

Climatix™ **Modbus communication, slave mode** **Integration guide**

POL63x controller and POL902 communication module

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1 About this document

1.1 Revision history

Version	Date	Changes	Section	Pages
1.0	01.03.2010	First edition		
	15.09.2010	Minor enhancements		
	02.12.2013	Product version VVS 9.0		
	07.02.2014	Minor enhancements		
	18.07.2014	Update for VVS10		
	07.10.2015	Minor enhancements		

1.2 Before you start

Validity

This document applies to the following products:

Name	Type (ASN)	Short name
Modbus communication module	POL902.00/STD	Modbus module
Controller with onboard modbus	POL63x.00/STD	Basic controller
Controller with onboard TCP/IP	POL638.00/STD	TCP/IP controller

Product versions

Description and functional scope of the products are based on the Climatix Valid Version Set 10.0 or higher and application based on Siemens standard.

Target audience

This document is intended for the following audience:

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

Prerequisites

The above target audience:

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

1.3 Reference documents

Further information

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

Document	Order no.
Data sheet "Communication module Modbus"	CB1Q3934en
Basic documentation "Modbus communication module"	CB1P3934en
Reference addresses "Modbus communication, slave mode" Note! Unique documentation for each application field	CB1Y3961en
Basic documentation "Climatix AHU application" Note! Unique documentation for each application field.	CB1P3977en

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 result in injury and/or serious damages.



This symbol denotes special information that, when failed to observe, may result in faulty functionality *or loss of data*.



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



This symbol marks passages containing tips and tricks.

Abbreviations

The following abbreviations are used in text and illustrations:

Abbreviation	Meaning
BACS	B uilding A utomation and C ontrol S ystem
BSP	B oard S upport P ackage (operating system)
Climatix	Controller family with common tools
Gateway	A device for transfer data between different kind of networks
HMI	H uman M achine I nterface, e.g Operator unit
HMI-DM	Climatix D ot M atrix HMI, POL895.51 or POL871.xx
HVAC	H eating, V entilating, A ir C onditioning
LSB	L east S ignificant B it
MSB	M ost S ignificant B it
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 safety

Field of application		Use Modbus communication only for control and monitoring.
Intended use		Trouble-free and safe product operation of the above products presupposes transport, storage, mounting, installation, and commissioning as intended as well as careful operation.
Electrical installation		Fuses, switches, wiring and grounding must comply with local safety regulations for electrical installations.
Wiring		When wiring, strictly separate AC 230 V mains voltage from AC 24 V safety extra-low voltage (SELV) to protect against electrical shock!
Commissioning and maintenance		Only qualified staff trained accordingly may prepare for use, commission, and maintain Modbus communication modules.
Maintenance		Maintenance of Climatix Controller and Modbus communication modules generally only means regular cleaning. We recommend removing dust and dirt from system components installed in the control panels during standard service.
Faults		Only authorized staff may diagnose and correct faults and recommission the plant. This applies to working within the panel as well (e.g. testing or changing fuses).
Storage and transport		Refer to the environmental conditions specified in the respective data sheets for storage and transport. If in doubt, contact your supplier.
Disposal		Devices contain electrical and electronic components; do not dispose of them in household garbage. Observe all local and applicable laws.

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 trained appropriately and have the technical knowledge required to use our products as intended.

Exemption from liability

Siemens 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 networks

2.1 Modbus protocol

Modbus, general information

The following section provides only 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 transactions 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: These modes have the following characteristics:

RTU (Remote Terminal Unit) mode

- Binary-coded data.
- Start and end of telegrams marked by timed pauses (a "silent interval") between the characters transmitted.
- Check sum algorithm: CRC (cyclical redundancy check).

ASCII mode

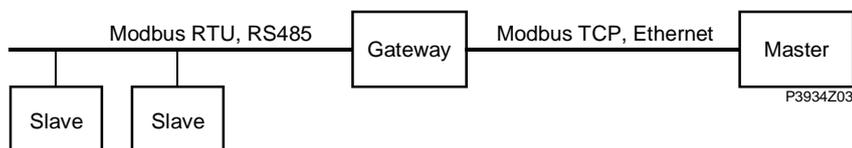
- Data in hexadecimal notation.
- Beginning and end of telegrams marked by start and end characters.
- Check sum algorithm: LRC (longitudinal redundancy check).

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

A Modbus TCP/RTU gateway helps connect a Modbus/TCP master to one or several Climatix controllers (slaves) if not a Climatix controller with internal TCP/IP onboard is available:



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

2.2 RS485 networks

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.

More than 32 devices on one RS485 trunk?

Yes, a repeater makes this possible.

However, in reality a repeater is not always necessary because:

Although the RS485 standard is based on just 32 full load devices, most RS485 chips need 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.

Read 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").

Unit loads of Climatix devices

The following table outlines the Climatix devices that are using 3-wire RS-485 network interfaces.

Product Name	Modbus Protocol	Terminal Usage	Network Electrical Loading (unit load)	Isolated RS485 common
POL635	Master/Slave	A+ B- REF	1/4	no
POL636	Master/Slave	A+ B- REF	1/4	no
POL638	Master/Slave	A+ B- REF	1/4	no
POL687	Master/Slave	A+ B- REF	1/4	yes
POL902	2 x Slave	A+ B- REF	1	yes

Topology

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

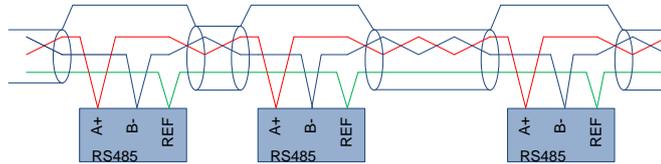
2.3 Topologies

Introduction

The RS485 standard is simple and well-proven. An important requirement however, is the selection of the right topology.

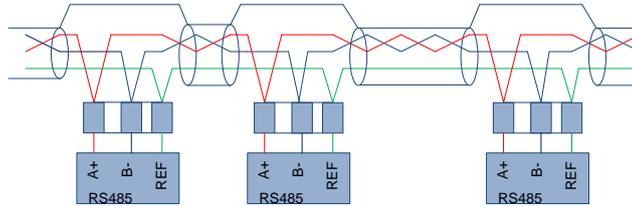
Best: Individual line

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.



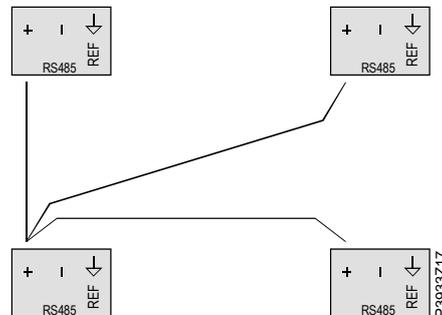
Impairment due to intermediate terminals

Connecting network devices via intermediate terminals can result in reflections and harmonics of electrical signals. Long, not twisted intermediate lines obviously increase the risk of interference.



Error-prone: Star

Avoid star topologies because errors/problems are hard to located and remove.



Note: Only one line + (TX) is shown for the example.

2.4 RS485, cable installation

Task of the third wire

In order to provide higher noise immunity and high data reliability, Climatix Modbus network interface is build as 3-wire connection RS-485 interfaces with a common reference signal REF.

Depending on the manufacturer, the third wire on 3-wire network interfaces has several names (for example: Common, Ground, Com. SC (Signal Common), R (for Reference), GND, SG (Signal Ground) or REF (e.g. in Climatix)).



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

Grounding Arrangements

The « REF » (common signal) must be connected to protective ground, preferably at **one point only** for the entire bus. Generally this point is to choose on the master device or on its Tap.



Before the « REF » (common signal) ist connected to earth ground, the wire must be tested with a DMM to ensure it is not already connected to earth ground. If the wire is connected to earth ground the fault condition must be remedied before terminating the wire to earth ground.



If the « REF » (common signal) is internally already connected to earth ground in a Modbus node, then it mustn't be connected with earth ground once again.

Risks due to missing third wire

You risk the following if you do not use a third wire:

- Destroyed RS485 inputs.
- Unstable work.
- 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

You do not need screens. The twisted cable for Tx and Rx suppresses interference more effectively than a screen.



The use of the shield as the third wire is prohibited.



An overall foil shield 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). These are the main sources of interferences.
- Frequency-controlled actuators are also source of high interference.
- Protect bus cable against undesired moving (e.g. due to vibrations).

RS485, cable installation, *continued*

Cable type

The network cable recommended for use with the 3-wire (isolated RS-485 common) is a single twisted pair cable with third wire (1.5-pair) that is used to tie the RS-485 reference (communication common) of all the nodes on the network together.

Pay attention to the impedance

Each cable has its own impedance. Some cables are designed for impedance independent of length. Use this kind of cable. Nominal impedance is a start for selection:

- A cable is well suited if a number e.g. 100 Ohm is indicated.
- The cable is not suited if impedance is indicated by meter/foot, as determination of the value for terminating resistances requires measurements and calculations. Thus, select a cable with the lowest possible capacity.

Cat5 cables?

Yes, these cables are good. 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	Specifications
Belden 3106A  Bild02	Multi-Conductor - EIA Industrial RS-485 PLTC/CM 22 AWG stranded (7x30) 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  Bild03	Multi-Conductor - EIA Industrial RS-485 PLTC/CM 22 AWG stranded (7x30) 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

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

- For a 9600 Baud rate and AWG26 (or wider) gauge, the maximum length is 1000m.
- The derivations must be short, never more than 20m. If a multi-port tap is used with n derivations, each one must respect a maximum length of 40m divided by n.
- The higher the baud rate, the more important is the cable installation quality. Issues such as twisted pair cable unfolded at each resistor gain importance.

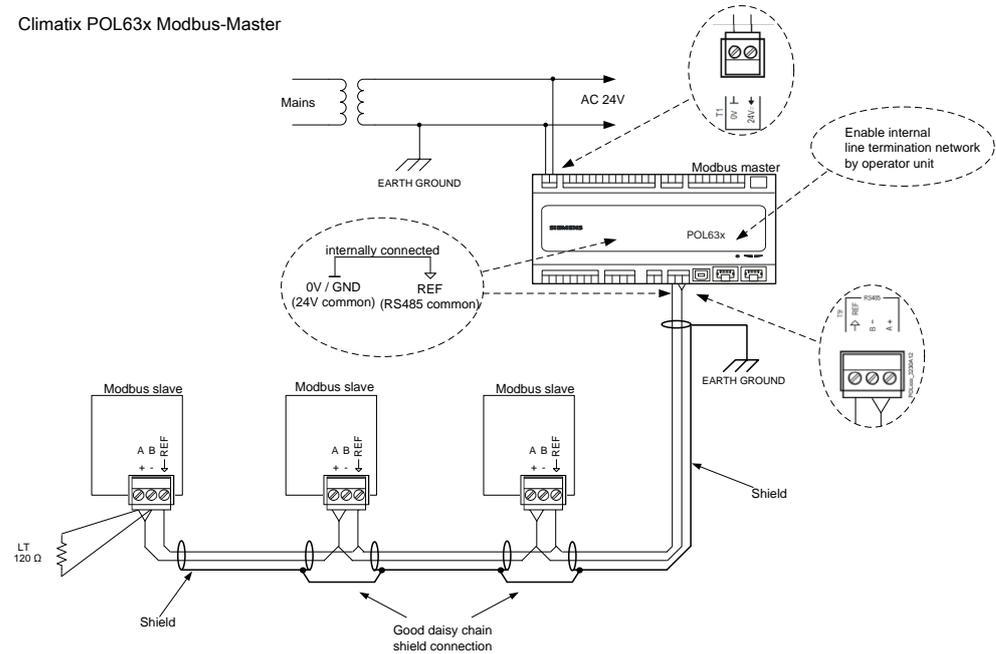
2.5 Wiring examples

Climatix devices with Modbus master

Climatix POL63x Modbus master

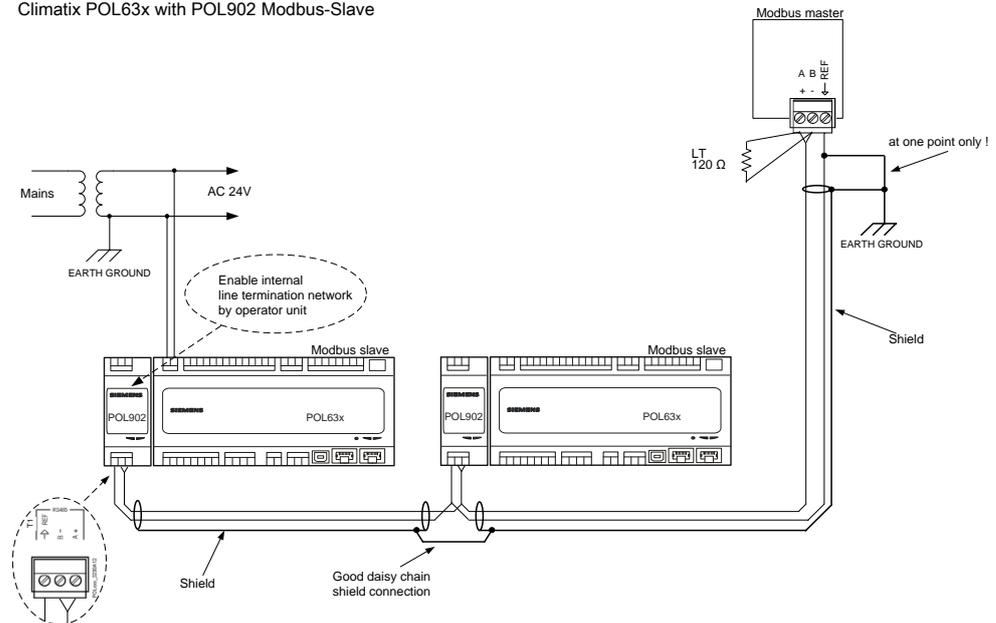
The following pictures show the correct wiring of Climatix POL63x controllers and POL902 communication modules with the Modbus master

Climatix POL63x Modbus-Master



Climatix POL63x with POL902 Modbus slave

Climatix POL63x with POL902 Modbus-Slave



The RS-485 common reference wire is referenced at one point (and only one point) to earth ground.



The use of the shield as the third wire is prohibited.



An overall foil shield and drain wire provide additional noise protection.

2.6 Line termination / polarization

Line Termination

To minimize the reflections from the end of the RS485-cable it is required to place a line termination near each of the 2 ends of the bus.

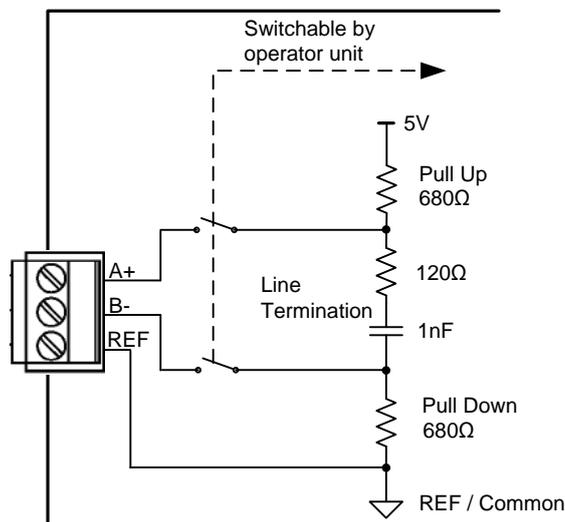
Line Polarization

When there is no data activity on an RS-485 balanced pair, the lines are not driven and, thus susceptible to external noise or interference. To insure that its receiver stays in a constant state, when no data signal is present, some devices need line polarization resistors (pull up / pull down) to bias the network. This will be done typically in the Modbus Master device and must be done in one place only.



The line termination and at the same time the polarization can, in POL63x and POI902, be enabled or disabled via the operator unit.

This means that a Climatix device can only enable the termination and polarization at one end of the RS-485 line. On the other end the termination must be set externally or with a device that can switch on the termination only (without polarization).



2.7 TCP/IP networks

Modbus TCP port

Modbus TCP in Climatix uses the TCP port 502. This port number is not changeable.

IP address

The IP address is assigned either dynamically via the DHCP server or set manually via HMI. Normally is to use fixed IP address.



If the controller is Server (Slave) he is able to serve 3 Modbus IP Clients, so it is possible to connect for example 3 touch panels to one controller at the same time. The onboard IP port can be used as Modbus IP port. Furthermore the WEB@HMI (web browser) can be used for remote service simultaneously.

2.8 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 "ModScan" from a computer. "Modbus Poll" can be downloaded from www.modbustools.com.

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

3 Commission instructions

3.1 General

Connection ways

There are up to 3 ways to communicate with Modbus on a Climatix controller:

- Internal RTU (POL63x)
- Internal TCP (POL638)
- External communication module POL902

Internal RTU (POL63x)

A Modbus RTU, via RS485, interface is always available on the basic controller POL63x.00/STD. It can be defined as the master or slave or switched off.

The internal Modbus interface is automatically set to master if any master function is enabled in the controller.

Internal TCP (POL638)

A Modbus TCP interface is available on the POL638.00/STD controller via the standard Ethernet port. The internal Modbus TCP interface can be used for slave mode and can be used for slave mode even if the RS485 port is used as master.

External communication module POL902

Two extra Modbus RTU slave interface, 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 interface already is used as a master interface.



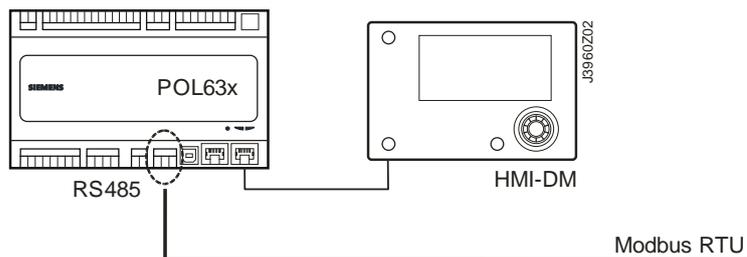
Prerequisite for commissioning any of the above mentioned ways:

Working application loaded and started in the Climatix controller.

3.2 Commission internal Modbus RTU

Involved devices

The picture shows the devices and connections involved in commissioning:



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).
3	Controller ON .

Configuration via operator unit

Proceed as follows to configure the controller for internal Modbus RTU:

Step	Action
1	Log in to HMI using the password for level 4 (Service), default 2000.
2	Go to Main Index > System overview > Communication > Modbus >
3	Select Device type (Internal mode) : Select the integrated Modbus interface RS485 to be used as slave. <i>Caution!</i> The integrated RS485 cannot be used as slave if already used as master. This selection is blocked when a function require master.
4	Go to Internal settings for RS485 >
5	Select Internal Modbus slave address : Enter the corresponding Modbus slave address (1...247).
6	Select Baudrate : Enter the transmission rate as per the Modbus (2400, 4800, 9600, 19200 and 38400). All participants must have the same setting.
7	Select Stop bits : One or two stop bits All participants must have the same setting.
8	Select Parity : None, even or odd parity. All participants must have the same setting
9	Select Response delay : Delays the response by n milliseconds.
-	Resp.fail timeout : Setting access time if used as master. The master must undertake read access within this period, otherwise an alarm is triggered. This has no influence for Modbus slave mode.
10	Select Termination : The RS485 topology must always be ended using wave resistors. They can be enabled or disabled here as described in section 2.6. Only enable this when it is needed both termination and polarization, otherwise use external line termination.
11	Select Reset required !! : When done, restart controller using this command.
Extra	Modbus comm is the alarm object and settings like alarm class etc for Modbus faults can be changed here.

Commission internal Modbus RTU, *cont.*

Configuration via operator unit, *cont.*

After restart, the internal Modbus RTU is configured and ready to use.



As a matter of principle, the controller must be restarted with "Reset required !!" or power off/on the controller after changing any settings to assume the data.

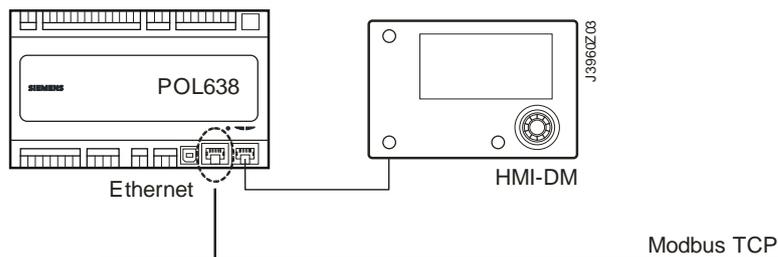


Other setting than described above has nothing to do with Modbus RTU slave mode and should not be changed.

3.3 Commission internal Modbus TCP

Involved devices

The picture shows the devices and connections involved in commissioning:



Connection

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

Configuration via operator unit

Proceed as follows to configure the controller for internal Modbus TCP:

Step	Action
1	Log in to HMI using the password for level 4 (Service), default 2000.
2	Go to Main Index > System overview > Communication > Modbus >
-	Device type (Internal mode): Selects if the integrated Modbus interface RS485 should be used as master or slave. This has no influence for Modbus TCP.
3	Go to Internal settings for IP-Config. (TCP/IP) > <i>Note!</i> Settings for TCP/IP can also be displayed and changed in: Main Index > System overview > Communication > IP-Config. >
-	Take care to change TCP/IP setting if the controller is already connected to Ethernet for other purpose.
4	Select functionality for DHCP : Active means that the IP address is given from a DHCP server on the network. Passive means that a fixed IP address will be used as the settings described below. Fixed IP address is preferred.
5	Select IP, Mask and Gateway : The IP settings for the controller are used for a fixed IP address and are only active if the DHCP parameter is set to Passive. <i>Note:</i> – End a line with #. Never use a “space” at the end.
6	Select Reset 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 "Reset required !!" or power off/on the controller after changing any settings to assume the data.



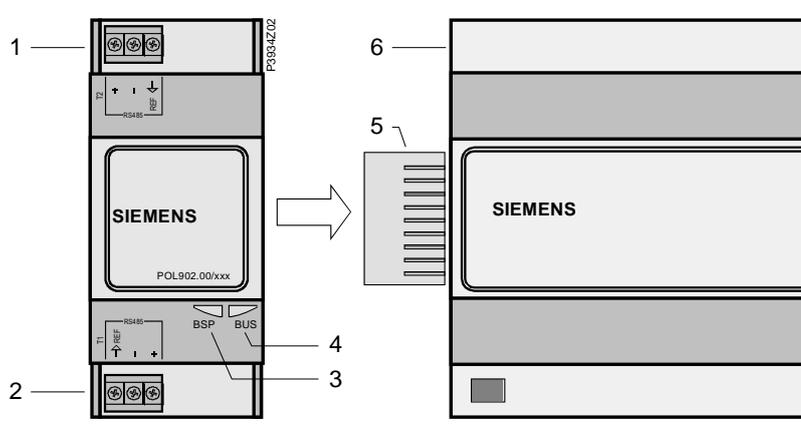
Other setting than described above has nothing to do with Modbus TCP slave mode and should not be changed.

3.4 The 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 / Connection
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.

Status LEDs

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

"BSP" LED

This LED informs on the status of the "Board Support Package" (BSP). Color and flashing frequency of the LED:

Color	Flashing frequency	Meaning / Mode
Red / Green	1 s "on" / 1 s "off"	BSP upgrade mode.
Green	Steady "on"	BSP operating and communication with controller working.
Yellow	Steady "on"	BSP operating, but no communication with controller.
Red	Flashing at 2Hz	BSP error (software error).
Red	Steady "on"	Hardware fault.

"BUS" LED

This LED shows the status of external communication with the bus, not to the controller. Color and flashing frequency of the LED:

Color	Flashing frequency	Meaning / Mode
Green	Steady "on"	All communication running, or if watchdog is disabled.
Red	Steady "on"	All configured communications down. Means no communication to the Master within set timeout. In case the timeout is set to zero the watchdog is disabled.
Yellow	Steady "on"	Startup, or one configured channel not communicating to the master.

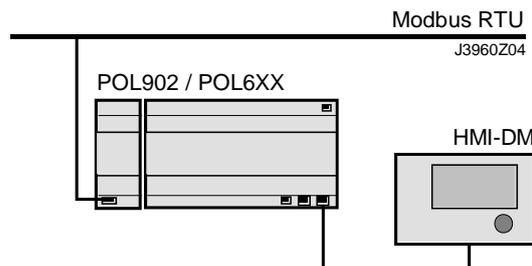


Power supply is outside the allowed range if both LEDs are dark.

3.5 Commission Modbus modules

Involved devices

The picture shows the devices involved in commissioning:



Connect Modbus module

Proceed as follows to connect the Modbus module to the Modbus bus via RS485 (see also description in section for the Modbus module):

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 should be connected. Use the T2 interface if an additionally master/bus should be connected.
4	Controller ON : → The module starts / initialization begins. → As soon as the two LEDs "BSP" and "BUS" are steady green, communication with the controller and Modbus bus is active. <i>Caution!</i> The controller must be reset 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-DM using the password for level 4 (Service), default 2000.
2	Go to Main Index > System overview > Communication > Modbus > Module[x] Modbus > or Main Index > System overview > Communication > Comm module overview > Module[x] Modbus > <i>Note! [x] is the position of the connected communication module. This is only information used when more than one module is connected.</i>
3	Go to Settings channel [y] > Channel 1 / Channel 2. Displays as of this point the data for the first Modbus channel (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)



Some applications use the name channel 0 for terminal 1 and channel 1 for terminal 2 and other applications may use the same channel number as for the terminal.

Commission Modbus modules, *cont.*

Configuration via operator unit, *cont.*

Step	Action
4	Select Slave address : Enter the corresponding Modbus slave address (1...247). Must be unique in the RS485 network
5	Select Baud rate : Enter the transmission rate as per the Modbus (2400, 4800, 9600, 19200 and 38400). 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 parity. All participants must have the same setting.
8	Select Response delay : Delays the response by n milliseconds.
9	Select Termination : The RS485 topology must always be ended using wave resistors. They can be enabled or disabled here as described in section 2.6. Only enable this when it is needed both termination and polarization, otherwise use external line termination.
10	Select Timeout comm : 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. In case the timeout is set to zero the watchdog is disabled.
11	Select Reset required !! : When done, restart 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 "Reset required !!" or power off/on the controller after changing any settings to assume the data.



Other settings than described above are only options and should normally not be changed.

Parameter list

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

Parameters	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
Advanced	Go to Advanced settings -> see below
Eng.unit support	Change dimensions to the imperial system
Communication Comm mapping (Language)	<i>Determines the objectnames, "Mapping", used for all Modbus addresses. Normally "Mapping1" (16384) that is the same as COM1. Normally hidden!</i>
Use default	Reset the module parameterization to default setting.
Module	Com module type (name)
Device ID	Module hardware ID
Trace	Show if log files are available for export

Blank page

4 Integration

4.1 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.

ModbusType	Reference	Description (refers to master device)
Coil Status	0xxxx	<u>Read/Write Discrete Outputs or Coils.</u> A 0x reference address is used to drive output data to a digital 1-bit output channel.
Input Status	1xxxx	<u>Read Discrete Inputs.</u> The 1-bit status of a 1x reference address is controlled by the corresponding digital input channel.
Input Register	3xxxx	<u>Read Input Registers.</u> A 3x reference register contains a 16-bit number.
Holding Register	4xxxx	<u>Read/Write Output or Holding Registers.</u> A 4x register is used to store 16-bits of numerical data (binary or decimal), or to send the data from the CPU to an output channel.

Leading character

The leading character is generally determined by the function code followed by the address specified for a given function. The leading character also identifies the I/O data type.

4.2 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 Code	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)

4.3 Reference Modbus addresses

Register restrictions

The internal Modbus onboard the controller has limited number of registers. Input and holding registers are limited to max 1000 addresses..

Addresses used

All reference addresses from 0001-1000 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.



Do not read/write any addresses above 1000. Doing so causes an exception and communication fails.

All address types start with 1, and due to that some Master devices start with 0 it is in that case necessary to subtract all addresses in the reference list with 1.

Use the right document for the actual application

All available reference addresses are found in a separate document and are specific for the actual application. All different applications, and in some cases also application versions, have different reference addresses. The specific document for the actual application must be used to see what reference addresses that are available.



The actual application name and version can be found using the HMI. In some cases it is also good to check the BSP versions for Controller and Modbus module. Latest BSP version for Modbus module should always be used.

Check actual versions

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

1. Log in to HMI-DM using the password for level 4 (Service), default 2000.
2. Select **Main Index > System overview > Versions >**

Parameter	Explanation / Example
+Application info	
Application manufacturer/name	e.g. Siemens
Application name/date	e.g. STD_AHU_vX.XX
+BSP version	Controller operating system.
Comm module 1	Communication module 1 operating system
Comm module 2	Communication module 2 operating system
Comm module 3	Communication module 3 operating system

Check actual versions (Alternative)

Older application versions could have another HMI structure and same information is found in a different place.

1. Select **Main Index > System overview > Application info >**
2. Select **Main Index > System overview > Target > BSP version**

5 Other information

5.1 Troubleshooting, tips

General

There are a few general things to be observed:

Subject	Measure
Versions	Check the actual application version, controller BSP and communication module BSP version before call any support.
Change settings	As a matter of principle, the controller must be restarted with "Reset required !!" or power off/on the controller after changing any settings in order the data are accepted.
Default setting	Use the "Use default" parameter to go back to default setting of the communication module, reset the controller, and do the parameterization again.

Modbus communication error

Non-adherence to the following rules may result in communication errors:

- The slave address must be unique in the network, valid addresses are from 1-247.
- Only reference addresses that are generated can be read/write, see chapter about reference addresses for more information about the specific application.
- All address types starts with 1, and due to that some Master devices starts with 0 it's in that case necessary to subtract all addresses in reference manual with 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 other products, on the Modbus network must have the same settings.
- The 3-wire bus is NOT interchangeable and must be connected correctly.
- In case of long distance and/or high baud rate, consider end-of-line resistors like 120 Ohms on both sides (according to RS485 rules). In Climatix this can be done via HMI.
- The REF must be used and connected properly.



Some devices have an integrated terminating resistance. It may be active by default. Deactivate it unless the device is the last in 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 fixed IP address should be used.
- Try to ping the controller if the communication is not working. If the ping fails something is wrong in the network or the IP settings.
- Check that the defined TCP/UDP port is open in the firewall. For Modbus the TCP port 502 is used.

5.2 FAQ 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, RemoteOPC TCP/IP

Network: Disconnected

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

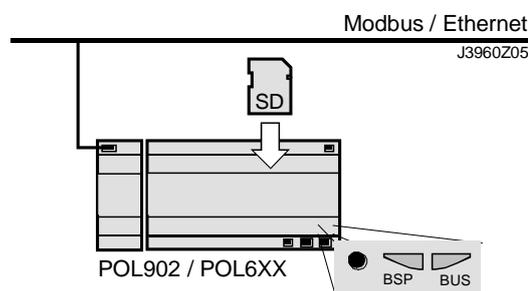
Step	Action
1	Select Start > Run on the Windows start bar: → The "Run" dialog box opens.
2	Enter CMD and click OK : → The "CMD.exe" DOS window opens.
3	Enter C:\>ping XXX.XXX.XXX.XXX and press Enter : → The ping result is displayed. <i>Note! (XXX.XXX.XXX.XXX is the set IP address)</i>

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

5.3 Upgrade application or BSP via SD card

Situation

The Climatix POL6XX controller and/or the Modbus communication module POL902 can in special cases be upgraded with new software. Direct upgrade from VVS8 to VVS10 is not possible.



Prerequisite

To upgrade the following items are needed:

- SD card
- Application- and/or BSP files from the actual manufacturer:

File	Used for...
POL902Mod...Vxx.ucf	Modbus Communication module, POL902, BSP
POL63x_BSP_Vxx.ucf	Controller, POL63x, BSP*
MBRTCode.ucf	Controller, POL63x, Application *
OBHcomp.ucf	Controller, POL63x, Communication mappings
HMIcomp.ucf	Controller, HMI structure
HMI4Web.ucf	Controller, HMI4WEB structure
ScopeConfig.ucf	Scope Light



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



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 your manufacturer to get instructions and necessary files.

5.4 Override I/Os via communication

Preamble

Some inputs can be overridden via Modbus, see reference addresses. However these inputs must first be setup for this before it works. Inputs can work, only via hardware, only via communication or as a combination.

Prerequisite

Input must first be enabled and hardware place selected in configuration.

Configuration via operator unit

Proceed as follows to select input handling:

Step	Action
1	Log in to HMI using the password for level 4 (Service), default 2000.
2	Select Main Index > Unit > Inputs > Element group > Element > <i>Example Main Index > Unit > Inputs > Temperatures > Outside temp ></i>
3	Select Special settings > Value selector , see selections below

Parameter	Range	Function
Value selector (Digital inputs)	<ul style="list-style-type: none"> – Hardware – Comm – And. – Or – PreferredHW – PrefComm 	Select valid input value for the application: <ul style="list-style-type: none"> – Value on hardware input. – Value from communications. – The input is 1, if the value on the hardware input and the value from communications = 1. Alarm triggers, if one of the two values is invalid. – The input is 1, if the value on the hardware input or the value from communications = 1. Alarm triggers, if one of the two values is invalid. – Value on hardware input has priority: If the value from the hardware changes to invalid, then the value from communications is taken. If the latter is also invalid, an alarm is triggered. – Value from communications has priority: If the value from communications changes to invalid, then the value from the hardware is taken. If the latter is also invalid, an alarm is triggered.
Value selector (Analog inputs)	<ul style="list-style-type: none"> – Hardware – Comm – Average – Minimum – Maximum – PreferredHW – PrefComm 	Select valid input value for the application: <ul style="list-style-type: none"> – Value on hardware input. – Value from communications. – Average from the values on hardware input and from communications. Alarm triggers, if one of the two values is invalid. – Lowest value from the values on hardware input and from communications. Alarm triggers, if one of the two values is invalid. – Highest value from the values on hardware input and from communications. Alarm triggers, if one of the two values is invalid. – Value on hardware input has priority: If the value from the hardware changes to invalid, then the value from communications is taken. If the latter is also invalid, an alarm is triggered. – Value from communications has priority: If the value from communications changes to invalid, then the value from the hardware is taken. If the latter is also invalid, an alarm is triggered.

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