ENGLISH

Anybus® Communicator™ - Modbus RTU Server to EtherNet/IP

USER MANUAL

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Important User Information

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Contact Information

Postal address:
Box 4126
300 04 Halmstad, Sweden

E-Mail: info@hms.se

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1. Preface

1.1. About This Document

This document describes how to install and configure Anybus® Communicator™.

For additional documentation and software downloads, FAQs, troubleshooting guides and technical support, please visit www.hms-networks.com/technical-support.

1.2. Document Conventions

Lists

Numbered lists indicate tasks that should be carried out in sequence:

1. First do this
2. Then do this

Bulleted lists are used for:

- Tasks that can be carried out in any order
- Itemized information

User Interaction Elements

User interaction elements (buttons etc.) are indicated with bold text.

Program Code and Scripts

```
Program code and script examples
```

Cross-References and Links

Cross-reference within this document: Document Conventions (page 1)

External link (URL): www.hms-networks.com

Safety Symbols

DANGER
Instructions that must be followed to avoid an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING
Instructions that must be followed to avoid a potential hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION
Instruction that must be followed to avoid a potential hazardous situation that, if not avoided, could result in minor or moderate injury.

IMPORTANT
Instruction that must be followed to avoid a risk of reduced functionality and/or damage to the equipment, or to avoid a network security risk.

Information Symbols

NOTE
Additional information which may facilitate installation and/or operation.

TIP
Helpful advice and suggestions.

1.3. Trademarks

Anybus® is a registered trademark of HMS Networks.

All other trademarks are the property of their respective holders.

2. Safety

2.1. Intended Use

The intended use of this equipment is as a communication interface and gateway.

The equipment receives and transmits data on various physical layers and connection types.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

2.2. General Safety

CAUTION
Ensure that the power supply is turned off before connecting it to the equipment.

CAUTION
This equipment contains parts that can be damaged by electrostatic discharge (ESD). Use ESD prevention measures to avoid damage.

CAUTION
To avoid system damage, the equipment should be connected to ground.

IMPORTANT
Using the wrong type of power supply can damage the equipment. Ensure that the power supply is connected properly and of the recommended type.

3. Cybersecurity

3.1. General Cybersecurity

IMPORTANT
It is important to maintain the cybersecurity of the Communicator.

Before connecting the Communicator to a PLC, ensure the PLC is configured and installed in accordance with the PLC supplier hardening guidelines.

IMPORTANT
To physically secure networks and equipment and to prevent unauthorized access, it is recommended to install the equipment in a locked environment.

IMPORTANT
After completing the configuration of the Communicator, lock the security switch to prevent unauthorized access to the Communicator built-in web interface.

IMPORTANT
To avoid exposure of sensitive data, always perform a factory reset before decommissioning the equipment.

Factory reset will reset any on site made configuration changes and set the Communicator to the same state as leaving HMS production.

See Reset to Factory Settings (page 62).

3.2. Security Advisories

For cybersecurity reasons, stay informed about new vulnerabilities and follow the recommended actions.

HMS Networks Security Advisories includes information about our product vulnerabilities and available solutions.

You find our Safety Advisories at www.hms-networks.com/cybersecurity/security-advisories.

3.3. How to Report a Vulnerability

HMS Networks place the utmost importance on the security of our products and systems, however, despite all the measures we take, it cannot be excluded that vulnerabilities persist.

To report a potential vulnerability in an HMS product or service, please visit www.hms-networks.com/cybersecurity/report-a-vulnerability and follow the instructions.

3.4. Product Cybersecurity Context

3.4.1. Security Defense in Depth Strategy

The defense in depth strategy of the Communicator includes the following security measures:

- Secure Boot: Security standard used to ensure that the Communicator boots using only software that is trusted by HMS Networks.
- Signed firmware: HMS Networks delivers digitally signed firmware. Before the firmware file is imported into the Communicator, the firmware upgrade function performs a validation of the file, to ensure that is authentic.
- Security switch: Used to lock unauthorized access to the Communicator built-in web interface.
- The Communicator is intended to be installed in a Process Control Network (PCN) environment. See Level 1 in the Purdue Model (page 6).
- To physically secure networks and equipment and to prevent unauthorized access, the Communicator is intended to be installed in a locked environment.

3.4.2. Purdue Model

The Communicator is intended to be part of the process control network in Level 1 (E), to enable communication between PLCs or between a PLC and peripheral devices.

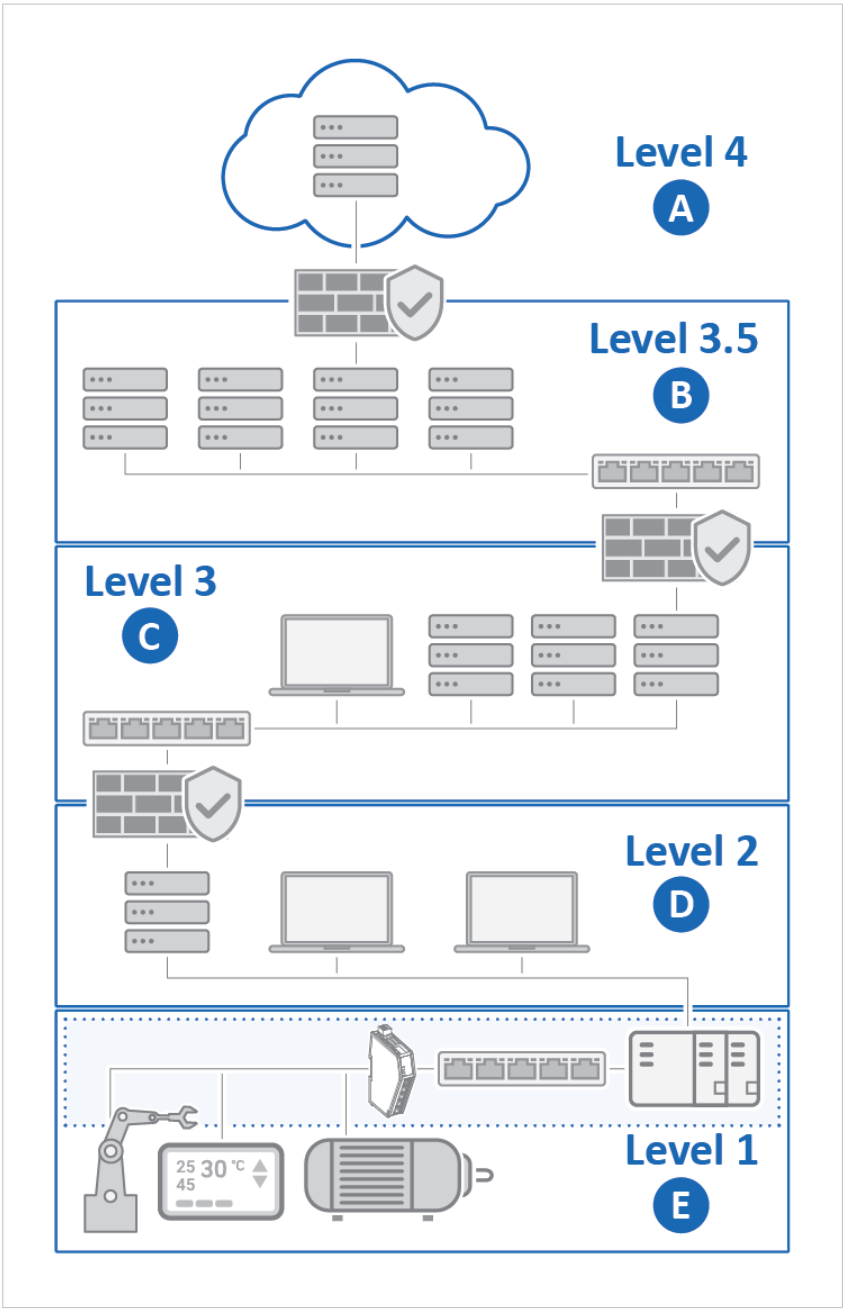


Figure 1. Purdue model, product security context

IT Network

A. **Level 4: Enterprise Network**
Example: Cloud solution, Business LAN (VPN)

B. **Level 3.5: Perimeter Network**
Example: Demilitarized Zone (DMZ)

OT Network

C. **Level 3: Advanced Control Network (ACN)**
Example: SCADA systems, Business control

D. **Level 2: Supervisory Control**
Example: Operator panels, Operator stations, Engineering stations

E. **Level 1: Process Control Network (PCN)**
Environment where the Communicator is installed
Example: Factory floor, Industrial product line

4. Preparation

4.1. Support and Resources

For additional documentation and software downloads, FAQs, troubleshooting guides and technical support, please visit www.hms-networks.com/technical-support.

TIP
Have the product article number available, to search for the product specific support web page. You find the product article number on the product cover.

4.2. Cabling

Have the following cables available:

- Power cable.
- Ethernet cable for configuration.
- Ethernet cable x 1 for connecting to the network.
- 7-pin screw terminal block connector is included with the product.

4.3. Mechanical Tools and Equipment

Have the following tools available:

– Flat-head screwdriver, size 5.5 mm
  Needed when removing the Communicator from DIN-rail.

– Flat-head screwdriver, size 3 mm
  Needed when connecting the cables to the 7-pin connector.

4.4. System Requirements

4.4.1. Supported Operating Systems

Operating System	Description
Windows 7 SP1, 32-bit	Windows 7 32-bit with Service Pack 1
Windows 7 SP1, 64-bit	Windows 7 64-bit with Service Pack 1
Windows 10 64-bit	Windows 10 64-bit
Windows 11 64-bit	Windows 11 64-bit

4.4.2. Supported Web Browsers

The Communicator built-in web interface can be accessed from the following standard web browsers.

- Google Chrome
- Microsoft Edge
- Mozilla Firefox

4.5. HMS Software Applications

Download the software installation files and user documentation from www.hms-networks.com/technical-support.

HMS IPconfig

Use the software application HMS IPconfig and scan your network to discover and change the Communicator IP address and to access the Communicator built-in web interface.

NOTE
As an alternative, you can set a static IP address within the same IP address range as the Communicator IP address on the computer accessing the Communicator built-in web interface.

NOTE
HMS IPconfig is only available for Windows.

4.6. Third-Party Software Applications

Microsoft Excel

Microsoft Excel, or equivalent software application that supports the Office Open XML Workbook (xlsx) file format. Needed to open and read the **Event log** file.

4.7. Software License Information

For license agreements regarding the third-party software used in the Communicator, refer to the *LICENSE.txt* file(s) included in the Communicator firmware update package zip file.

To download the Communicator firmware update package zip file, please visit www.hms-networks.com/technical-support.

TIP
Have the product article number available, to search for the product specific support web page. You find the product article number on the product cover.

5. About Anybus Communicator

5.1. How the Communication Works

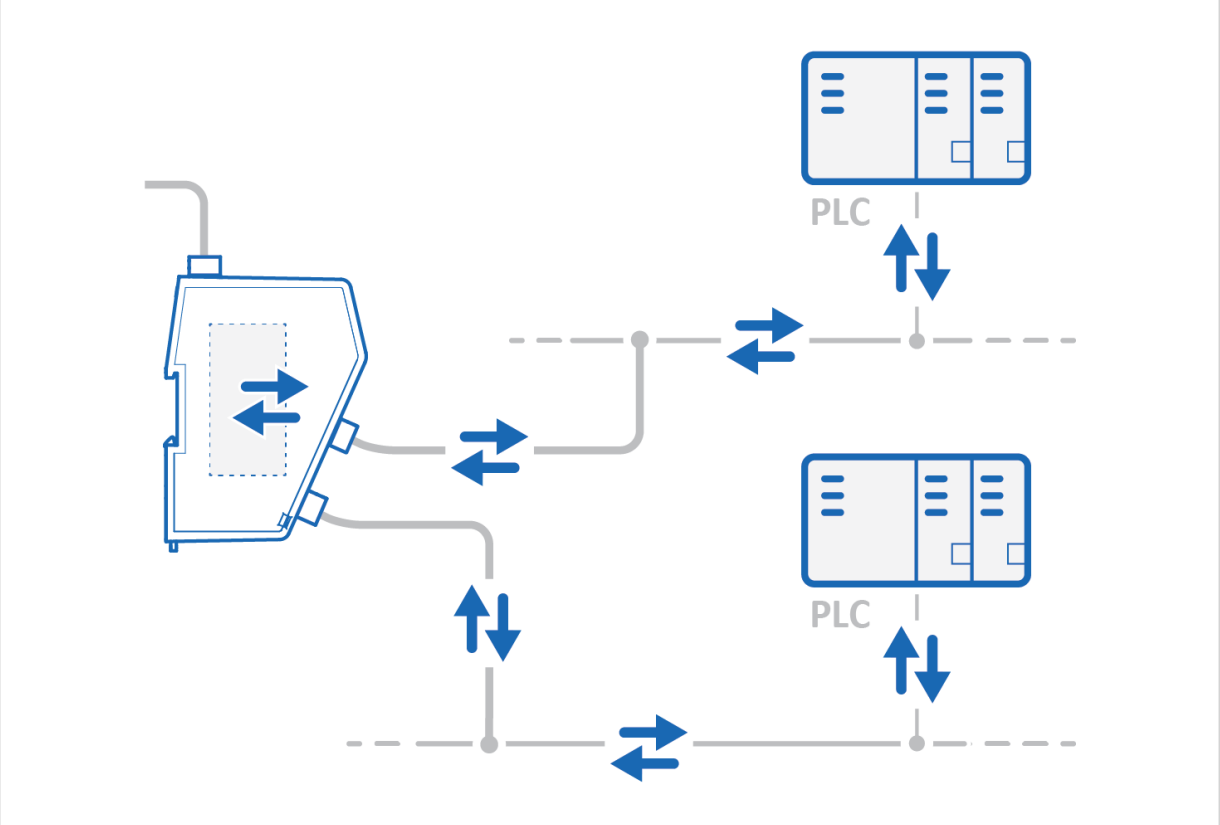


Figure 2. Process data traffic overview

The Communicator enables communication between a Client device connected to a Modbus RTU network and a Client device connected to a EtherNet/IP network.

The Client device can, for example, be a PLC control system or a Gateway.

The Communicator main task is to transfer cyclic I/O data between the two networks.

5.2. How the Data Exchange Works

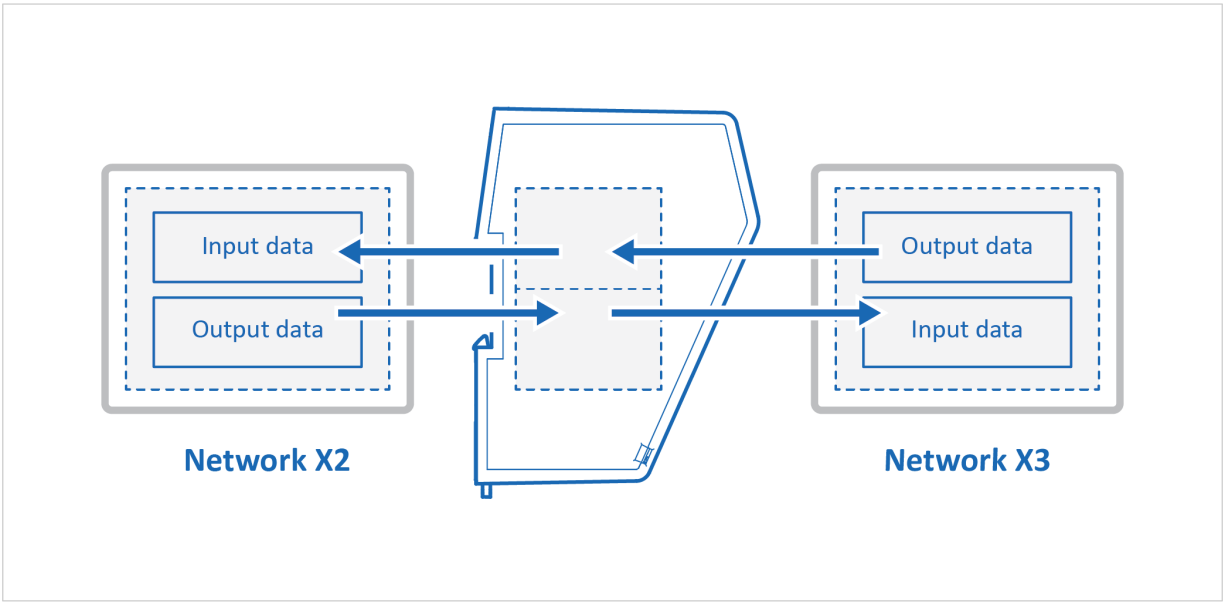


Figure 3. The Communicator internal memory areas

The data exchanged between the Communicator and the Modbus RTU and the EtherNet/IP resides in the Communicator internal memory buffer.

Input Data

This Input data area is read by the EtherNet/IP.

Output Data

The Output data area is read/written by the Modbus RTU.

5.3. Data Integrity

A snapshot of the process data buffer between the Client and the server interface is used during the operation of executing all the transactions within one cycle.

When the cycle is completed, the process data available on the server interface is updated and a new snapshot is created for the next cycle.

6. Installation

6.1. External Parts

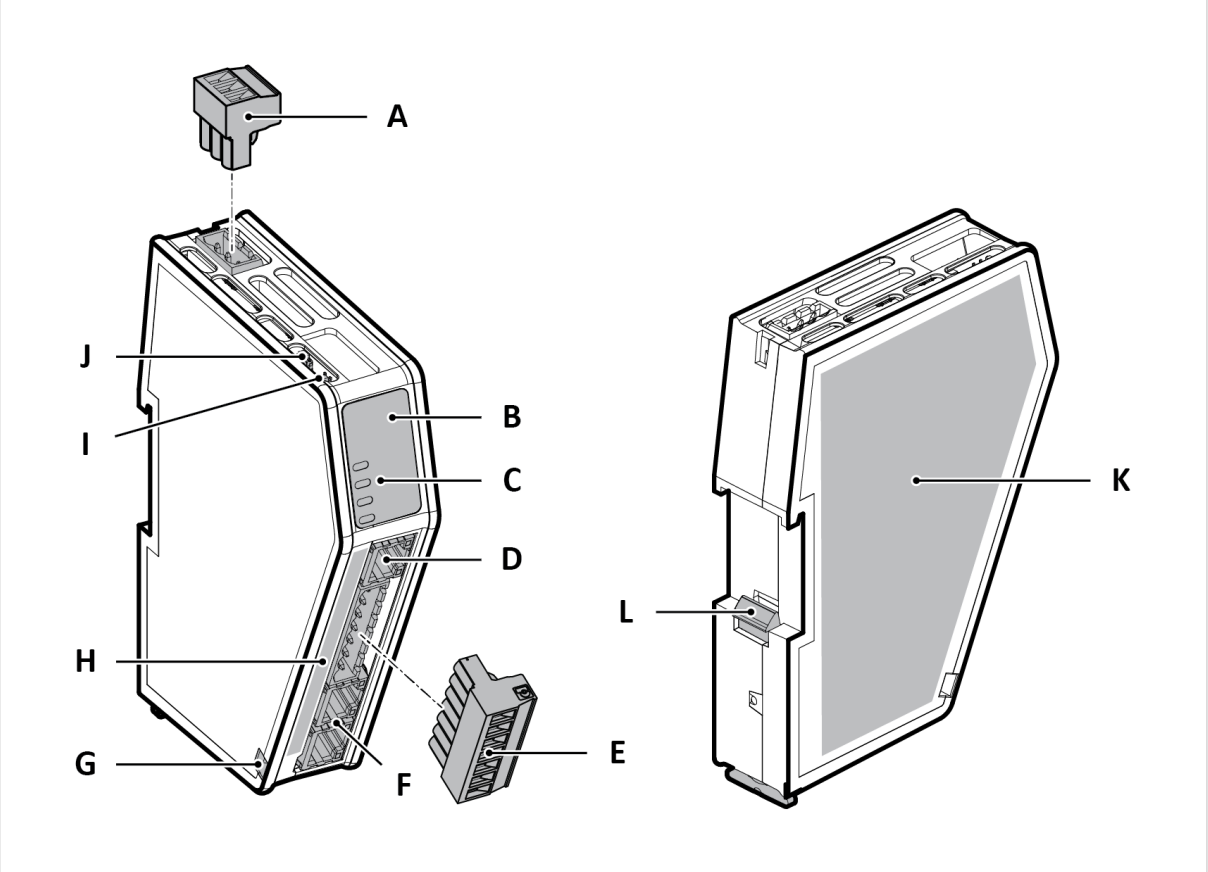


Figure 4. External parts

A. Power connector
B. Label with LED designation
C. Status LEDs
D. Configuration port
E. 7-pin connector
F. EtherNet/IP port x 2
G. Cable tie mount
H. Laser engraved connectors designation
I. Security switch
J. Factory reset button
K. Laser engraved label with product information
L. DIN rail locking mechanism

6.2. Connector Port Guide

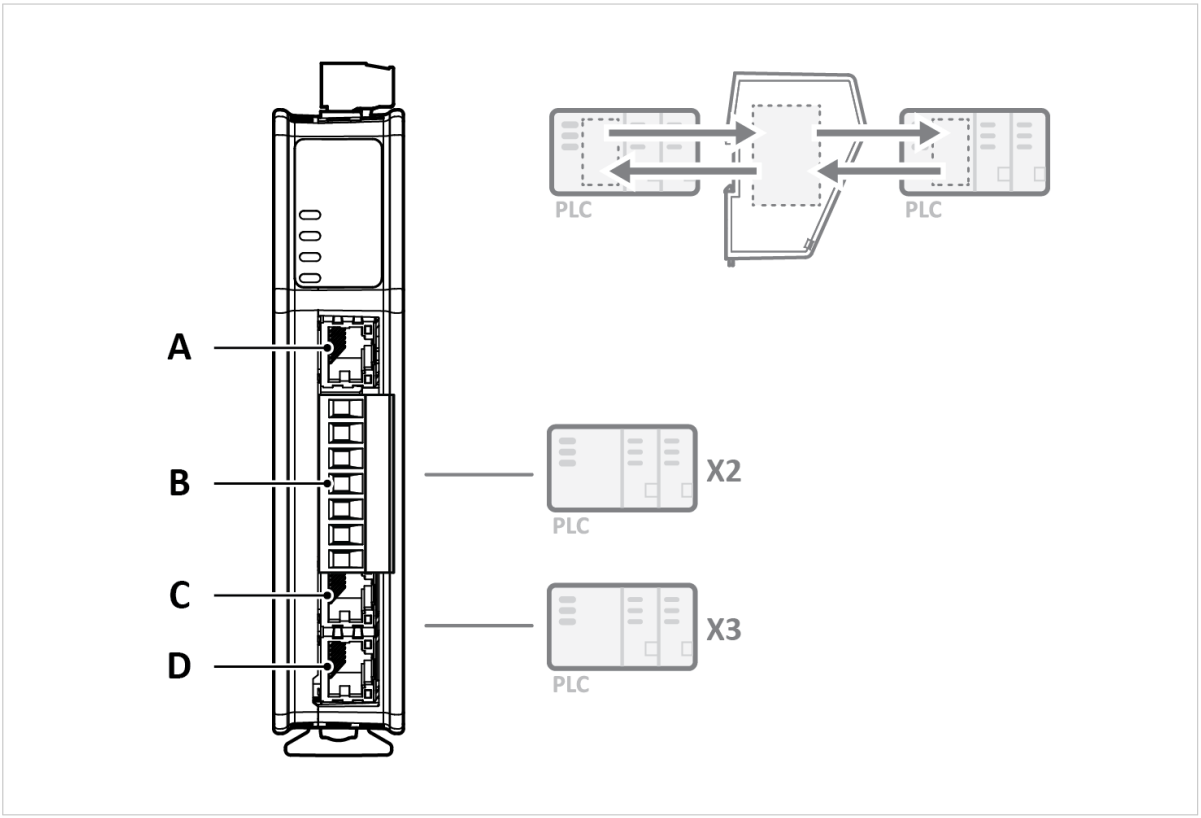


Figure 5. Communicator connector ports

Position	Port Number	Connector	Port Usage
A	X1	Ethernet RJ45	Configuration port
B	X2	7 Pin Screw Terminal Block	Modbus RTU network
C	X3.1	Ethernet RJ45	EtherNet/IP network
D	X3.2	Ethernet RJ45	EtherNet/IP network

See also Connect to Modbus RTU Network and Connect to EtherNet/IP Network (page 16).

6.3. DIN Rail Mounting

IMPORTANT
The equipment must be electrically grounded through the DIN rail for EMC compliance. Make sure that the equipment is correctly mounted on the rail and that the rail is properly grounded.

IMPORTANT
To physically secure networks and equipment and to prevent unauthorized access, it is recommended to install the equipment in a locked environment.

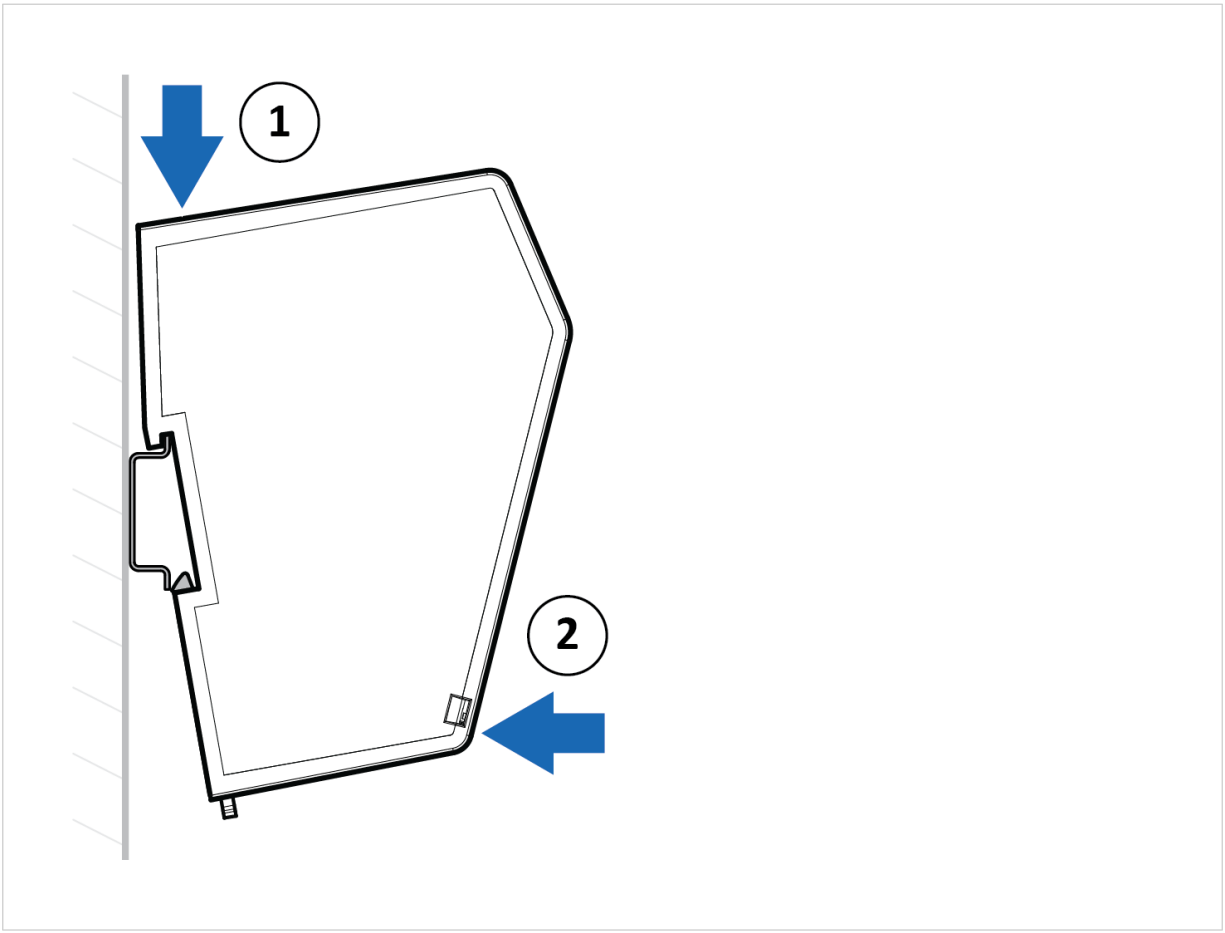


Figure 6. Attach the Communicator on the DIN rail

To attach the Communicator on the DIN rail:

1. Insert the upper end of the DIN rail clip into the DIN rail.
2. Push the bottom of the DIN rail clip into the DIN rail.

6.4. Connect to Modbus RTU Network

NOTE
Use minimum 90 oC copper (Cu) wire only.

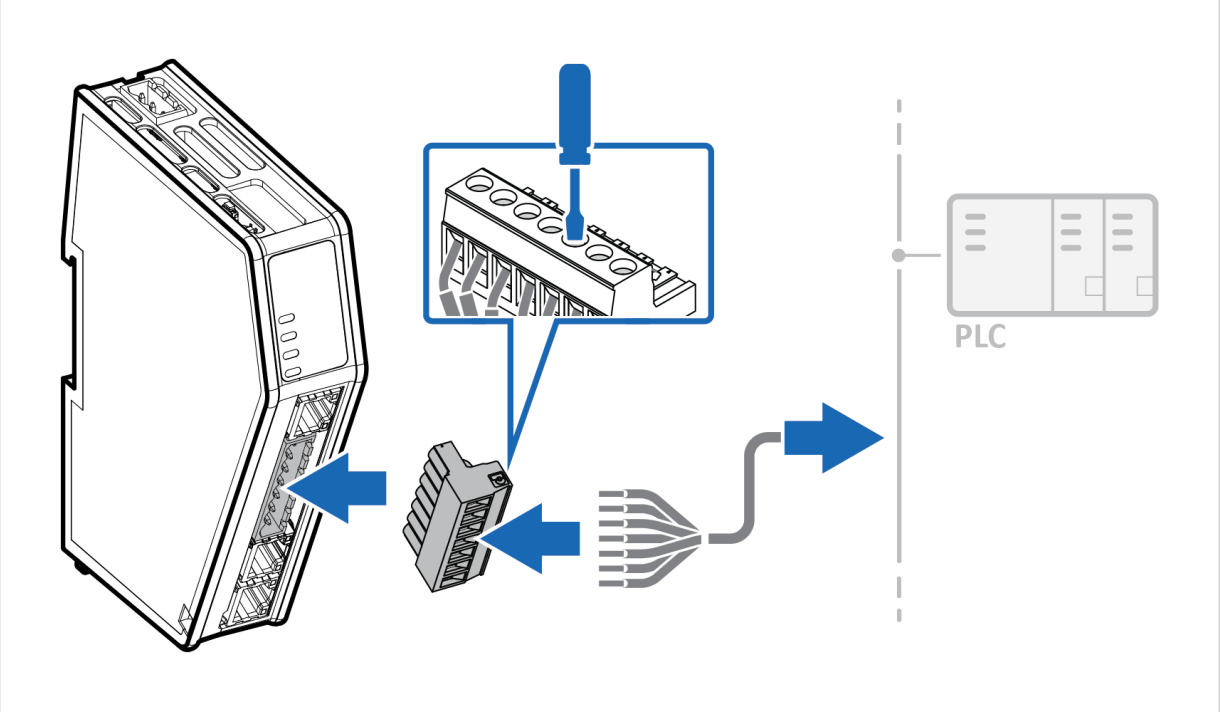


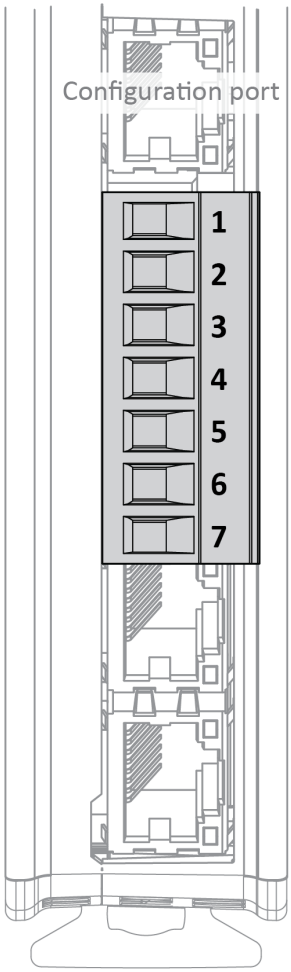
Figure 7. Connect to Modbus RTU network

Procedure

1. Insert the cable wires into the 7-pin connector and tighten the wire clamp screws.
2. Connect the 7-pin connector to the Communicator.
3. Connect the Communicator to your Modbus RTU network.

Modbus RTU Serial Connector Pinout

NOTE
Use minimum 90 oC copper (Cu) wire only.

7-pin connector	Pin	Signal
	1	+5 V OUT
	2	RS485+ A
	3	RS485- B
	4	Signal GND
	5	Functional Earth (FE)
	6	RS232 Tx Transmit Data
	7	RS232 Rx Receive Data

6.5. Connect to EtherNet/IP Network

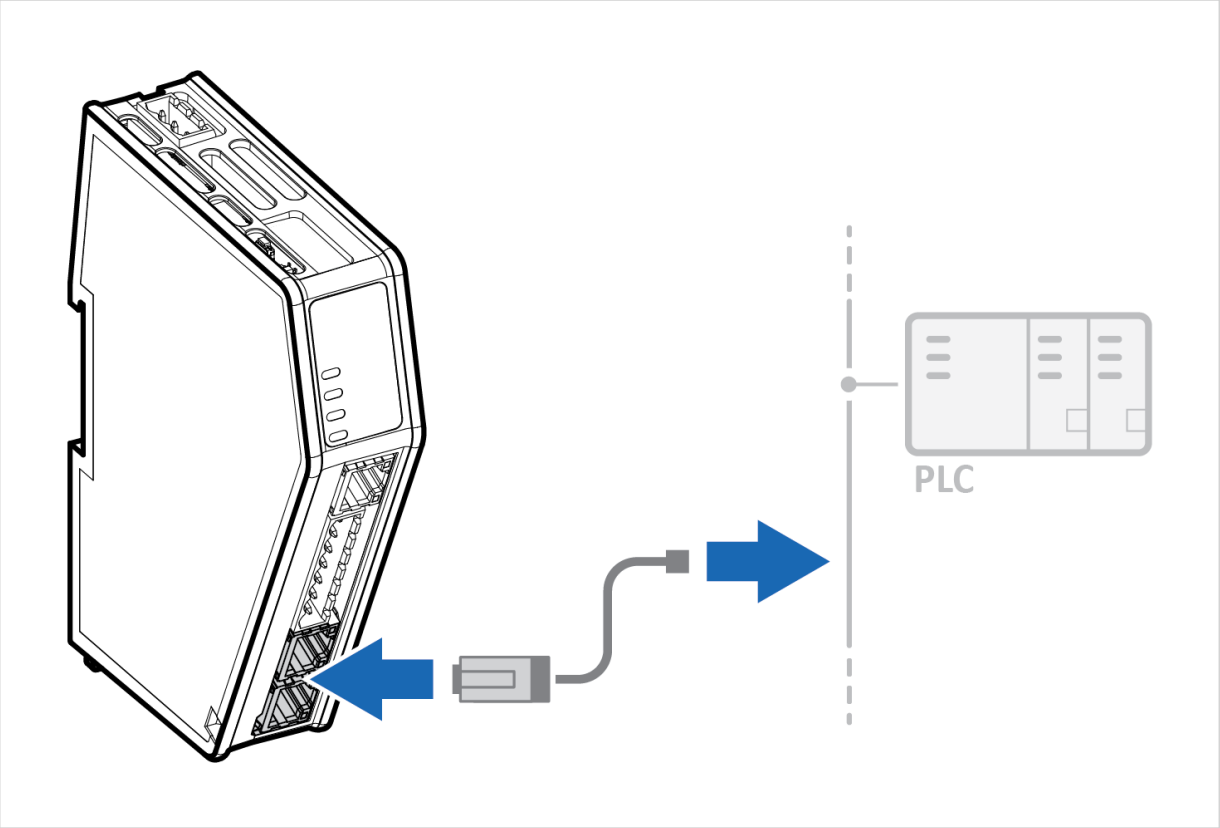
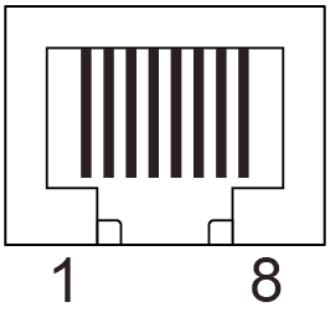


Figure 8. Connect to EtherNet/IP network

Connect the Communicator, lower connector, to your EtherNet/IP

network.

Ethernet RJ45 Connector	Pin	Description
	1	TD+
	2	TD-
	3	RD+
	4	Not used
	5	Not used
	6	RD-
	7	Not used
	8	Not used

6.6. Connect to Power

CAUTION
Ensure that the power supply is turned off before connecting it to the equipment.

IMPORTANT
Using the wrong type of power supply can damage the equipment. Ensure that the power supply is connected properly and of the recommended type.

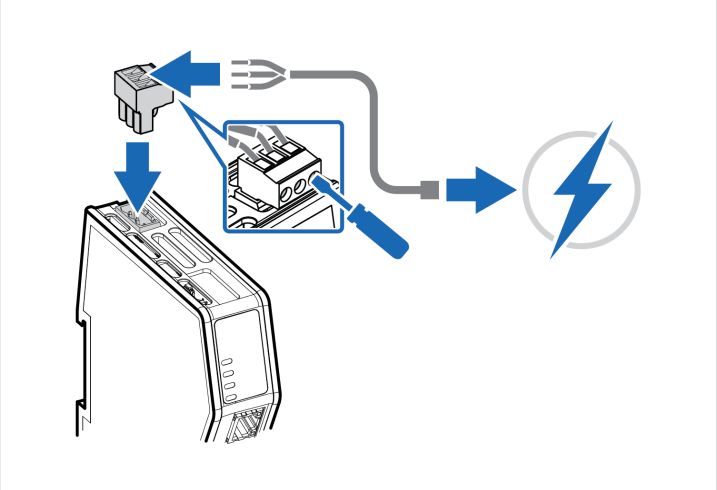
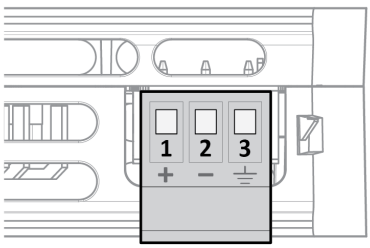


Figure 9. Connect to power

Power Connector Pinout

Power port	Pin	Description
	1	12-30 VDC Power Connector
	2	Ground (GND)
	3	Functional Earth (FE)

Procedure

1. Insert the cable wires to the terminal block and tighten the wire clamp screws.
2. Connect the terminal block to the Communicator.
3. Connect the Communicator to a power supply.
4. Turn on the power supply.

6.7. Security Switch

IMPORTANT
After completing the configuration of the Communicator, lock the security switch to prevent unauthorized access to the Communicator built-in web interface.

When the security switch is in its locked position, the Communicator built-in web interface cannot be accessed, and the Communicator cannot be configured using the built-in web interface. Network specific parameters, configured via the PLC is still available.

To Lock and Unlock the Security Switch

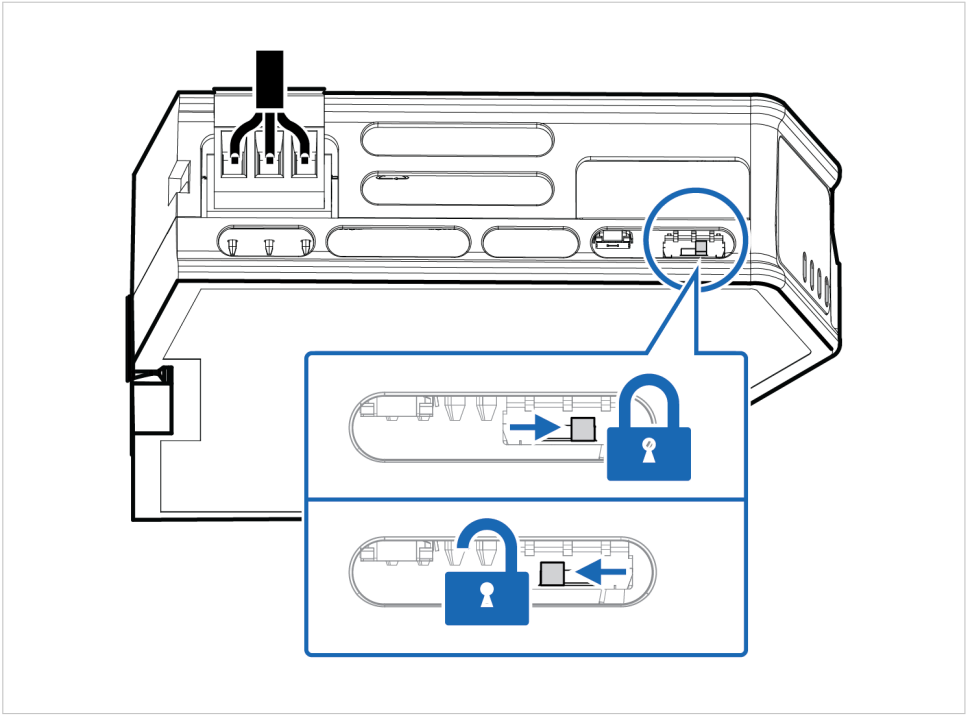


Figure 10. Security switch in locked and unlocked position

Use a pointed object, such as a ballpoint pen.

- To **lock** the security switch, push the toggle towards the **Communicator front**.
- To **unlock** the security switch, push the toggle towards the **Communicator back**.

Security Switch Status LED

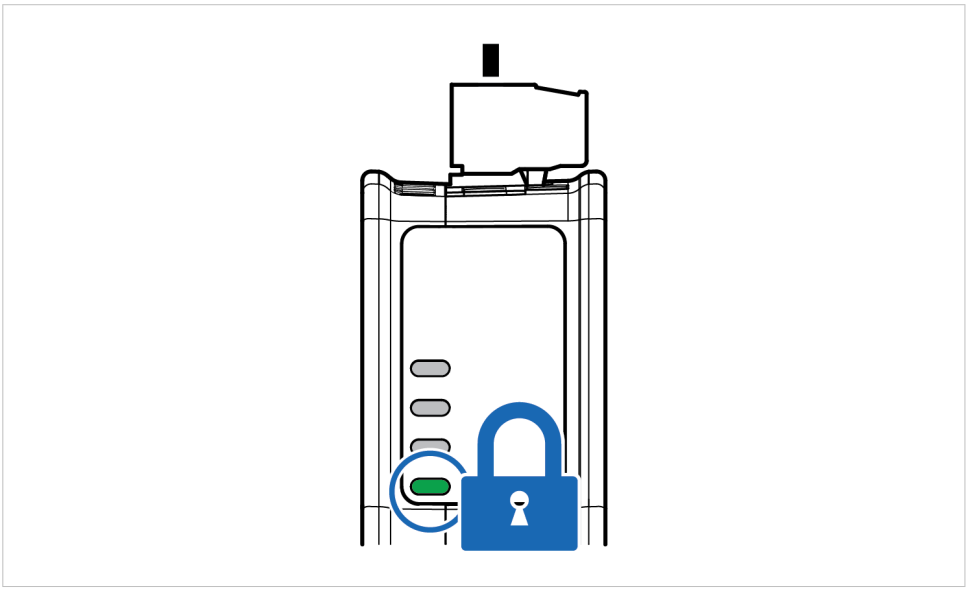


Figure 11. Security switch locked status LED

When the security switch is in its:

- locked position, the security switch status LED turn solid green.
- unlocked position, the security switch status LED is turned off.

6.8. Lock the Cables

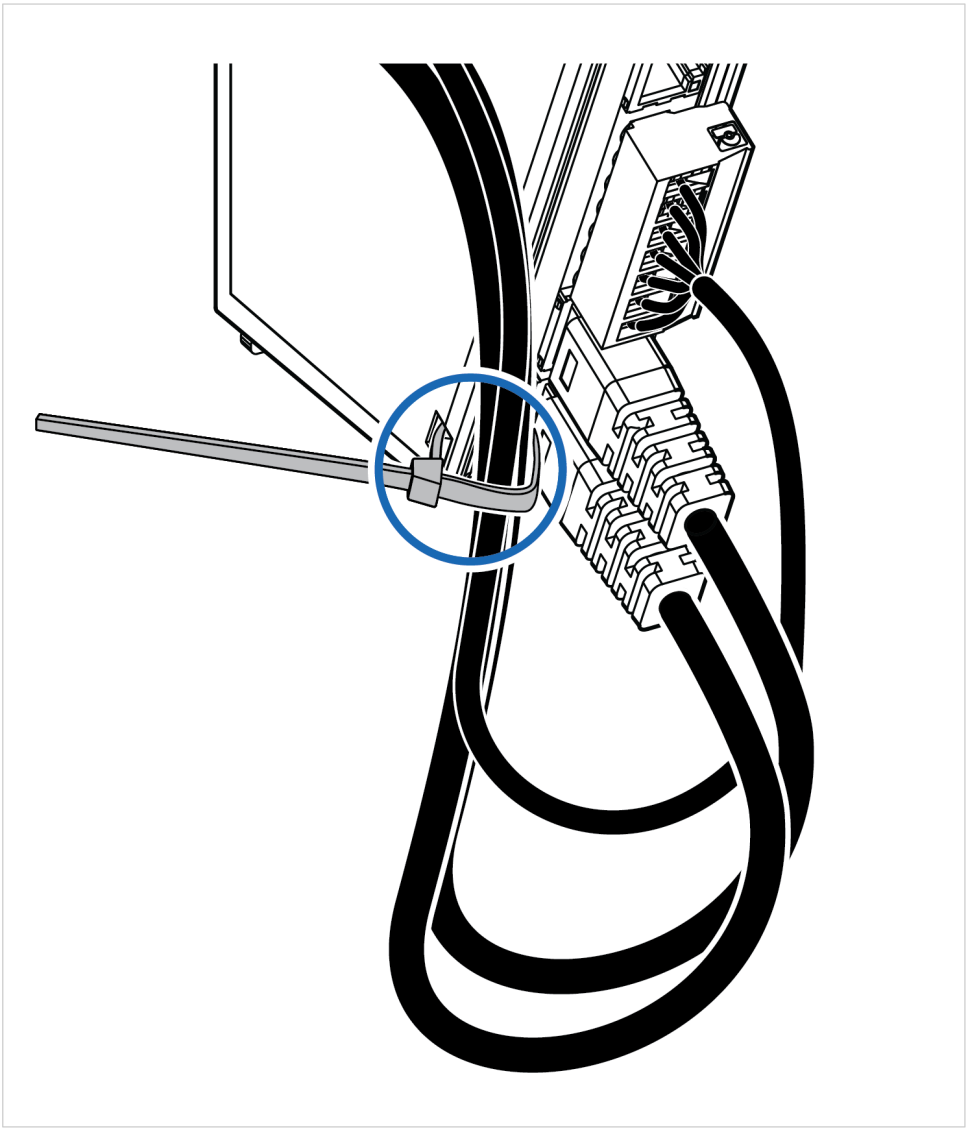


Figure 12. Lock the cables

To strain relieve the cables, place a cable tie in the holder and lock the cables.

6.9. DIN Rail Demount

Before You Begin

IMPORTANT
Be careful when removing the Communicator from the DIN-rail. If not removed properly, the DIN rail locking mechanism and the product cover can break.

Have a flat-blade screwdriver, size 5.5 mm, available.

Procedure

Remove the Communicator from the DIN rail:

1. Insert the screwdriver into the Communicator DIN rail locking mechanism.
2. To unlock the Communicator DIN rail locking mechanism, turn the screwdriver clockwise.

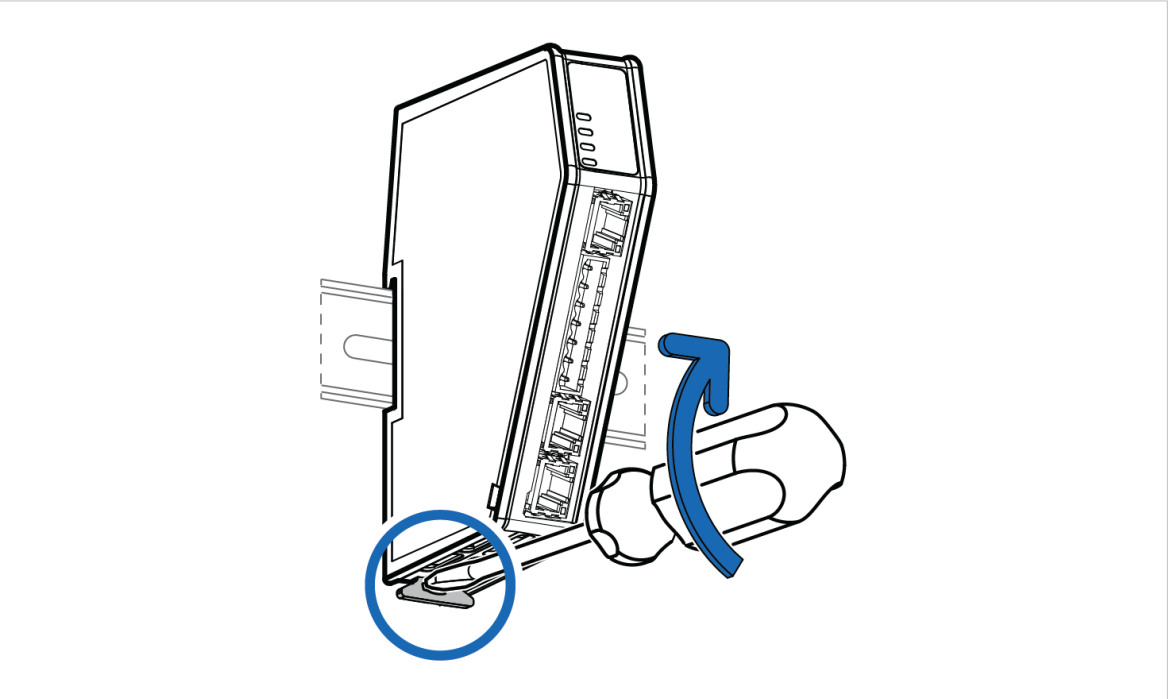


Figure 13. Unlock the Communicator

3. Hold the screwdriver in the DIN rail locking mechanism while you unhook the Communicator from the DIN rail.

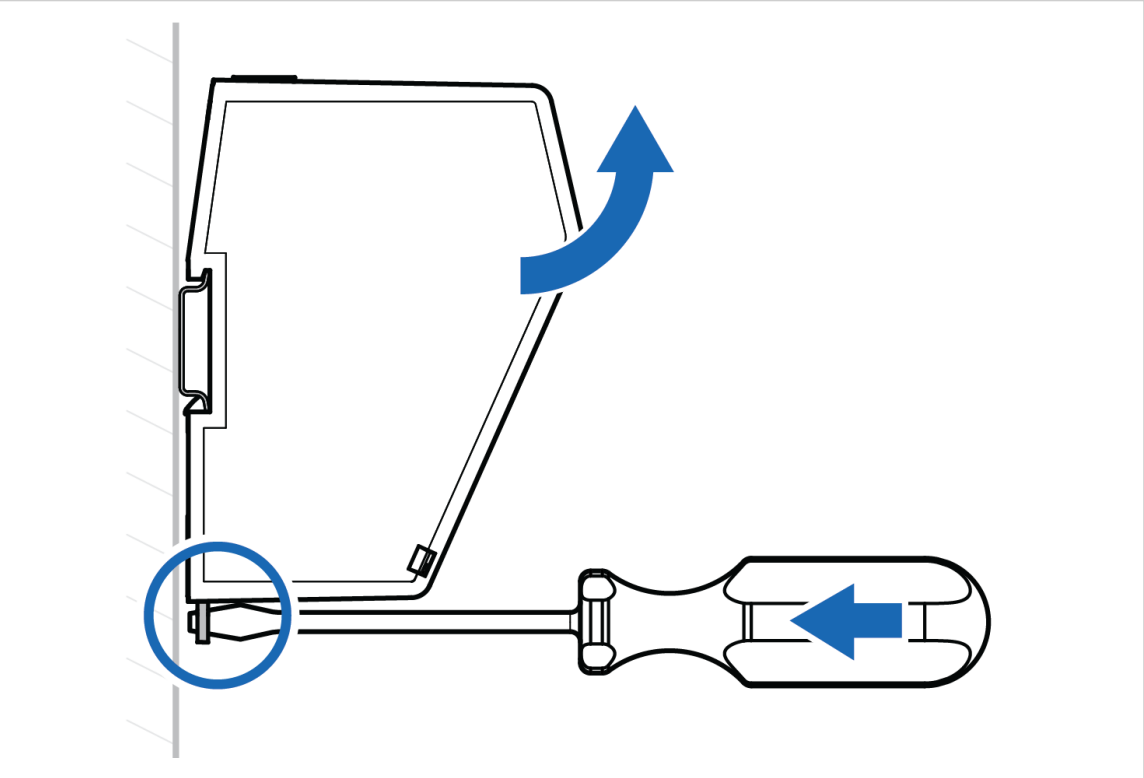


Figure 14. Unhook the Communicator

7. Communicator Configuration

7.1. Modbus RTU Settings

7.1.1. Communication Settings

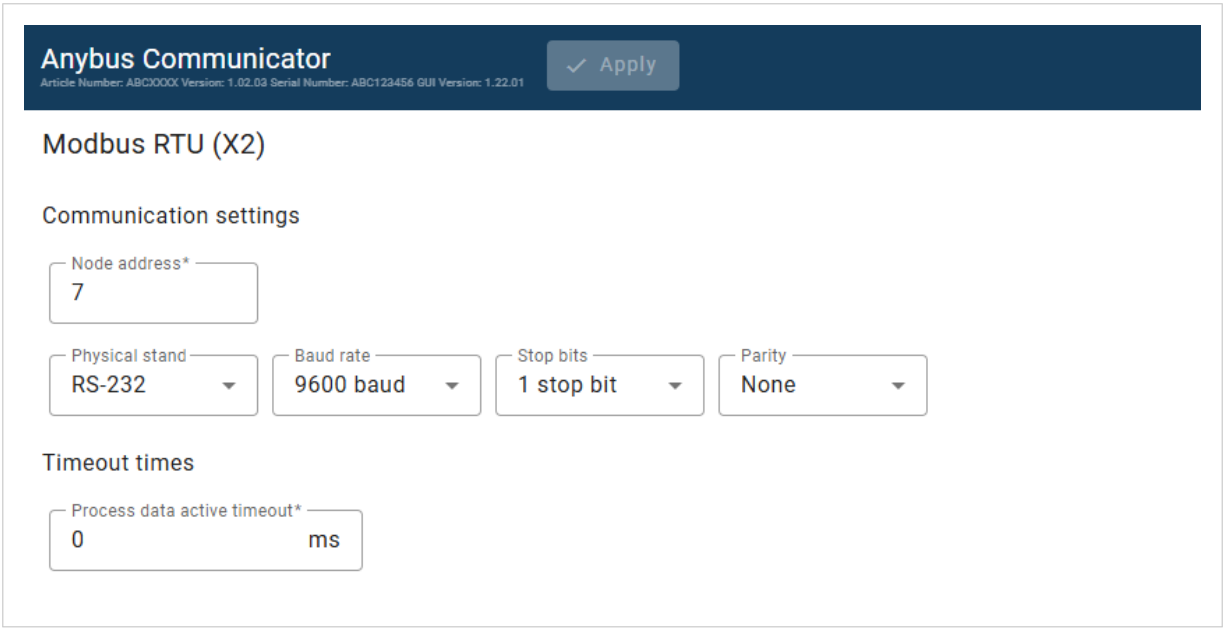


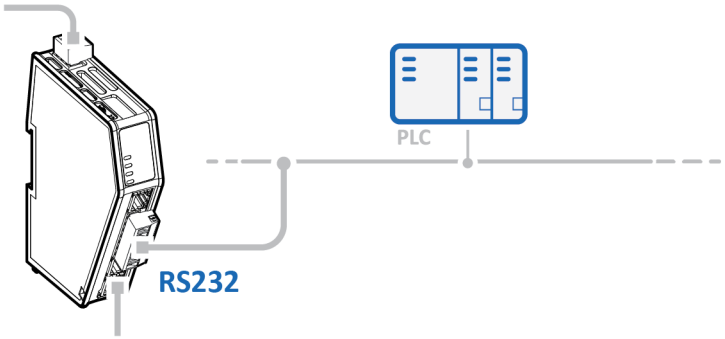
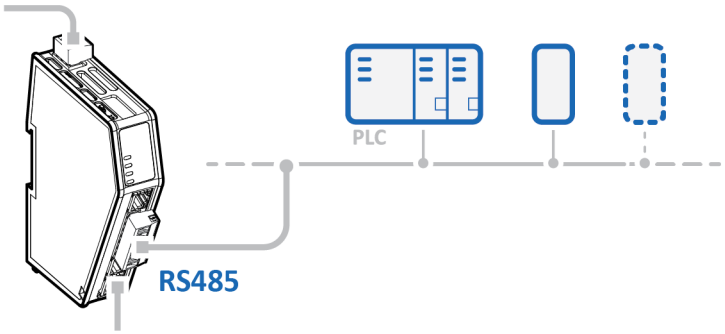
Figure 15. Communication, Basic settings

Node Address
Enter the **Node address** for the Modbus RTU server connected to the Communicator.

Physical Standard

Specify the physical interface type for the Modbus RTU network.

Select a physical standard from the **Physical standard** drop-down menu.

Setting	Value	Description
Physical standard	RS-232, Default standard	Use RS-232 when one single device is connected to the network. 
	RS-485	Use RS-485 when multiple devices are connected to the network. 

Baud Rate

Specify the baud rate; the serial transfer speed, maximum bits per second.

Select a baud rate value from the **Baud rate** drop-down menu.

Setting	Value
Baud rate	1200 baud
	1800 baud
	2400 baud
	4800 baud
	9600 baud, Default value
	19200 baud
	35700 baud
	38400 baud
	57600 baud
	115200 baud
	128000 baud

Stop Bits
Specify the number of stop bits used to indicate the end of data transmission.

Select a stop bits value from the **Stop bits** drop-down menu.

Setting	Value
Stop bits	1 stop bit, Default value
	2 stop bit

Parity
Specify if parity should be used to detect errors in the data.

Select parity value from the **Parity** drop-down menu.

Setting	Value	Description
Parity	None, Default value	No parity checking Parity bit is not transmitted
	Odd	Odd parity checking
	Even	Even parity checking

Timeout Times

Process Data Active Timeout
Specify the maximum allowed time between two incoming messages in steps of 10 ms.

To enable **Process data active timeout**, enter a value between 1 and 65535 milliseconds (ms).

If this time is exceeded, the Modbus RTU network is considered to be offline.

The data sent to the EtherNet/IP network is frozen.

To enable clear data, see Process Data Settings (page 34).

A value of 0 disables this feature, i.e. the Modbus RTU network can never go offline.

The default value is 0 ms.

Apply Configuration
To apply the settings, click **Apply** in the built-in web interface header and follow the instructions.

7.1.2. Legacy Mode for Anybus Address Mode | Modbus RTU

Advanced settings option for Modbus RTU Server.

About Legacy Mode
Use Legacy Mode when you want to make a new Communicator compatible with the X-gateway Anybus Address Mode.

See also Legacy Address Mode I/O Data Mapping (page 46).

To Use Legacy Mode

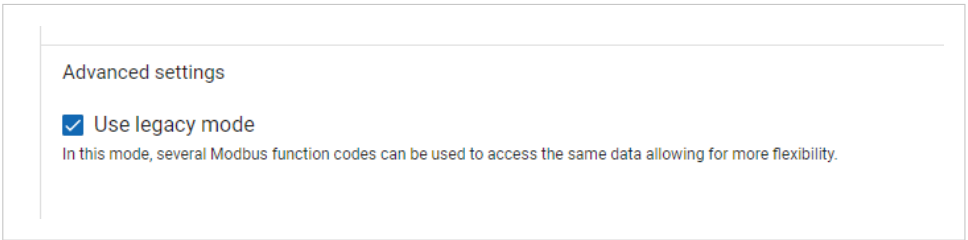


Figure 16. Advanced settings > Use legacy mode

To enable Legacy mode, select the **Use legacy mode** checkbox.

7.2. EtherNet/IP Settings

7.2.1. EtherNet/IP IP Settings

To Use DHCP Server

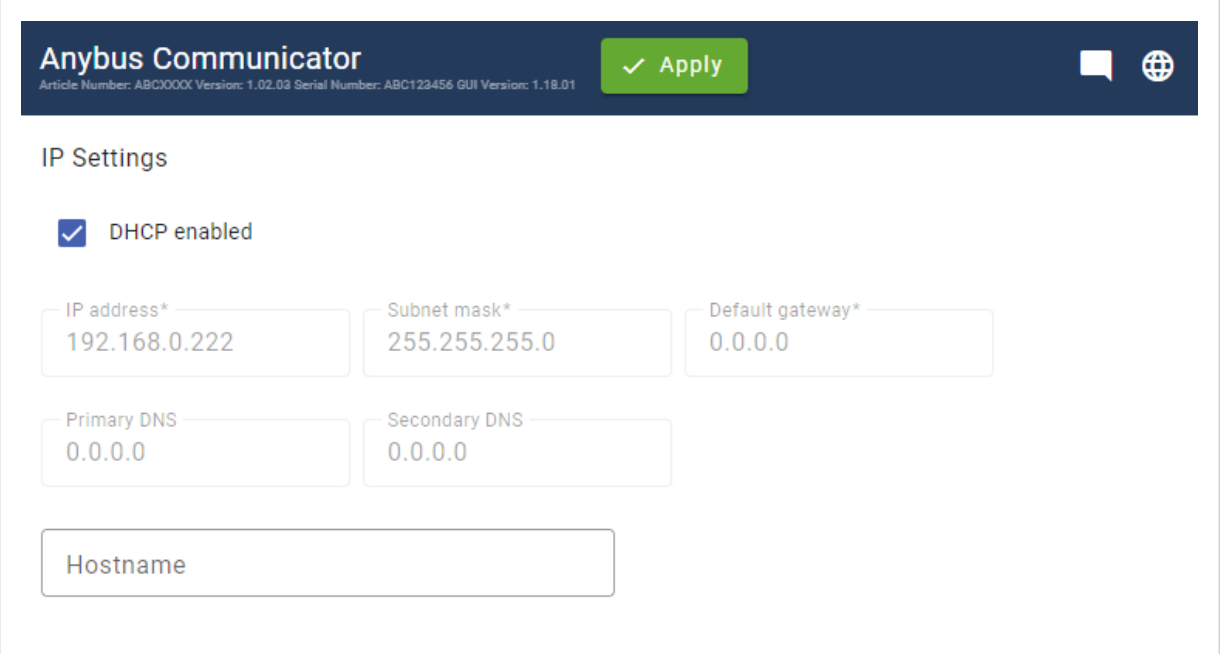


Figure 17. IP Settings, DHCP enabled

By default, the IP settings are provided by the high level network DHCP server. The **DHCP enabled** checkbox is selected.

Default Communicator IP Settings

The Communicator comes with the following factory default IP settings:

Setting	Default value
DHCP	Enabled
IP address	There is no default IP address.
Subnet mask	255.255.255.0
Gateway address	There is no default Gateway address.
Primary DNS server	There is no default Primary DNS server.
Secondary DNS server	There is no default Secondary DNS server.
Hostname	You can label the Communicator. Maximum length is 64 characters. No symbol characters, punctuation characters, or whitespace are permitted. Write the Hostname as one single word.

To Configure IP Settings Manually

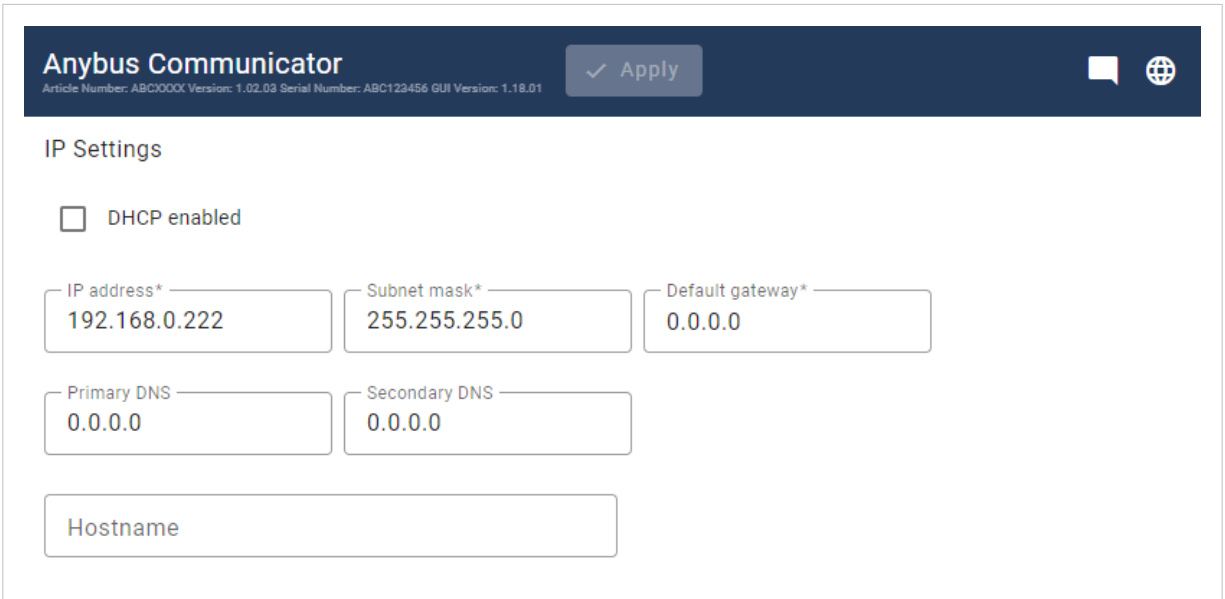


Figure 18. EtherNet/IP IP Settings, DCHP disabled

1. Deselect the **DHCP enabled** checkbox.
2. Configure the IP settings.

Setting	Description
IP address	The EtherNet/IP network IP address in IPv4 dot-decimal notation
Subnet mask	The EtherNet/IP network Subnet mask in IPv4 dot-decimal notation.
Gateway address	The EtherNet/IP network Gateway address in IPv4 dot-decimal notation. If there is no gateway available, set the Gateway address to: 0.0.0.0
Primary DNS	The EtherNet/IP network Primary DNS in IPv4 dot-decimal notation.
Secondary DNS	The EtherNet/IP network Secondary DNS in IPv4 dot-decimal notation.
Hostname	You can label the Communicator. Maximum length is 64 characters. No symbol characters, punctuation characters, or whitespace are permitted. Write the Hostname as one single word.

Naming the Host

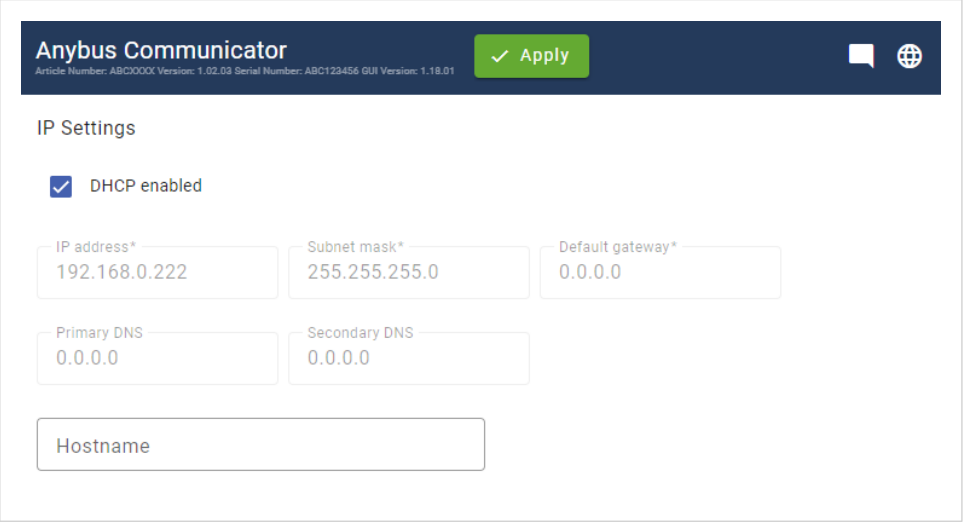


Figure 19. IP Settings Hostname

You can label the Communicator.

- The maximum allowed length of the Hostname is 64 characters.
- No symbol characters, punctuation characters, or whitespace are permitted.
- Write the Hostname as one single word.

7.2.2. Connection Settings

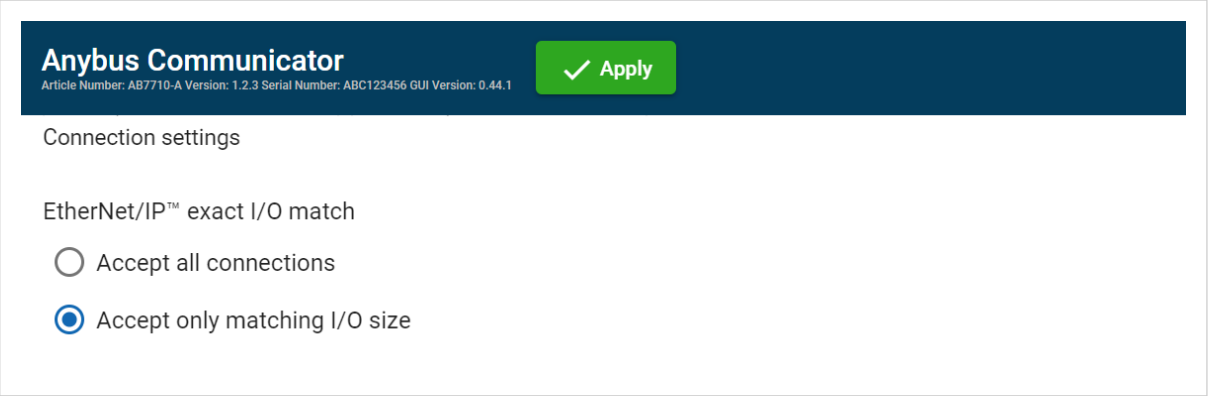


Figure 20. **EtherNet/IP** page, Connection settings

When the EtherNet/IP Client (PLC) opens a connection to the Communicator, it specifies an I/O data size.

By default the Communicator is set to **Accept Only Matching I/O Sizes**.

The connections must match the I/O size configured on the **EtherNet/IP** page, refer to To Use DHCP Server (page 27) and To Configure I/O Sizes Manually.

You can change to **Accept All Connections**.

The Communicator will accept all connections with an I/O size that is equal to or smaller than the configured I/O size in the Communicator.

7.2.3. Legacy Mode for Electronic Data Sheets (EDS) File

Before You Begin

IMPORTANT
Legacy mode does not support acyclic communication.

If you already have an Anybus X-gateway device description file installed in your PLC, legacy mode allows you to continue using the settings from the device description file for the new Communicator.

Procedure
To enable the legacy mode, select the **Use legacy mode** checkbox.

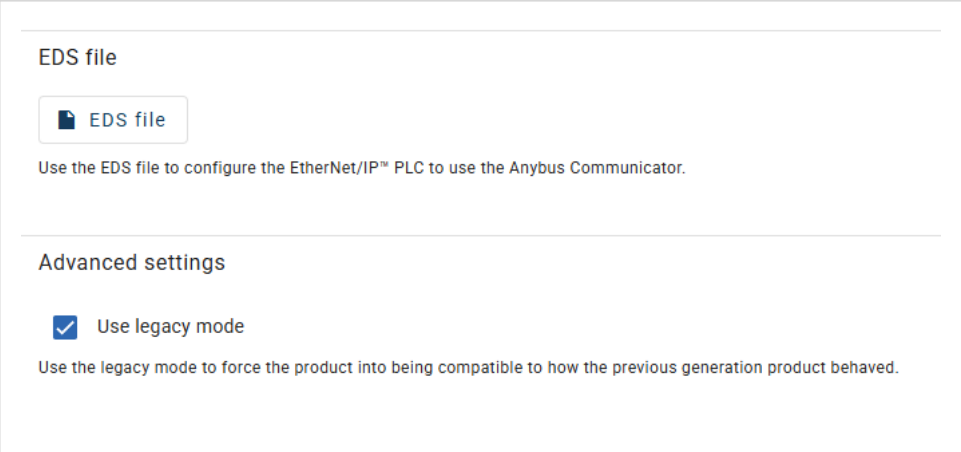


Figure 21. Advanced settings > Use legacy mode

When Use legacy mode is enabled, the device description file download becomes inactive.

7.3. I/O Configuration

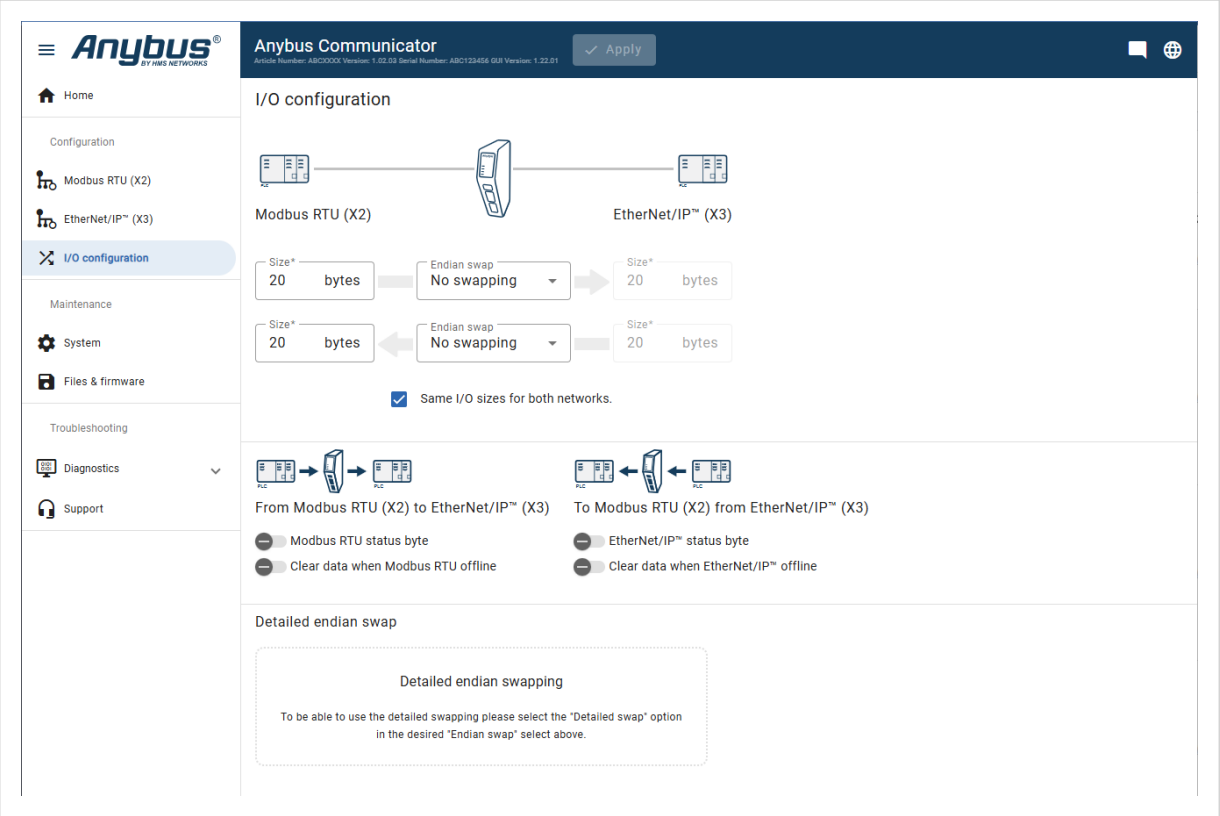


Figure 22. I/O configuration page

Enter the desired **Size** for the network input data and output data.

By default, the Communicator is set to use the same I/O sizes for both the Modbus RTU and the EtherNet/IP networks.

To configure different sizes for the networks, deselect the **Same I/O sizes for both networks** checkbox.

7.3.1. Endian Swap

By default, Communicator uses **No swapping**.

About Endianness

Big-endian (BE)

The big-endian format places the most significant byte of the data at the byte with the lowest memory address.

Little-endian (LE)

The little-endian format places the least significant byte of the data at the byte with the lowest memory address.

7.3.2. Convert Between Big-Endian and Little-Endian

To convert between big-endian and little-endian you must reverse the byte order.

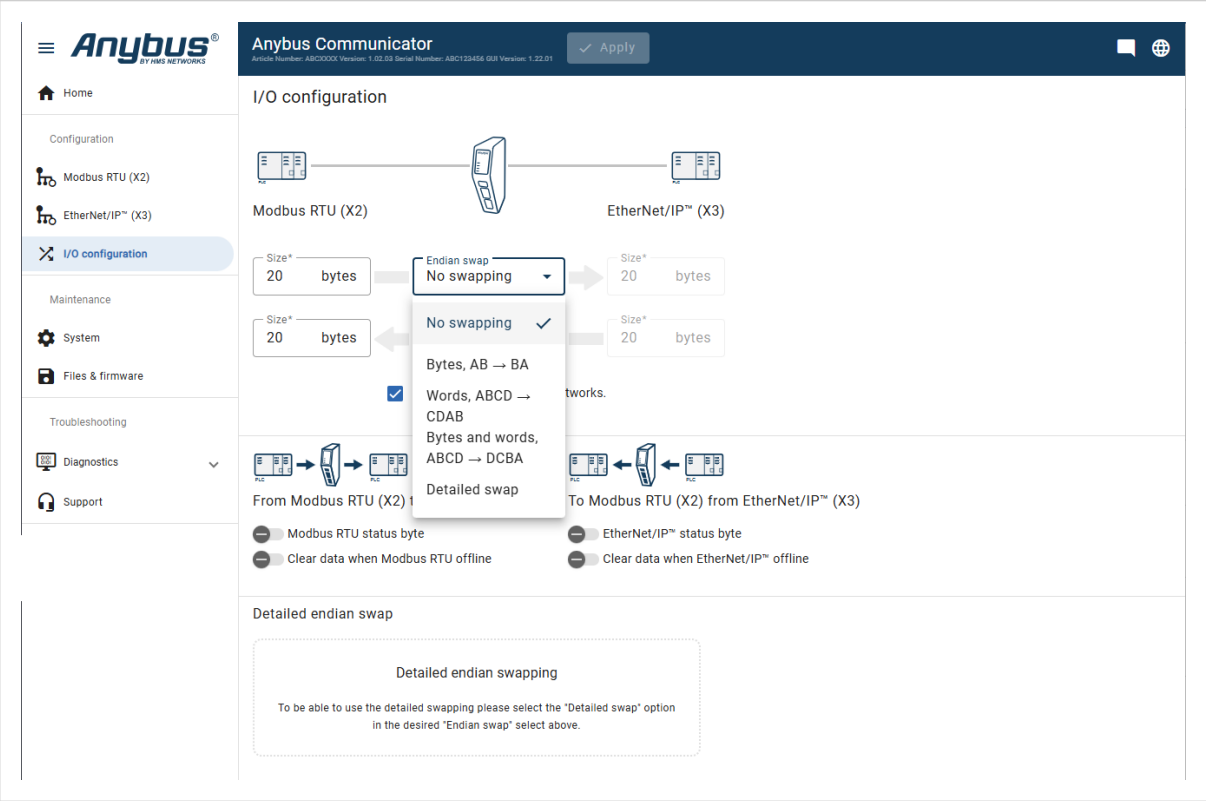


Figure 23. **I/O configuration** page, Endian swap

To reverse the byte order:

1. In the web-interface left sidebar menu, click **I/O configuration**.
2. In the data map, select the connection for which you want to do swap the byte order.
3. Select the endian swap type from the **Endian swap** drop-down menu.

Setting	Description
No swapping	Default setting No swapping is performed on the data.
Bytes	Swap 2 bytes A B C D becomes B A D C
Words	Swap 4 bytes A B C D becomes C D A B
Bytes and words	A B C D becomes D C B A
Detailed swap	With Detailed swap, you can select a Endian swap method for each byte in the I/O Configuration. Set the endian swap type **No swap**, **Bytes, AB → BA**, **Word swap, ABCD → CDAB** or **Bytes and words, ABCD → DCBA** for each bite. See Build Detailed Endian Swap (page 33).

4. To apply the settings, click **Apply** in the web-interface header, and follow the instructions.

7.3.3. Build Detailed Endian Swap

If you have multiple data types, you can use the **Detailed endian swap** to change different parts of the data area in different ways.

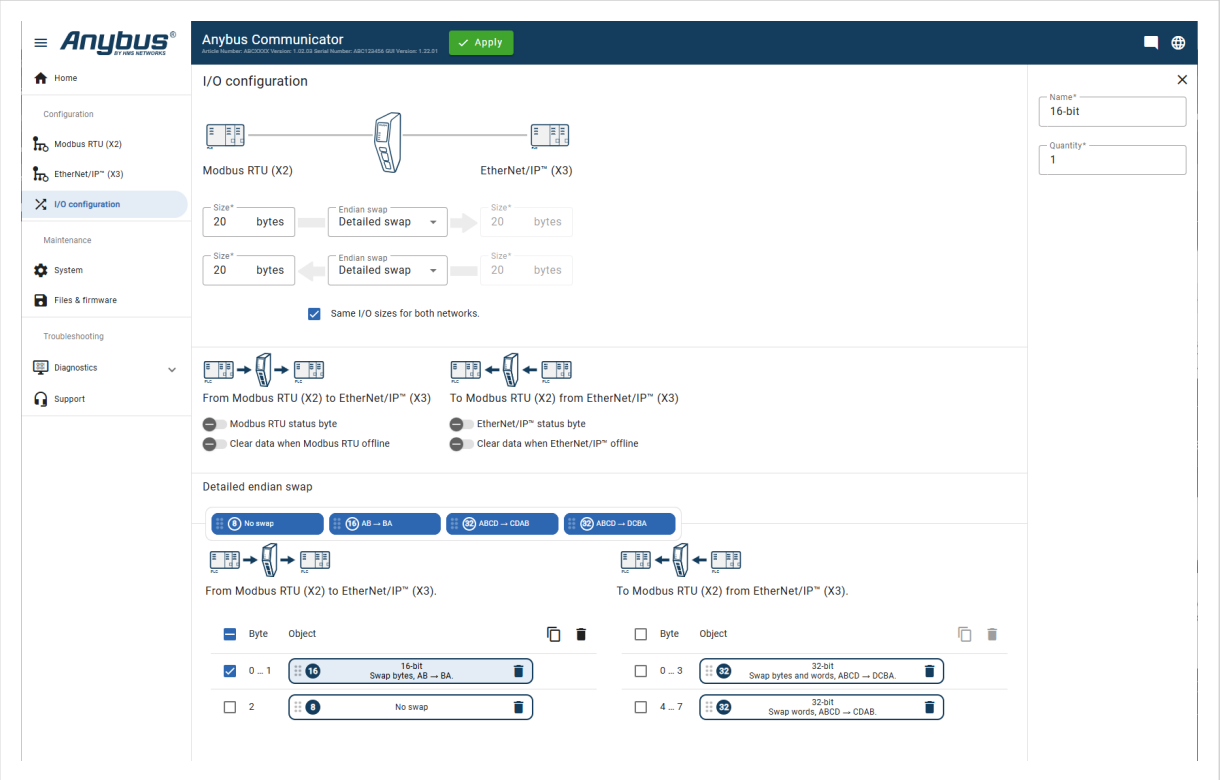


Figure 24. Detailed endian swap example

1. In the **Endian swap** drop-down menu for the desired network(s), select **Detailed swap**.
2. Build the detailed endian swap.

- To add an endian swap object: Drag and drop the desired endian swap object from the toolbar into the drag and drop fields.
- To duplicate an endian swap object: Select the checkbox in front of the endian swap object that you want to duplicate and click the **Duplicate selected** button.
  You can select multiple endian swap objects and duplicate the group.
- To change the order of the endian swap objects, drag and drop the endian swap objects in the list.

7.3.4. Process Data Settings

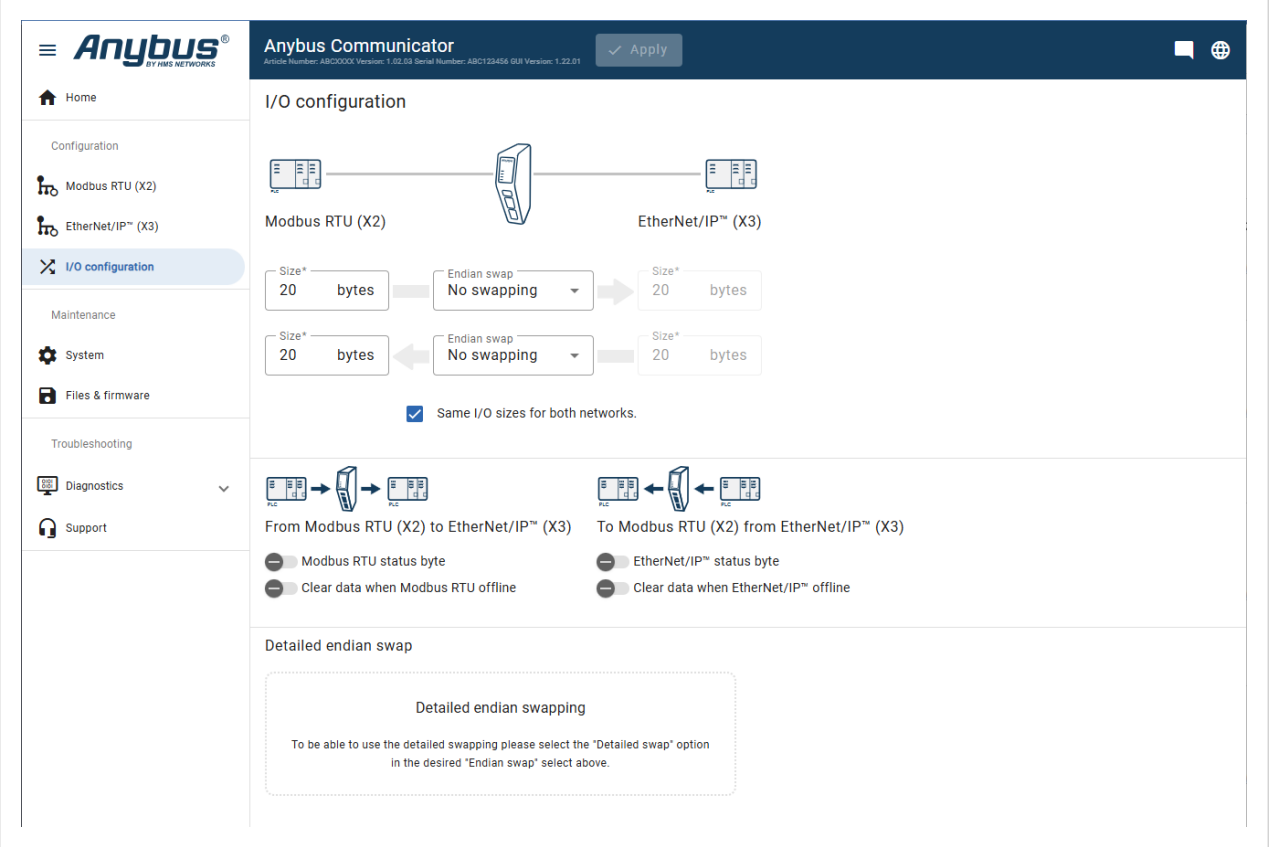


Figure 25. I/O configuration page

Status Byte

IMPORTANT
Adding a status byte to the I/O area after the data swap can cause data to be overwritten.

A status byte is used where a bit is:

- 1 if the corresponding network is online
- 0 if the corresponding network is not online

When status byte is enabled, it replaces the first data position in the data packet.

By default the status byte settings are disabled.

To enable **Modbus RTU status byte** and/or **EtherNet/IP status byte**, click the slide toggle(s).

Clear Data

When clear data is enabled, any data sent to/from the Communicator while the network is offline is reset to zero.

By default the clear data settings are disabled.

To enable clear data, click the slide toggle for each network.

7.4. Configuration Notes

You can add notes to describe the Communicator configuration.

7.4.1. Add Configuration Note

Procedure

1. To open the **Configuration Notes** window, click on the **comments** icon .

Figure 26. Configuration note, comment icon

2. To add a new configuration note, click **Add**.

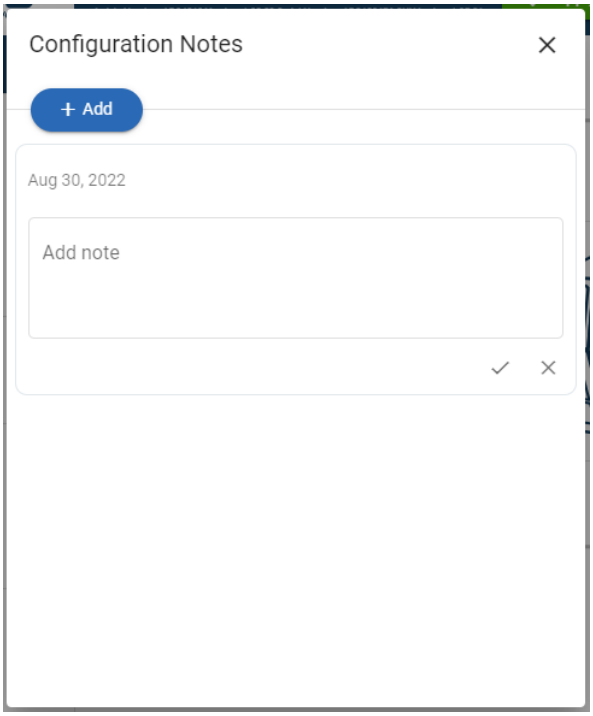


Figure 27. Add new configuration note

3. Write your configuration note and click **accept** ✓.

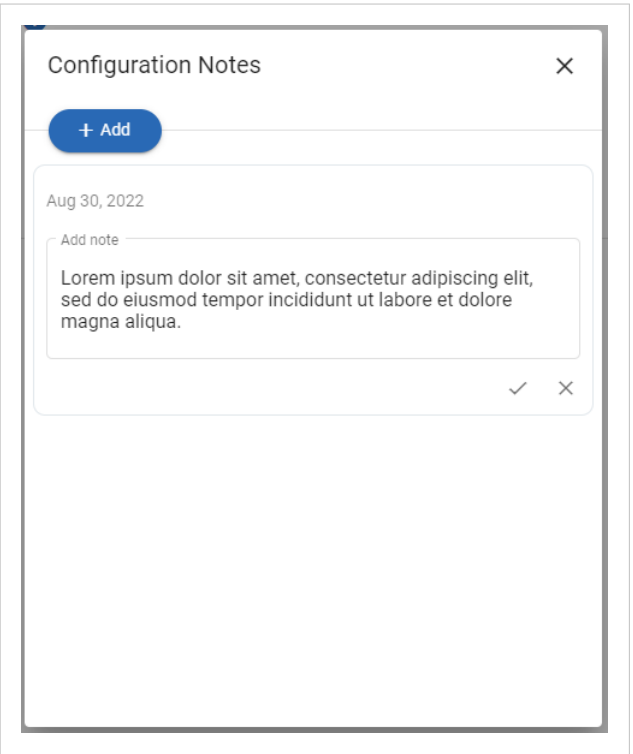


Figure 28. Write a configuration note

The configuration note is added to the list.

4. To close the window, click **close** ×.
5. To save the configuration note, click **Apply** in the web-interface header, and follow the instructions.

7.4.2. View and Edit Configuration Notes

To view and/or edit a note, click on the **comments** icon .

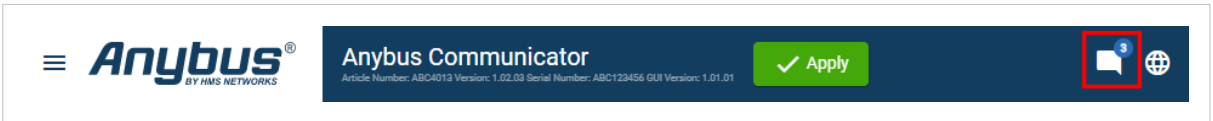


Figure 29. Example: The comment icon indicates that there are three added notes

The configuration notes are listed in the **Configuration Note** window.

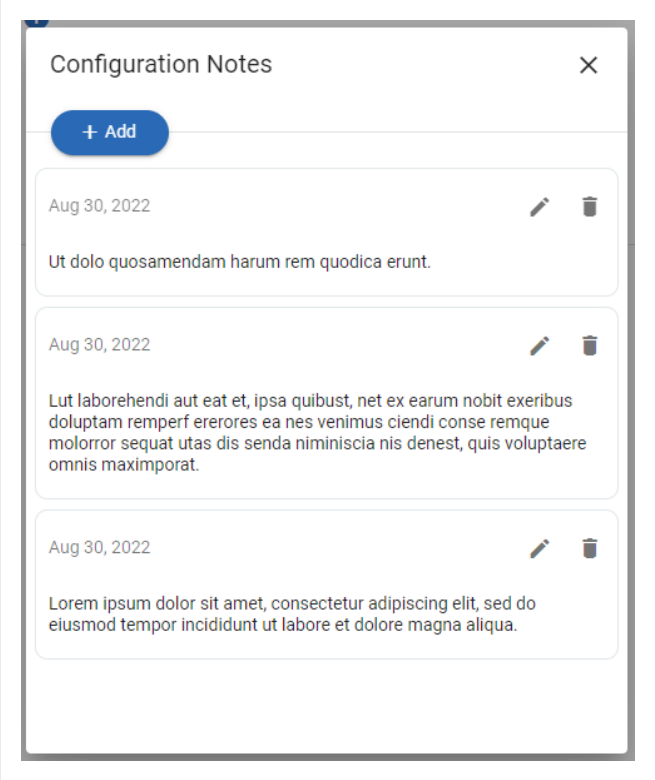


Figure 30. Example: The Configuration Notes window with added notes

7.5. Apply Configuration

Before You Begin

NOTE
When you apply the configuration, any existing configuration is overwritten.

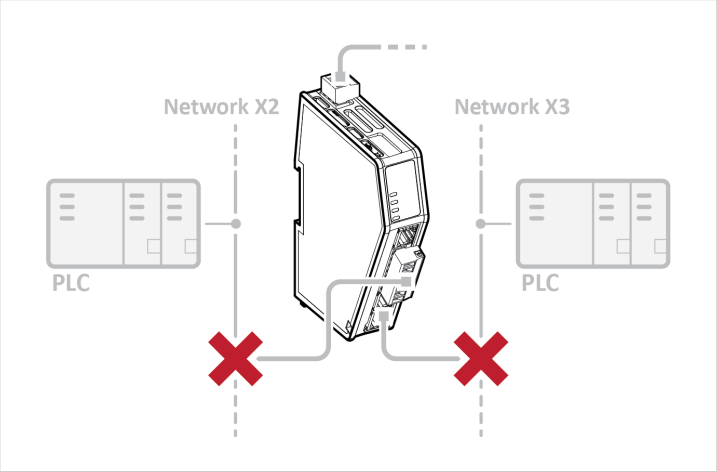


Figure 31. Disconnect the Communicator from the networks

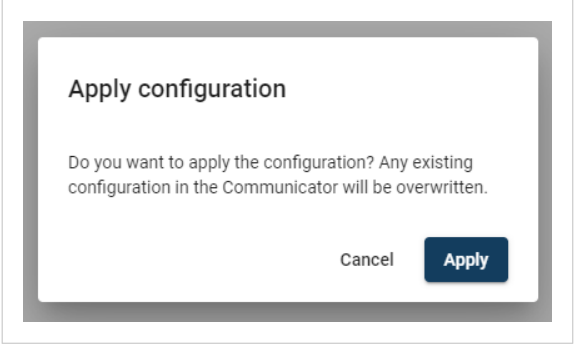
Before you can apply the configuration, ensure that there is no active communication on the Modbus RTU network or the EtherNet/IP network where the Communicator is connected.

Procedure

To make the settings take effect, download the configuration to the Communicator:

1. In the web-interface header, click **Apply**

2. To confirm download, click **Apply**.
   The configured settings are downloaded and applied to the system.



7.6. To Use an Existing Configuration

When you have configured a Communicator and want to use the same settings to configure additional Communicator, do the following.

Procedure

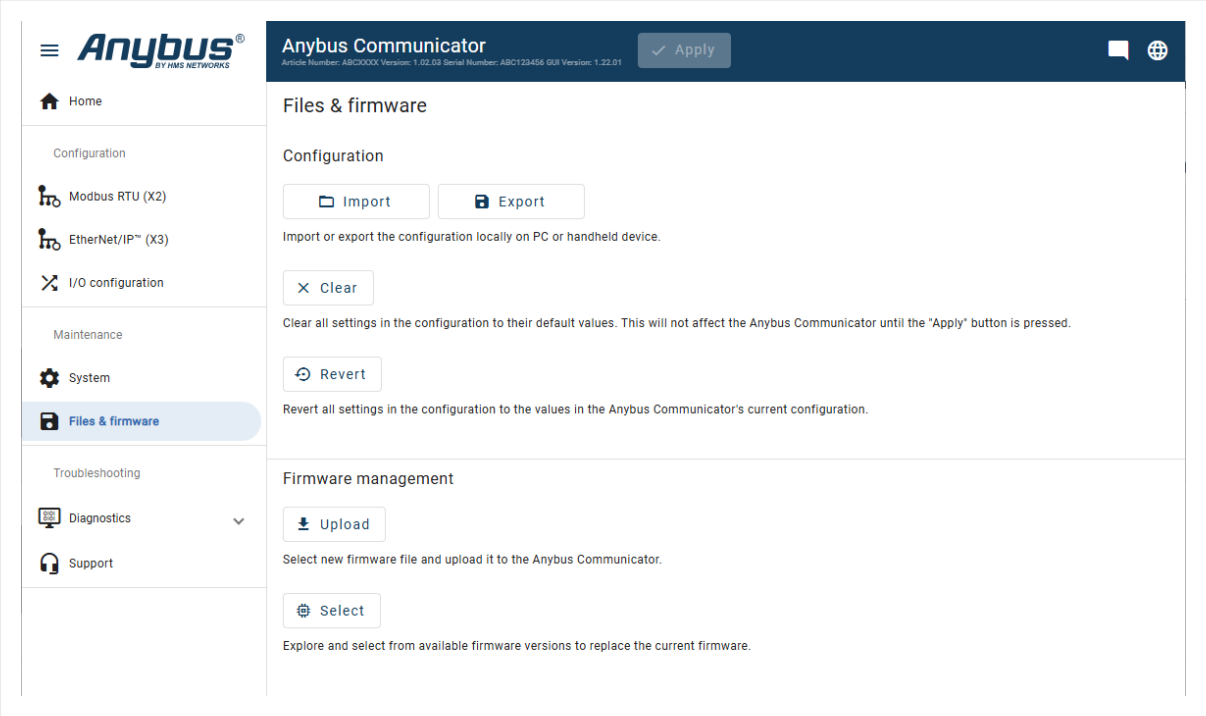


Figure 32. **Files & firmware** page

In the built-in web-interface of the Communicator with the configuration you want to use:

1. On the **Files & firmware** page, click **Export**
   The configuration is saved in a configuration file and downloaded to your PC.

In the built-in web-interface of the new Communicator to be configured:

2. On the **Files & firmware** page, click **Import**
3. In the Import configuration window, click **Select file (.conf)**.
4. In the Open dialog box, browse to and select the configuration file and click **Open**.
5. To import the configuration file, click **Import**.

Result

All the configuration settings are imported.

To apply the settings, click **Apply** in the web-interface header, and follow the instructions.

8. PLC Configuration

8.1. PLC Device Security

IMPORTANT
It is important to maintain the cybersecurity of the Communicator.

Before connecting the Communicator to a PLC, ensure the PLC is configured and installed in accordance with the PLC supplier hardening guidelines.

8.2. Export Product EDS File

Option if the PLC program requires a product file, EDS (Electronic Data Sheet) file, describing how the Communicator can be used on the EtherNet/IP network.

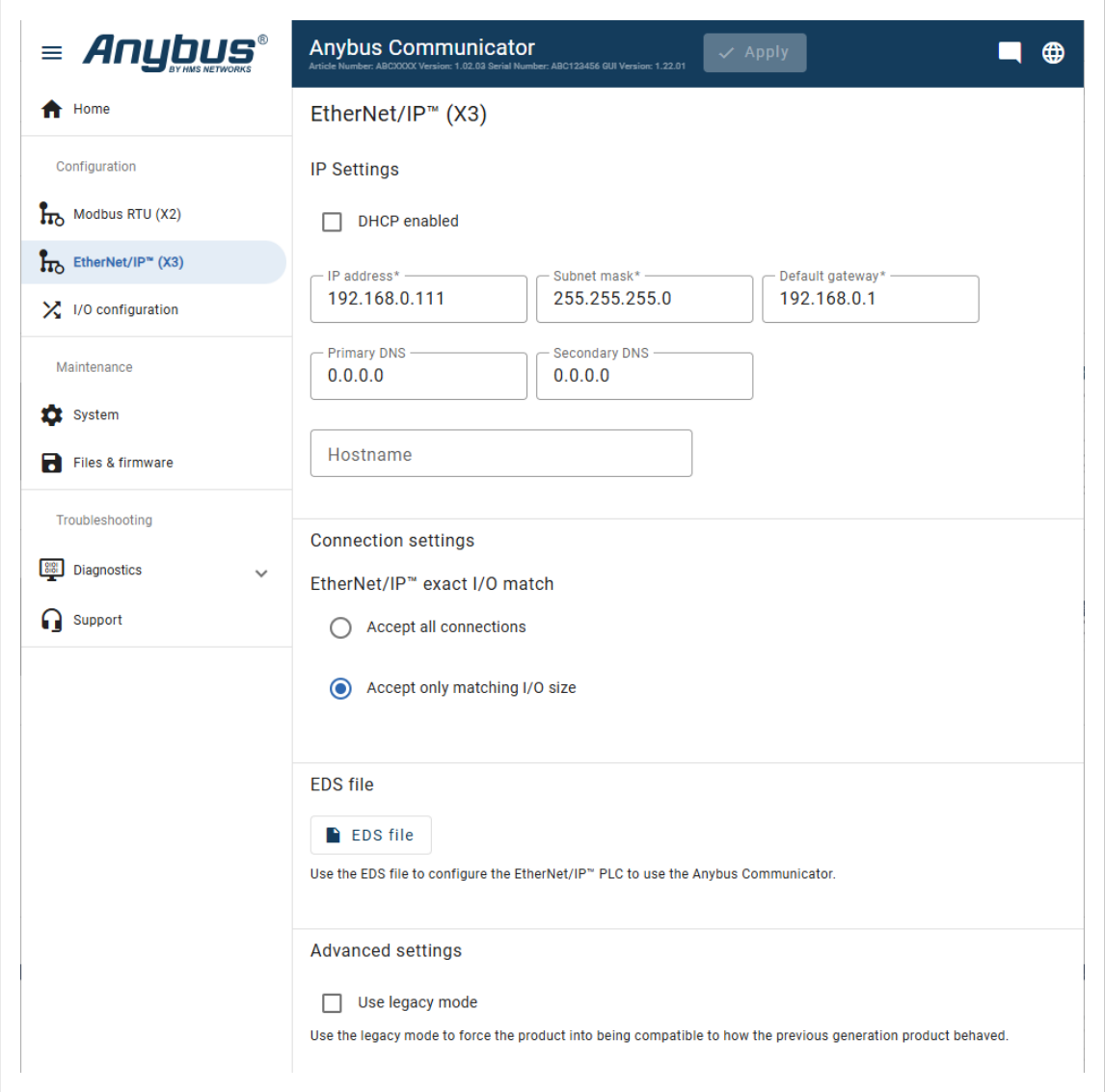


Figure 33. Export Product EDS File

You find the *EtherNet/IP™ EDS* file on the **EtherNet/IP™** page.

To export the EDS file, click **EDS file**.

The EDS file is downloaded to your PC.

8.3. Modbus Addressing and Register Mapping

For information about the Modbus Transactions, refer to the Modbus Organization.

8.3.1. The Difference Between Address and Register Start

To read or write data from a Modbus device you can use either Address or Register.

TIP

If Register is used, add +1 to the Address value.

Example 1. Modbus Function Code 0x04 Read Input Registers

Table 1. Modbus client values

Address	Register	Modicon Register
0	1	30001
1	2	30002
2	3	30003

Example 2. Modbus Function Code 0x03 Read Holding Registers

Table 2. Modbus client values

Address	Register	Modicon Register
0	1	40001
1	2	40002
2	3	40003

8.3.2. To Read and Write Data

To Read Data
To read data, you can use different Modbus Functions.

Discrete Inputs

- Modbus Function 0x02 Read Discrete Input Status

Discrete Input start at address 0.

Input Registers

- Modbus Function 0x04 Read Input Register
- Modbus Function 0x03 Read Holding Registers

The Input Registers starts at address 0 which corresponds to Register 1.

To use Read Holding Registers the address is offset to address 2048 which corresponds to Register 2049.

The first Input Register (30001)
The first Input Register (30001) can be read using Modbus Function code 0x04 Read Input Registers at Address 0 or Register 1.

You can also use Read Holding Registers (Modbus Function code 0x03) to read the same data (at Address 42048 = Register 42049) or use Read Discrete Inputs 0x02 at address 0..15.

To Write Data
To write data, you can use different Modbus Functions.

Coils

- Modbus Function 0x05 Force Single Coil
- Modbus Function 0x0F Force Multiple Coils

Coils starts at address 0.

Holding Registers

- Modbus Function 0x06 Write Single Register
- Modbus Function 0x10 Write Multiple Registers

The Holding Registers starts at address 0 which corresponds to Register 1.

Holding Register (40001)
The first Holding Register (40001) can be written to using Modbus Function code 0x06 Write Single Register at Address 0 or Register 1.

To read back what has been written, you can use Read Holding Registers 0x03 at address 0..749 = Register 1..750 (40001..40750) or Read Coils 0x01 at address 0..11999.

Data Encoding

Modbus uses the big-endian format for addresses and data items.

When a numerical value larger than one byte is transmitted, the most significant byte is sent first.

Example 3. Big-Endian Data Encoding

For a 16-bit register value of 0x1234:

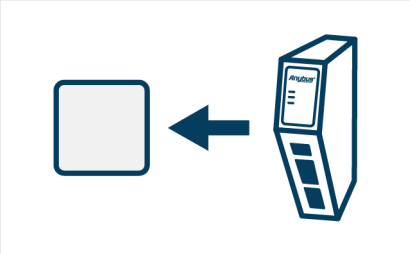
- The first byte sent is 0x12.
- The second byte sent is 0x34.

See also Convert Between Big-Endian and Little-Endian (page 32).

8.3.3. Default Address Mode I/O Data Mapping

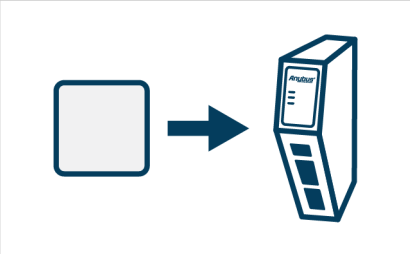
The following Modbus function codes are compatible with the default addressing mode.

Input Data to Client/Server - Data to Modbus



Process I/O data offset		Discrete input address		Input register address		Holding register address	
HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC
0x0000 - 0x0001	0 - 1	0x0000 - 0x000F	0 - 15	0x0000	0	0x0800	2048
0x0002 - 0x0003	2 - 3	0x0010 - 0x001F	16 - 31	0x0001	1	0x0801	2049
...	...	...	...	...	...	...	...
0x05D8 - 0x05D9	1496 - 1497	0x2EC0 - 0x2ECF	11968 - 11983	0x02EC	748	0x0AEC	2796
0x05DA - 0x05DB	1498 - 1499	0x2ED0 - 0x2EDF	11983 - 11999	0x02ED	749	0x0AED	2797

Output Data From Client/Server - Data From Modbus TCP

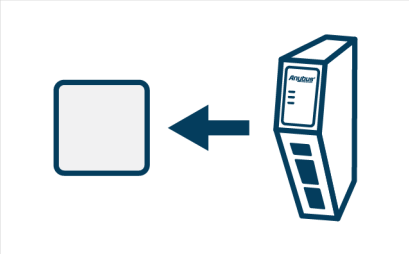


Process I/O data offset		Coil address		Holding register address	
HEX	DEC	HEX	DEC	HEX	DEC
0x0000 - 0x0001	0 - 1	0x0000 - 0x000F	0 - 15	0x0000	0
0x0002 - 0x0003	2 - 3	0x0010 - 0x001F	16 - 31	0x0001	1
...	...	...	...	...	...
0x05D8 - 0x05D9	1496 - 1497	0x2EC0 - 0x2ECF	11968 - 11983	0x02EC	748
0x05DA - 0x05DB	1498 - 1499	0x2ED0 - 0x2EDF	11983 - 11999	0x02ED	749

8.3.4. Legacy Address Mode I/O Data Mapping

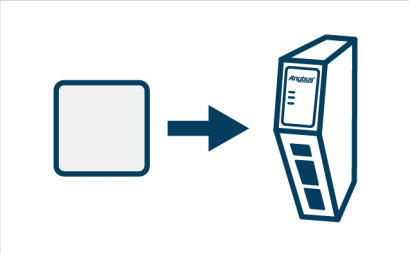
The following Modbus function codes are compatible with the Modbus **Use legacy mode** setting.

Input Data to Client/Server - Data to Modbus



Process I/O data offset		Discrete input address		Coil address		Input register address		Holding register address	
HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC
0x0000 - 0x0001	0 - 1	0x0000 - 0x000F	0 - 15	0x0000 - 0x000F	0 - 15	0x0000	0	0x0000	0
0x0002 - 0x0003	2 - 3	0x0010 - 0x001F	16 - 31	0x0010 - 0x001F	16 - 31	0x0001	1	0x0001	1
...	...	...	...	...	...	...	...	...	...
0x01FC - 0x01FD	508 - 509	0x0FE0 - 0x0FEF	4064 - 4079	0x0FE0 - 0x0FEF	4064 - 4079	0x00FE	254	0x00FE	254
0x01FE - 0x01FF	510 - 511	0x0FF0 - 0x0FFF	4080 - 4095	0x0FF0 - 0x0FFF	4080 - 4095	0x00FF	255	0x00FF	255

Output Data From Client/Server - Data From Modbus



Process data offset		Discrete input address		Coil address		Input register address		Holding register address	
HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC
0x0000 - 0x0001	0 - 1	0x4000 - 0x400F	16384 - 16399	0x4000 - 0x400F	16384 - 16399	0x0400	1024	0x0400	1024
0x0002 - 0x0003	2 - 3	0x4010 - 0x401F	16400 - 16415	0x4010 - 0x401F	16400 - 16415	0x0401	1025	0x0401	1025
...	...	...	...	...	...	...	...	...	...
0x01FC - 0x01FD	508 - 509	0x4FE0 - 0x4FEF	20448 - 20463	0x4FE0 - 0x4FEF	20448 - 20463	0x04FE	1278	0x04FE	1278
0x01FE - 0x01FF	510 - 511	0x4FF0 - 0x4FFF	20464 - 20479	0x4FF0 - 0x4FFF	20464 - 20479	0x04FF	1279	0x04FF	1279

9. Verify Operation

Before You Begin

Ensure that the Communicator is connected to your PC, to a power supply and to the OT network.

See Installation (page 11).

9.1. Communicator Status Monitor

On the Home page, you can get a quick overview of the network and the Communicator operating status.

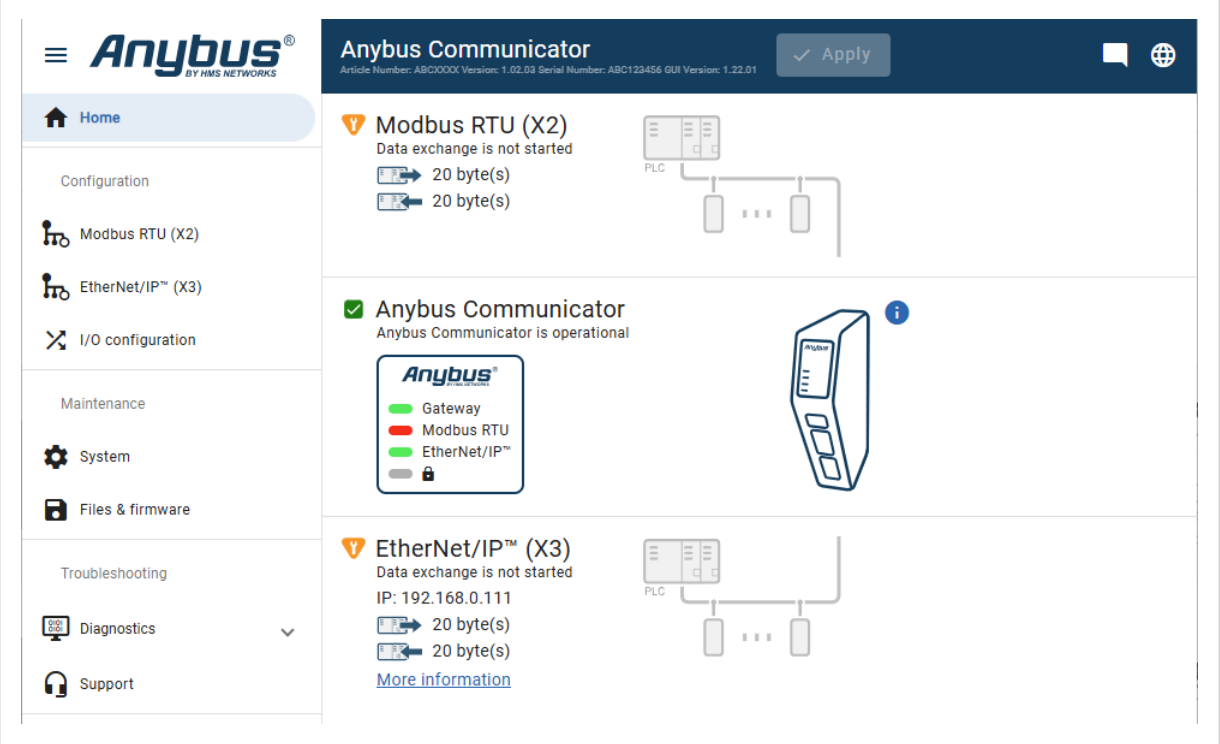


Figure 34. Home page

Gateway status

Overview the Communicator LED indications remotely.

For information about the LED indication, see Communicator LED Indicators (page 49).

Network Status and Settings

Overview communication status and the current networks settings.

Status Symbols

Symbol	Description
	Internal error has occurred, and operation cannot be guaranteed.
	Out of Specification.
	Check Function: • Initial state where non network components are started and configured. • Network startup in progress. • Invalid configuration detected.
	Normal operation.

9.2. Communicator LED Indicators

NOTE
Before you can verify operation, you must configure the Communicator.

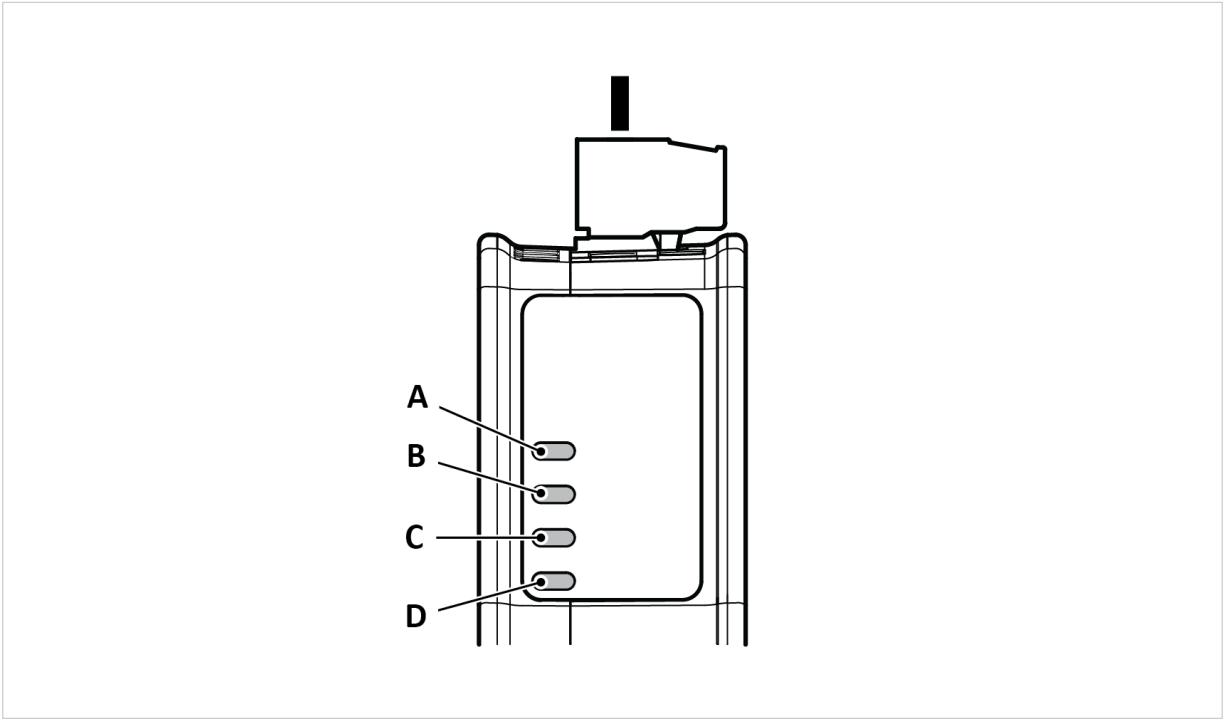


Figure 35. Gateway status (A), Lower connector (B), Upper connector (C) and Security Switch (D)

LED A - Gateway status	
Operation Status	**Description**
Off	No power
Green, flashing	Startup phase
Green, solid	Operational
Red, flashing	Invalid configuration
Green/Red, flashing	Power up self-test/Firmware update/Firmware recovery

LED B - EtherNet/IP, Lower connectors	
Operation status.	**EtherNet/IP**
Off	No power/No EtherNet/IP IP address.
Green, flashing	EtherNet/IP online, no connections established.
Green, solid	EtherNet/IP online, one or more connections established.
Red, solid	Duplicated EtherNet/IP IP address.
Red, flashing	One or more connections timed out.

LED C - Modbus RTU, Upper connector	
Operation status.	**Modbus RTU**
Off	No power, no active nodes, or all nodes are stopped.
Green, flashing	Waiting for first Modbus message.
Green, solid	At least one Modbus message received.
Red, solid	Fatal event.

LED C - Modbus RTU, Upper connector	
Operation status.	**Modbus RTU**
Red, flashing	Connection timeout. No Modbus messages has been received within the configured process active timeout time.

Security switch - LED D	
Operation status	**Description**
Off	No power/Security switch is unlocked/Exception/Fatal error
Green	Security switch is locked

Fatal Error and Exception Error

Fatal error: A fatal error causes the Communicator firmware application to crash in an uncontrolled manner.

Exception error: An exception error causes the Communicator to enter a controlled error state. The Communicator firmware application is still running.

LED	Fatal error	Exception error
A	Red, solid	Red, solid
B	Red, solid	Off
C	Red, solid	Off
D	Off	Off

9.3. Ethernet LED Indicators

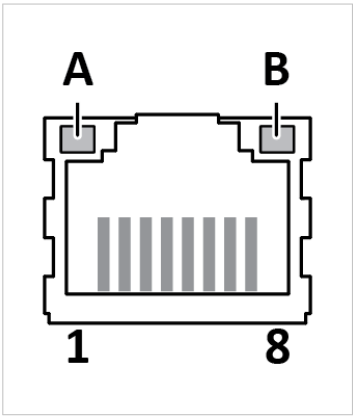


Figure 36. LED A. Activity LED B. Not used

LED A	Function
Off	No link (or no power)
Green	Link (100 Mbit/s) established
Green, flashing	Activity (100 Mbit/s)
Yellow	Link (10 Mbit/s) established
Yellow, flashing	Activity (10 Mbit/s)

LED B	Function
Off	Not used

10. Maintenance

10.1. Action on Fatal Error

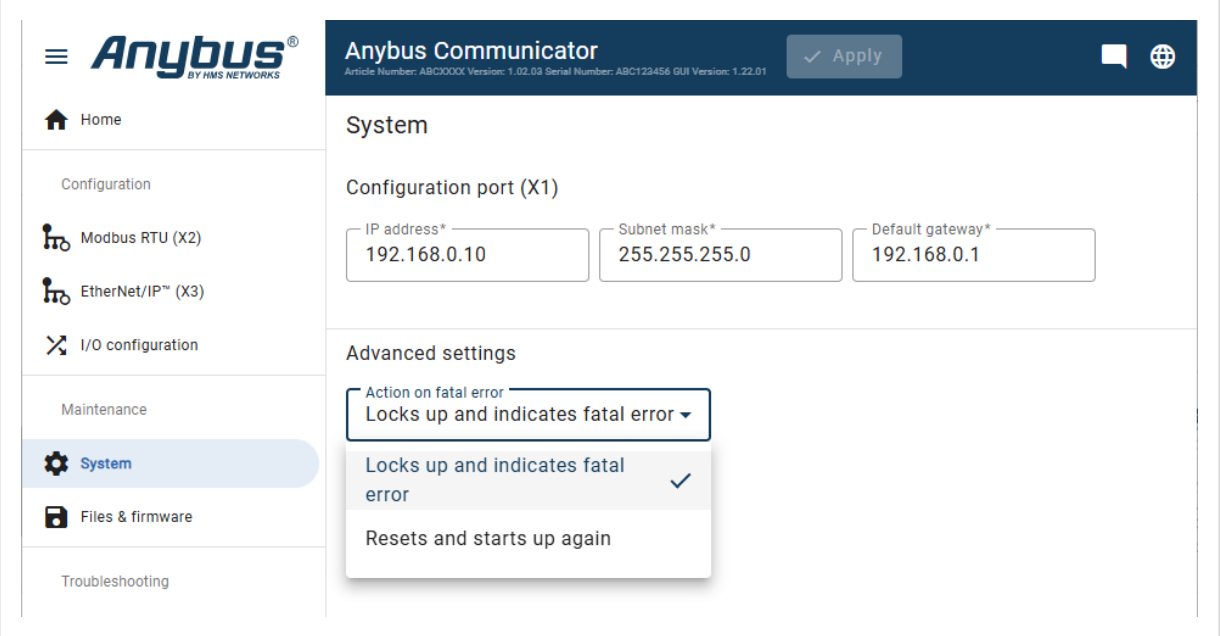


Figure 37. System page, Action on fatal error menu

A fatal error causes the Communicator firmware application to crash in an uncontrolled manner.

You can configure how the Communicator should behave if a fatal error occurs.

In the **Action on fatal error** menu, select one of the following settings:

- **Locks up and indicates fatal error**: Default setting, the Communicator locks up and the LED indicators indicates a fatal error.
- **Resets and starts up again**: The Communicator is rebooted to reset the system and return to normal operation.

10.2. Configuration Port IP Settings

On the **System** page you can change the IP address of the Communicator configuration port.

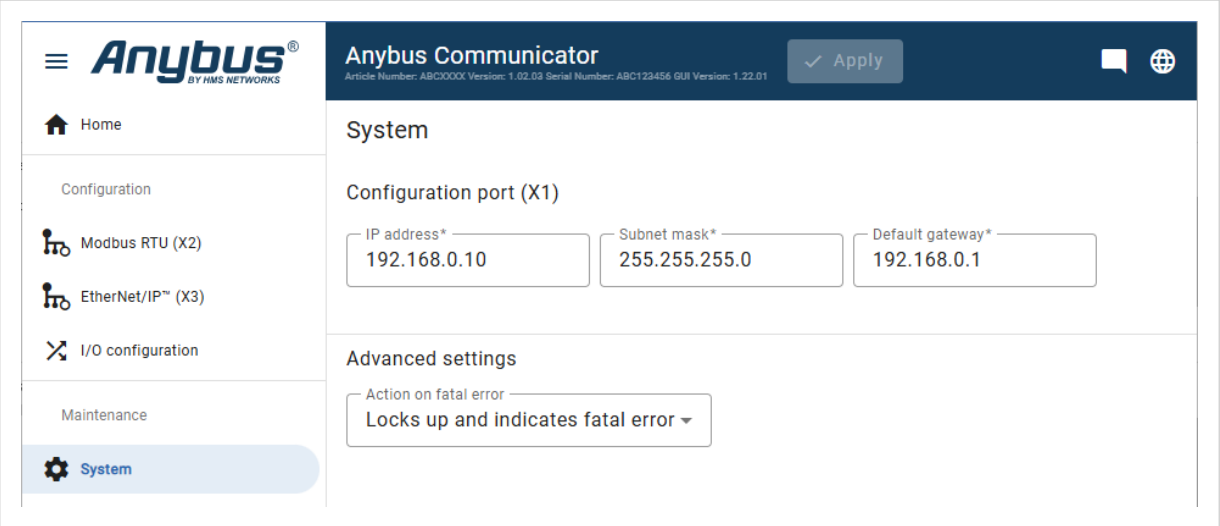


Figure 38. System page, Configuration port settings

Default Configuration Port IP settings

Setting	Default value
IP address	192.168.0.10
Subnet mask	255.255.255.0
Gateway	There is no default Gateway address.

10.3. Configuration File Handling

10.3.1. Export Configuration

You can export the current configuration, to import and use the same settings to configure additional Communicator.

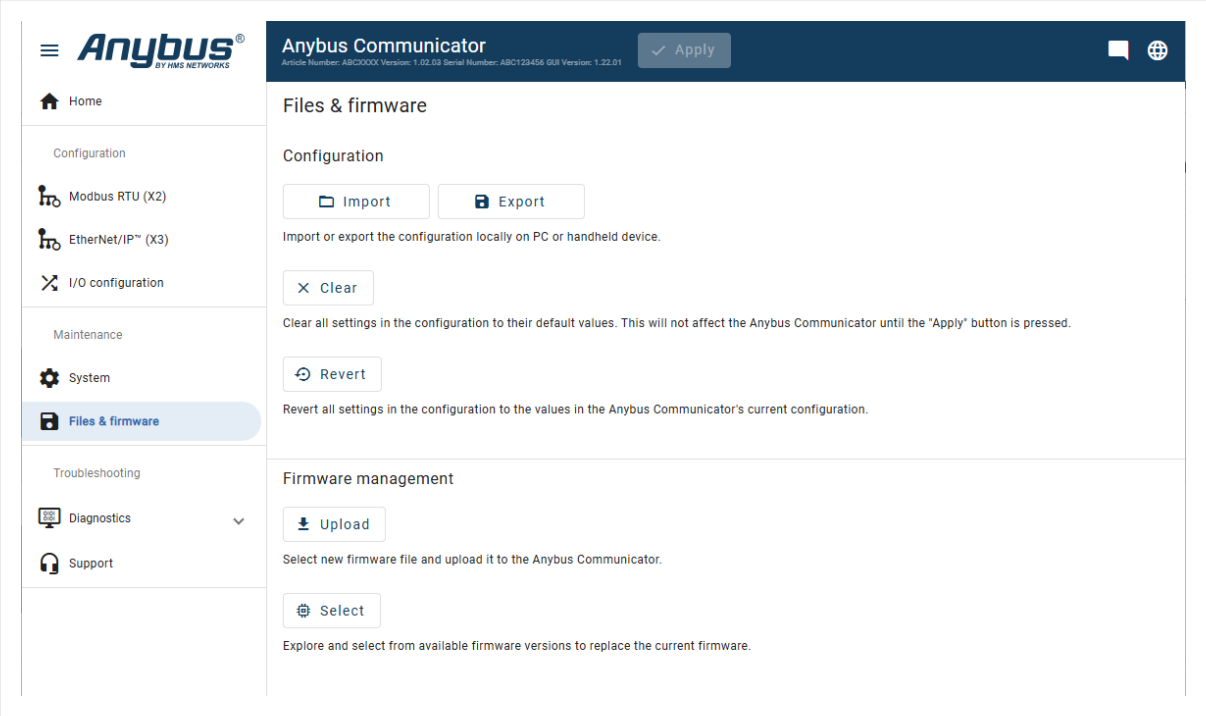


Figure 39. Files & firmware page

To export a configuration file:

In **Files & firmware**, click **Export**.

The configuration settings are stored in a .conf file and downloaded to your PC.

10.3.2. Import Configuration

To easily configure multiple Communicator with the same settings, you can import a configuration file.

Before You Begin

The supported file format is .conf.

Procedure

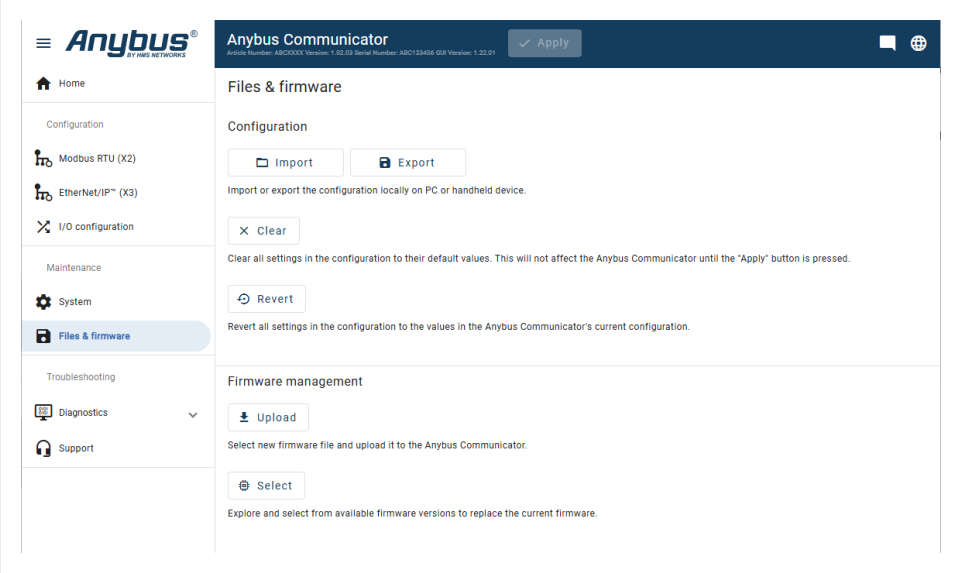


Figure 40. Files & firmware page

Import configuration file:

1. On the **Files & firmware** page, click **Import**.
2. In the Import configuration window, click **Select file (.conf)**.
3. In the Open dialog box, browse to and select the configuration file and click **Open**.
4. In the Import configuration window, click **Import**.
5. In the Communicator address settings window:
   - To import IP settings from the selected configuration file, click **Imported settings**.
     All configuration settings are imported.
   - To continue using the current IP settings, click **Configured settings**.
     All configuration settings except the IP settings are imported.
6. The configuration file is parsed.
   - If the configuration is compatible, the settings are imported.
   - If any compatibility mismatches occur, a message about the mismatch appears.
7. To apply the settings, click **Apply** in the web-interface header, and follow the instructions.

10.4. Clear and Revert Configuration

You can restore all settings in a configuration to the default settings.

Procedure

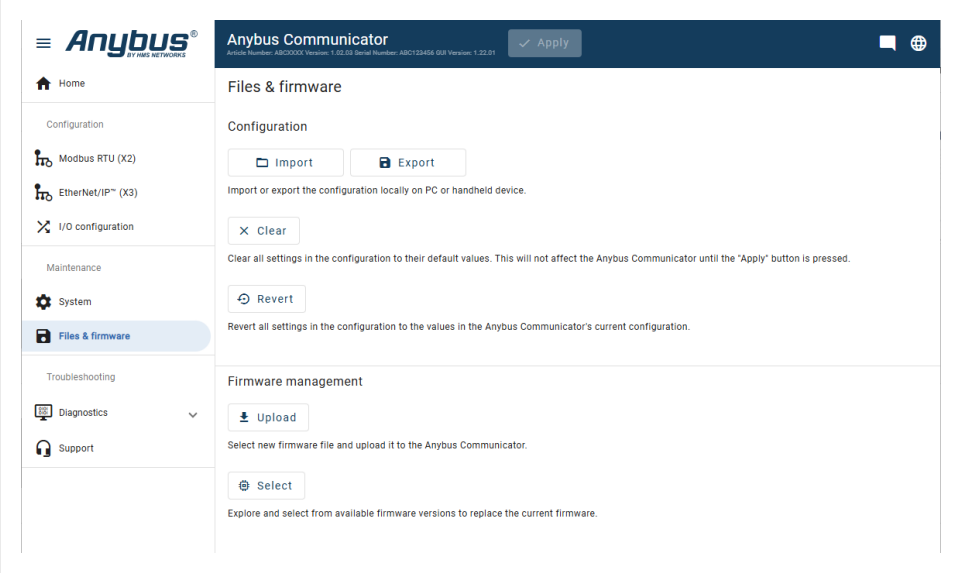


Figure 41. Files & firmware page

To Clear the Configuration

When you want to clear a configuration and return to the default settings.

1. On the **Files & firmware** page, click **Clear**.
2. In the Confirm clear window, click **Clear**.
3. To apply the change, click **Apply** in the web-interface header, and follow the instructions.

To Revert the Configuration

When you want to remove any configuration made in a current session and re-load the configuration from the gateway.

1. On the Files & firmware page, click **Revert**.
2. In the Confirm revert window, click **Revert**.
3. To apply the change, click **Apply** in the web-interface header, and follow the instructions.

10.5. Firmware Management

10.5.1. View the Firmware Version

On the **Support** page, you can view the current applied firmware version.

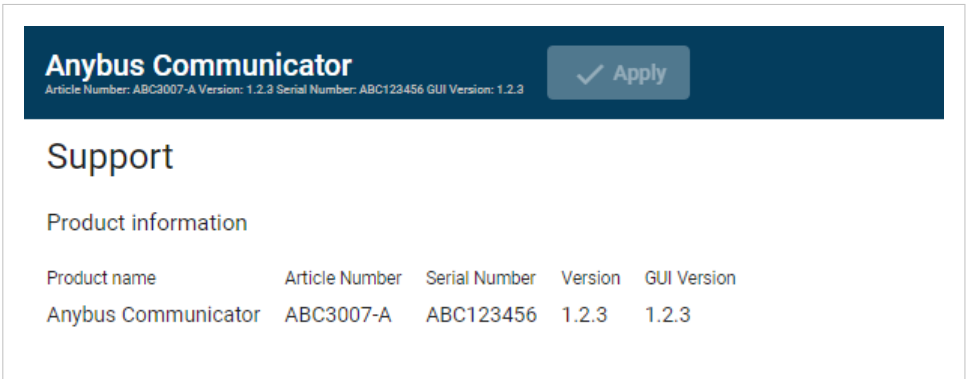


Figure 42. Support page, Product information example

10.5.2. Firmware and Configuration Compatibility

Compatibility after firmware upgrade

Current configuration is still compatible after upgrading the firmware.

Compatibility after firmware downgrade

IMPORTANT

Compatibility after a firmware downgrade cannot be guaranteed.

The current configuration may use features not available in the older firmware version.

10.5.3. Firmware File Validation

Before the firmware file is imported into the system, the firmware upgrade function performs a validation of the file, to ensure that:

- the firmware is compatible with the Communicator hardware
- the firmware is suited for the product
- the officially HMS software signatures are valid
- that the firmware file is not corrupt or damaged

If the firmware file does not pass the validation, the firmware file is rejected and an error message appear.

10.5.4. Update Firmware

Before You Begin

Ensure to disconnect the Communicator from the OT networks.

Procedure

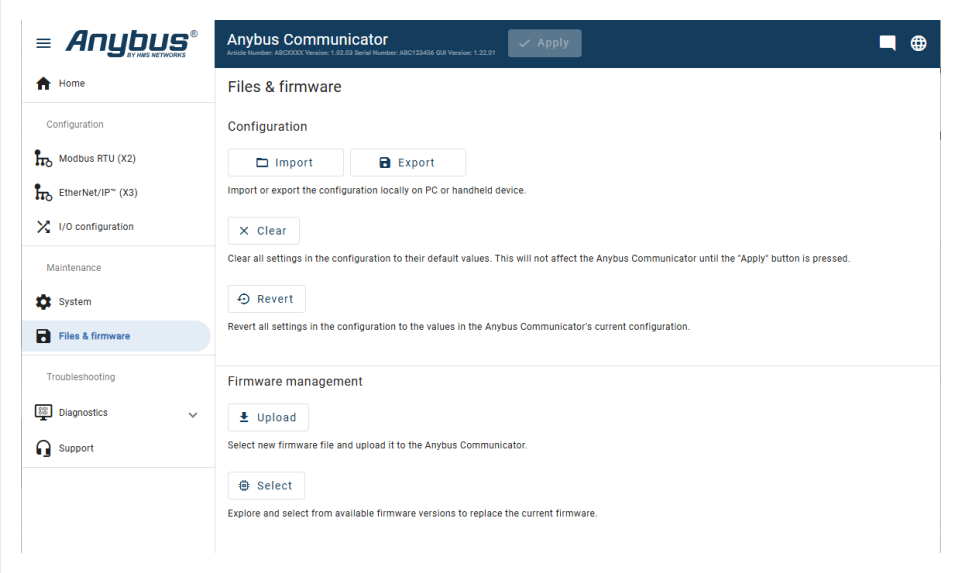


Figure 43. Files & firmware page

To update the firmware:

1. On the **Files & firmware** page, click **Upload**.
2. In the Upload Firmware window, click **Select firmware (.hiff)**.
3. In the Open dialog box, browse to and select the firmware file and click **Open**.
4. To start the firmware upgrade, click **Update firmware**.
   The firmware file is validated and transferred.

Result

- If the firmware file passes the validation: The firmware is upgraded and then the Communicator automatically reboots, for the upgrade to take effect.
- If the firmware file is rejected: An error message appears.

10.6. Change Language

Default language is **English**.

To change the language of the Communicator built-in web interface:

1. In the Communicator built-in web-interface header, click the **Language** icon .

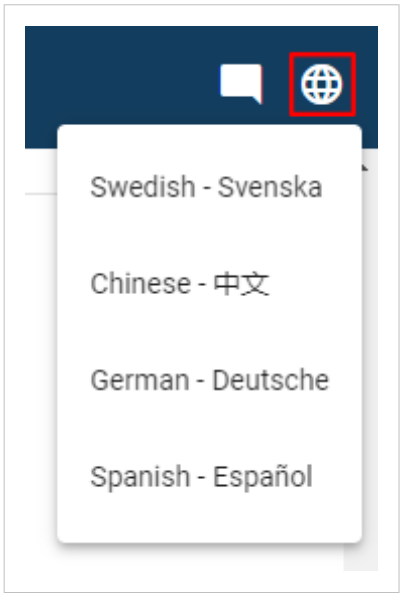


Figure 44. Language menu

2. Select a new language from the list.

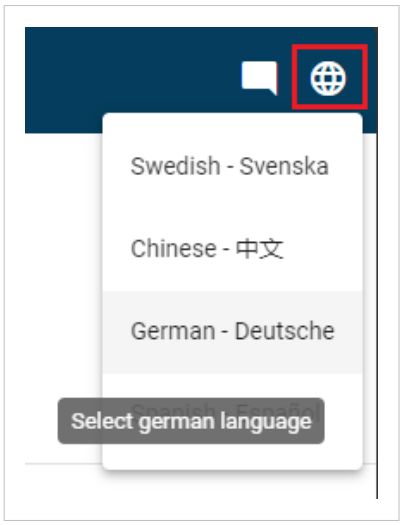


Figure 45. Example: Change language to German

The language change takes effect immediately.

11. Troubleshooting

11.1. Diagnostics

11.1.1. I/O Data

On the **Diagnostics**, **I/O data** page you can monitor how the data flow between the **Modbus RTU** side and the **EtherNet/IP** side, including any configured endian conversions.

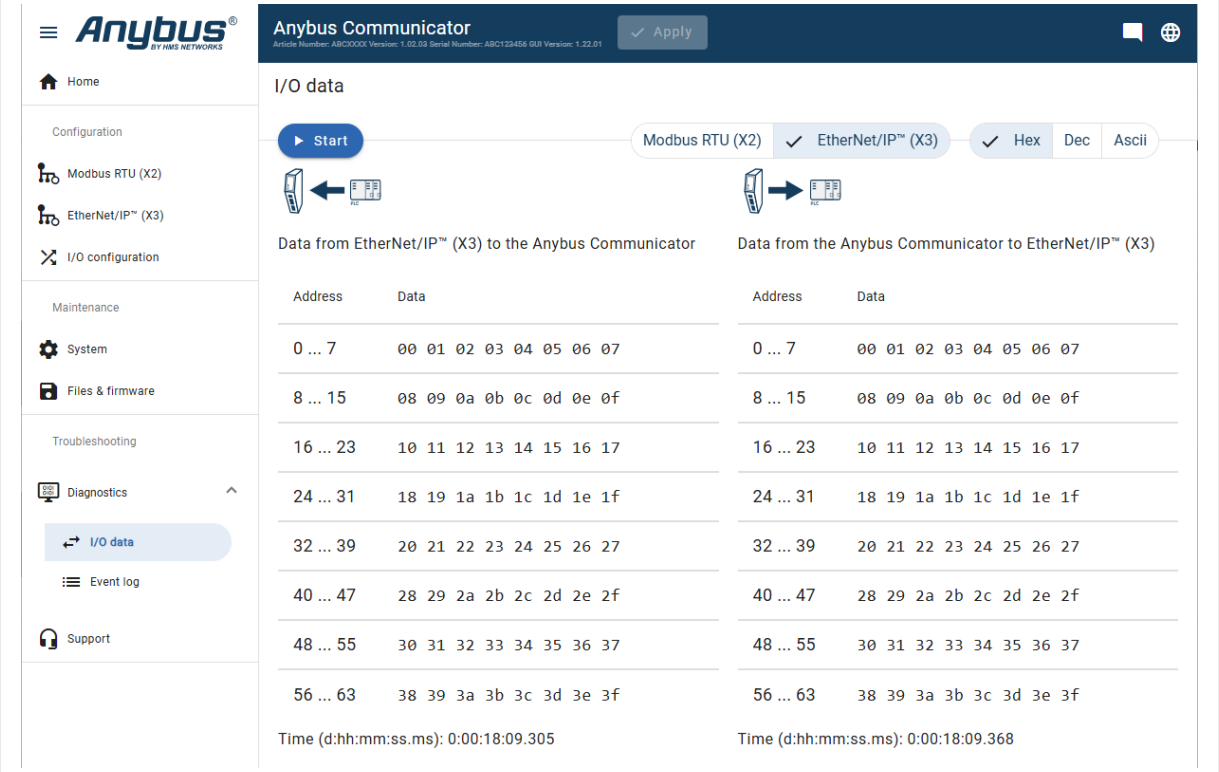


Figure 46. I/O data

I/O data is updated twice every second.

Switch between the OT networks

To switch between the networks, select **Modbus RTU** or **EtherNet/IP**.

Select how data is displayed

To choose if the data should be displayed in Hexadecimal, Decimal or ASCII, click **Hex**, **Dec** or **Ascii**.

Start and Stop Data flow

- To start the data flow, click **Start**.
- To end the data flow, click **Stop**.

11.1.2. Event Log

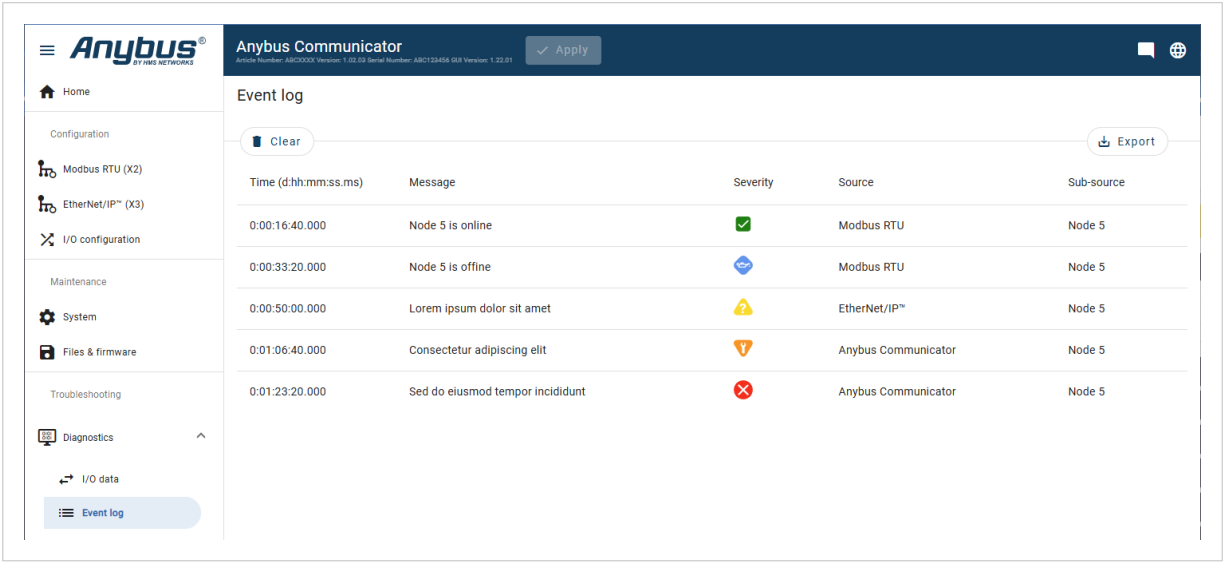


Figure 47. Event log page example

How To Analyze the Information

The log follows the FIFO principle, first in and first out. The oldest (first) value is processed first.

Time (d:hh:mm:ss.ms)	The duration from when the X-gateway was powered on until the event occurred.
Message	A brief description of the event.
Severity	The severity of the event occurred. For description of the symbols, see Communicator Status Monitor (page 47).
Source	Communicator
	EtherNet/IP
	Modbus RTU
Sub-source	The nodes connected to the subnetwork and the PLC connected to the high level network. If there is a problem with a node the node name is displayed in the Sub-source column.
	Example 4. Sub-source number If the node name is 5, number 5 is displayed in the Sub-source column.

To clear the current log, click **Clear**.

11.1.3. LED Status

On the Home page, you can remotely monitor the Communicator LED status.

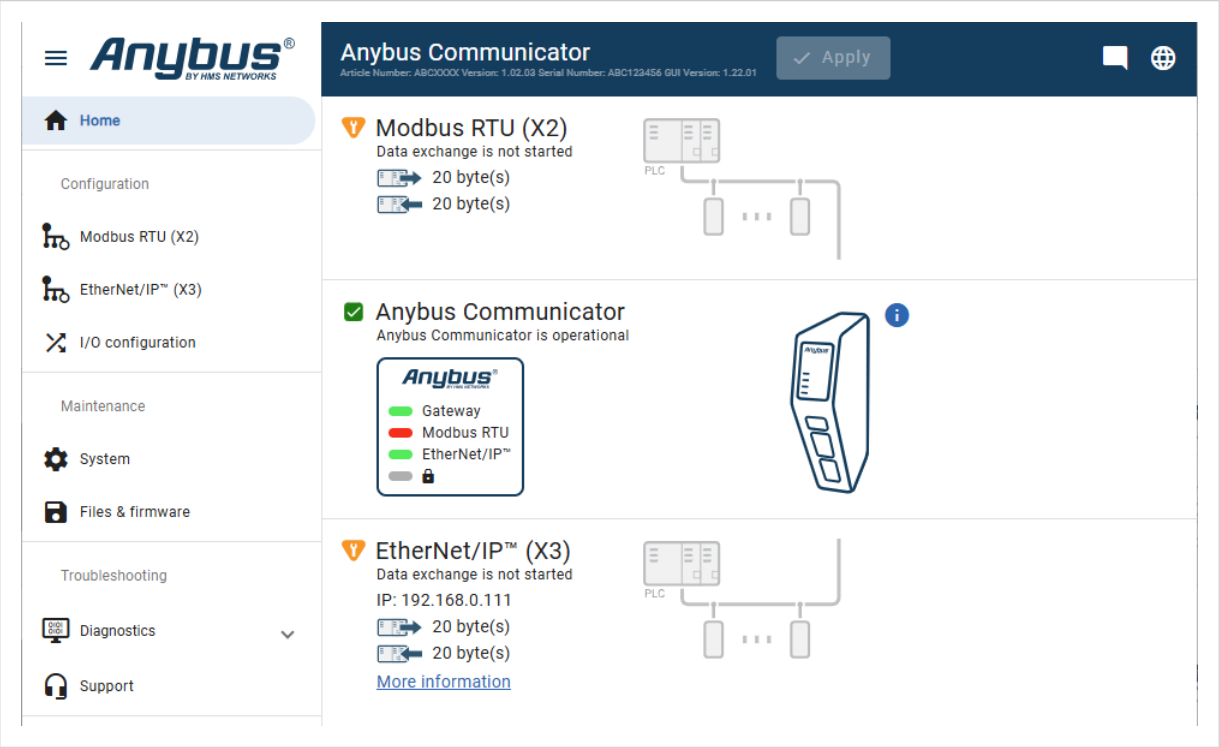


Figure 48. Home page

For information about the LED indication, see Communicator LED Indicators (page 49).

11.2. Reset to Factory Settings

Before You Begin

Factory reset will reset any on site made configuration changes and set the Communicator to the same state as leaving HMS production.

When the Firmware has been updated, factory reset will revert the Communicator configuration to initial state after the update.

Procedure

To reset the Communicator:

1. Disconnect the Communicator from power.

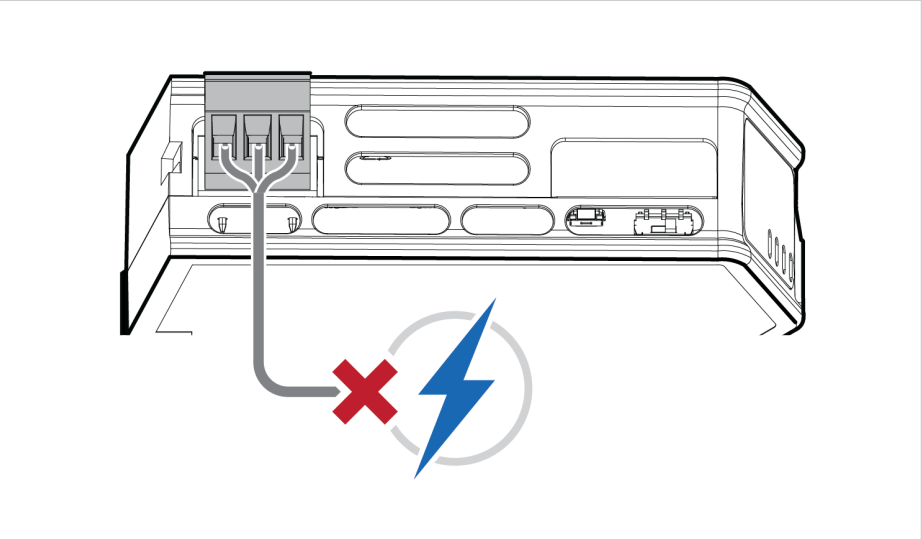


Figure 49. Disconnect power

2. Use a pointed object, such as a ballpoint pen to press and hold the **Reset** button.

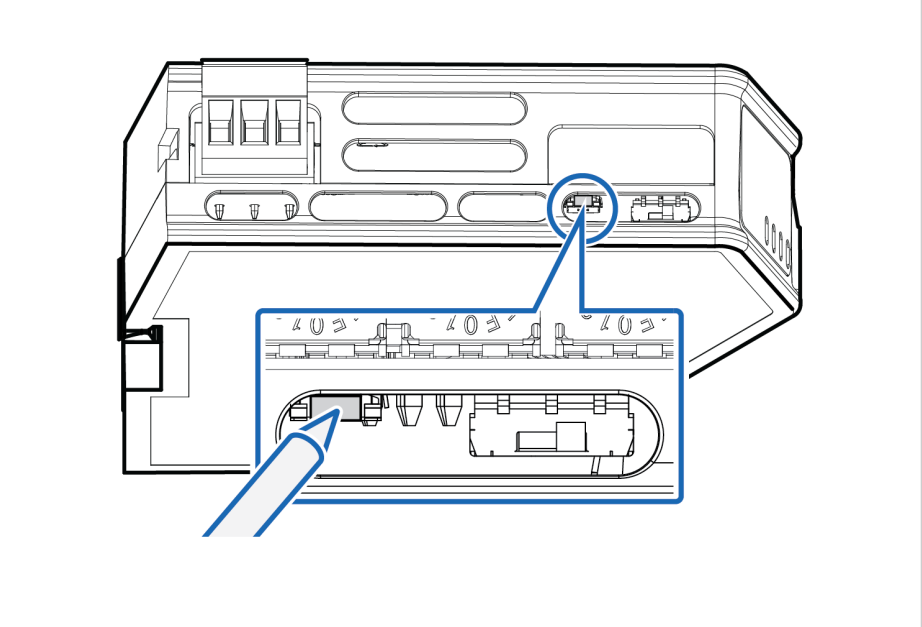


Figure 50. Press and hold **Reset** button

3. While holding the **reset** button, reconnect the Communicator to power.

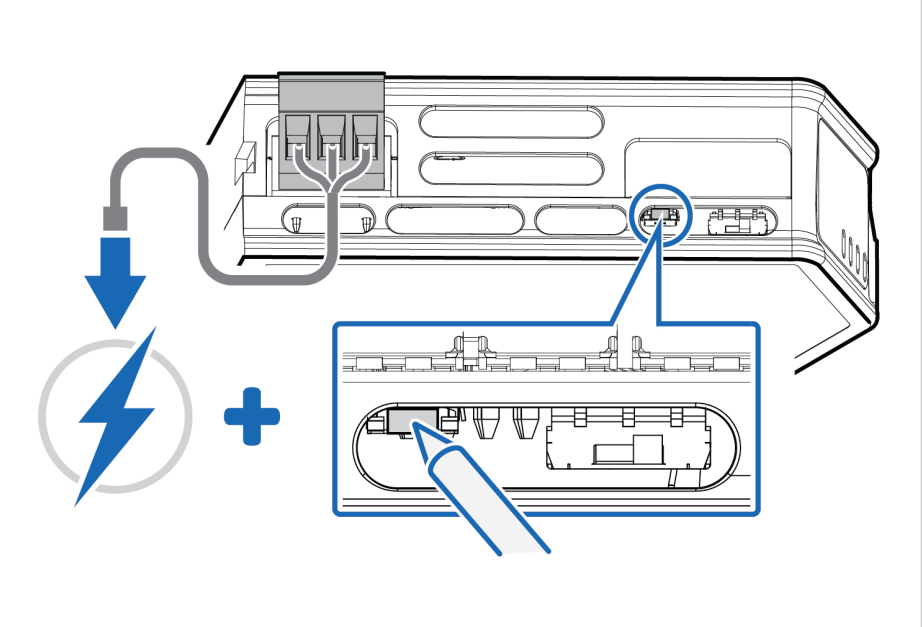


Figure 51. Hold **Reset** button and reconnect power

4. Release the **reset** button.
   The Communicator enters exception state.

5. Reboot the Communicator.

Result

When the Communicator has successfully rebooted, the Communicator configuration is reset to the factory default configuration or the current configuration after firmware upgrade.

To Do Next

To ensure that the Communicator built-in web-interface is synchronized.

1. Open the Communicator built-in web interface.

2. Navigate to the **Files & firmware** page and click **Revert**.

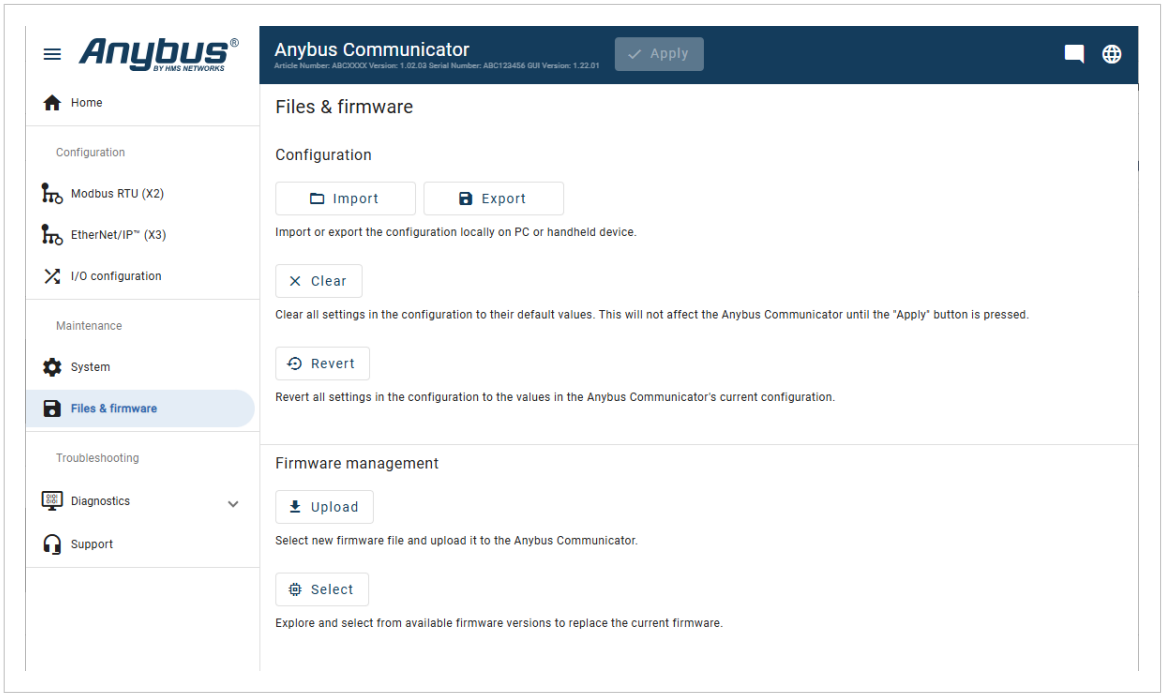


Figure 52. Files & firmware, Revert

11.3. Firmware Upgrade Error Management

Before You Begin

If the firmware update process is interrupted or if the power is lost during the update process, the Communicator goes into fallback mode.

The firmware file from the latest update attempt remains in the flash memory, but it is not active.

Procedure

To complete the interrupted firmware update:

1. Disconnect the Communicator from power.

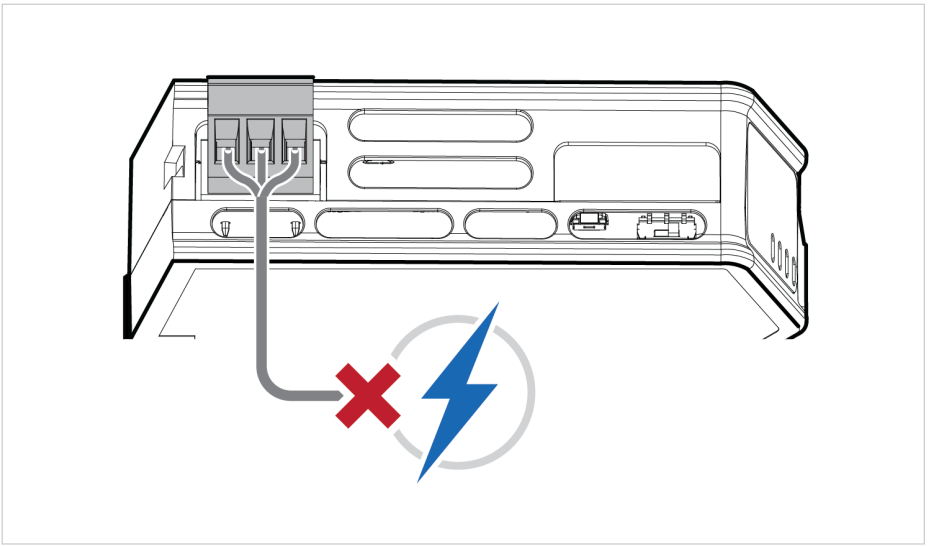


Figure 53. Disconnect power

2. Reconnect the Communicator to power.

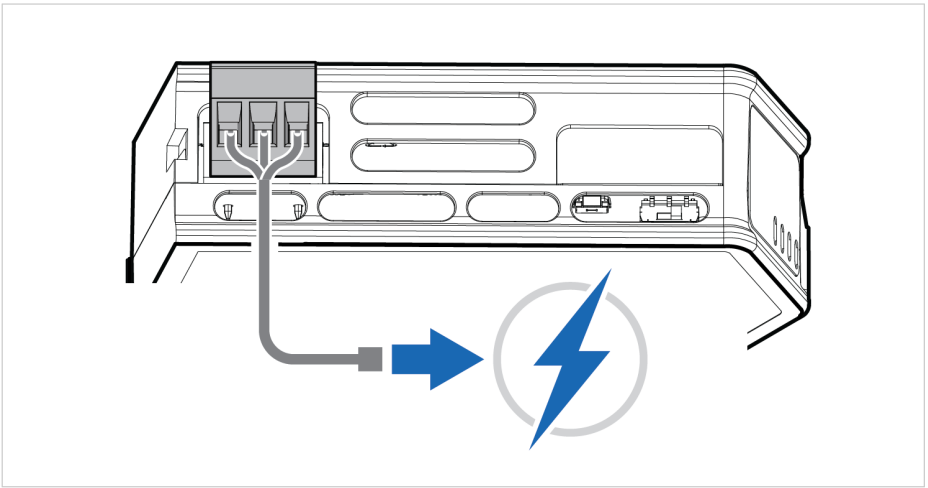


Figure 54. Reconnect power

3. Leave the Communicator for 10 minutes.
   The Gateway status led indicator flashes red and green until the firmware upgrade is completed.

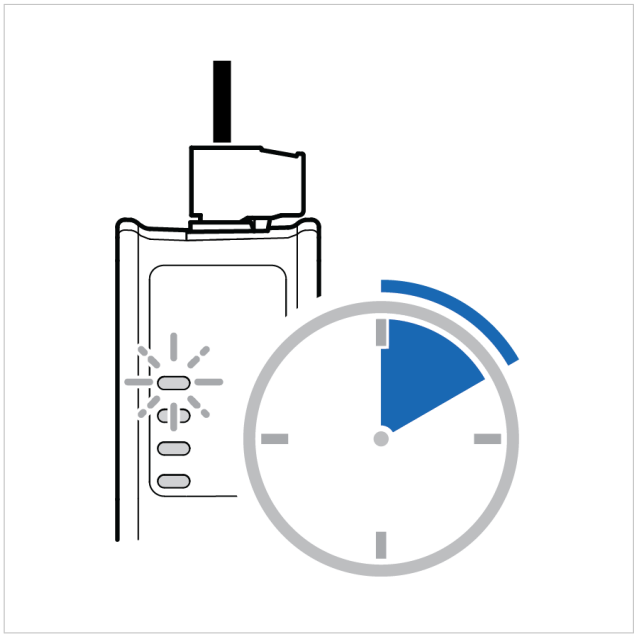


Figure 55. Firmware upgrade LED indication

Result

The Communicator recover and return to normal operation.

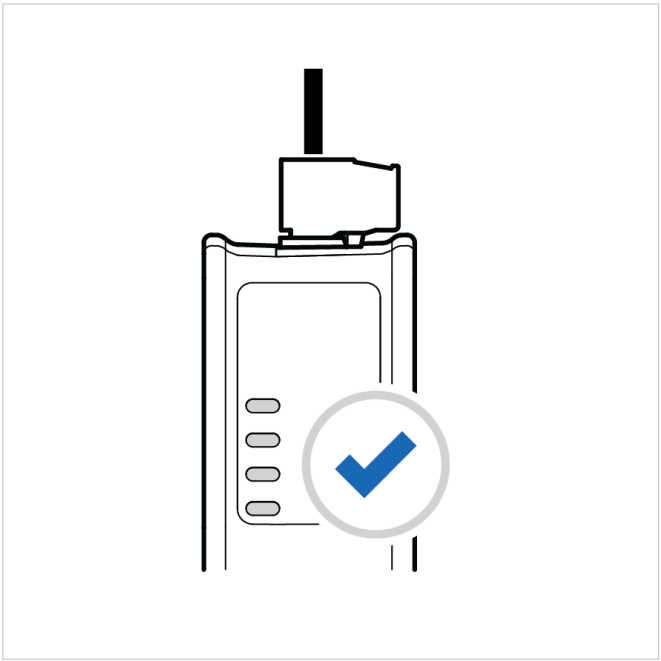


Figure 56. Recover and return to normal operation

To Do Next

To check LED status, refer to Communicator LED Indicators (page 49)

11.4. Support

11.4.1. Support Package

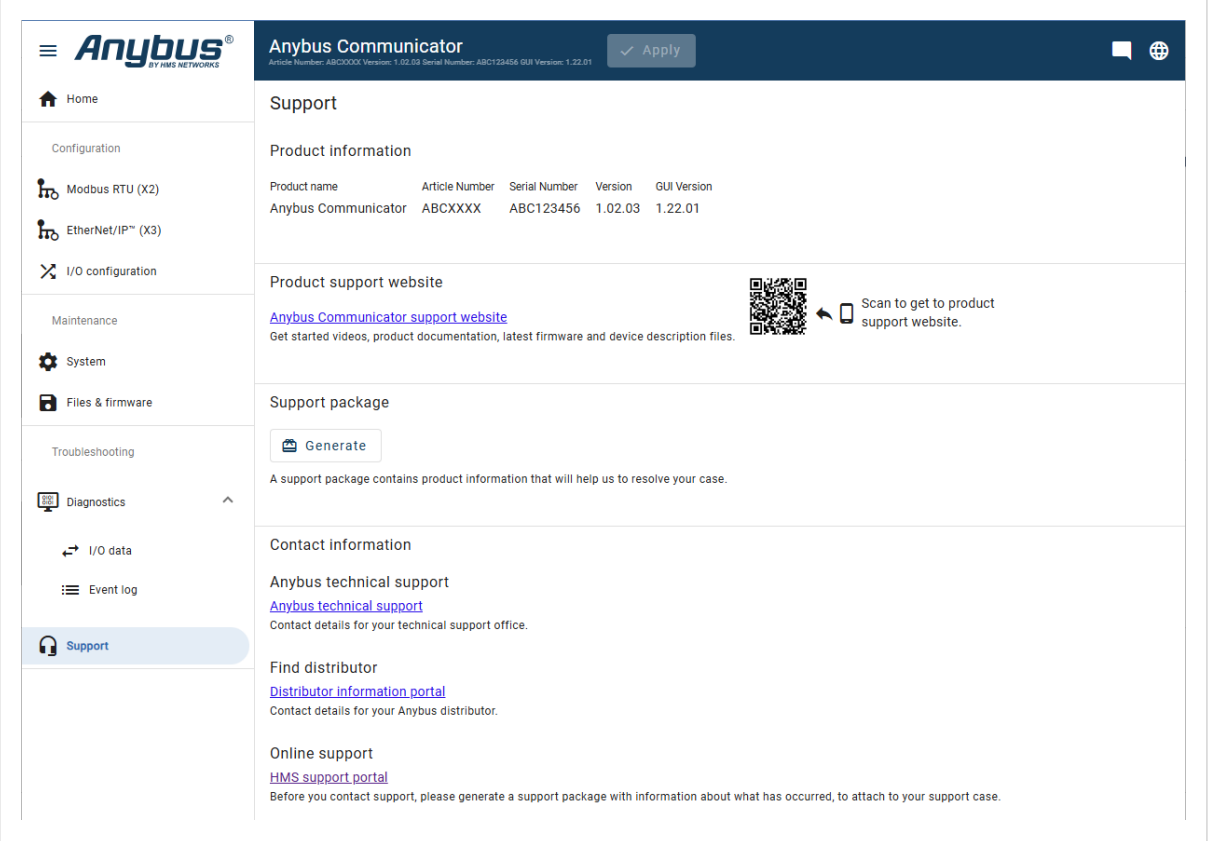


Figure 57. Support page example

Before you create a ticket for technical support, generate a support package.

The support package contains information about what has occurred and will help the Anybus technical support team resolve the support case as quickly and efficiently as possible.

Support Package Content
The information in the support package is available to open and read, the files are not locked or encrypted.

Generate Support Package
On the **Support** page, click **Generate**.

A zip file with the support files is downloaded to your PC.

Create a Support Ticket
1. On the **HMS Networks** home page, navigate to the **Support** main menu and click **Support portal**.
2. In the **Support portal**, create a support ticket and upload the support package.

12. Technical Data

For complete technical specifications and regulatory compliance information, please visit www.hms-networks.com.

12.1. Technical Specifications

Article identification	ABC4024
Configuration connector	RJ45
Upper connector	7-pin screw connector
Lower connector	RJ45 x 2
Power connector	3-pin screw connector
Power supply	12-30 VDC, Reverse voltage protection and short circuit protection
Power consumption	Typical: 90 mA @ 24 V (2.2 W) Max: 3 W
Storage temperature	-40 to +85 °C
Operating temperature	-25 to +70 °C
Humidity	EN 600068-2-78: Damp heat, +40°C, 93% humidity for 4 days EN 60068-2-30: Damp heat, +25°C – +55°C, 95% RH, 2 cycles
Vibration	See datasheet
Housing material	Plastic, See datasheet for details
Protection class	IP20
Product weight	150 g
Dimensions	27 x 144 x 98 mm (W x H x D) with connectors included
Mounting	DIN-rail

13. End Product Life Cycle

13.1. Secure Data Disposal

IMPORTANT
To avoid exposure of sensitive data, always perform a factory reset before decommissioning the equipment.

Factory reset will reset any on site made configuration changes and set the Communicator to the same state as leaving HMS production.

See Reset to Factory Settings (page 62).

14. Reference Guides

14.1. About Input Registers and Holding Registers

Modbus data is most often read and written as registers which are 16-bit pieces of data.

Holding registers and Input registers are both 16-bit registers.

TIP
If Register is used, add +1 to the Address value.

Input Registers

Input registers can only be read.

Holding Registers

Holding registers can be read or written.

These registers can be used for a variety of things such as inputs, outputs, configuration data, or other requirement for holding data.

14.2. Modbus Data Model

Discretes Input	Single bit	Read-Only	Data can be provided by the I/O system.
Coils	Single bit	Read-Write	Data can be alterable by the application program.
Input Registers	16-bit word	Read-Only	Data can be provided by the I/O system
Holding Registers	16-bit word	Read-Write	Data can be alterable by the application program.

Reference: MODBUS Application Protocol Specification V1.1b3, April 26 2012

For more information refer to the Modbus organization website.

14.3. Modbus Function Codes

Reference: MODBUS Application Protocol Specification V1.1b3, April 26 2012

For more information refer to the Modbus organization website.

Nr	Function	Function Code	Description
1	Read Coils	0x01	Read from 1 to 2000 contiguous status of coils in a remote device.
2	Read Discrete Inputs	0x02	Read from 1 to 2000 contiguous status of discrete inputs in a remote device.
3	Read Holding Registers	0x03	Read the contents of a contiguous block of holding registers in a remote device.
4	Read Input Registers	0x04	Read from 1 to 125 contiguous input registers in a remote device.
5	Write Single Coil	0x05	Write a single output to ON or OFF in a remote device.
6	Write Single Register	0x06	Write a single holding register in a remote device.
8	Diagnostics (Serial Line only)	0x08	For Modbus RTU, not supported by Modbus TCP. Diagnostics provides a series of tests to check the communication system between a client device and a server, or to diagnose various internal error conditions within a server.
15	Write Multiple Coils	0x0F	In a sequence of coils, force each coil to either ON or OFF in a remote device.
16	Write Multiple Registers	0x10	Write a block of contiguous registers in a remote device.
22	Mask Write Register	0x16	In a single transaction, modify the contents of a specified holding register using a combination of an AND mask, an OR mask, and the register's current contents. Can be used to set or clear individual bits in the register.
23	Read/Write Multiple Registers	0x17	Performs a combination of one read operation and one write operation. The write operation is performed before the read.

14.4. Modus Exception Codes

Exception Code	Name	Description
01	Illegal Function	The server does not recognize or permit the function code.
02	Illegal Data Address	The data address (register, discrete input or coil number) is not an permitted address for the server. If multiple registers were requested, at least one was not permitted.
03	Illegal Data Value	A value in the query data field is not allowed by the server. This indicates there is a problem with the structure of the rest of the request, such as an incorrect implied length.

Reference: MODBUS Application Protocol Specification V1.1b3, April 26 2012

For more information refer to the Modbus organization website.