User Manual

Anybus® X-gateway Modbus-TCP CC-Link

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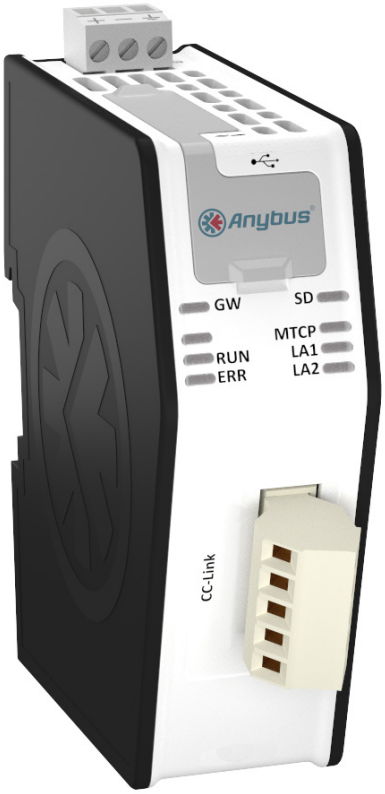
Rev. 1.11



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HMS Industrial Networks
Mailing address: Box 4126, 300 04 Halmstad, Sweden
Visiting address: Stationsgatan 37, Halmstad, Sweden

E-mail: info@hms-networks.com
Web: www.anybus.com

Important User Information

This document is intended to provide a good understanding of the functionality offered by the Anybus X-gateway Modbus-TCP - CC-Link. The reader of this document is expected to be familiar with high level software design, and communication systems in general.

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ESD Note:	This product contains ESD (Electrostatic Discharge) sensitive parts that may be damaged if ESD control procedures are not followed. Static control precautions are required when handling the product. Failure to observe this may cause damage to the product.
Warning:	DO NOT USE SD CARD OR USB CONNECTOR WHILE CIRCUIT IS LIVE UNLESS THE AREA IS KNOWN TO BE FREE OF IGNITABLE CONCENTRATIONS OF FLAMMABLE GAS OR VAPORS.

NOTE
From X-gateways produced in September 2024 onwards, SD card functionality is no longer included.

Anybus X-gateway Modbus-TCP - CC-Link User Manual
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P. About This Document

For more information, documentation etc., please visit the HMS website, www.anybus.com.

P.1 Related Documents

Document	Author
Modbus Application Protocol Specification V1.1B	Modbus Organization

P.2 Document History

Revision	Date	Author(s)	Chapter(s)	Description
1.00	2011-06-28	KaD	-	First official release
1.10	2012-11-21	KaD	2, 3, 5, 7, B	Major update
1.11	2024-11-01	N/A	N/A	Added Note: SD card functionality is no longer included.

P.3 Conventions & Terminology

The following conventions are used throughout this manual:

- Numbered lists provide sequential steps
- Bulleted lists provide information, not procedural steps
- The terms 'Anybus', 'X-gateway' or 'module' refers to the Anybus X-gateway module
- Hexadecimal values are written in the format NNNNh, where NNNN is the hexadecimal value
- A byte always consists of 8 bits
- The terms 'master', 'scanner', 'client' and 'controller' will be used interchangeably to describe a controlling unit on the network
- The terms 'slave', 'adapter', 'server' and 'device' will be used interchangeably to describe units that are controlled by controlling units on the network

P.4 Sales and Support

Sales		Support	
HMS Sweden (Head Office)			
E-mail:	sales@hms.se	E-mail:	support@hms-networks.com
Phone:	+46 (0) 35 - 17 29 56	Phone:	+46 (0) 35 - 17 29 20
Fax:	+46 (0) 35 - 17 29 09	Fax:	+46 (0) 35 - 17 29 09
Online:		Online:	www.anybus.com
HMS North America			
E-mail:	us-sales@hms-networks.com	E-mail:	us-support@hms-networks.com
Phone:	+1-312 - 829 - 0601	Phone:	+1-312-829-0601
Toll Free:	+1-888-8-Anybus	Toll Free:	+1-888-8-Anybus
Fax:	+1-312-629-2869	Fax:	+1-312-629-2869
Online:		Online:	www.anybus.com
HMS Germany			
E-mail:	ge-sales@hms-networks.com	E-mail:	ge-support@hms-networks.com
Phone:	+49 (0) 721-96472-0	Phone:	+49 (0) 721-96472-0
Fax:	+49 (0) 721-96472-10	Fax:	+49 (0) 721-96472-10
Online:	www.anybus.de	Online:	www.anybus.de
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Phone:	+81 (0) 45-478-5340	Phone:	+81 (0) 45-478-5340
Fax:	+81 (0) 45-476-0315	Fax:	+81 (0) 45-476-0315
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HMS China			
E-mail:	cn-sales@hms-networks.com	E-mail:	cn-support@hms-networks.com
Phone:	+86 (0) 10-8532-3183	Phone:	+86 (0) 10-8532-3023
Fax:	+86 (0) 10-8532-3209	Fax:	+86 (0) 10-8532-3209
Online:	www.anybus.cn	Online:	www.anybus.cn
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Phone:	+39 039 59662 27	Phone:	+39 039 59662 27
Fax:	+39 039 59662 31	Fax:	+39 039 59662 31
Online:	www.anybus.it	Online:	www.anybus.it
HMS France			
E-mail:	fr-sales@hms-networks.com	E-mail:	fr-support@hms-networks.com
Phone:	+33 (0) 3 68 368 034	Phone:	+33 (0) 3 68 368 033
Fax:	+33 (0) 3 68 368 031	Fax:	+33 (0) 3 68 368 031
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E-mail:	uk-sales@anybus.co.uk	E-mail:	support@hms-networks.com
Phone:	+44 (0) 1926 405599	Phone:	+46 (0) 35 - 17 29 20
Fax:	+44 (0) 1926 405522	Fax:	+46 (0) 35 - 17 29 09
Online:	www.anybus.co.uk	Online:	www.anybus.com
HMS Denmark			
E-mail:	info@anybus.dk	E-mail:	support@hms-networks.com
Phone:	+45 (0) 22 30 08 01	Phone:	+46 (0) 35 - 17 29 20
Fax:	+46 (0) 35 17 29 09	Fax:	+46 (0) 35 - 17 29 09
Online:	www.anybus.com	Online:	www.anybus.com
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E-mail:	in-sales@anybus.com	E-mail:	in-support@hms-networks.com
Phone:	+91 (0) 20 40111201	Phone:	+46 (0) 35 - 17 29 20
Fax:	+91 (0) 20 40111105	Fax:	+46 (0) 35 - 17 29 09
Online:	www.anybus.com	Online:	www.anybus.com

1. Getting Started

The purpose of this chapter is to give a short description on how to install the X-gateway and get it up and running, transferring I/O data between the Modbus-TCP network and the CC-Link network.

Perform the following steps when installing the module:

1. Mount the module. See "Mounting the X-gateway" on page 15 for details.
2. Connect the X-gateway to the Modbus-TCP network. See "External View" on page 14.
3. Connect the power cable and apply power.
4. Access the configuration web pages.
   - Connect a PC to the Modbus-TCP network (see "External View" on page 14) and open a web browser. Enter the IP address of the X-gateway and access the configuration web pages. If the IP address of the X-gateway is unknown, use the Anybus IPconfig tool to find it. See "Anybus IPconfig Tool" on page 41.
   - Configure the Modbus-TCP client. See "Modbus Client" on page 30.
   - Set up all Modbus servers and transactions using the configuration web pages. See "Modbus Servers" on page 31 and "Network Configuration" on page 25.
   - Configure the X-gateway slave interface. See "CC-Link (Slave Interface)" on page 34.
5. Configure the CC-Link master. See "Configuring the CC-Link Network" on page 9.
6. Connect the X-gateway to the CC-Link network. See "External View" on page 14.

2. Anybus X-gateway Modbus-TCP

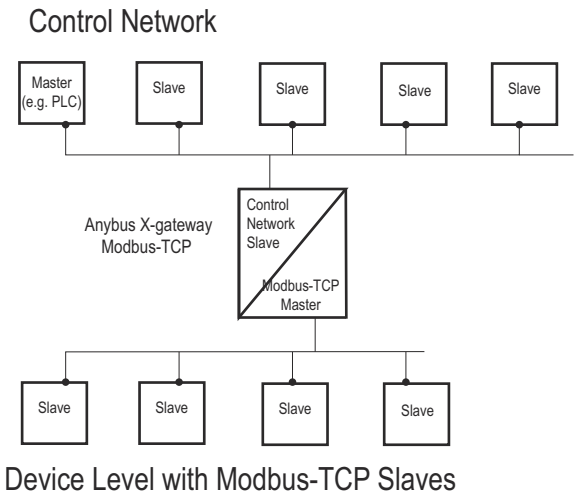
2.1 Introduction

The Anybus X-gateway Modbus-TCP is a series of network gateways, used to provide a seamless connection between a Modbus-TCP network and a controlling network. This particular product connects a Modbus-TCP network to a CC-Link network. The X-gateway enables the master of the CC-Link network to control the Modbus-TCP network. These X-gateways makes it possible to integrate Modbus-TCP devices into almost any other PLC system and their supported networks.

The X-gateway is based on patented Anybus technology, a proven industrial communication solution used all over the world by leading manufacturers of industrial automation products. Each module offers Modbus-TCP master connectivity to one of these industrial networks: EtherNet/IP, CC-Link, Modbus-TCP, ControlNet, EtherCAT, PROFINET, Modbus RTU, CANopen, DeviceNet and PROFIBUS DPV1.

No proprietary configuration software is needed. All necessary configuration is made via the built-in web interface.

The X-gateway transmits I/O data transparently between the two networks.



2.2 Features

Anybus X-gateways for Modbus-TCP act as intelligent links between two industrial networks. On the Modbus-TCP network, they function as clients (masters) while they function as slaves on the CC-Link network. The implementation is based on the Anybus NP30 ASIC technology.

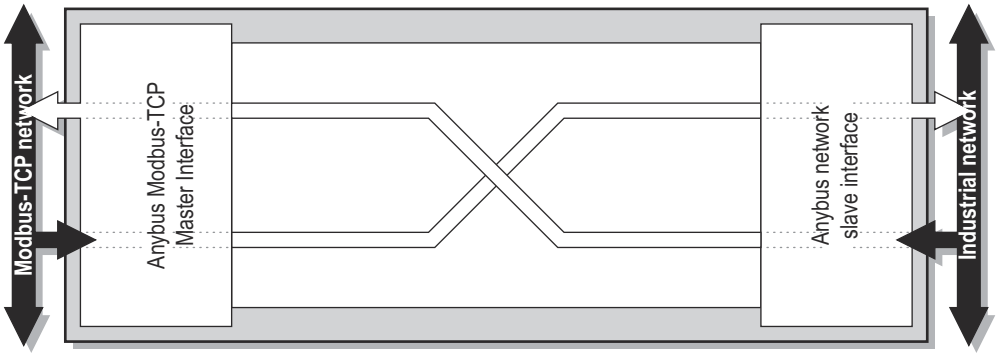
2.3 Configuring the CC-Link Network

The Anybus X-gateway Modbus-TCP is a CC-Link slave on the CC-Link network. The general settings for the slave interface are configured using the configuration web pages (see "CC-Link (Slave Interface)" on page 34). All data transfers must be configured using the CC-Link configuration tool. Please note that the size of the I/O data that can be read from and written to the module is defined when configuring the X-gateway using the configuration web pages.

There are a number of different configuration tools for CC-Link available on the market. The choice of tool depends on the application and the CC-Link master of the network.

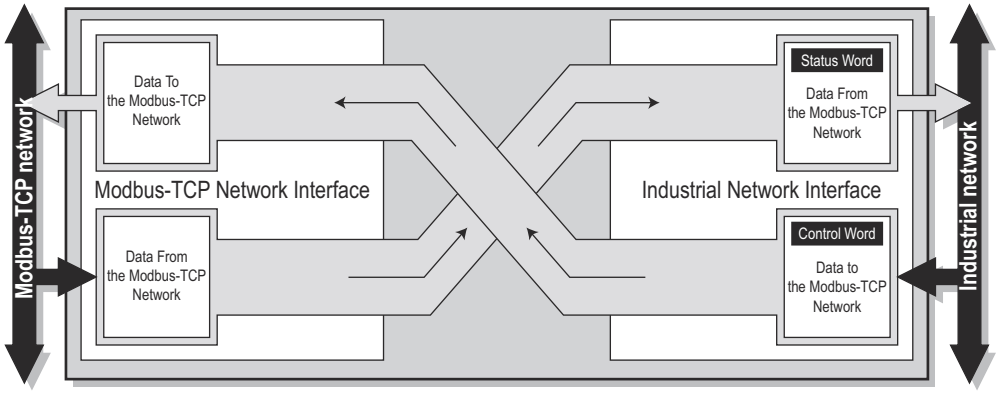
2.4 Functional Overview

Internally, the X-gateway consists of an intelligent gateway platform, an Anybus Modbus-TCP interface and an Anybus CC-Link (slave) interface. The Modbus-TCP interface and the Anybus CC-Link (slave) interface are interconnected through the intelligent gateway platform, which basically forwards data from one network to the other and vice versa as shown below. This design allows almost any other industrial network to be connected to a Modbus-TCP master on a separate Modbus-TCP network.



2.5 Data Exchange

Each of the two network interfaces exchanges data on its network through two buffers. The X-gateway forwards the data between these buffers as shown below. Note that this process is separated from the network data exchange. While the X-gateway ensures data consistency (where applicable), it does not feature any built-in mechanisms for synchronization between the Modbus-TCP network and the CC-Link network.



Each buffer holds a maximum of 256 bytes of data. The first two bytes in either direction can be dedicated for control/status information, and another eight bytes of data coming from the Modbus-TCP network can feature a live list. Please note that the actual number of bytes that can be exchanged is highly network dependent.

Through the dedicated control word, the master on the CC-Link network starts/stops the exchange of data on the Modbus-TCP network, and also resets the X-gateway if needed. The master on the CC-Link network can see the status of the Modbus-TCP network in the corresponding status word. The live list feature gives the master on the CC-Link network the opportunity to continuously see and monitor the status of each individual transaction on the Modbus-TCP network.

The amount of data that shall be exchanged, and the use of the control/status word and the live list, is specified separately for each application. This means that even though up to 256 bytes of data can be potentially forwarded to an interface, the amount of data that will actually be exchanged on that network is determined by the Modbus-TCP settings and the limitations of the master side fieldbus.

The available control/status and live list functionality is described below. Also note that the terminology and definitions used for different types of data vary greatly between different networking systems.

2.6 I/O Mapped Data

I/O mapped data is cyclic data, exchanged between the networks and/or devices at a high transfer rate. It is associated with data that is continuously sent on the network.

2.7 Control/Status Word

The Control/Status word is disabled by default, and can be enabled/disabled when configuring the CC-Link network via the configuration web pages. See "CC-Link (Slave Interface)" on page 34.

For information about how to access the Control/Status word, see "Mapping Overview" on page 36.

The Control word is a 16-bit word used by the CC-Link network to control the Anybus X-gateway and subsequently also the Modbus-TCP network.

Bit	RY	Value	Description
0 (Least significant bit)	0	0	Puts the X-gateway in idle state
		1	Puts the X-gateway in run state
1	1	-	A reboot of the X-gateway is triggered by a rising edge, i.e. a transition from 0 to 1
2-7	2-7	Set to zero	Unused
8-15	8-15	Set to zero	Unused

The Status word is a 16-bit word used by the X-gateway to report its current actual status to the CC-Link network.

Bit	RX	Value	Description
0 (Least significant bit)	0	0	The X-gateway is in idle state
		1	The X-gateway is in run state
1	1	-	This bit is reflecting the state of bit 1 in the control word Either 0 or 1
2-7	2-7	(reserved)	Unused
8-15	8-15	(reserved)	Unused

2.8 Live List

The live list features the possibility for the CC-Link network to retrieve a list containing the status of every transaction on the Modbus-TCP network.

The live list is disabled by default, and can be enabled/disabled when configuring the CC-Link network settings. See "CC-Link (Slave Interface)" on page 34. If the live list is enabled, it will occupy either RX0 - RX63 (control/status word not enabled) or RX16 - RX79 (control/status word enabled and occupying RX0 - RX15) in the input data area.

All transactions and their places in the live list are also visible in the Transaction Monitor on the configuration web pages.

The live list consists of a bit array with 64 elements, where each bit corresponds to a transaction on the Modbus-TCP network as in the table below.

Byte 7		**Byte 6-1**	**Byte 0**			
Bit 63	**Bit 62-56**	**Bit 55-8**	**Bit 7**	**Bit 6 - 2**	**Bit 1**	**Bit 0**
Status of transaction no 63	Status of transaction no 62-56	...	Status of transaction no 7	Status of transaction no 6 - 2	Status of transaction no 1	Status of transaction no 0

- **Bit set to 1**

  Transaction successful.

- **Bit set to 0**

  Transaction not successful.

  Note: the reason for the unsuccessful transaction can be found on the corresponding index in the transaction monitor.

The order of the transactions in the live list conforms to the order in which they are stored in the Modbus Server list.

Example

Consider the following configuration:

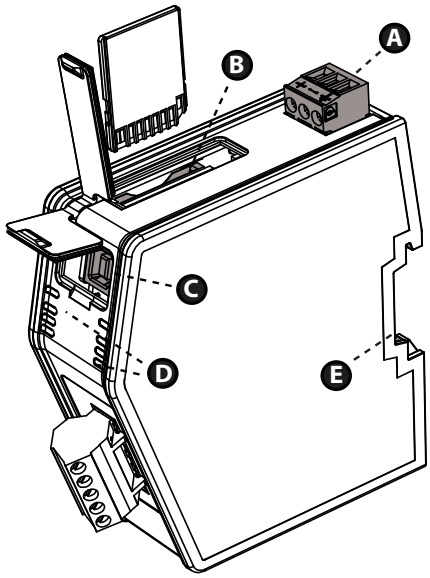
- Server 1 : a total of 2 transactions
- Server 2 : a total of 3 transactions
- Server 3 : a total of 1 transaction

This scenario will produce a live list as follows (assuming that the transactions are successful):

Bit 63	**Bit 62 - 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
-	-	Server 3, transaction 1	Server 2, transaction 3	Server 2, transaction 2	Server 2, transaction 1	Server 1, transaction 2	Server 1, transaction 1
0	0	1	1	1	1	1	1

3. About the Anybus X-gateway Modbus-TCP

3.1 External View



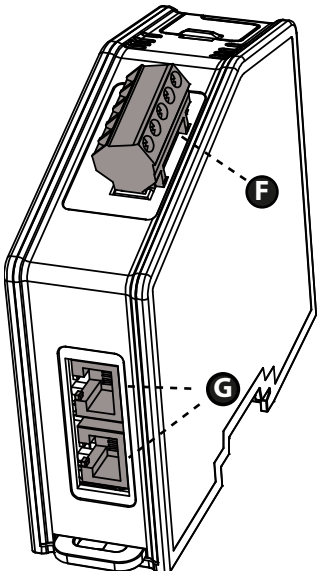
- **A: Power Connector**
  This connector is used to apply power to the X-gateway. It is also possible to connect protective earth (PE) to the power connector. See "Power Connector" on page 19.

- **B: SD Card Slot**
  This slot adds the possibility to store and load configurations from an SD card. See "SD Card Functionality" on page 20.

- **C: USB Port**
  This port adds the possibility to connect a PC to the X-gateway to perform firmware upgrades. See "USB Connector" on page 18.

- **D: Status LEDs**
  See "Status LEDs" on page 17.

- **E: DIN-rail Connector**
  The DIN-rail mechanism fastens the X-gateway to a DIN-rail and connects the module to protective earth (PE). See "Mounting the X-gateway" on page 15.



- **F: CC-Link Connector**
  See "CC-Link Connector" on page 18.

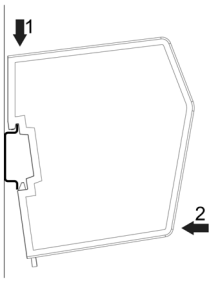
- **G: Modbus-TCP Connectors**
  2-port switch with daisy-chain functionality. See "Modbus-TCP Connectors" on page 18.

NOTE
From X-gateways produced in September 2024 onwards, SD card functionality is no longer included.

3.2 Mounting the X-gateway

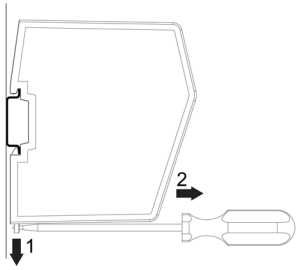
The Anybus X-gateway Modbus-TCP can be physically installed either by mounting it onto a DIN-rail or, if installed in areas exposed to vibration, by mounting it on a wall for more stability.

3.2.1 DIN-rail Mounting

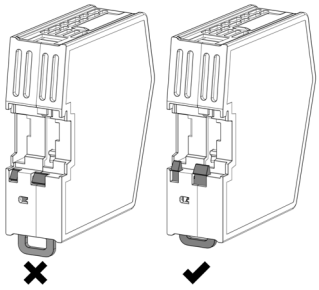


Make sure the DIN-rail fastening mechanism on the back of the module is in a fixed and closed position, i. e. pushed all the way up.

To mount the module, first hook it on to the DIN-rail (1), then push it against the DIN-rail to make it snap on (2).



To unmount the module, a screwdriver is needed. Use the screwdriver to push the DIN-rail fastening mechanism on the back of the module down until it locks in a fixed and open position (1). Then unhook the module from the DIN-rail (2).



Note: Do not leave the module with the DIN-rail fastening mechanism in a fixed and open position. This may eventually wear the fastening mechanism out so it cannot be used efficiently. Be sure to push the DIN-rail fastening mechanism back into the fixed and closed position after unmounting the module.

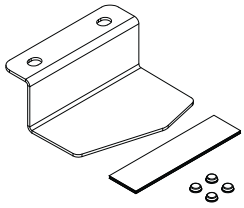
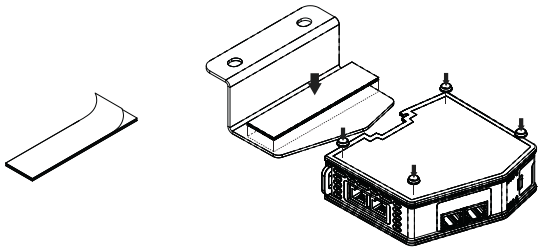
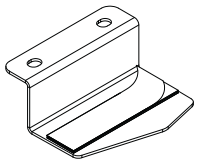
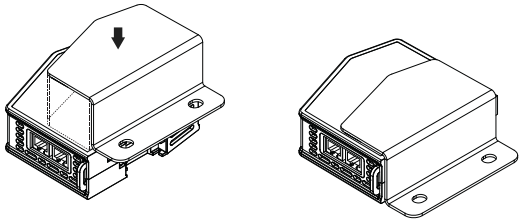
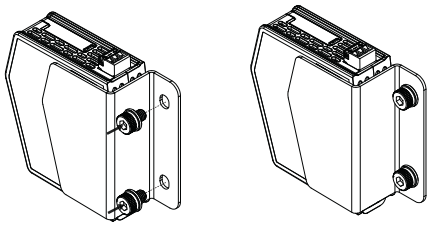
3.2.2 Wall Mounting

Use the wall mounting option if there is a need to place the X-gateway in an environment exposed to vibration. This way of mounting the module offers more stability than the traditional DIN-rail mounting.

Note: The X-gateway should be fastened in a standing-up position, to ensure a constant air flow.

Note: When mounting the X-gateway to a wall using the wall mount option, do not forget to connect the module to protective earth (PE) via the power connector. See "Power Connector" on page 19.

Mounting Instructions

Step	Description	Visual description
1	Open up the package containing the wall mounting accessories. - One metal frame - Industrial velcro - Four plastic vibration dampers	
2	Remove the plastic protection from one side of the velcro. Attach the velcro to the metal frame. Attach the four plastic vibration dampers to the X-gateway, on the side that will face the wall.	
3	Remove the plastic protection from the other side of the velcro.	
4	Turn the X-gateway around, so that the plastic vibration dampers face downwards. Fasten the metal frame to the X-gateway by pressing the frame firmly against the X-gateway, making the two velcro parts attach to each other.	
5	Attach the metal frame and the X-gateway to a wall using screws and washers (not enclosed).	

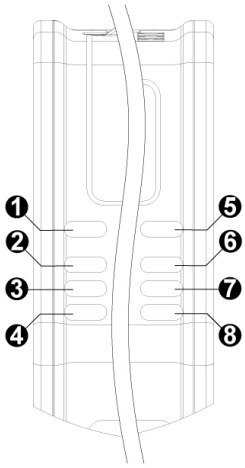
3.3 Status LEDs

Note: A test sequence is performed on all LEDs during startup.

Note: An identification LED sequence can be performed on LEDs 1, 5 and 6 by clicking the "Wink device" button in the X-gateway Management section in the web configuration interface.

X-gateway and Modbus-TCP Network LEDs

LED no	State	Status
1 - Gateway Status (GW)	Off	Power off
	Alternating red/green	Missing configuration
	Flashing green	Idle
	Green	Running
	Flashing red	Invalid configuration
	Red	Fatal error
5 - SD card (SD)	Green	Accessing SD card
	Flashing red	Failure
6 - Modbus-TCP Status (MTCP)	Off	Power off
	Green	Communicating with Modbus-TCP network
	Flashing red	Transaction error or timeout
	Red	Fatal error
7, 8 - Ethernet Link 1 (LA1), Ethernet Link 2 (LA2)	Off	No link
	Flashing green	Receiving/transmitting Ethernet packets at 10/100 Mbit



CC-Link Network LEDs

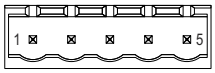
LED no	State	Status
2	Not used	-
3 - RUN	Off	No network participation
	Green	Participating, normal operation
	Red	Fatal error (restart X-gateway)
4 - ERROR	Off	No error detected
	Red	Fatal error (restart X-gateway)
	Flickering red	CRC error

NOTE
From X-gateways produced in September 2024 onwards, SD card functionality is no longer included.

3.4 CC-Link Connector

The connector for the CC-Link network is found at the lower front of the module.

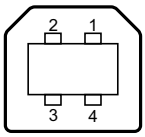
Pin no	Signal	Description
1	DA	Positive RS485 RxD/TxD
2	DB	Negative RS485 RxD/TxD
3	DG	Signal ground
4	SLD	Cable shield
5	FG	Protective earth (PE)



3.5 USB Connector

At the upper front of the module there is a USB connector used for firmware upgrades.

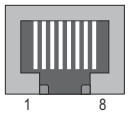
Pin no.	Description
1	+5V Input
2	USBDM (USB communication signals)
3	USBDP (USB communication signals)
4	Signal GND
Housing	Cable Shield



3.6 Modbus-TCP Connectors

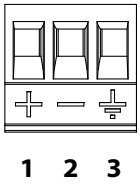
The Modbus-TCP connectors are found at the bottom of the module.

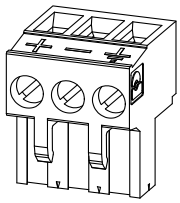
Pin no.	Description
1	TX+
2	TX-
3	RX+
4	Not connected
5	Not connected
6	RX-
7	Not connected
8	Not connected
Housing	Shield



3.7 Power Connector

Pin no.	Description
1	+24V DC
2	GND
3	PE (Protective Earth)





Notes:

- Use 60/75 or 75×C copper (CU) wire only.
- The terminal tightening torque must be between 5... 7 lbs-in (0.5... 0.8 Nm)

  See also...
  - "Power Supply" on page 39.

4. SD Card Functionality

Using an SD card with the X-gateway adds the following features:

- **Easy backup**.
  Every applied change in the configuration will automatically be saved to the X-gateway and the SD card. See "Easy Backup" on page 24.
- **Simple configuration copy**.
  Using the SD card, the configuration on one X-gateway can be copied to other X-gateways. See "Simple Configuration Copy" on page 24.
- **Easy replacement**.
  If an X-gateway malfunctions during operation, a replacement module can easily be configured by moving the SD card to the new module. See "Easy Replacement" on page 24.

A configuration on the X-gateway is saved automatically to the SD card in any of these two events:

- A configuration is applied in the X-gateway Management section
- A configuration is restored from a backup file

Important

The SD card acts as a master in the X-gateway. When an X-gateway is turned on with an SD card inserted, and that SD card contains a valid configuration file, the configuration on the SD card will always overwrite any configuration on the X-gateway.

NOTE
From X-gateways produced in September 2024 onwards, SD card functionality is no longer included.

4.1 General Advice and Guidelines

Turn the power off before inserting or removing an SD card from the X-gateway.

Do not turn the X-gateway off while the SD LED indicates that the SD card is being accessed. Refer to "Status LEDs" on page 17 for more information.

The X-gateway will not write any data to a write-protected SD card.

4.2 Starting Up

1. Format the SD card for the FAT file system using a PC. The X-gateway cannot use an unformatted SD card.
2. Make sure the SD card is empty and that it is not write-protected.
3. Turn the X-gateway off.
4. Insert the SD card into the SD card slot in the X-gateway.
5. Turn the X-gateway on.
6. Create the configuration. When finished, press the apply button in the X-gateway Management section to reboot using the new configuration. During the reboot, the latest applied configuration will automatically be copied and saved to the SD card.
7. Now, the SD card is synchronized with the X-gateway. Both the SD card and the X-gateway contain the latest applied configuration.

Every time a new configuration is applied in the X-gateway Management section, it is also copied to the SD card to ensure synchronization.

4.3 Easy Backup

Every time a configuration change is applied in the X-gateway Management section using the configuration web pages, the configuration is saved both in the memory of the X-gateway and on the SD card. This is the easiest way of keeping a continuously updated configuration backup.

4.4 Simple Configuration Copy

If a configuration on one X-gateway needs to be copied to one or more other X-gateways, it is easily done using an SD card.

1. Turn the X-gateway running the desired configuration off.
2. Remove the SD card from the X-gateway containing the desired configuration and insert it into another one.

   Note 1: The firmware version must be the same or higher in the new X-gateway.

   Note 2: The new X-gateway must support the same network type as the first X-gateway.
3. Turn the new X-gateway on. The new X-gateway will automatically start up using the configuration found on the SD card.

Important

If the configuration was protected by authentication information, the same information will be needed to alter the configuration in the new X-gateway.

4.5 Easy Replacement

If an X-gateway malfunctions during operation, the SD card functionality makes it easy to get the application up and running again fast.

1. Turn the malfunctioning X-gateway off.
2. Replace the old X-gateway with a new one.

   Note 1: The firmware version must be the same or higher in the new X-gateway.

   Note 2: The new X-gateway must support the same network type as the old X-gateway.
3. Remove the SD card containing the configuration file from the old X-gateway and insert it into the new one.
4. Turn the new X-gateway on. If the SD card contains a valid configuration file, the X-gateway will automatically start up using the configuration found on the SD card.

Important

If the configuration was protected by authentication information, the same information will be needed to alter the configuration in the new X-gateway.

Depending on the settings of the master network, the communication link between the X-gateway and the master may no longer be valid. X-gateway settings that were configured from outside the configuration web pages will need to be set again.

4.6 SD Card Synchronization Failure

In the event of applying a configuration or restoring a configuration from a backup file, the SD card synchronization can fail. There are many possible reasons for an SD card write failure:

- The SD card is write-protected.
- The configuration file on the SD card is write-protected.
- The SD card memory is full.
- The SD card file system is corrupt.
- The SD card is damaged.

If the SD card write process fails, the reboot cycle of the X-gateway will halt. The GW LED will indicate "invalid configuration" and the SD LED will indicate "failure". See "Status LEDs" on page 17.

To eliminate the problem, follow the steps below:

1. Turn the X-gateway off.
2. Remove the SD card. Find the cause of the problem.
3. Insert an SD card.

   Note: This SD card must **not** contain a configuration file. If it does, the configuration on the SD card will overwrite the configuration on the X-gateway.
4. Turn the X-gateway on. The X-gateway will run the configuration that was applied or restored when the SD card write process failed.
5. Apply the configuration in the X-gateway Management section to save the configuration to the SD card.
6. Now, the SD card is synchronized with the X-gateway. Both the SD card and the X-gateway contain the latest applied configuration.

5. Modbus-TCP Functions

The Modbus-TCP protocol is an implementation of the standard Modbus protocol, running on top of TCP/IP. The same function codes and addressing model are used.

The Anybus X-gateway Modbus-TCP supports a subset of the functions described in the Modbus-TCP specification.

Modbus-TCP transactions are normally transmitted and received on TCP port no. 502. The X-gateway features the possibility to set TCP ports individually for each Modbus-TCP server.

For detailed information regarding the Modbus-TCP protocol, consult the Open Modbus-TCP Specification.

The Anybus X-gateway Modbus-TCP supports the following Modbus-TCP functions:

Modbus Function	Function Code	No. of Bits/Registers[a]	Direction	Associated with Buffer
Read Coils	1	1-2000	Modbus to Gateway	Input buffer
Read Discrete Inputs	2	1-2000		
Read Holding Registers	3	1-125		
Read Input Registers	4	1-125		
Write Single Coil	5	1	Gateway to Modbus	Output buffer
Write Single Register	6	1		
Write Multiple Coils	15	1-1968		
Write Multiple Registers	16	1-123		
Read/Write Multiple Registers	23	1-125 read 1-121 write	Bidirectional	Input and output buffers

a. Please refer to the Modbus Application Protocol Specification V1.1B for more detailed information.

Modbus-TCP functions are used as important parts of transactions to Modbus-TCP servers. After configuring a server within the Modbus-TCP network, functions can be assigned to it by clicking the 'Add transaction' button in the built-in web interface.

See also...

- "Network Configuration" on page 25
- "Modbus Servers" on page 31

6. CC-Link Data Handling

6.1 Bit Area vs. Word Area

On CC-Link, data is divided into two categories as follows:

- **Bit Area**

  Data is accessed on a bit-by-bit basis. Data is commonly referred to as RX #nn (Slave->Master) and RY #nn (Master->Slave) where 'nn' represents an addressable point (i.e. a single bit) in the Bit Area.

- **Word Area**

  Data is accessed as 16-bit words. Data is commonly referred to as RWr #nn (Slave->Master) and RWw #nn (Master->Slave) where 'nn' represents an addressable point (i.e. a word) in the Word Area.

6.2 Data Sizes

CC-Link Version 1

Using CC-Link version 1, the total amount of I/O data to be used in the application can be set using the occupied stations value. The following data sizes are possible:

Occupied Stations	Bit Points	Word Points
1	32 bits	4 words
2	64 bits	8 words
3	96 bits	12 words
4	128 bits	16 words

CC-Link Version 2

Using CC-Link version 2, it is possible to use larger data sizes through extension cycles. Combining a choice of occupied stations with extension cycles enables the possibility to use the following sizes in the application:

Occupied Stations	1 Extension Cycle	2 Extension Cycles	4 Extension Cycles	8 Extension Cycles
	Points	Points	Points	Points
1	32 bits	32 bits	64 bits	128 bits
	4 words	8 words	16 words	32 words
2	64 bits	96 bits	192 bits	384 bits
	8 words	16 words	32 words	64 words
3	96 bits	160 bits	320 bits	640 bits
	12 words	24 words	48 words	96 words
4	128 bits	224 bits	448 bits	896 bits
	16 words	32 words	64 words	128 words

Note: The Anybus X-gateway can only handle I/O data up to 256 bytes in either direction.

7. Network Configuration

7.1 General Information

The Anybus X-gateway features built-in web pages for easy configuration. The web pages are all described in this chapter. To access the web configuration pages, the following system requirements need to be met:

- Internet Explorer 8.0 or 9.0
- Javascript enabled

Note: Altering the configuration while the X-gateway is exchanging data between the two networks may affect performance.

Note: Only one user at a time should be accessing the configuration web pages. If two or more users make simultaneous changes to the configuration, the configuration saved last will overwrite other changes.

There are things to take into consideration when making the configuration.

- Remember to apply the configuration in order for changes to take effect. See "X-gateway Management" on page 35. As soon as you have saved data to the configuration but not yet applied it, you will see the box below at the top of the web pages:

  The configuration needs to be applied for changes to take effect. Go to **X-gateway Management** page to apply the configuration or cancel changes.

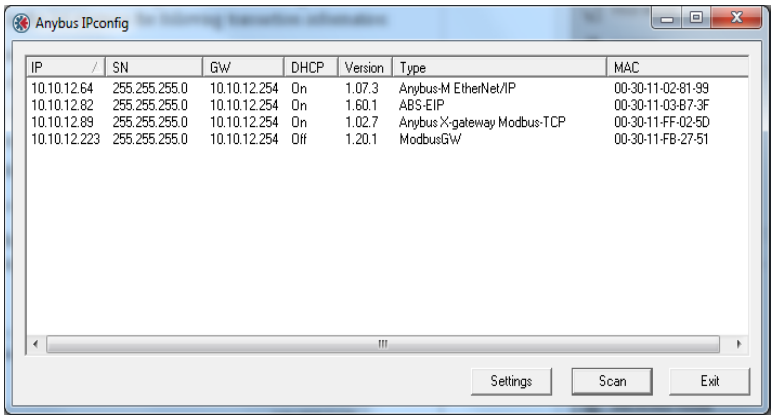
- A maximum of 64 Modbus-TCP servers can be added to the configuration.
- A maximum of 64 transactions can be set up to the servers in the configuration.
- Take care when choosing scan times for the transactions. The mimimum allowed scan time (ms) is the total number of transactions multiplied by three and cannot be less than 10 ms.
- Take care not to map too much data. The data limits are 256 bytes input data and 256 bytes output data, including optional control/status word and live list. See "Data Sizes" on page 24.

7.2 Introduction

To display the configuration and status web pages of the X-gateway, start a web browser and type the IP address of the module in the address field.

The default IP address of the X-gateway is 192.168.0.100. To connect a computer to the X-gateway, make sure that both the computer and the module are using the same subnet mask, e.g. 255.255.255.0. Change the IP address of the computer to 192.168.0.X, where X is any number between 0 and 255 except 100.

If, for example, there is a DHCP server on the network, the IP address might be unknown. In that case, use the Anybus IPconfig tool to find it. The Anybus IPconfig tool can be downloaded from www.anybus.com.

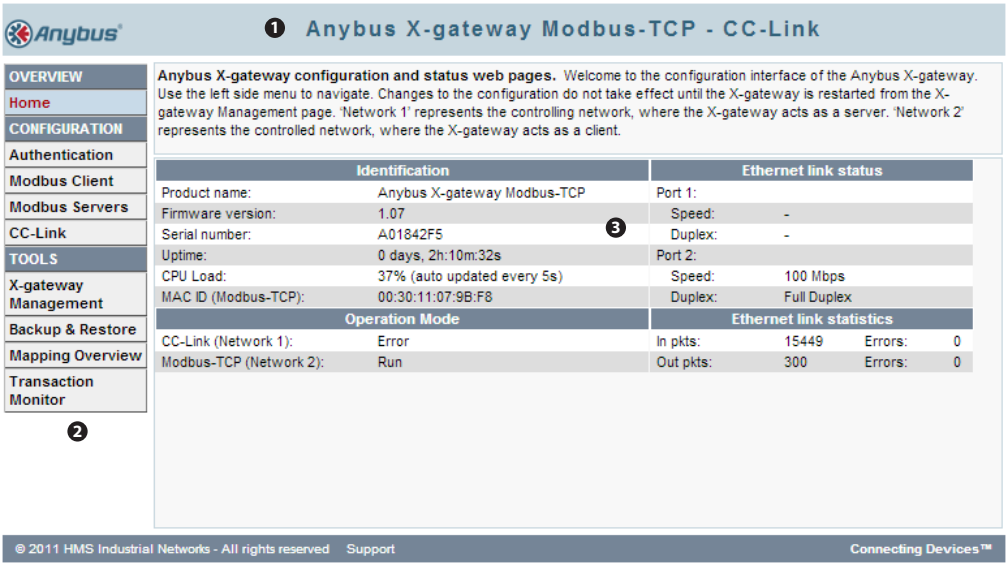


If a list of connected devices does not show automatically, press the scan button. Identify the IP address of the X-gateway by its type 'Anybus X-gateway Modbus-TCP' or by its MAC address. The MAC address of the X-gateway can be found at the bottom of the module.

For additional information about the Anybus IPconfig tool, see "Anybus IPconfig Tool" on page 45.

7.3 Overview

The configuration and status web pages are divided into three sections:



1. **Headline Section**

   Shows the Anybus logo and the name of the product.

2. **Navigation Section**

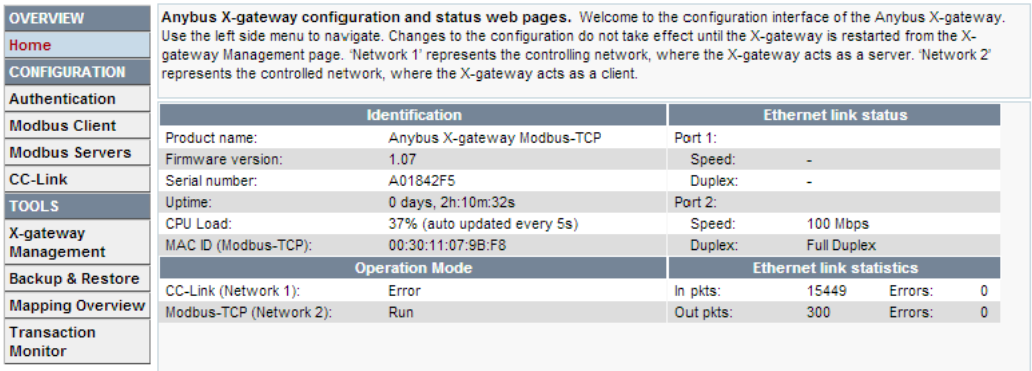
   All functionality is easily accessed from the different links. Every link and its corresponding functionality will be explained later in this chapter.

3. **Content Section**

   Clicking a link will display its contents in the content section. A short text describing the functionality of the current page will be available at the top of the section.

7.3.1 Home

The introductory window of the configuration and status web pages presents important error tracking information, as well as general information and statistics.



Operation Mode

The table below shows the correlation between the operation modes of the CC-Link network and the Modbus-TCP network.

		CC-Link (Network 1)	
		I/O data exchanged	**No I/O data exchanged**
Modbus-TCP (Network 2)	**Run**	Data is exchanged between the two networks	The CC-Link network exchanges no data. Data to the Modbus-TCP network is in clear, freeze, stop or safe value state
	Idle	The Modbus-TCP network exchanges no data. Data to the CC-Link network is in clear or freeze state	No data is exchanged. Both networks, independently, are in clear, freeze, stop or safe value state

In case of an error on the CC-Link network, the following additional fieldbus statuses may appear:

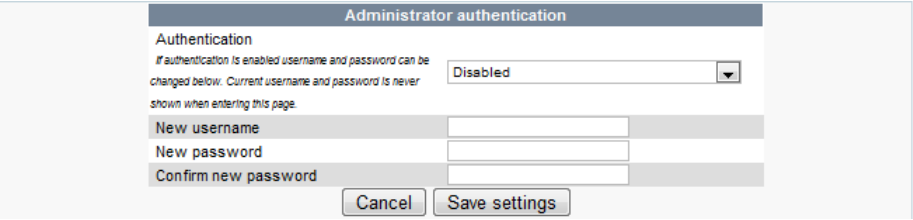
CC-Link (Network 1)	Description
Error	Possible causes: - Timeout error - 0 channel carrier detection status - insufficient number of data for the host When the problem disappears, the module returns to the previous state.
Shutdown	Configuration error or unexpected error (the X-gateway needs a restart)

7.4 Configuration

Please note that changes made to the configuration will not be used by the X-gateway until they have been applied and saved. See "X-gateway Management" on page 35.

7.4.1 Authentication

Authentication can be enabled or disabled. If enabled, it is possible to set a username and password to protect the configuration.



When choosing a username and a password, use only the valid characters shown below.

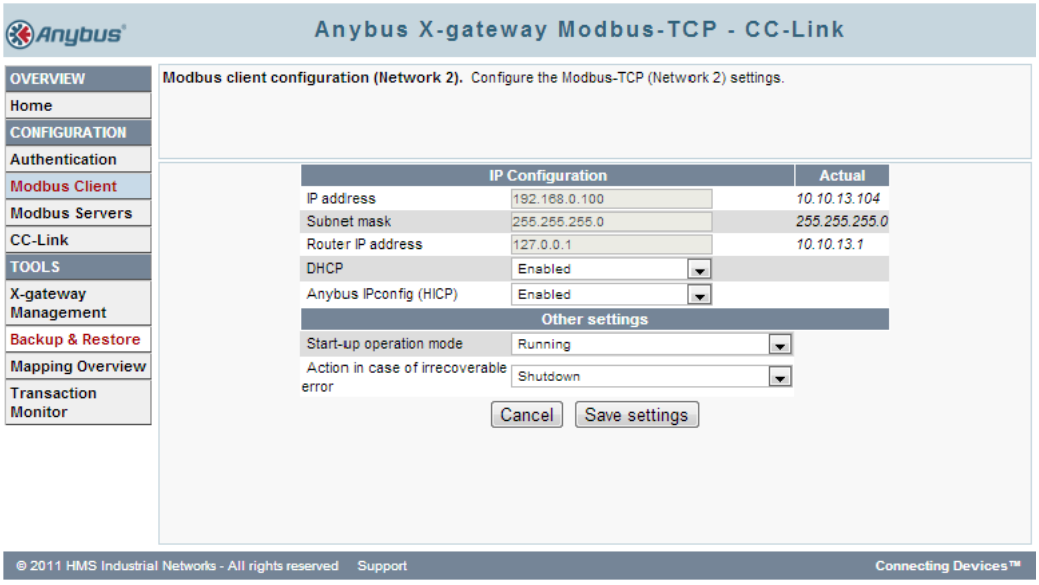
Item	Valid characters
Username	A-Z, a-z, 0-9, _ (underscore). Max length: 13 characters
Password	A-Z, a-z, 0-9, _ (underscore). Max length: 12 characters

Important Notice

Note that it is very important to save the authentication information. There is no way to retrieve a lost username or password. If the authentication information is lost, the only way to restore the X-gateway is to download new firmware via the USB interface. This will erase any configuration currently on the module.

7.4.2 Modbus Client

Configuration of the client side of the Modbus-TCP network. On this side, the X-gateway will act as a Modbus-TCP client. To the right, in the "Actual" column, the currently used values can be seen.



Available IP Configuration Settings

Item	Description
IP address	If not set by DHCP (or HICP), set these values manually
Subnet mask	
Router IP address	
DHCP	Enabled by default. When enabled, the X-gateway can obtain the TCP/IP settings dynamically from the DHCP server of the Modbus-TCP network
Anybus IPconfig (HICP)	Enabled by default. When enabled, the TCP/IP settings for the Modbus-TCP network can be configured temporarily with the Anybus IPconfig tool. See "Anybus IPconfig Tool" on page 45

Start-up Operation Mode

Value	Description
Running	The Modbus-TCP client starts to exchange data with the servers as soon as possible after start-up
Idle	The Modbus-TCP client does not exchange any data with the servers and waits for instructions via the control word

Action in Case of Irrecoverable Error

If the X-gateway encounters an irrecoverable error, there are two possible options.

Value	Description
Shutdown	The X-gateway will shut down. All LEDs will display red.
Restart	The X-gateway will restart.

When finished configuring the Modbus-TCP client, click 'Save settings'. Note that the changes will not take effect until they are applied in the X-gateway management section. See "X-gateway Management" on page 35.

7.4.3 Modbus Servers

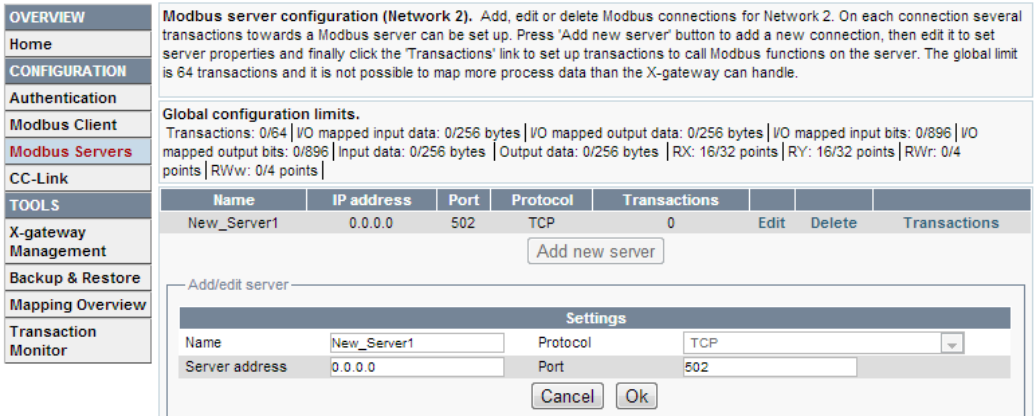
The configuration of the servers on the Modbus-TCP network is made here. The X-gateway can handle up to 64 different servers, and a maximum of 64 transactions distributed among those servers. It is possible to map up to 256 bytes of data in either direction, including control/status word and live list.

The global configuration limits box keeps track of the number of added transactions and the current amount of input and output data.

Global configuration limits.
Transactions: 0/64 | I/O mapped input data: 0/256 bytes | I/O mapped output data: 0/256 bytes | I/O mapped input bits: 0/896 | I/O mapped output bits: 0/896 | Input data: 0/256 bytes | Output data: 0/256 bytes | RX: 16/32 points | RY: 16/32 points | RWr: 0/4 points | RWw: 0/4 points |

Add Server

Click 'Add server' to add a server to the configuration. Click 'Edit' to see and edit the settings:



Available editable settings:

Setting	Description
Name	While not required, renaming the server makes the configuration easier to comprehend. Note that it is only possible to use uppercase and lowercase characters, numerals and underscore (_) Default name is 'New_Server', followed by an incremental suffix Max length: 32 characters
Server address	The IP address of the server
Protocol	TCP
Port	Default Modbus-TCP port is 502. If the server requires it, it is possible to change Value range: 0 - 65535

When the server is configured, click 'Ok'.

Note: When the server and its settings are configured, transactions must be added to the server. See "Add Transactions" on page 32. At any time, it is possible to have only one server without specified transactions.

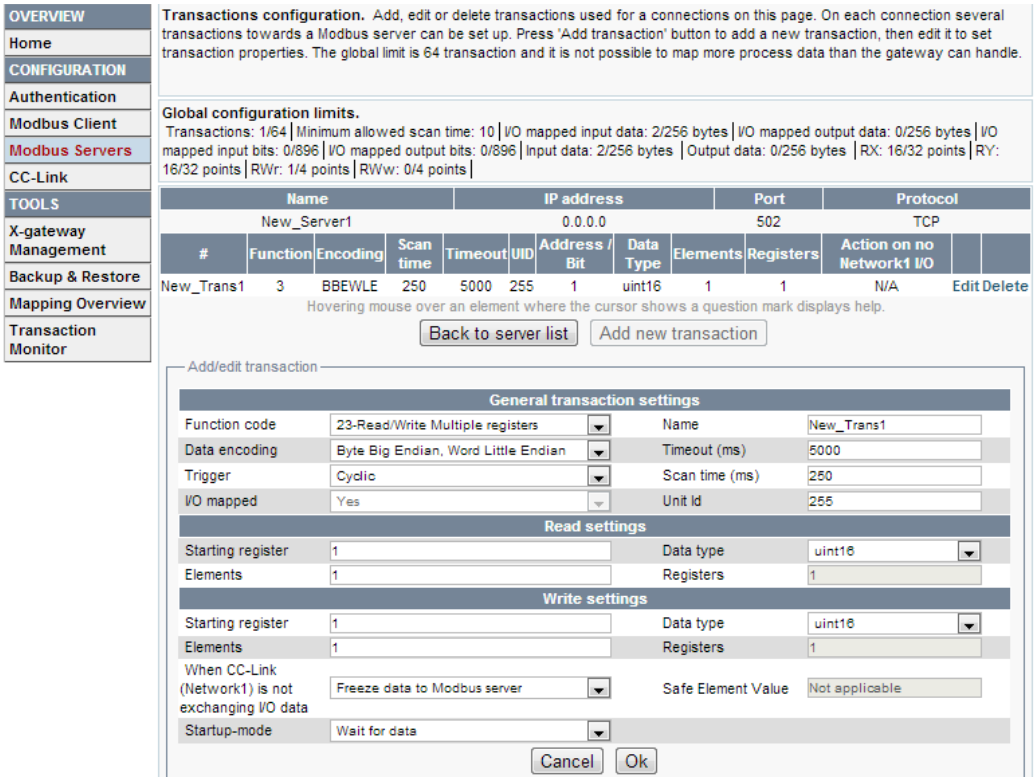
Add Transactions

Transactions represent the data that is read from/written to the servers of the Modbus-TCP network.

The global configuration limits box keeps track of the number of added transactions, the current minimum allowed scan time, and the current amount of data.

Global configuration limits.
Transactions: 1/64 | Minimum allowed scan time: 10 | I/O mapped input data: 2/256 bytes | I/O mapped output data: 0/256 bytes | I/O mapped input bits: 0/896 | I/O mapped output bits: 0/896 | Input data: 2/256 bytes | Output data: 0/256 bytes | RX: 16/32 points | RY: 16/32 points | RWr: 1/4 points | RWw: 0/4 points |

To add transactions, find the server in the server list and click 'Transactions'. This presents a list of all transactions configured for that server. Click 'Add transaction' to add a new default transaction to the list and click 'edit'.



The available settings will be described on the next page.

Available settings

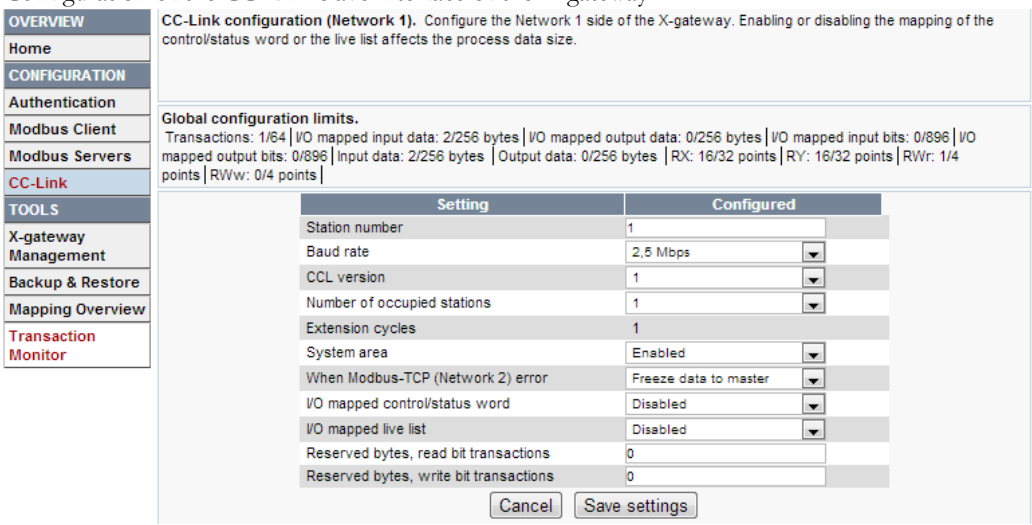
Setting	Description
Function code	The function code defines the purpose of the transaction Choose from the available different Modbus functions, see “Modbus-TCP Functions” on page 26
Data encoding	Decides in what order the different bytes of the received/transmitted data shall be sent on the network
Trigger	Only applicable for write transactions Cyclic On data change
I/O mapped	Not in use
Name	While not required, renaming the transaction makes the configuration easier to comprehend. Note that it is only possible to use uppercase and lowercase characters, numerals and underscore (_) Default name is ‘New_Trans’, followed by an incremental suffix Max length: 32 characters
Timeout (ms)	The time span within which the server must return a response to the transaction If no response is received within the timeout period, the connection to the server will be closed If the connection to the server is closed, all transactions to that server will be affected Value range: 10 - 65535 (ms)
Scan time (ms)	The scan time defines how often the transaction shall be resent, e.g. the time cycle of a repeating transaction Minimum scan time (ms) is calculated by multiplying the total number of transactions by three The minimum scan time will increase by adding more transactions Value range: 10 - 10000 (ms)
Unit ID	Only applicable for Modbus RTU servers. If the Modbus-TCP server functions as a router to Modbus RTU servers, it is possible to send transactions to a single Modbus RTU server using the unit ID Value range: 0 - 247; 255 If not communicating with a Modbus RTU server, use the value 255 (default)
Starting register/bit	The starting Modbus server register or bit to write to/read from Value range: 1 - 65536
Elements	The number of elements to write/read Value range: See “Modbus-TCP Functions” on page 26.
When CC-Link (network 1) is not exchanging I/O data	Note: Only available for I/O mapped write transactions Clear data to Modbus server: only zeros will be transmitted Freeze data to Modbus server: the data that was stored last will be repeated Write safe value: choose a specific value to transmit for every element (See safe element value below) Stop: no data will be transmitted to the Modbus server
Data type	Write/read data either as two byte integers (uint16) or four byte integers (uint32)
Registers	The resulting amount of registers to write/read. The calculation is based on the number of elements to read/write and the chosen data type
Safe Element Value	Note: Only available for write transactions A numeric value to send for every element if network 1 (CC-Link) is not exchanging I/O data
Startup-mode	Wait for data: all data for the transaction must have been sent from the CC-Link network and received by the X-gateway before the transaction is carried out Directly

When finished editing the transaction, click ‘Ok’. All data resulting from configured transactions will be mapped to the internal memory of the X-gateway. Read transactions will be mapped to the input area, and write transactions will be mapped to the output area. See “Mapping Overview” on page 36 for more information.

Note: The X-gateway needs to be restarted before any changes will take effect. See “X-gateway Management” on page 35.

7.4.4 CC-Link (Slave Interface)

Configuration of the CC-Link slave interface of the X-gateway.



What is shown is the currently stored configuration, provided that all changes are saved and applied to the X-gateway.

Note that no changes will take effect until the configuration has been applied. See "X-gateway Management" on page 35.

Available settings for the CC-Link network

Setting	Description
Station number	The X-gateway station number on the CC-Link network Default value: 1 Value range: 1 - 64 Value 0: station number not set Value >64: not valid **Note:** The sum of the station number and the number of occupied stations may not exceed 65
Baud rate	Values: 156 kbps, 625 kbps, 2.5 Mbps, 5 Mbps, 10 Mbps
CCL version	Values: 1 or 2[a]
Number of occupied stations	Values: 1 - 4[a]
Extension cycles	CC-Link version 1: value: 1 (not editable) CC-Link version 2: values: 1, 2, 4, 8[a]
System area	Enabled by default Used for initial handshake
When Modbus-TCP (Network 2) error	The "Freeze data to master" option instructs the X-gateway to keep sending the latest received data from the Modbus-TCP network to the CC-Link master
	The "Clear data to master" option instructs the X-gateway to clear the input data area and send only zeros to the CC-Link master
I/O mapped control/status word	If enabled, the control/status word is mapped to the RY/RX area respectively. See "I/O Mapped Data" on page 12
I/O mapped live list	If enabled, the live list is mapped to the RX area. See "Live List" on page 13
Reserved bytes, read bit transactions	0: dynamic 1 - 128: The number of bytes that shall be reserved for bit transactions
Reserved bytes, write bit transactions	0: dynamic 1 - 128: The number of bytes that shall be reserved for bit transactions

a. See "CC-Link Data Handling" on page 24 for more information.

7.5 Tools

7.5.1 X-gateway Management

Apply changes

Permanently store changes made to the configuration and reboot, using the new configuration.

No changes made in the configuration will be permanently stored or used by the X-gateway until they are applied by clicking 'Apply'.

Before storing and rebooting, the X-gateway will validate the not yet stored configuration. If errors are found, the X-gateway will produce an information message with instructions to correct the errors. The X-gateway will not store an invalid configuration.

Reboot and undo changes

The X-gateway will be restarted. All changes made since the last configuration was loaded will be undone.

Undo changes

Undo all changes made since the last configuration was loaded.

Factory reset

Reset the X-gateway to completely remove the configuration currently stored in the module.

Wink device

Clicking the "Wink device" button will start a 15 second LED sequence on LEDs 1, 5 and 6 on the X-gateway. For identification purposes.

7.5.2 Backup and Restore

Backup the configuration that is currently used to file, or restore a previously saved configuration from file.

It is not possible to backup or restore the configuration until all changes are either applied or undone. See "X-gateway Management" on page 35.

Two things can happen when loading an old configuration:

- **Configuration valid:**
  The X-gateway will reboot and automatically use the previously stored configuration.
- **Configuration not valid:**
  The X-gateway will produce an error message. The chosen configuration will not be accepted or loaded into memory.

Important Notice

Before loading a previously stored configuration, locate any authentication information associated with it. If a valid configuration is loaded that is protected by a password, the X-gateway can not be reconfigured until the authentication information has been provided.

7.5.3 Mapping Overview

This page provides a representation of the input and output memory buffers of the X-gateway, as well as a list of all applied transactions.

It shows the mapping of all I/O data resulting from the currently applied configuration.

- Transactions involving Modbus register functions will be mapped to the RWr (read data) or RWw (write data) areas.
- Transactions involving Modbus coil functions will be mapped to the RX (read data) or RY (write data) areas.

If the control/status word and live list are enabled on the CC-Link configuration page, they will show here and be mapped in the RX/RY data areas before any coil transactions.

Data Mapping Overview. Shows how configured transactions, control word, status word and live list are mapped from Network 2 to Network 1 in the X-gateway and vice versa.

Network 1 (CC-Link)

RX/RY

RX

Bit index (hex)	Description/Transaction name
00 .. 0F	Status
10 .. 4F	Live-List
B0 .. BF	System area

RY

Bit index (hex)	Description/Transaction name
00 .. 0F	Control
10 .. 18	New_Trans3
B0 .. BF	System area

RWr/RWw

RWr

Word index (hex)	Transaction name	Transaction data type
00 .. 03	New_Trans1	uint16
04 .. 09	New_Trans2	uint16

RWw

Word index (hex)	Transaction name	Transaction data type
00 .. 07	New_Trans1	uint16

Network 2 (Modbus-TCP Client)

Name	IP address	Port	Protocol
New_Server1	0.0.0.0	502	TCP

#	Function	Encoding	Scan time	Timeout	UID	Address / Bit	Data Type	Elements	Registers	Action on no Network1 I/O
New_Trans1	23	BBEWLE	250	5000	255	1/1	uint16/uint16	4/8	4/8	Freeze
New_Trans2	3	BBEWLE	250	5000	255	1	uint16	6	6	N/A
New_Trans3	15	N/A	250	5000	255	1	bit	9	N/A	Freeze

In this example, the RX/RY area contains the control word, the status word and the live list. The RY area also contains the configured coil transaction (New_Trans3).

The RWr/RWw areas contains two transactions. One read/write transaction (New_Trans1) and one read transaction (New_Trans2).

Note that changes to the configuration that are not applied and saved will not show here.

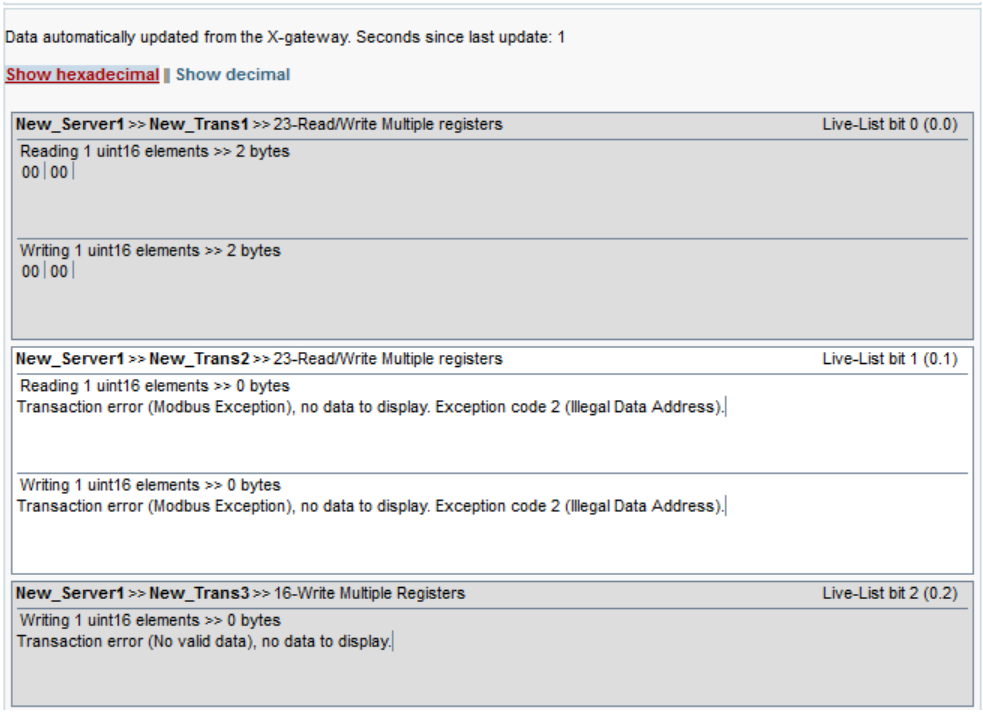
7.5.4 Transaction Monitor

The transaction monitor interface presents a detailed list of all transaction units currently operating on the Modbus-TCP network. The data is automatically updated, and it is possible to choose to view the data either in decimal or in hexadecimal values. The time that has passed since the last update is visible at the top of the transaction list. Every post in the list contains the following transaction information:

- Server name and transaction unit name
- The type of Modbus function chosen for the transaction
- The size of the data read from or written to the Modbus-TCP network
- The actual data read from or written to the Modbus-TCP network
- The bit position of the transaction unit in the live list (also presented as byte.bit).

If there is a transaction error, an error message will appear instead of the data. The error message will be followed by a Modbus exception code. For more information, see "Standard Modbus exception codes" on page 38.

A red frame around the list indicates that the web browser has lost connection to the web server of the X-gateway. If this happens, try reloading the page by clicking on "Transaction Monitor" in the menu to the left.



Note: Viewing the transaction monitor may affect performance.

Standard Modbus exception codes

If Modbus transactions fail, the slaves can respond with an exception code.

Exception Code	Description
00	No error
01	Illegal function
02	Illegal data address
03	Illegal data value
04	Slave device failure
05	Acknowledge
06	Slave device busy
08	Memory parity error
0A	Gateway path unavailable
0B	Gateway target device failed to respond

Note: If the slave responds with an exception code not in the list, refer to the documentation of the slave for details.

A. Technical Specification

A.1 Protective Earth (PE) Requirements

In order to achieve proper EMC behavior, the product must be connected to protective earth (PE) via the DIN-rail connector. If the DIN-rail cannot be used, PE must be connected to the power connector.

HMS Industrial Networks does not guarantee proper EMC behavior unless these PE requirements are fulfilled.

Note: Make sure the DIN-rail is properly connected to PE.

A.2 Power Supply

Supply Voltage

The X-gateway requires a regulated 24 V (20.4 V to 28.8 V) DC power source.

Power Consumption

The typical power consumption is 150 mA at 24 V.

A.3 Environmental Specification

A.3.1 Temperature

Operating

-25° to +70° Celsius

Non-operating

-40° to +85° Celsius

A.3.2 Relative Humidity

The product is designed for a relative humidity of 5% to 95% noncondensing.

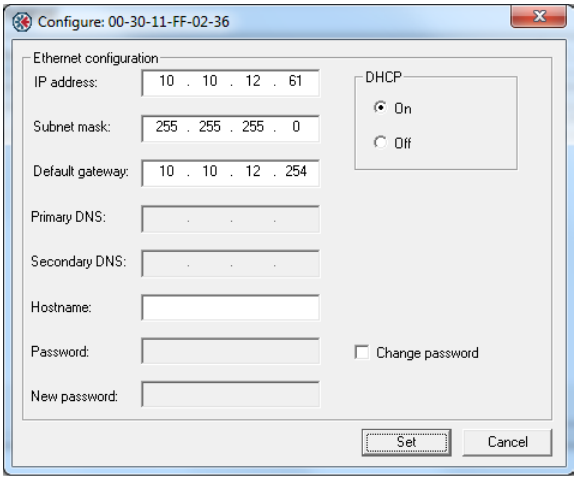
A.4 EMC (CE) Compliance

EMC compliance testing has been conducted according to the Electromagnetic Compatibility Directive 2004/108/EC. For more information please consult the EMC compliance document, see product/support pages for Anybus X-gateway Modbus-TCP at www.anybus.com.

B. Anybus IPconfig Tool

The X-gateway supports the HICP protocol used by the Anybus IPconfig tool and all Anybus products.

It is possible to see and alter the TCP/IP settings for the X-gateway manually by using the IPconfig Tool.



At start-up, the IPconfig tool presents a list of all Anybus products that are connected to the network. The list can be refreshed by clicking 'scan'. The X-gateway is identified in the list by its type 'Anybus X-gateway Modbus-TCP' or by its MAC address (found at the bottom of the module).

Right-clicking a row in the list makes it possible to either visit the web interface of the product, or bring up the configuration window. Double-clicking a row also brings up the configuration window.

In the configuration window the TCP/IP settings can be set or changed. Save the new settings by clicking 'set', or exit without saving by clicking 'cancel'.

Note: the IPconfig tool provides the opportunity to set a username and a password. The X-gateway, however, will not accept any configuration changes where the password has been altered.

Note: if the X-gateway configuration is protected by a password, it is not possible to alter the TCP/IP settings.

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