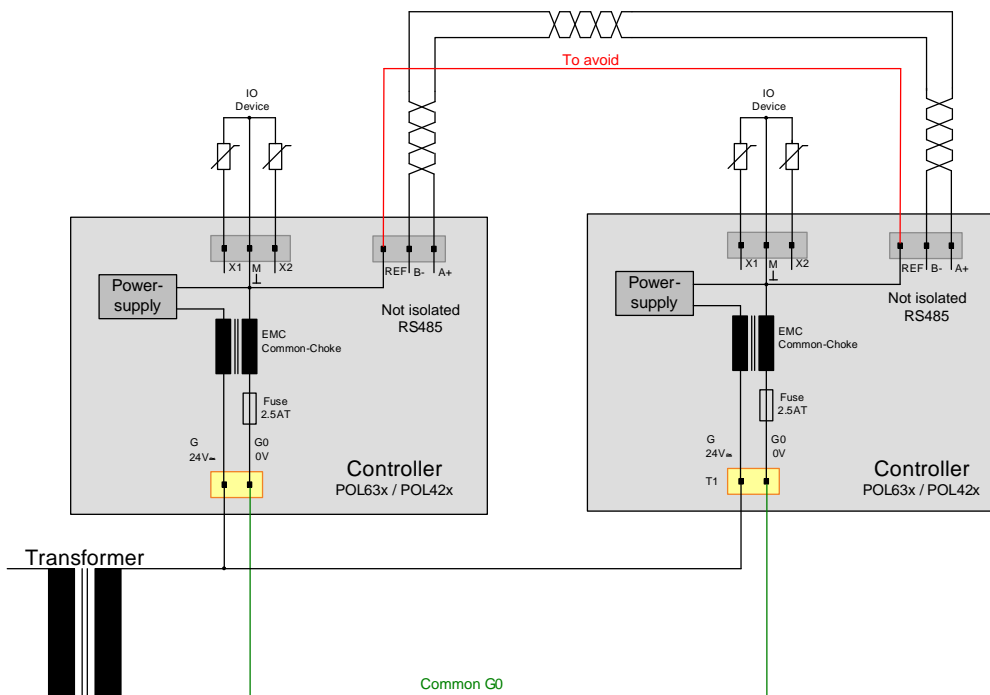
Both RS485-Interfaces can be referred using the common G0 connection.

In this case, you must disconnect the REF:

- to avoid bypassing the fuse
- to avoid high current on the REF line if G0 becomes disconnected

Two controllers with own supply source, and G0 is connected to ground
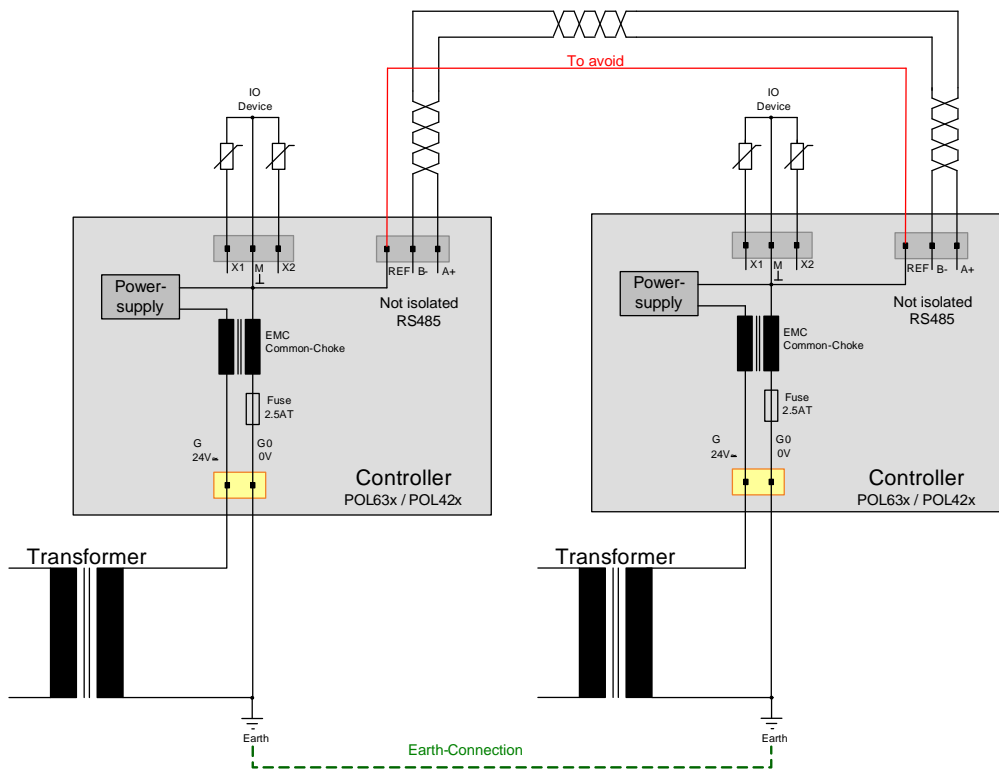
Both RS485-Interfaces can be referred using a low impedance ground connection.
Disconnect the REF in this case:

- to avoid bypassing the fuse
- to avoid high current on REF line if G0 becomes disconnected

Modbus/IP Communication with POL902.00

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4 Commissioning

4.1 General

Connections

There are up to 3 ways to communicate over Modbus:

- Internal RTU (T9[638] ~14 or older, T6[648])
- Internal TCP (648)
- External communication module POL902 (638,648)

Internal RTU

- 2 Modbus RTU interfaces, via RS485, are available by default.
- The interfaces can be defined as master, slave or switched off.
- The first internal Modbus interface (T6) is automatically set to master if any master function is enabled in the controller.
- The second internal Modbus interface (T14) is used for slave mode and internal integration.

Internal TCP

- A Modbus TCP interface, via the standard ethernet port, is available by default.
- The internal Modbus TCP interface is primarily used for slave mode.
- The internal Modbus TCP interface can be switched off.
- The ethernet interface can be used for Modbus and other communication protocols at the same time.

Communication module POL902

Two extra Modbus RTU slave interfaces is provided with the external Modbus communication module POL902. This is typically used when there is needed more than one connection, example connection to both a BMS system and a Touch panel. The module is also needed in case the internal RTU interfaces already is used as a master interfaces e.g 638 ~14 or older.

Prerequisite

Prerequisite for commissioning the aforementioned communications:

A **working application** that supports Modbus is loaded and started on the Climatix controller.

4.2 Commission Modbus RTU, slave mode

Connection   Proceed as follows to connect the Climatix controller to the Modbus line:

Step	Action
1	Controller **OFF**.
2	**Connect Modbus bus cable to the RS485 interface (pins A+ and B-, REF for GND).** **POL 63x Interface:1 (T9) is used internal on ~14 or newer but older units it can be used.**
3	Controller **ON**.
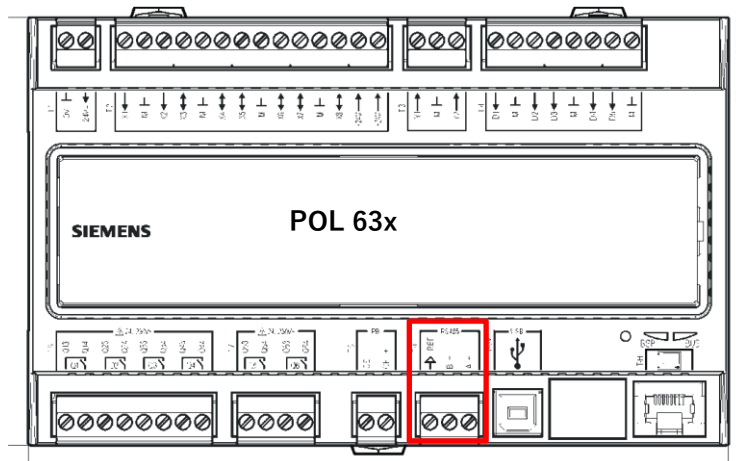
T9 Interface:1

Step	Action
1	Controller **OFF**.
2	Connect Modbus bus cable to the RS485 interface (pins A+ and B-, REF for GND). **POL 64x Interface:2 (T6) is recommended. Connection as for isolated nodes.** *POL 64x Interface:1 (T14) is used for internal communication and integration*
3	Controller **ON**.
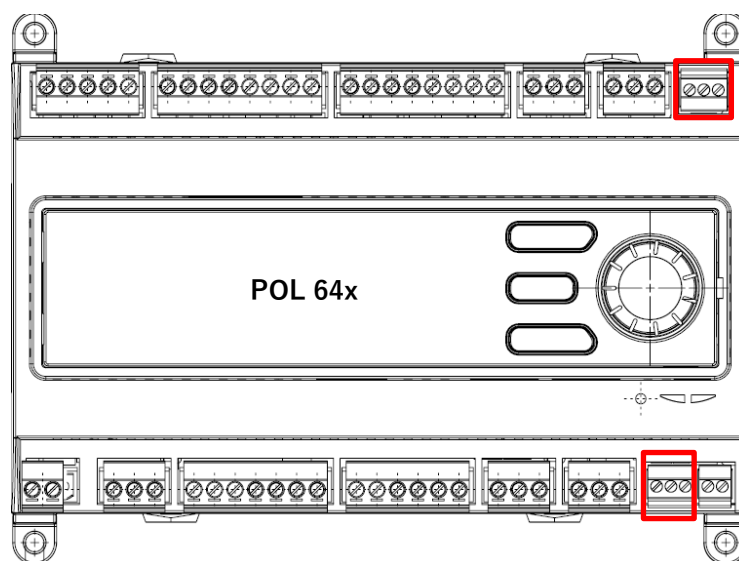
T6 Interface:2

External

T14 Interface:1

Internal

Modbus/IP Communication with POL902.00

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Configuration via operator unit 63x   Proceed as follows to configure the controller for internal Modbus RTU, slave mode:

Step	Action
1	Log in to HMI with the level 4 PIN (Service), Default **2000**.
2	Go to **Mainmenu > System overview > Communication > Modbus >**
3	Select **Internal mode:** Select the intergradet Modbus interface RS485(T9) to be used as slave. *Caution!* The integrated RS485 cannot be used as slave if already used as master. This selection is blocked when a function require master.
4	Select **Internal slave Address**: Enter the corresponding Modbus slave address (1…247). *Caution!* This is true for Modbus TCP as well.
5	Select **Internal settings for RS485 >**
6	Select **Slave address** Enter the corresponding Modbus slave address (1…247).
7	Select **Baud rate**. Enter the transmission rate as per the Modbus (9600, 19200, 38400, 57600 or 115200). **NOTICE! All participants must have the same setting.** **(NOTICE! Don't Change the settings for the internal Modbus if IV Produkt uses internal Modbus)**
8	Select **Parity**. Even, Odd or None. **NOTICE! All participants must have the same setting**
9	Select **Stop bits**. One or Two stop bits. **NOTICE! All participants must have the same setting**
10	Select **Delay**. Delays the response by n milliseconds.
-	**Resp.timeout** . Response time if used as master. The master must undertake read access within this period, otherwise an alarm is triggered. This has no influence on the Modbus slave mode.
-	Select **Termination:** The RS485 topology must always be ended using wave resistors.
11	Select **Restart required !** When done, restart controller using this command.
Extra	Other settings for Modbus master, like alarm class, etc., for Modbus faults can be changed. This has no influence on the Modbus slave mode.

- After restart, the internal Modbus RTU is configured and ready to use.
- As a matter of principle, the controller must be restarted with **"Restart required !"** or power off/on the controller after changing any settings to assume the data.
- Settings other than those described above have nothing to do with Modbus RTU slave mode and should not be changed.

Configuration via operator unit 64x   Proceed as follows to configure the controller for internal Modbus RTU, slave mode:

Step	Action
1	Log in to HMI with the level 4 PIN (Service), Default **2000**.
2	Go to **System settings > Communications >**
3	Select **Communic.config. - Modb.Slave RS485:2(T6)** Activate the Modbus RTU slave interface. Commit by also select "Done".
4	Select **Communic.config. - Modbus Term.RS485:2** if termination is needed. Commit by also select "Done". Always terminate the RS485 topology with wave resistors (described in section 2.6).
5	Go to **Modbus RTU (RS485) >**
6	Select **Slave address** Enter the corresponding Modbus slave address (1…247).
	For the used interface, normally RS485:2
7	Select **Baud rate**. Enter the transmission rate as per the Modbus (9600, 19200, 38400, 57600 or 115200). **NOTICE! All participants must have the same setting.**
8	Select **Parity**. Even, Odd or None. **NOTICE! All participants must have the same setting**
9	Select **Stop bits**. One or Two stop bits. **NOTICE! All participants must have the same setting**
10	Select **Delay**. Delays the response by n milliseconds.
-	**Resp.timeout** . Response time if used as master. The master must undertake read access within this period, otherwise an alarm is triggered. This has no influence on the Modbus slave mode.
11	Select **Restart required !** When done, restart controller using this command.
Extra	Other settings for Modbus master, like alarm class, etc., for Modbus faults can be changed. This has no influence on the Modbus slave mode.

- After restart, the internal Modbus RTU is configured and ready to use.
- As a matter of principle, the controller must be restarted with **"Restart required !"** or power off/on the controller after changing any settings to assume the data.
- Settings other than those described above have nothing to do with Modbus RTU slave mode and should not be changed.

4.3 Commission Modbus TCP

Connection Connect the Climatix controller to the Ethernet (Modbus TCP) with a standard network cable.

Configuration via operator unit 63x Proceed as follows to configure the controller for internal Modbus TCP:

Step	Action
1	Log in to HMI with the level 4 PIN (Service), Default **2000**.
2	Go to **Mainmenu > System overview > Communication >**
3	Select **TCP/IP / IP-Config.** DHCP set to "Passive" select "Done"
-	Note: The Modbus RTU (RS485) settings have no influence for Modbus TCP.
4	Go to **IP-Config / IP-Config. >**
-	**NOTICE! Take care to change TCP/IP setting if the controller is already connected to Ethernet for other purpose.**
5	Select **DHCP** setting. • Active: DHCP server issues addresses. • Passive: IP address is fixed (normally)
6	Select **IP address**. Enter controller IP address if DHCP is set to passive. End a line with #.
7	Select **Subnet mask**. Enter subnet mask if DHCP is set to passive. End a line with #.
8	Select **Default gateway**. Enter gateway address if DHCP is set to passive. End a line with #.
9	Select **Restart required !** When done, restart controller using this command.

- After restart, the internal Modbus TCP is configured and ready to use.
- As a matter of principle, the controller must be restarted with **"Restart required !"** or power off/on the controller after changing any settings to assume the data.
- Settings other than those described above have nothing to do with Modbus TCP slave mode and should not be changed.

Connection Connect the Climatix controller to the Ethernet (Modbus TCP) with a standard network cable.

Configuration via operator unit 64x Proceed as follows to configure the controller for internal Modbus TCP:

| Step	Action
1	Log in to HMI with the level 4 PIN (Service), Default **2000**.
2	Go to **System settings > Communications >**
3	Select **TCP/IP / IP-Config.** DHCP set to "Passive" select "Done"
-	Note: The Modbus RTU (RS485) settings have no influence for Modbus TCP.
4	Go to **IP-Config / IP-Config. >**
-	**NOTICE! Take care to change TCP/IP setting if the controller is already connected to Ethernet for other purpose.**
5	Select **DHCP** setting. • Active: DHCP server issues addresses. • Passive: IP address is fixed (normally)
6	Select **IP address**. Enter controller IP address if DHCP is set to passive. End a line with #.
7	Select **Subnet mask**. Enter subnet mask if DHCP is set to passive. End a line with #.
8	Select **Default gateway**. Enter gateway address if DHCP is set to passive. End a line with #.
9	Select **Restart required !** When done, restart controller using this command.

- After restart, the internal Modbus TCP is configured and ready to use.
- As a matter of principle, the controller must be restarted with **"Restart required !"** or power off/on the controller after changing any settings to assume the data.
- Settings other than those described above have nothing to do with Modbus TCP slave mode and should not be changed.

4.4 Modbus module

Design

The figure shows the Modbus module. Properties:

- Two galvanically separated RS485 interfaces.
- Connection to the Climatix controller via internal communications extension bus using the plug on the controller's left.
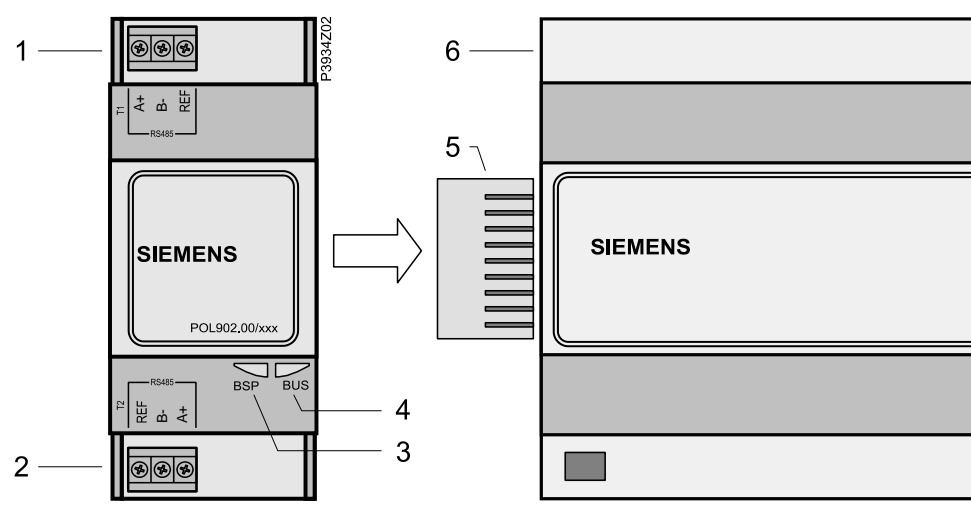
Elements and connections

The elements and connections in the figure are:

Pos.	Element/Pin
1	Modbus RS485 interface T1 (slave, channel 1).
2	Modbus RS485 interface T2 (slave, channel 2).
3	Status display "BSP" (Board Support Package).
4	Status display "BUS" (bus connections o.k./bus traffic).
5	Plug connection (Communication extension bus).
6	Climatix controller POL6XX.

Modbus/IP Communication with POL902.00

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Status LEDs

The status LEDs "BSP" and "BUS" can light red, green and orange during operation.

LED	Color	Flashing frequency	Meaning/operating mode
BSP	Red/green	1 s red/1 s green	BSP upgrade mode in progress
	Green	Steady on	BSP operating and communication with controller working
	Orange	Steady on	BSP operating, but no communication with controller or BSP upgrade mode active
	Red	Flashing at 2 Hz	BSP error (software error)
	Red	Steady on	Hardware fault
BUS	Green	Steady on	• All communication is running, or • Timeout is set to zero (communication monitoring is disabled)
	Orange	Steady on	• Startup, or • One configured channel is not communicating to the master (2 interfaces activated, but communication of one (T1 or T2) is interrupted)
	Red	Steady on	• All configured communications are down (no communication to the master within set timeout), or • Mapping file not loaded

🛈	If both LEDs stay dark: Power supply is outside the allowed range.

4.5　Commission Modbus modules

Connect Modbus module

Proceed as follows to connect the Modbus module to the Modbus bus via RS485:

Step	Action
1	Controller **OFF**.
2	Connect Modbus module to controller using plug connection.
3	Connect Modbus bus cable to Modbus module (pins + and -, REF for GND). • Use the T1 interface if only one master/bus is connected. • Use the T2 interface to connect an additional master/bus. • **Connection as for isolated nodes.**
4	Controller **ON**. • The module starts/initialization begins. • Communication with the controller is active as soon as the LED "BSP" is steady green. **NOTICE! The controller must be restarted a second time to update HMI; prior to parameterization.**.

Configuration via operator unit

Proceed as follows to configure the Modbus module for Modbus RTU step-by-step:

Step	Action
1	Log in to HMI with the level 4 PIN (Service), Default **2000**.
2	Go to **System settings > Communications > Communic.modules > Modbus module [x] >** Or **> Mainmenu > System overview > Communication > Communic.modules > Modbus module [x] >** Note! [x] is the position of the connected communication module. This is only information used when more than one module is connected.
3	Select **+Channel [y] >** Channel 1/Channel 2. Displays as of this point the data for the first (channel 1, terminal T1) and the second Modbus channel (channel 2, terminal T2) of the module. These are the corresponding parameters, with the exception of Enable.
-	Select **Enable**. Only for channel 2. Set to **Active** to enable channel 2 (T2).
4	Select **Slave address**. Enter the corresponding Modbus slave address (1…247). Must be unique on the RS485 network.
5	Select **Baud rate**. Enter the transmission rate as per the Modbus (9600, 19200, 38400, 57600 or 115200). All participants must have the same setting.
6	Select **Stop bits**. One or two stop bits All participants must have the same setting.
7	Select **Parity.** None, Even, or Odd. All participants must have the same setting.

8	Select **Resp.delay**. Delays the response by n milliseconds.
9	Select **Termination**. Always terminate the RS485 topology with wave resistors (described in section 2.6).
10	Select **Watchdog [ms]**. Timeout for the communication watchdog. The BUS LED goes to red or yellow if one or both of the interfaces/channels has no communication to the master within the set time. The watchdog is disabled if the timeout is set to zero.
11	Back one step to **Communic.modules** menu. Select **Restart required !** When done, restart the controller using this command.

- After restart, the Modbus module is configured and ready to use.
- As a matter of principle, the controller must be restarted with "**Restart required !**" or power off/on the controller after changing any settings to assume the new values.
- Other settings than described above are only options and are normally not being changed.

Parameter list

The following table lists all other Modbus module parameters which are displayed by the HMI in the "Modbus module [x]" page:

Parameter	Explanation
State	Current status of the communication module.
Comm failure	Active = Communications error
Slave	Displays whether the channel is used
Timeout	Active = Indicates communication timeout
Software version	Module BSP version (Firmware version)
Device revision	Hardware revision
Advanced	Go to Advanced settings -> see below
Eng. unit support	Displays units in the metric or the imperial system
Mapping	Select alternative Modbus registers (Normally not available)
Use default	Restart communication module parameterization to default setting.
Restart required!	Execute to restart the module.
Module	Com module type (e.g. POL902MOD).
Device ID	Module hardware ID
Trace	Show if log files are available for export. Creation can be made in next lines.

5 Integration

5.1 Map registers

Modbus data formats
Modbus registers are organized into reference types identified by the leading numeric character of the reference address:

The "x" following the leading character represents a four-digit reference address.

Modbus type	Reference	Description (refers to a master device)
Coil status	0xxxx	Read/write discrete outputs or coils. A 0x reference address drives output data to a digital 1-bit output channel. Normally used for binary settings and selections.
Input status	1xxxx	Read discrete inputs. The 1-bit status of a 1x reference address is controlled by the corresponding digital input channel. Normally used to present any status like alarms etc.
Input register	3xxxx	Read input registers A 3x reference register contains a 16-bit number. Normally used to present current values.
Holding register	4xxxx	Read/write output or holding registers. A 4x register stores 16-bits of numerical data (binary or decimal), or sends the data from the CPU to an output channel. Normally used for setpoints and settings.

Leading character
The leading character is generally determined by the function code followed by the address specified for a given function.
"x" is also commonly used as a separator between the leading character and the reference address. As example can the same holding address be presented as 40120 as well as 4x0120. Both means Holding register 120. "x" will further on be used as a separator.

5.2 Function codes

Meaning
The functions below are used to access the registers outlined in the register map of the module for sending and receiving data.

Function codes	Modbus function	Modbus master application
01	Read CoilStatus-Register (ID-COIL)	Read coil registers (bit register) from slave: (0xAdr)
02	Read InputStatus-Register (ID-STATE)	Read state registers (bit register) from slave: (1xAdr)
03	Read Holding-Register (ID-HOLD)	Read holding registers (16 bit register) from slave: (4xAdr)
04	Read Input-Register (ID-INP)	Read input registers (16 bit register) from slave: (3xAdr)
05	Write Single Coil-Register	Write one single coil register (bit register) to slave: (0xAdr)
06	Write Single Holding-Register	Write one single holding register (16 bit register) to slave: (4xAdr)
15	Write multiple Coil-Register	Write multiple coil registers (bit registers) to slave: (0xAdr)
16	Write multiple Holding-Register	Write multiple holding registers (16 bit registers) to slave: (4xAdr)

5.3 Reference Modbus addresses

Addresses used

All reference addresses are generated and can be accessed even if not listed.

As a result, multiple coils/registers can be forced/reset even if there is a gap between two reference addresses.

!	***NOTICE***
	Error accessing addresses
	Accessing addresses above listed addresses cause exceptions and communication fails.
	• Do not read/write any addresses above listed addresses.

i	All address types start with 1. However, some master devices start with 0. In this case, subtract all addresses in the reference list by 1.

Using the right document!

All available reference addresses are in a separate document and are specific to the actual application. Always use the specific document for the actual application with the correct, available reference addresses!

i	The actual application name and version can be viewed in the HMI. We recommend checking the controller's BSP version, and if used the communication module version. It is recommended to always update the communication module version.

Check actual versions

Proceed as follows to see the actual application name and BSP versions:

Select **System settings > Versions > / MainMenu > System overview > Versions >**

Parameter	Explanation/examples
+Application info	
> (Application manufacturer/name)	e.g. IV Produkt AHU
> (Application version/date)	e.g. vX.XX
>BSP version	e.g. 10
+Serial number	e.g. xxxxxxxxxxxxx

6 Other information

6.1 Troubleshooting, tips

General measures   There are a few important items to remember:

Item	Action
Versions	Check the actual application version, controller BSP and communication module BSP version before calling support.
Change settings	The controller must be restarted as a rule with "Restart required !!" or power off/on the controller after changing any settings for them to take effect.
Default settings	Use the "Use default" parameter to go back to communication module's default settings, restart the controller, and reconfigure it.

Modbus communication error   Failure to comply with the following rules may result in a communication error:

- The slave address must be unique on the network, valid addresses are from 1-247.
- Only reference addresses that are generated can be read/write, see Section 4.3, Reference Modbus addresses.
- All address types start with 1. However, some master devices start with 0. In this case, subtract all addresses in the reference list by 1.
- Response delay must in some cases be used, if the network, other devices or the Master requires this.

RS485 network   Observe the following for RS485 network design and structure:

- Baud rate, parity and stop bits must match network and master. All devices, including third-party devices, on the Modbus network must have the same settings.
- The 3-wire bus is NOT interchangeable and must be connected correctly.
- Consider using end-of-line resistors (e.g. 120 Ohms) on both sides (according to RS485 rules) for long distances and/or high baud rates. This can be done via HMI on Climatix.
- The REF must be used and connected properly.

Some devices have an integrated terminating resistance that may be enabled by default. Disable it unless the device is the last one on the network. Consult the data sheet.

Some providers install a number of pull-up/pull-down resistances in their devices, allowing for selection via software or jumper.

TCP/IP network   Observe the following for TCP/IP network design and structure:

- Check that the DHCP parameter is set to "Passive" if using a fixed IP address.
- Try to ping the controller if the communication is not working. If the ping fails something is wrong on the network or IP settings.
- Check that the defined TCP port is open in the firewall. For Modbus the TCP port 502 is by default used. The TCP port can, in some applications, be changed.

BMS

Trouble with Building Management System (BMS) you can try following:

- Download CAS (chipkin Automation System) its free and good for troubleshooting Modbus system.
- Try connecting your PC directly to the Climatix and communicate directly.
- Try restarting the climatix after any possible change of settings.
- Is the cable connected to the right port? (common mistake)
- Is the communication patched the whole way to BMS? (Should say "Link" under TCP/IP settings).
- Might be an issue if you have to many clients at the same time (3 for POL 63x 9 for 64x). If you had a network error the BMS could open a new session and the old session is locked for 1 hr. If reconnection occurs multiple times it could be that there are no available sessions left.
- Communication comes and goes, common issue when there is too much traffic, e.g. an IP camera or other devices that use the network to send broadcast messages.
- Make sure the Slave address is unique for this line.

6.2 FAQs on TCP/IP

TCPI/UDP ports

Port number	Type	Used for …
21		FTP
23	UDP	Telnet/Ping
80		Web
502	TCP	Modbus
4242	TCP	Scope, Climatix OPC (TCP/IP)

Disconnected network?

Ping the communication module using the IP address to test communications:

Step	Action
1	Select **Start** > **Search** on the Windows start bar:
2	Enter **CMD** and click **OK**: ⌗The "CMD.exe" DOS window opens.
3	Enter **C:\>ping XXX.XXX.XXX.XXX** and press **Enter**: → The ping result is displayed. *Note! (XXX.XXX.XXX.XXX is the set IP address)*

You are dealing with a network or IP settings error if pinging does not work.

6.3 Override I/Os via communication

Introduction

Some inputs can be overridden via Modbus, see Section 4.3, Reference Modbus addresses. However these inputs must first be setup in advance. Inputs must first be enabled and hardware place selected in configuration.

Requirements

Input must first be enabled and the hardware space selected in the configuration.

Configuration via operator unit

Proceed as follows to select input handling:

Step	Action
1	Log in to HMI with the level 4 password (Service), Default **2000**.
2	Select **Unit > Inputs/Outputs > / Mainmenu > Unit > Inputs/Outputs > Analog Inputs/Outputs >** *Example Unit > Inputs/outputs > Analog inputs > Outside temp > / Mainmenu > Unit > Inputs/outputs > Analog inputs > Outside temp >*

Parameter	Area	Function
Value selector (Digital inputs)		Select valid input value for the application:
	Hardware	• Value on hardware input.
	Comm	• Value from communications.
	AND	• Input is 1, if value on hardware input **and** communications = 1. Alarm triggers (if enabled), if one of the two values is invalid.
	OR	• Input is 1, if value on hardware input **or** communications = 1. Alarm triggers (if enabled), if one of the two values is invalid.
	Pref HW	• Value on hardware input has priority. The value from communications is taken, if the value is invalid. An alarm triggers (if enabled), if both values are invalid.
	Pref Comm	• Value from communications has priority. The value from the hardware input is taken if the value from communications is invalid. An alarm triggers (if enabled), if both values are invalid.
Value selector (Analog inputs)		Select valid input value for the application:
	Hardware	• Value on hardware input.
	Comm	• Value from communications.
	Average	• Average from the values on hardware input and from communications. Alarm triggers (if enabled), if one of the two values is invalid.
	Minimum	• The lowest value from the values on hardware input and from communications. Alarm triggers (if enabled), if one of the two values is invalid.
	Maximum	• The highest value from the values on hardware input and from communications. Alarm triggers (if enabled), if one of the two values is invalid.
	Pref HW	• Value on hardware input has priority. The value from communications is taken, if the value is invalid. An alarm triggers (if enabled), if both values are invalid.
	Pref Comm	• Value from communications has priority. The value from the hardware input is taken if the value from communications is invalid. An alarm triggers (if enabled), if both values are invalid.

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6.4 Upgrade application or BSP via SD card

Situation

The Climatix POL6x8 controller and/or the Modbus communication module POL902 can be upgraded with new software. It is recommended to always use latest version.

Modbus / Ethernet

J3960Z05

SD

POL902 / POL6XX

BSP   BUS
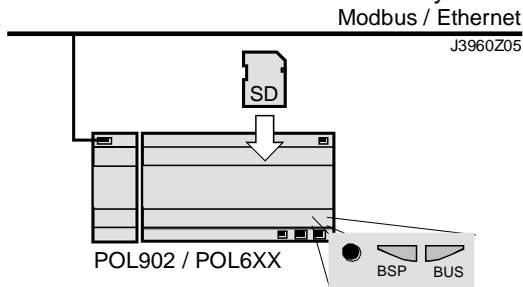
Prerequisite

To upgrade the following items are needed:

- SD card
- Application- and/or BSP files from IV Produkt:

File	Used for…
POL902Mod…Vxx.ucf	Modbus Communcation module, POL902, BSP
POL6xx_BSP_Vxx.ucf	Controller, POL6xx, BSP*
MBRTCode.ucf	Controller, POL6xx, Application *
OBHcomp.ucf	Controller, POL6xx, Communication mappings
HMIcomp.ucf	Controller, HMI structure
HMI4Web.ucf	Controller, HMI4WEB structure

⚠ * These files may set all settings in the controller to default!

ℹ All settings can be saved to the SD card before the upgrade and then loaded again after the upgrade.

Upgrade procedure

The upgrade procedure and how to save/load all settings are not described in this manual. Contact IV Produkt to get instructions and necessary files.

Modbus/IP Communication with POL902.00