User Manual
Anybus® X-gateway
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Rev: 2.10

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Important User Information

This document is intended to provide a good understanding of the functionality offered by the Anybus X-Gateway.

The reader is expected to be familiar with high level software design, and communication systems in general. The use of advanced interface-specific functionality may require in-depth knowledge of networking internals and/or information from the network specifications. In such cases, the persons responsible for the implementation of this product should either obtain the necessary specifications to gain sufficient knowledge, or alternatively limit the implementation in such a way that this is not necessary.

Liability

Every care has been taken in the preparation of this manual. Please inform HMS Industrial Networks AB of any inaccuracies or omissions. The data and illustrations found in this document are not binding. We, HMS Industrial Networks AB, reserve the right to modify our products in line with our policy of continuous product development. The information in this document is subject to change without notice and should not be considered as a commitment by HMS Industrial Networks AB. HMS Industrial Networks AB assumes no responsibility for any errors that may appear in this document.

There are many applications of this product. Those responsible for the use of this device must ensure that all the necessary steps have been taken to verify that the applications meet all performance and safety requirements including any applicable laws, regulations, codes, and standards.

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The examples and illustrations in this document are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular implementation, HMS Industrial Networks AB cannot assume responsibility for actual use based on these examples and illustrations.

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Trademark Acknowledgements

Anybus ® is a registered trademark of HMS Industrial Networks AB. All other trademarks are the property of their respective holders.

WARNING:	This is a class A product. in a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.
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.

Table of Contents

P. About This Document

This document provides an understanding of the functionality shared by the various versions of the Anybus X-gateway. It does not, however, cover any network-specific features. These are instead covered in separate documents known as Interface Addendums.

The reader is expected to be familiar with communication systems in general, and industrial networking systems in particular. For more information, documentation etc., please see www.anybus.com.

P.1 Document History

P.1.1 Revision List

Revision	Date	Author(s)	Chapter(s)	Description
1.00	2004-04-02	PeP	All	First release
1.01	2005-02-14	PaL	5, 7 and 8	Reset bit, offset bits main menu
1.02	2005-09-01	PaL	6, 7 and 8	Changed default setting of Control/Status and Live List
1.10	2007-06-25	PeP	All	Major rewrite
1.11	2007-11-23	PeP	2	Minor update
1.12	2009-05-08	KeL	Preface and 2	Minor update
1.13	2011-02-07	KaD	3, B	Minor update
1.20	2013-01-21	SDa	1, 2	Minor corrections. New document template.
2.00	May 2014	SDa	Several	New hardware and Anybus Configuration Manager
2.10	August 2014	SDa	1, 4, B	Updates for UL approval

P.2 Conventions & Terminology

The following conventions are used throughout this manual:

- Numbered lists provide sequential steps
- Bulleted lists provide information, not procedural steps
- The terms 'gateway' and 'X-gateway' refer to the Anybus X-gateway
- Hexadecimal values are written in the format NNNNh, where NNNN is the hexadecimal value.
- All measurements in this document have a tolerance of ±0.25mm unless otherwise stated
- 16/32 bit values are generally stored in Motorola (big endian) format unless otherwise stated.
- The term "byte" always refers to a string of 8 bits

P.3 Support

For contact information and support, please refer to the contact and support pages at: www.anybus.com/support

1. About the Anybus X-gateway

1.1 Introduction

The Anybus X-gateway is a series of network gateways, used to provide a seamless connection between two networks of different types.

The gateway is based on patented Anybus technology; a proven industrial communication solution used by leading manufacturers of industrial automation products all over the world.

The X-gateway enhances the common gateway concept by providing gateway versions with both master and slave functionality, as well as Ethernet capabilities.
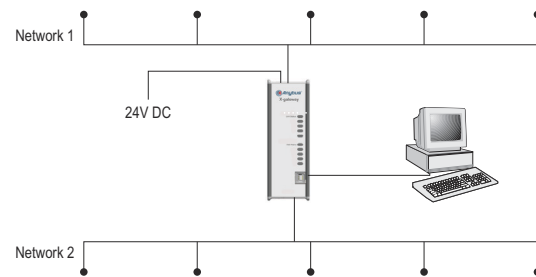
1.2 Functional Overview

Internally, the gateway consists of two Anybus-S network interface cards, interconnected through an intelligent gateway platform, which forwards data from one network to the other and vice-versa, as shown below. This design allows almost any combination of network systems, in both master and slave configurations.
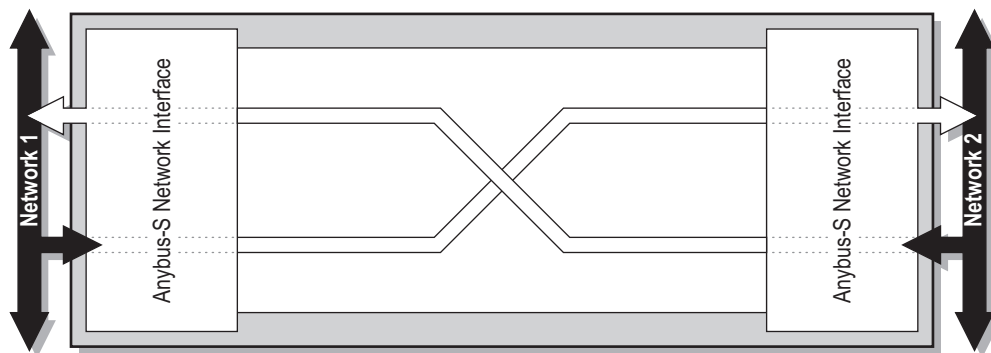

Note: This document does not describe any features specific to a particular network. Such information is instead available in supplementary documents, known as "X-gateway Interface Addendums".

1.3 External View

The flexible design of the X-gateway platform allows each network interface to be mounted at the top or bottom of the unit. Note that this will affect the orientation of the on-board switches and network connectors.

Front View

Network A mounts in upper slot
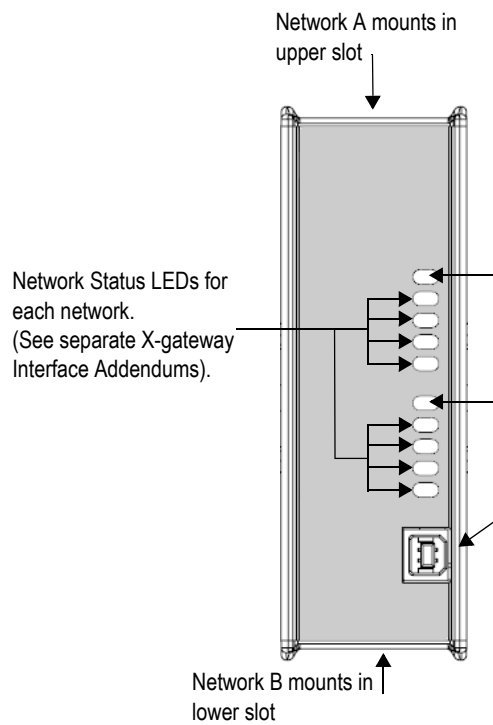
Gateway Status LEDs

These LEDs (1 per network) reflect the overall status of each network interface.

Colour	Indication
Green	Communication running
Green, flashing	Transport provider connected
Red	Communication error
Red, flashing	Network interface error
Off	No power

Network Status LEDs for each network.
(See separate X-gateway Interface Addendums).
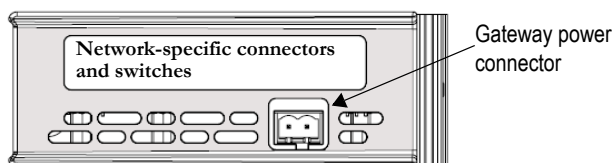
Gateway Configuration Connector

This USB connector enables the connection of a PC to the gateway, for configuration purposes.

See also: "Anybus Configuration Manager" on page 16.

Network B mounts in lower slot

Top Panel

The top panel of the Anybus X-Gateway includes the connectors & switches specific to the installed network. See the separate X-gateway Interface Addendum for further information.

This panel also includes the unit's power connector. See also "Power Supply" on page 19.

Network-specific connectors and switches

Gateway power connector

Bottom Panel

Network-specific connectors and switches
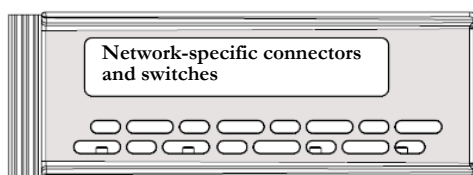
The bottom panel of the Anybus X-Gateway includes the connectors & switches specific to the installed network.

1.4 Installation

1.4.1 DIN-rail Installation

The gateway is DIN-rail mountable. To ensure proper EMC behaviour, the DIN-rail must be connected to protective earth (PE).
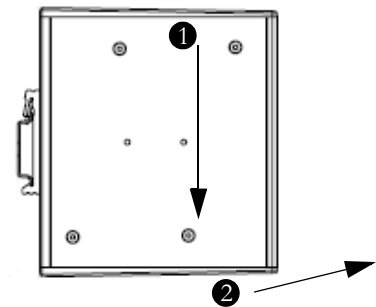
Snap On

To fasten the gateway to the DIN-rail, align it with the DIN-rail connector, according to the figure shown here. Press firmly on the top (1) and push the lower part into position (2).
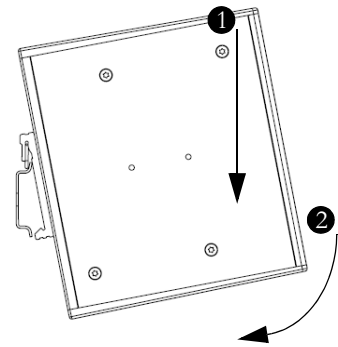
Snap Off

To remove the gateway from the DIN rail, press firmly on the top (1) and pull the lower part away from the rail (2).

1.4.2 Power

The gateway requires a regulated 24VDC ±20% Class 2 power source. Power is applied via a 2-pole pluggable screw connector.

Note that this connector is polarized; using the wrong polarity will not work and may even damage the product.

1.4.3 Network Installation

Where applicable, specific installation procedures for specific networks are described in the separate interface addendums for each product.

2. Basic Operation

2.1 Data Exchange

Each of the two network interfaces exchange data on it's network through two buffers. The gateway forwards the data between these buffers as shown below. Note that this process is separated from the network data exchange; while the gateway ensures data consistency (where applicable), it does not feature any built-in mechanisms for synchronisation between the two networks.
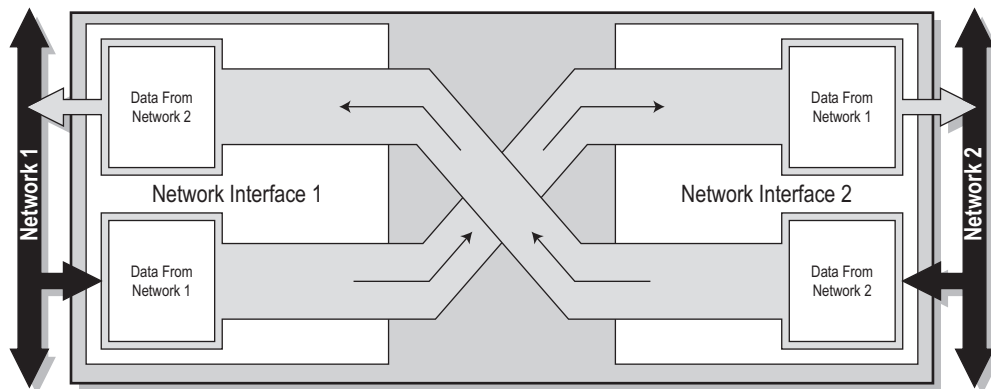
Each buffer holds up to 512 bytes of data, which is the theoretical upper limit for the number of bytes that can be exchanged in each direction. Note however that the actual number of bytes that can be exchanged is highly network dependent.

Besides network I/O, these buffers are optionally also used to provide access to network status information, and to control various aspects of the gateway. This may be general diagnostic information (called the 'Status Word'), list of active slaves (known as the 'Live List'), or other network specific status information. A dedicated Control Word may be used to start/stop the exchange of data, or to reset the gateway if needed.

Most networks distinguishes between fast cyclical I/O and less time critical acyclic data. Where applicable, this is also reflected in how data is treated by the gateway and the on-board network interfaces.

The amount of data that shall be exchanged, and the use of the control- and status functionality, is specified separately for each network via the Gateway Config interface. This means that even though up to 512 bytes of data can be forwarded to an interface, the amount of data that will actually be exchanged on that network is determined by settings in the network interface itself. While this may not seem logical at first, it allows data exchange regardless of network specific needs and limitations.

Note that the available control- and status functionality highly depends on the actual gateway configuration. Also note that the terminology and definitions used for different types of data varies greatly between different networking systems. In this document, they are simply referred to as 'I/O Data' (as in fast, cyclic data) and 'Parameter Data' (as in acyclic, slow data).

See also...

2.2 Status & Diagnostics

2.2.1 Status Word

Optionally, the gateway provides runtime status and diagnostics through the Status Word. This functionality is disabled by default, but can be enabled separately for each network via the Gateway Config Interface.

Status Word Contents:

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Gateway Cycle Counter				General Error Counter				(reserved)				Master Mode		Init	Run

(MSB)   (LSB)

- **Gateway Cycle Counter**

  This 4-bit counter is incremented for each successful gateway cycle, i.e. each time data has been successfully transferred between the network interfaces.

- **General Error Counter**

  This 4-bit counter is incremented each time the throughput of the gateway exceeds 100 ms.

- **Master Mode**[1]

  These bits indicate the current operation mode of the on-board master to the other network (these bits are not available on the master/scanner side).

  The exact definition of these bits depend on the network in question. For further information, consult the interface addendum for the on board master/scanner.

- **Init**

  This bit indicates if the other network interface has been initialised as follows:

  1: Other network interface successfully initialised.
  0: Could not initialise other network interface.

- **Run**

  This bit indicates the status of the data exchange on the other network as follows:

  1: Other network is on line / running
  0: Other network is not on line / not running

See also...

- See also "Controlling the Gateway from the Network" on page 13.
- See "Anybus Configuration Manager" on page 16.

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1. Master configurations only.

2.2.2 Live List (Master Configurations Only)

Optionally, the gateway provides a list of the active status of the slaves associated with the on board master. The list is assembled by the master interface and forwarded to the other network each gateway cycle. This functionality is disabled by default, but can be enabled via the Gateway Config Interface.

Live List Contents:

Offset	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
0	Slave 0	Slave 1	Slave 2	Slave 3	Slave 4	Slave 5	Slave 6	Slave 7
1	Slave 8	Slave 9	Slave 10	Slave 11	Slave 12	Slave 13	Slave 14	Slave 15
2	Slave 16	Slave 17	Slave 18	Slave 19	Slave 20	Slave 21	Slave 22	Slave 23
3	Slave 24	Slave 25	Slave 26	Slave 27	Slave 28	Slave 29	Slave 30	Slave 31
4	Slave 32	Slave 33	Slave 34	Slave 35	Slave 36	Slave 37	Slave 38	Slave 39
5	Slave 40	Slave 41	Slave 42	Slave 43	Slave 44	Slave 45	Slave 46	Slave 47
6	Slave 48	Slave 49	Slave 50	Slave 51	Slave 52	Slave 53	Slave 54	Slave 55
7	Slave 56	Slave 57	Slave 58	Slave 59	Slave 60	Slave 61	Slave 62	Slave 63

- **Bit Set (1)**

  Slave active.

  (The exact interpretation of this bit is network specific. Consult the separate interface addendum for the master network interface)

- **Bit Cleared (0)**

  Slave not active.

  (The exact interpretation of this bit is network specific. Consult the separate interface addendum for the master network interface)

Note 1: Although certain masters may support more than 64 slaves, only node number 1... 64 will be represented in the Live List.

Note 2: The EtherNet/IP Scanner Interface does not feature a Live List. Instead, it is possible to represent statistics about configured, active, and erroneous connections.

See also...

- 3-16 "Anybus Configuration Manager"

2.2.3 Network Specific Status

Some network interfaces may provide additional registers or status lists. For further information, consult the separate interface addendums for your product.

2.3 Controlling the Gateway from the Network

2.3.1 Control Word

It is possible to control certain aspects of the gateway from the network by setting the corresponding bits in the Control Word.

This functionality is disabled by default, but can be enabled separately for each network interface through the Gateway Config Interface. Note that if enabled, certain actions may be required in order for the gateway to start exchanging data.

Control Word Contents:

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
								Reset				Master Mode			

(MSB)   (LSB)

- **Master Mode**[1]

  These bits specify the current operation mode of the on-board master from the other network (these bits are not available on the master/scanner side).

  The exact definition of these bits depend on the network in question, however common for all networks is that if the Control Word has been enabled, it is required to specify a value for these bits in order for the gateway to start exchanging data.

  See also...
  - 3-16 "Anybus Configuration Manager"
  - Interface addendum for the on board master/scanner.

- **Reset**

  This bit is used to reset the gateway.

  > 1: Restart the gateway and re-initialize both network interfaces.
  > 0: (no action)

See also...

- 2-11 "Status & Diagnostics"
- 3-16 "Anybus Configuration Manager"

2.3.2 Network Specific Controls

Some interfaces may provide additional methods of controlling the gateway from the network. For further information, consult the separate interface addendums for your product.

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1. Master configurations only.

2.4 Data Mapping

If enabled, the Control- and Status Words, and the Live List (when available), affects how data is mapped to the on-board network interfaces.

Note: The actual representation of the data on the network is highly network specific and is described in detail in the interface addendums for your product.

Typical Slave to Slave Gateway Configuration

The figure below illustrates how data is mapped in a typical slave-to-slave gateway configuration. Note the Control- and Status Words, which in this particular example has been enabled for both networks.
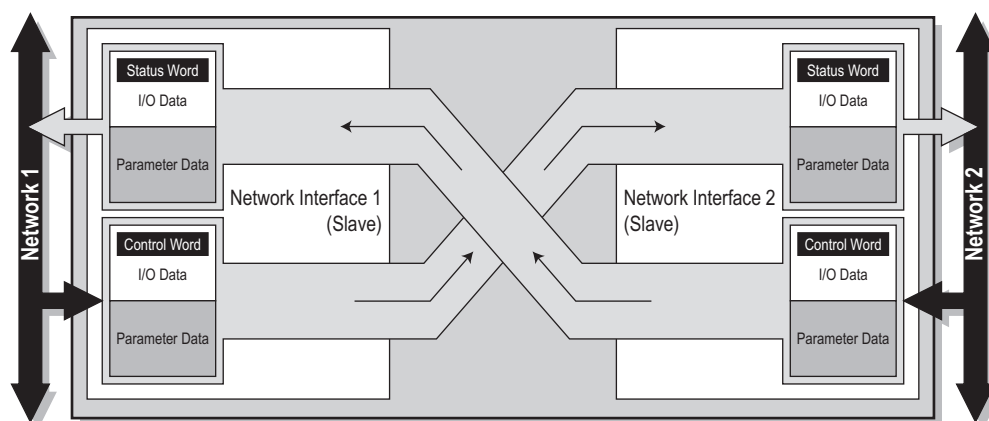
See also...

- 2-11 "Status & Diagnostics"
- 2-13 "Controlling the Gateway from the Network"

Typical Master to Slave Gateway Configuration

The figure below illustrates how data is mapped in a typical master-to-slave gateway configuration. The mapping is similar to that of the slave-to-slave configuration above, but additionally also features the 'Live List', which indicates the active status of the slaves attached to the on-board master interface.
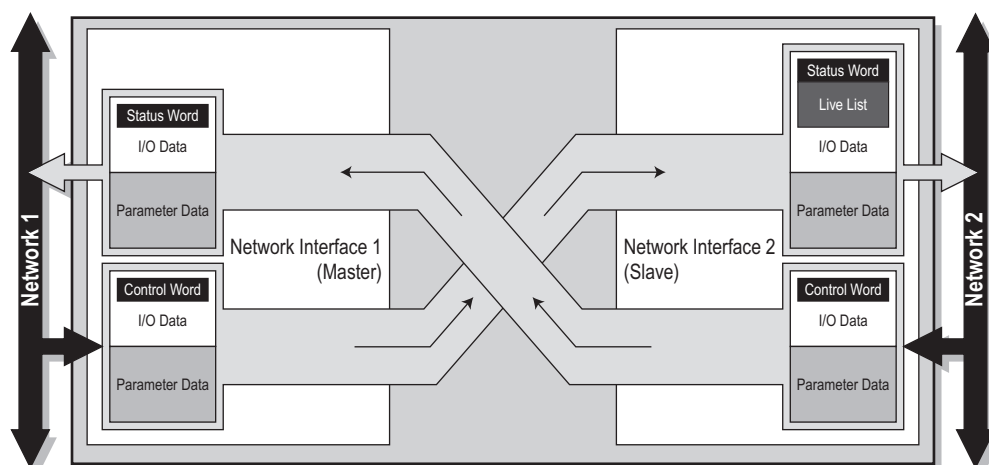
See also "Live List (Master Configurations Only)" on page 12.

2.5 Error Handling

When a network goes off line, it is often desirable to have certain control over what happens on the other network. The gateway can either freeze (keep the current value) or clear (set to zero) the data from the network that has gone off line.

Which action to perform can be specified via the Gateway Config Interface.

See "Anybus Configuration Manager" on page 16.

3. Anybus Configuration Manager

3.1 General Information

In general, the X-gateway requires very little effort to get it up and running. However, since all networks are different, certain settings may need adjustment to suit a particular application.

This can be achieved by using the Anybus Configuration Manager (ACM), which accesses the gateway settings via the USB connector. ACM is Windows-based software available free of charge from www.anybus.com
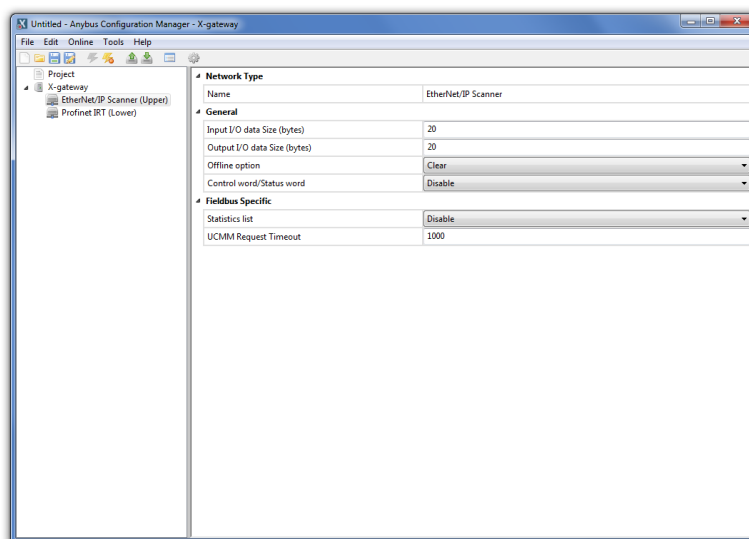

Note: This document only covers the common procedures applicable to all gateway configurations (with some minor exceptions). Where applicable, network-specific settings are described separately in the online help available from ACM.

See also: "Gateway Config Interface (USB)" on page 19.

3.2 Open Communication to the X-gateway

1. Connect a USB cable between the USB port on the X-Gateway and a USB port on the PC.

2. Start Anybus Configuration Manager. The window will look much like the example here.

3. Go to the menu **Online>>Select Connection**.

4. In the list of connections that appears, select the one to use. If the connection requires configuration, click the **Config** button.

5. Click **Connect** to open the connection.
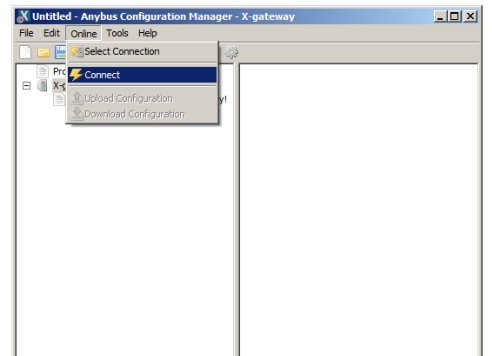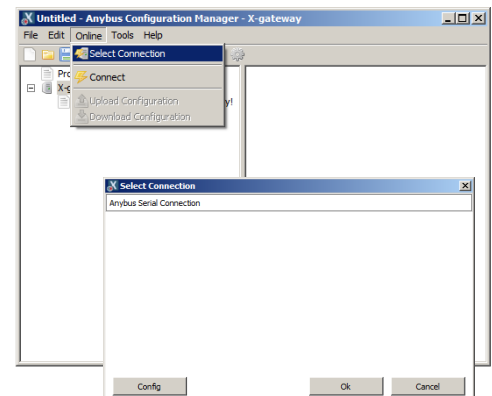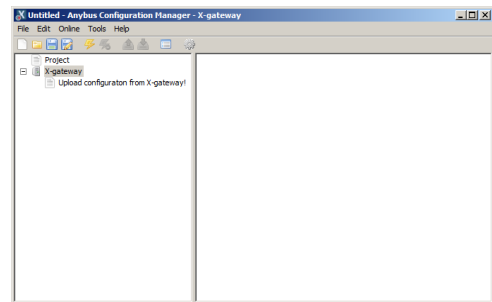
3.3 Download and Change the Configuration

Now that Anybus Configuration Manager has an active connection to the X-gateway, the interface configurations from the unit can be uploaded, viewed and modified.

1. Click **Upload configuration from X-gateway**.

2. After the current configuration has loaded, it can then be edited as required.
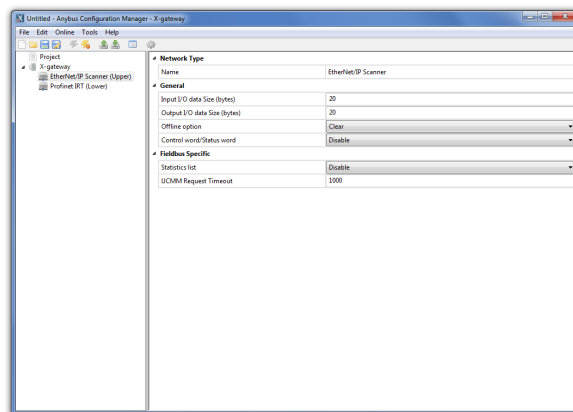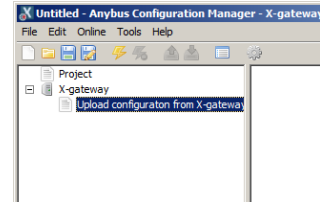
3. After making changes to the configuration, select **Online>>Download Configuration**. The new configuration is saved to the X-gateway.
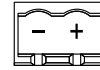
To check that the new configuration was saved successfully, the configuration can be uploaded again from the X-gateway.

For further information on all of the available settings for each network interface, please see the online help in Anybus Configuration Manager.

4. Connectors and Cables

4.1 Power Supply

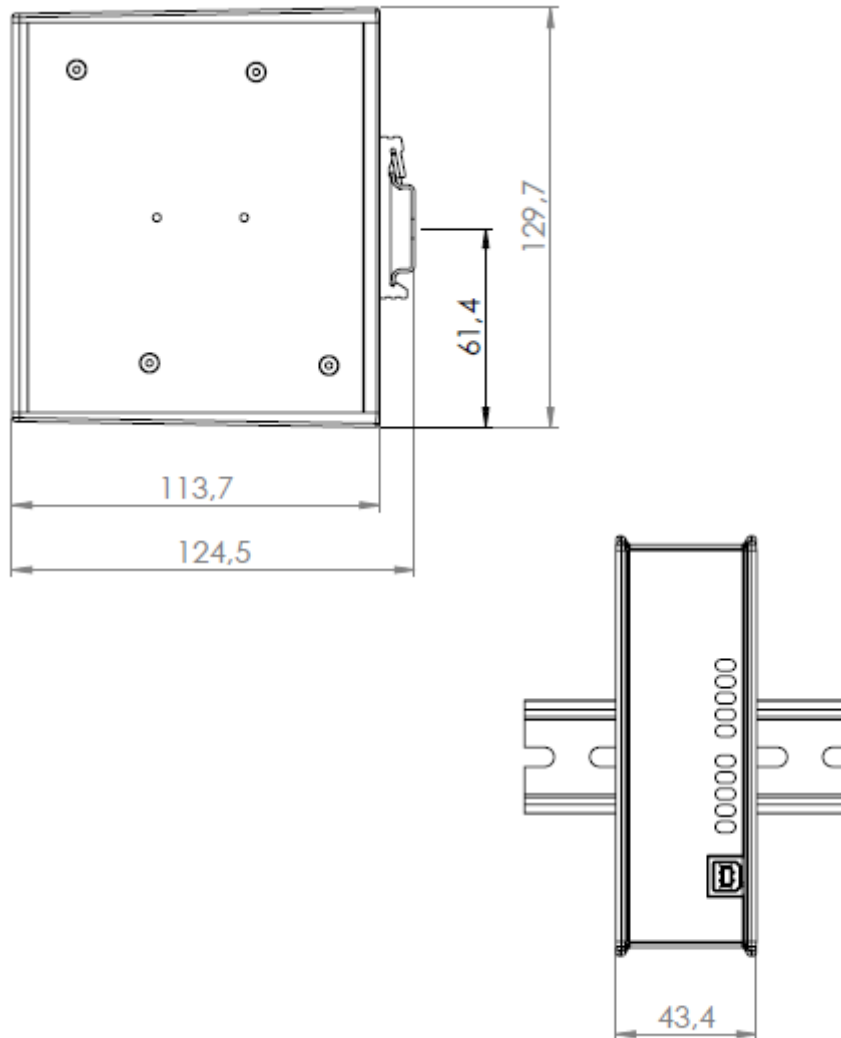| Pin	Signal
-	Ground
+	+24V DC ±20%, Class 2

4.2 Gateway Config Interface (USB)

The configuration interface for the Anybus X-Gateway is provided via a USB-B socket on the front surface.

Note that all other network-specific connectors are detailed in the documentation for each network.

A. Mechanical Drawings

B. Technical Specifications

Power

The gateway requires a regulated 24V±20% DC Class 2 power source. Maximum power consumption is 400mA at 24VDC. Typical consumption is 200mA at 24VDC.

Protective Earth and Shielding

The product must be connected to protective earth (PE) via the DIN-rail connector in order to achieve proper EMC behaviour.

Temperature

Operating

Profinet IRT Fibre Optic: -25 to +50 degrees Celsius

All other models: -25 to +65 degrees Celsius. Test performed according to IEC-68-2-1 and IEC 68-2-2.

Non-operating

-40 to +85 degrees Celsius. Test performed according to IEC-68-2-1 and IEC 68-2-2.

Relative Humidity

The product is designed for a relative humidity of 5-95%, non-condensing.

Test performed according to IEC 68-2-30.

EMC Compliance

The onboard network interfaces are tested according to the following:

Electrostatic discharge	+/- 4 kV	EN 61000-4-2
Electromagnetic RF fields	10 V/m 80 MHz - 1 GHz 3 V/m 1,4 GHz - 2,0 GHz 1 V/m 2,0 GHz - 2,7 GHz	EN 61000-4-3
Fast Transients	+/- 1 kV	EN 61000-4-4
Surge protection	+/- 1 kV	EN 61000-4-5
RF conducted interference	10 V/ms	EN 61000-4-6
Emission (at 3 m)	50 dB 30 MHz - 230 MHz 57 dB 30 MHz - 1 GHz	EN 55016-2-3