

X-gateway Interface Addendum **Modbus Plus Slave**

Doc: HMSI-27-261
Rev: 2.00



HALMSTAD • CHICAGO • KARLSRUHE • TOKYO • BEIJING • MILANO • MULHOUSE • COVENTRY • PUNE • COPENHAGEN

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

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

Important User Information

This document is intended to provide a good understanding of the functionality offered by the Interface described here.

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.

HMS Industrial Networks AB will under no circumstances assume liability or responsibility for any problems that may arise as a result from the use of undocumented features, timing, or functional side effects found outside the documented scope of this product. The effects caused by any direct or indirect use of such aspects of the product are undefined, and may include e.g. compatibility issues and stability issues.

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.

Intellectual Property Rights

HMS Industrial Networks AB has intellectual property rights relating to technology embodied in the product described in this document. These intellectual property rights may include patents and pending patent applications in the US and other countries.

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

Preface	About This Manual	
	How To Use This Manual	P-1
	Important User Information	P-1
	Related Documentation	P-1
	Revision List.....	P-1
	Conventions Used in This Manual	P-2
	Support	P-2
Chapter 1	About the AnyBus-X Modbus Plus Slave Interface	
	Overview	1-1
	<i>Modbus Plus Status LED:s</i>	1-1
	<i>Connectors and Switches</i>	1-1
Chapter 2	Installation and Configuration	
	Node ID Configuration.....	2-1
	Source ID Configuration	2-1
Chapter 3	Modbus Plus Data Exchange	
	General.....	3-1
	<i>Supported Modbus Commands</i>	3-1
	<i>Incoming & Outgoing Data Definition</i>	3-1
	Outgoing Data Exchange (Gateway to Modbus Plus)	3-2
	Incoming Data Exchange (Modbus Plus to Gateway)	3-3
Chapter 4	Modbus Error Handling	
Appendix A	Technical Specification	
	Modbus Plus Interface Details.....	A-1
	Modbus Plus Connector Pinout	A-1

P. About This Manual

P.1. How To Use This Manual

This document describes the various features of the AnyBus-X Modbus Plus Slave interface, basic network installation procedures and various network specific details. General information and operating instructions for the AnyBus-X Generic Gateway are available in the AnyBus-X Generic Gateway User Manual.

The reader of this document is expected to be familiar with the Modbus Plus fieldbus system, and communication systems in general. For further information, documentation etc., please www.anybus.com

P.2. Related Documentation

Document	Author
AnyBus-X Generic Gateway User Manual	HMS
AnyBus-S MBP Fieldbus Appendix	HMS

P.3. Revision List

Revision	Date	Author	Chapter	Description
1.00	2004-04-02	PeP	All	First release
1.01	2004-11-11	PaL	Appendix A	Updated connector Pinout
1.02	2010-10-01	KeL	3	Clarified description of data exchange
2.00	May 2014	SDa	All	New hardware and Anybus Configuration Manager

P.4. Conventions Used in This Manual

The following conventions are used throughout this manual:

- Numbered lists provide sequential steps
- Bulleted lists provide information, not procedural steps
- The term ‘AnyBus-X’ is used when referring to the AnyBus-X Generic Gateway
- The term ‘Slave interface’ is used when referring to the AnyBus-X Modbus Plus Slave interface.
- The term ‘user manual’ is used when referring to the AnyBus-X Generic Gateway User Manual.
- Hexadecimal values are written in the format NNNNh, where NNNN is the hexadecimal value.
- 16/32 bit values are generally stored in Motorola (big endian) format unless otherwise stated.

P.5. Support

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

1. About the Modbus Plus Slave Interface

The Modbus Plus Slave interface acts as a host device. A host device can be read and written to from another Modbus Plus host device or controller. The Slave interface will not initiate any point-to-point communication to other nodes, it will only respond to incoming commands. It can, however, broadcast Global Data to other nodes on the network, and extract Global Data from another node.

1.1. External View

1.1.1. Modbus Plus Status LED:s

LED	Colour/ state	Indication
Gateway Status		Consult the user manual for further details.
ERROR	Red	Communication error
	Off	-
	Flash every 160ms	Normal operation
	Flash every 1s	Interface is in MONITOR_OFFLINE state
	2 flashes	Interface is in MAC_IDLE never-getting-token state
ACTIVE	3 flashes	Interface not detecting any other nodes
	4 flashes	Duplicate node ID detected
	Off	-
	Off	-
INIT	Green	Peer interface initialised
	Off	-

1.1.2. Connectors and Switches

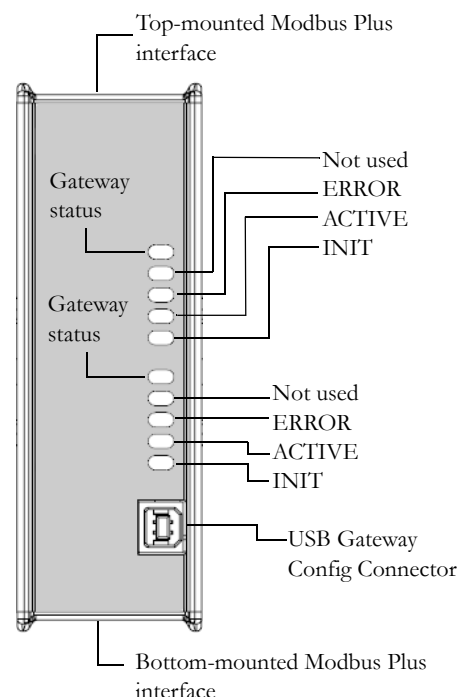
USB Gateway config connector

Consult the X-gateway user manual for further details.

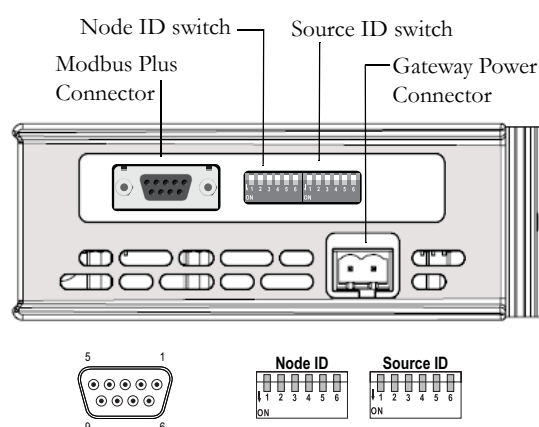
Modbus Plus network connector

See “Modbus Plus Connector Pinout” on page 11.

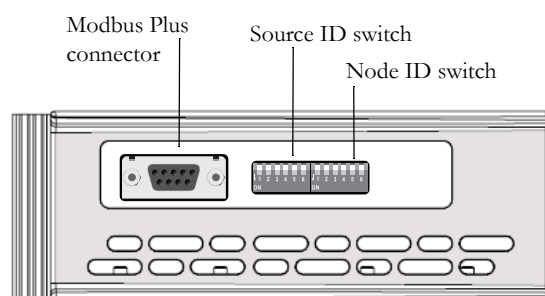
Front View



Top-mounted Interface



Bottom-mounted Interface



Node ID switches

See “Node ID Configuration” on page 6.

Source ID switches

See “Source ID Configuration” on page 6..

Gateway power connector

Consult the X-gateway user manual for further details.

2. Installation and Configuration

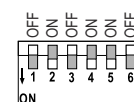
2.1. Node ID Configuration

Each node on a Modbus Plus network must be assigned a unique node ID. Six switches are used to set the Modbus node ID of the Slave interface in binary form. The switches are read once during startup, i.e. the gateway must be restarted for any changes to have effect.

Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6	Node ID
ON	ON	ON	ON	ON	ON	1
ON	ON	ON	ON	ON	OFF	2
ON	ON	ON	ON	OFF	ON	3
...	...	...	...	...	...	...
OFF	OFF	OFF	OFF	ON	OFF	62
OFF	OFF	OFF	OFF	OFF	ON	63
OFF	OFF	OFF	OFF	OFF	OFF	64

Example:

In this example, the Modbus node ID will be 42.



Note: Depending on if the Slave interface is top or bottom mounted, the orientation of the switches are different.

2.2. Source ID Configuration

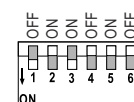
The Slave interface uses a Source ID from 1 to 64 to configure which node it will extract Global Data from during the token pass.

Six switches are used to set the Modbus node ID of the Slave interface in binary form. The switches are read once during startup, i.e. the gateway must be restarted for any changes to have effect.

Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6	Station ID
ON	ON	ON	ON	ON	ON	1
ON	ON	ON	ON	ON	OFF	2
ON	ON	ON	ON	OFF	ON	3
...	...	...	...	...	...	...
OFF	OFF	OFF	OFF	ON	OFF	62
OFF	OFF	OFF	OFF	OFF	ON	63
OFF	OFF	OFF	OFF	OFF	OFF	64

Example:

In this example, the Modbus source ID will be 24.



Note: Depending on if the Slave interface is top or bottom mounted, the orientation of the switches will be different.

3. Modbus Plus Data Exchange

3.1. General

The Slave interface can be read/written to by another node on the network. On Modbus Plus, data from/to the gateway is represented as Global Data and Point-to-Point Data. The origin of the incoming Global Data is determined by the Source ID switches (see 2-6 “Source ID Configuration” for further information). Global Data is then exchanged automatically each token pass. The Point-to-Point Data exchange will be carried out over a longer time interval via specific requests from other nodes.

The amount of data that is represented as Global Data vs. the amount that is represented as Point-to-Point data can be configured via the Gateway Config interface. Global data corresponds to I/O data and Point-to-Point Data corresponds to parameter data. Note that all accesses on Modbus are word-oriented (16bit), and it is therefore recommended to set the data sizes to even values in order to retain data consistency.

The Slave Interface can exchange up to 32 words of Global Data (I/O data) and 125 words of Point-to-Point Data (parameter data) in each direction.

3.1.1. Supported Modbus Commands

The Slave interface communicates according to the Modbus Plus protocol. This means that it can communicate with all Modbus Plus nodes that comply with this protocol, but it does not necessarily mean that all services available in the Modbus Plus protocol specification are supported.

The following Modbus commands are accepted by the Slave interface:

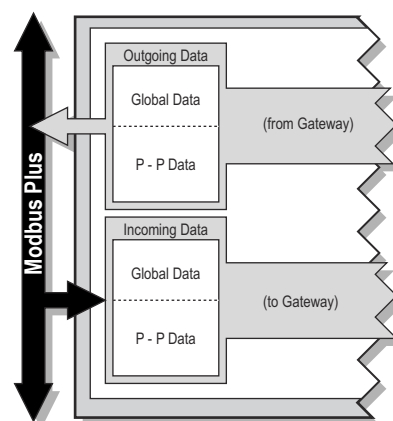
- Read Holding Registers (0x03)
- Preset Single Register (0x06)
- Preset Multiple Registers (0x10)

3.1.2. Incoming & Outgoing Data Definition

As in all communication systems, the terms ‘incoming’ and ‘outgoing’ can be ambiguous, because their meaning depends on which end of the link is being referenced.

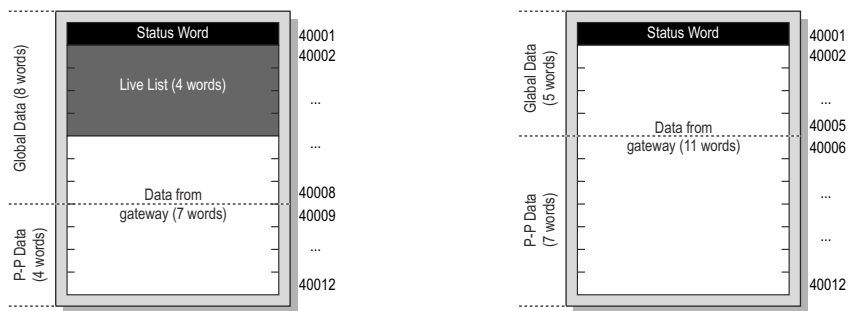
In this document, the term ‘Outgoing Data’ symbolizes data that has been forwarded from another network. The term ‘Incoming Data’ symbolizes data that should be forwarded to another network.

Due to the bidirectional nature of the Modbus networking system, Incoming Point-to-Point Data can be both read and written. Outgoing Data can for natural reasons only be read.



3.2. Outgoing Data Exchange (Gateway to Modbus Plus)

Outgoing data is mapped to Modbus register 40001 and forward. Depending on the type of gateway and how it has been set up to operate, up to 5 words (registers 40001 to 40005) may be occupied by the Status Word and the Live List, see below. (For further information about the Status Word and the Live List, consult the main user manual)



Example A:

Global Data Size = 8 words (16 bytes)
Point-to-point Data Size = 4 words (8 bytes)
Live List = Enabled
Control & Status Word = Enabled

Example B:

Global Data Size = 5 words (10 bytes)
Point-to-point Data Size = 7 words (14 bytes)
Live List = Disabled
Control & Status Word = Enabled

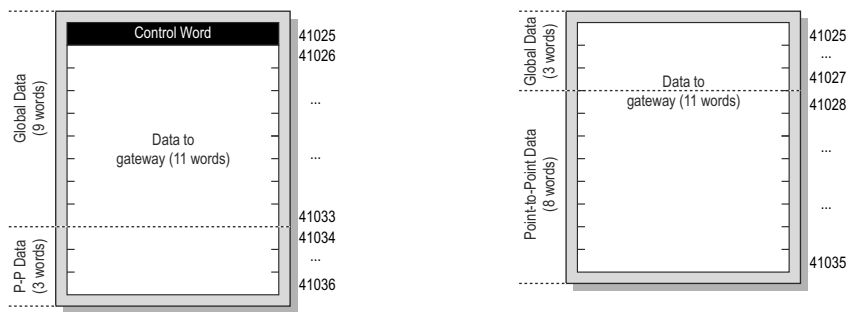
Outgoing Global Data is broadcasted each bus cycle and can be consumed by any node on the network. Furthermore, outgoing Global Data and Point-to-Point Data can be read by other nodes using Modbus command 0x03 ('Read Holding Registers'). Note however that Modbus command 0x06 ('Preset Single Register') and 0x10 ('Preset Multiple Registers') will only work for incoming data, see next page.

Note: The Live List is only available on master-slave gateway versions. Consult the main user manual for further information.

3.3. Incoming Data Exchange (Modbus Plus to Gateway)

Incoming data is mapped to Modbus registers 41025 and forward. Depending on how the gateway is set to operate, the first word (register 41025) may be occupied by the Control Word, see below. (For more information about the Control Word, consult the main user manual).

Note that depending on how the gateway is configured, the first two bytes consumed by the gateway may be interpreted as control information (Control Word), see below.



Example A:

Global Data Size = 9 words (18 bytes)
 Point-to-point Data Size = 3 words (6 bytes)
 Control Word = Enabled

Example B:

Global Data Size = 3 words (6 bytes)
 Point-to-point Data Size = 8 words (16 bytes)
 Control Word = Disabled

The incoming Global Data is extracted automatically each bus cycle from the Source Node specified using the Source ID switches (see 2-6 “Source ID Configuration”) provided that the specified node supports Global Data transactions. Incoming Global Data can also be read by other nodes using Modbus command 0x03 (‘Read Holding Registers’).

Incoming Point-to-Point Data can be read by other nodes using Modbus command 0x03 (‘Read Holding Registers’), or written to using commands 0x06 (‘Preset Single Register’) and 0x10 (‘Preset Multiple Registers’)

Note: The Live List is only available on master-slave gateway versions. Consult the main user manual for further information.

4. Modbus Error Handling

With the exception of broadcast messages, the Modbus Master expects a normal response upon sending a Query. If no response is returned (e.g. due to a transmission error), this will eventually trigger a timeout condition in the Master.

If the Slave interface receives a Query but is for some reason unable to process it (i.e. the Master tries to access a non-existent Coil or Register), an exception response is returned to inform the Master of the nature of the error.

The following Exception Responses may be returned by the Slave interface:

Exception Code	Name	Description
01h	Illegal Function	The Query contains an illegal or unsupported function call
02h	Illegal Data Address	The Query contains an illegal data address
03h	Illegal Data Value	The Query contains invalid data
06h	Host Side Busy	Host side is busy, reissue the command later

A. Technical Specification

A.1. Modbus Plus Interface Details

- **Transmission media**
Modbus Plus one differential line and shield
- **Cable**
Shielded copper cable, One Twisted pair
- **Topology**
Token Bus Structure, virtual token ring.
- **Galvanically isolated bus electronics**
- **Baud rate**
1Mbit/s (Modbus Plus standard)
- **Global Data size**
32 words in each direction (32 words in and 32 words out)
- **Point-to-point data size**
Up to 125 words
- **Supported Modbus Commands**
0x03 - “Read Holding Registers”
0x06 - “Preset Single Register”
0x10 - “Preset Multiple Registers”

A.2. Modbus Plus Connector Pinout

Modbus Plus connectivity is provided via a 9 pin female D-sub connector.

#	Signal
housing	Connected to PE
1	Cable shield
2	Modbus Plus Line B
3	Modbus Plus Line A
4	-
5	-
6	-
7	-
8	-
9	-

