X-gateway Interface Addendum

ControlNet Adapter

Doc: HMSI-27-257
Rev: 2.00

Connecting Devices™

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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.

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!

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.

ControlNet Adapter X-Gateway Interface Addendum

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About This Document

How To Use This Document

This document describes network specific features and procedures needed when operating the ControlNet Adapter Interface for the Anybus X-gateway. For general information and operating instructions for the Anybus X-gateway, consult the Anybus X-gateway User Manual.

Related Documents

Document	Author
Anybus X-gateway User Manual	HMS
Anybus-S ControlNet Fieldbus Appendix	HMS
Common Industrial Protocol (CIP) specification	ODVA
ControlNet Specification	ODVA

Document History

Revision List

Revision	Date	Author	Chapter	Description
1.00	2004-03-10	PeP	All	First release
1.10	2007-11-19	PeP	All	Major rewrite
2.00	May 2014	SDa	Multiple	New hardware and Anybus Configuration Manager

Conventions & Terminology

The following conventions are used throughout this document:

- Numbered lists provide sequential steps
- Bulleted lists provide information, not procedural steps
- The term 'X-gateway' refers to the Anybus X-gateway
- The term 'Interface' refers to the ControlNet Adapter interface for the Anybus X-gateway.
- The term 'user manual' refers to the Anybus X-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.

Support

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

1. Basic Operation

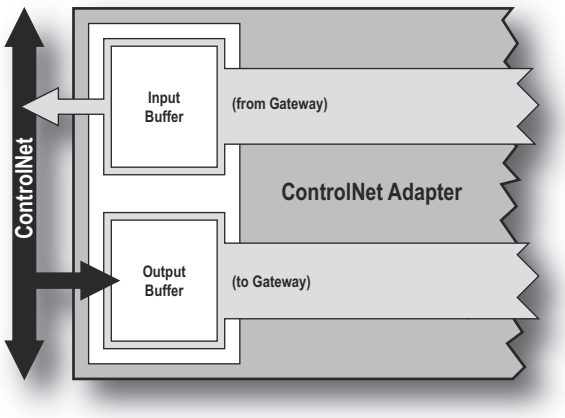
1.1 General Information

1.1.1 Support

The ControlNet Adapter Interface for the Anybus X-gateway implements a ControlNet communications adapter (profile no. 12). The interface acts as an adapter, which means it can be accessed by a ControlNet scanner, but it will not initiate communication by itself.

The interface exchanges data through two buffers as follows:

- **Input Buffer**
  This buffer holds data forwarded *from* the other network, i.e. data which can be read by the ControlNet scanner.
- **Output Buffer**
  This buffer is forwarded *to* the other network, i.e. data which can be written by the ControlNet scanner.



1.2 Features

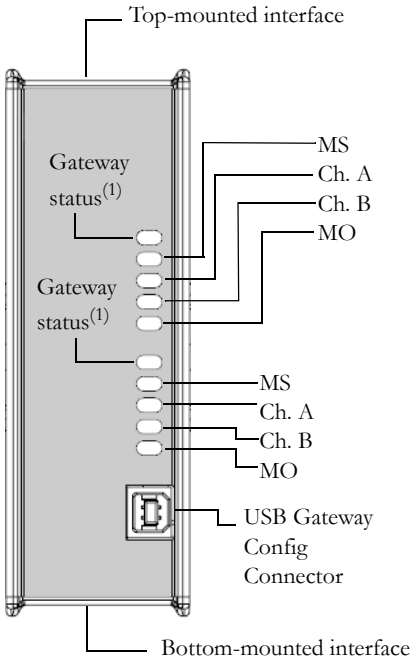
- Communications Adapter, profile 12
- Network Access Port (NAP)
- Media redundancy support
- Up to 450 bytes of I/O data in each direction
- UCMM Client / Server support
- On-board configuration switches
- Galvanically isolated bus electronics

1.3 External View

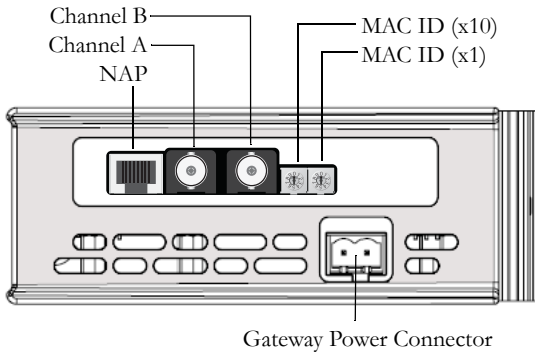
1.3.1 ControlNet Status LEDs

LED(s)	Colour	Indication
Gateway Status	See the Gateway User manual for further information.	
MS	Green	Initialised
	Green, Flashing	Waiting for initialisation
	Red	Major unrecoverable fault
	Red, Flashing	Minor recoverable fault
Ch. A *and* Ch. B	Off	Module not initialized
	Red	Major fault
	Alternating red/green	Self test
	Red, flashing	Node configuration error
Ch. A *or* Ch. B	Off	Channel disabled
	Green	Normal operation
	Green, flashing	Temporary error or not configured
	Red, flashing	No other nodes, or media fault
	Red & green, flashing	Network configuration error
MO	Off	No connection has been opened
	Green	A connection has been opened

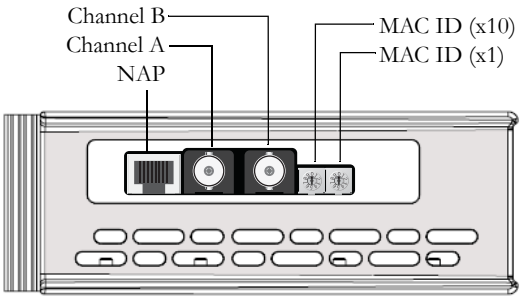
Front View



Top-mounted interface



Bottom-mounted interface



1.3.2 Connectors and Switches

Network Access Port (NAP).

See "Network Access Port (NAP)" on page 22.

ControlNet Channel A

See "ControlNet Connectors (BNC)" on page 22.

ControlNet Channel B

See "ControlNet Connectors (BNC)" on page 22.

Configuration Switches

See "Configuration Switches" on page 8.

Power connector

Consult the Gateway user manual for further details.

USB Gateway Config Connector

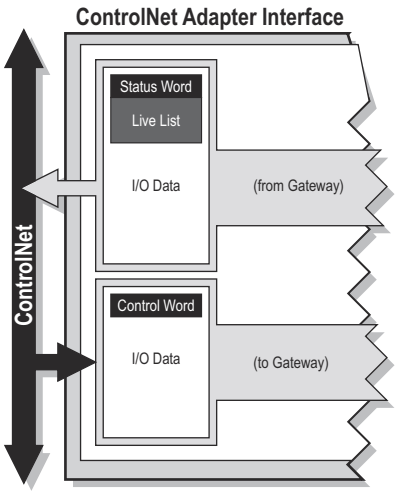
Consult the Gateway user manual for further details.

3. Data Exchange

3.1 General Information

The Adapter Interface exchanges up to 450 bytes I/O Data of data in each direction. This data can be accessed by means of I/O connections towards the Assembly Object.

The amount of data to exchange on ControlNet is specified through the Gateway Config Interface.

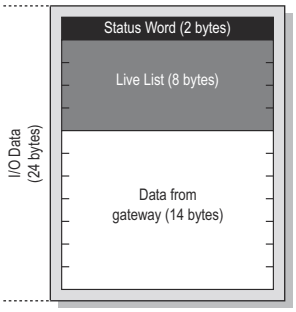


See also...

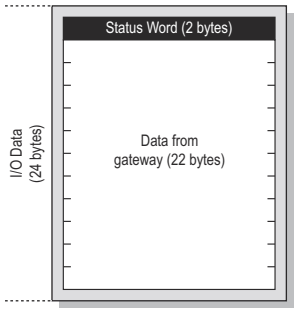
- See “Gateway Config Interface” on page 8.
- See “Assembly Object, Class 04h” on page 14.

3.1.1 Input Data (Gateway to ControlNet)

Depending on the actual gateway configuration and how it has been set up to operate, parts of the data produced by the ControlNet Adapter Interface may be used to represent status information (i.e. Status Word, Live List etc.).



Example A:
I/O Data Size = 24
Live List = Enabled
Control & Status Word = Enabled



Example B:
I/O Data Size = 24
Live List = Disabled
Control & Status Word = Enabled

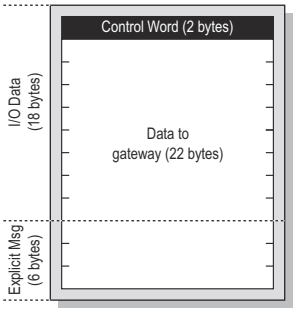
See also...

- See "Assembly Object, Class 04h" on page 14.

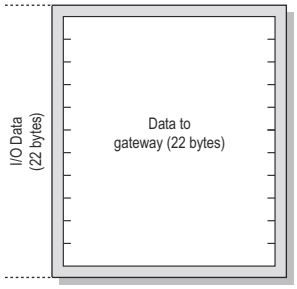
Note: The Live List is only available on master-slave gateway versions.

3.1.2 Output Data (ControlNet to Gateway)

Depending on the actual gateway configuration and how it has been set up to operate, the first two bytes consumed by the ControlNet Adapter Interface may be interpreted as control information (i.e. the Control Word).



Example A:
I/O Data Size = 24
Control Word = Enabled



Example B:
I/O Data Size = 22
Control Word = Disabled

See also...

- See "Assembly Object, Class 04h" on page 14.

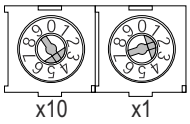
2. Installation and Configuration

Configuration Switches

On a FIP network, each node must be assigned its own unique node address. The slave interface features onboard switches for node address configuration, providing an address range of 1 - 99. The switches are read once during startup, i.e. the gateway must be restarted for any changes to have effect.

Example:

In this example, the FIP node address will be 42 (4 x 10)+(2 x 1).



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

2.1.

2.2. Gateway Config Interface

The X-Gateway and the ControlNet interface may be configured by using the software tool **Anybus Configuration Manager** (ACM), which is available from www.anybus.com/support

When ACM is connected to the gateway via the USB configuration connector, the following settings are available:

Network Type	
Name	Controlnet Slave
General	
Input I/O data Size (bytes)	20
Output I/O data Size (bytes)	20
Offline option	Clear
Control word/Status word	Disable
Fieldbus Specific	
Run/Idle header	Disabled

See also...

- The Anybus X-gateway User Manual, for full details on using ACM.
- The online help in ACM, for further help on the available settings.

4. CIP Object Implementation

4.1 General Information

The ControlNet Adapter Interface implements the following standard objects:

- Identity Object, Class 01h
- Message Router, Class 02h
- Assembly Object, Class 04h
- Connection Manager Object, Class 06h
- ControlNet Object, Class F0h

In addition, the following vendor specific objects are implemented:

- Diagnostic Object, Class AAh

4.2 Identity Object, Class 01h

4.2.1 General Information

Object Description

-

Implemented Services

Class services: Get Attribute All

Instance services: Get Attribute All
Reset (see 7-13 “Service Details: Reset”)

4.2.2 Class Attributes

#	Access	Name	Type	Value
1	Get	Revision	UINT	0001h
2	Get	Max Instance	UINT	0001h

4.2.3 Instance Attributes

#	Access	Name	Type	Value
1	Get	Vendor ID	UINT	005Ah (HMS Industrial Networks AB)
2	Get	Device Type	UINT	000Ch (Communications Adapter)
3	Get	Product Code	UINT	000Eh (Anybus-S ControlNet)
4	Get	Revision	Struct of: USINT, USINT	 (Major fieldbus version) (Minor fieldbus version)
5	Get	Status	WORD	(see 7-13 “Device Status”)
6	Get	Serial Number	UDINT	(assigned at manufacturing)
7	Get	Product Name	SHORT_STRING	‘Anybus-S CNT’

4.2.4 Device Status

bit(s)	Name
0	Module Owned (A master/scanner has allocated the Adapter Interface)
1	(reserved)
2	Configured (always set to zero)
3	(reserved)
4... 7	Extended Device Status: Value: Meaning: 0000b Power-up/Self-test 0010b Faulted I/O Connection 0011b Awaiting Connection 0100b Non-volatile configuration bad 0110b Connection in Run mode 0111b Connection in Idle mode
8	Set for minor recoverable faults
9	Set for minor unrecoverable faults
10	Set for major recoverable faults
11	Set for major unrecoverable faults
12... 15	(reserved)

4.2.5 Service Details: Reset

There are two types of network reset requests on ControlNet:

- **Type 0: 'Power Cycling Reset'**

  This causes the Adapter Interface to restart its internal ControlNet software layer. The overall operation of the gateway remains unaffected, i.e. the gateway will neither reset itself nor the other network interface.

- **Type 1: 'Out of box reset'**

  This causes the Adapter Interface to revert to an 'out of box' configuration and restart its internal ControlNet software layer. The overall operation of the gateway remains unaffected, i.e. the gateway will neither reset itself nor the other network interface.

4.3 Message Router, Class 02h

4.3.1 General Information

Object Description

-

Implemented Services

Class services: -

Instance services: -

4.3.2 Class Attributes

(no class attributes)

4.3.3 Instance Attributes

(no instance attributes)

4.4 Assembly Object, Class 04h

4.4.1 General Information

Object Description

This object provides to the I/O Data in the Input- and Output Buffers.

Implemented Services

Class services: Get Attribute Single

Instance services: Get Attribute Single
Set Attribute Single

4.4.2 Class Attributes

#	Access	Name	Type	Contents
1	Get	Revision	UINT	0002h

4.4.3 Instance Attributes - Instance/Connection Point 64h

This instance is used to access Input I/O Data.

#	Access	Name	Type	Contents
3	Get	Data	Array of USINT	Input I/O Data

4.4.4 Instance Attributes - Instance/Connection Point 96h

This instance is used to access Output I/O Data.

#	Access	Name	Type	Description
3	Set	Data	Array of USINT	Output I/O Data

4.5 Connection Manager Object, Class 06h

4.5.1 General Information

Object Description

-

Implemented Services

Class services:	Forward Open Forward Close
Instance services:	-

4.5.2 Class Attributes

(no class attributes)

4.5.3 Instance Attributes

(no instance attributes)

4.6 ControlNet Object, Class F0h

4.6.1 General Information

Object Description

-

Implemented Services

Class services:	Get Attribute All
Instance services:	Get Attribute All Get And Clear

4.6.2 Class Attributes

#	Access	Name	Type	Contents
1	Get	Revision	UINT	0001h
2	Get	Max Instance	UDINT	00000001h

4.6.3 Instance Attributes, Instance 01h

#	Access	Name	Type	Contents
81h	Get	Current_link_config	Struct of:	
		Link_config	Struct of:	
		NUT_length	UINT	NUT length in 10 us ticks
		smax	USINT	0 to 99
		umax	USINT	1 to 99
		slotTime	USINT	In 1 us ticks
		blanking	USINT	In 1.6 us ticks
		gb_start	USINT	In 10 us ticks
		gb_center	USINT	In 10 us ticks
		reserved	UINT	Reserved
		modulus	USINT	127 (required)
		gb_prestart	USINT	In 10 us ticks
		TUI	Struct of:	
		unique_ID	UDINT	Keeper CRC
		status_flag	UINT	TUI flag
		reserved	USINT[16]	Reserved

#	Access	Name	Type	Description
82h	Get, Get and Clear	diagnostic_counters	Struct of:	
		buffer_errors	UINT	Buffer event counter
		error_log	BYTE[8]	Bad MAC frame log
		event_counters	Struct of:	
		good_frames_transmitted	BYTE[3]	Good MAC frames transmitted (LSB first)
		good_frames_received	BYTE[3]	Good MAC frames received (LSB first)
		selected_channel_frame_errors	USINT	Framing errors detected on active receive channel
		channel_A_frame_errors	USINT	Framing errors detected on channel A
		channel_B_frame_errors	USINT	Framing errors detected on channel B
		aborted_frames_transmitted	USINT	MAC frames aborted during transmission (transmit underflows)
		highwaters	USINT	LLC transmit underflow and LLC receive over-flow
		NUT_overloads	USINT	No unscheduled time in NUT (All time used for scheduled transmissions)
		slot_overloads	USINT	More scheduled data queued for one NUT than allowed by sched_max_frame parameter
		blockages	USINT	Single Lpacket size exceeds sched_max_frame parameter
		non_concurrence	USINT	Two or more nodes could not agree whose turn it is to transmit
		aborted_frames_received	USINT	Incomplete MAC frames received
		lonely_counter	USINT	Number of times nothing heard on network for 8 or more NUTs
		duplicate_node	USINT	MAC frame received from node with local node's MAC ID
		noise_hits	USINT	Noise detected that locked the modem rx PLL
		collisions	USINT	Rx data heard just as we are going to transmit
		Mod_MAC_ID	USINT	MAC D of the current moderator node
		non_lowman_mods	USINT	Moderator frames heard from non-lowman nodes
		rouge_count	USINT	Rouge events detected
		unheard_moderator	USINT	MAC frames being heard but no moderators being heard
		vendor_specific	USINT	-
		reserved	BYTE[4]	Reserved
		vendor_specific	USINT	Not used (00h)
		vendor_specific	USINT	Not used (00h)
		reserved	BYTE	Reserved

#	Access	Name	Type	Description
83h	Get	station_status	Struct of:	
		smac_ver	USINT	MAC implementation (02h)
		vendor_specific	BYTE[4]	Vendor specific (00 18 00 00h)
		channel_state	BYTE	Channel state LEDs, redundancy warning, and active channel bits
84h	Get	MAC_ID	Struct of:	
		MAC_ID_current	USINT	Current MAC ID
		MAC_ID_switches	USINT	MAC ID switch settings
		MAC_ID_changed	BOOL	MAC ID switches changed since reset
		reserved	USINT	Reserved
86h	Get	error_log	Struct of:	
		buffer_errors	UINT	Buffer event counter
		error_log	BYTE[8]	Bad MAC frame log

4.7 Diagnostic Object, Class AAh

4.7.1 General Information

Object Description

This vendor specific object provides access to misc. diagnostic information.

Implemented Services

Class services: Get Attribute All

Instance services: Get Attribute All
Get Attribute Single

4.7.2 Class Attributes

#	Access	Name	Type	Contents
1	Get	Revision	UINT	0001h

4.7.3 Instance Attributes, Instance 01h

#	Access	Name	Type	Contents
01h	Get	Module serial number	UDINT	(unique serial number assigned during manufacturing)
04h	Get	Module Software version	UINT	(fieldbus software revision)
11h	Get	Input Total Size	UINT	(total size of Input Buffer)
14h	Get	Output Total Size	UINT	(total size of Output Buffer)

5. Technical Specification

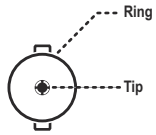
5.1 ControlNet Interface Details

- **Redundant Operation**
  If redundant operation is needed, both ControlNet channels should be used
- **Cable**
  RG-6 quad shield cable
- **Topology**
  Bus, star or tree topologies possible
- **Galvanically isolated bus electronics**[1]
- **On board Mac ID switches**
- **Data Rate**
  5Mbit/s (Standard)

5.2 ControlNet Connectors (BNC)

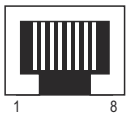
ControlNet connectivity is provided through two BNC coaxial connectors.

#	Signal
Tip	ControlNet
Ring	Shield



5.3 Network Access Port (NAP)

#	Signal	Description
1	GND	Signal Ground
2	-	(not connected)
3	Tx_H	Transmit Data, positive
4	Tx_L	Transmit Data, negative
5	Rx_L	Receive Data, negative
6	Rx_H	Receive Data, positive
7	-	(not connected)
8	Shield	Connected to PE



1. ControlNet Channels A and B are galvanically isolated. The NAP connector is not.