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User Manual

Anybus® Communicator™ for Modbus RTU

Doc. Id. HMSI-27-313
Rev. 3.11

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Important User Information

This document contains a general introduction as well as a description of the technical features provided by the Anybus Communicator, including the PC-based configuration software.

The reader of this document is expected to be familiar with PLC and software design, as well as communication systems in general. The reader is also expected to be familiar with the Microsoft® Windows® operating system.

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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.

Anybus Communicator Modbus RTU User Manual

Doc: HMSI-27-313

Table of Contents

P. About This Document

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

P.1 Related Documents

Document name	Author
Anybus Communicator - Modbus RTU Installation Sheet	HMS
Modbus Protocol Reference Guide, PI-MBUS-300 Rev. J.	Modicon, Inc
DF1 Protocol and Command Set - Reference Manual, 1770-6.5.16, October 1996	Allen-Bradley

P.2 Document History

Summary of Recent Changes (3.01... 3.10)

Change	Page(s)
Screenshots and descriptions of ABC Tool updated for Anybus Configuration Manager	Multiple
Changed “ABC” to “Communicator RS232/422/485”	Multiple
Amended description of “Update time” parameter	34, 35
Added description for Consume/Response to “Object Delimiter” parameter	42
Changed “Maximum Data Length” limit	42
Removed obsolete “Start Bits” parameter	51
Removed obsolete “ABCC ExtLink Wizard” entry	64
Replaced “Sales and Support” info with link to website	8
Added parameters to checksum object description	43
Minor text edits, typo corrections	Multiple

Summary of Recent Changes (3.10... 3.11)

Revision	Change	Page(s)
3.11	Added compliance info	76

Revision List

Revision	Date	Author	Chapter	Description
2.00	2005-08-25	PeP	All	Second major release
2.50	2006-04-05	PeP	All	Major update
2.51	2006-06-01	PeP	-	Minor corrections
2.52	2006-12-22	PeP	-	Minor corrections
2.53	2007-11-23	PeP	All	Minor updates
2.54	2009-04-23	KeL	All	Misc. minor corrections and updates
3.00	2011-02-08	KaD	All	Misc. minor corrections, new template and DF1 functionality
3.01	2011-09-30	KaD	All	Misc corrections and updates, new Anybus Configuration Manager name
3.10	March 2015	ThN	All	Misc corrections and updates, new Doc ID.
3.11	March 2015	ThN	B	Added compliance info

P.3 Conventions & Terminology

The following conventions are used throughout this document:

- Numbered lists provide sequential steps
- Bulleted lists provide information, not procedural steps
- The term 'user' refers to the person or persons responsible for installing the Anybus Communicator in a network.
- The term 'gateway' refers to the Anybus Communicator.
- Hexadecimal values are written in the format 0xNNNN, where NNNN is the hexadecimal value.
- Decimal values are represented as NNNN where NNNN is the decimal value
- As in all communication systems, the terms "input" and "output" can be ambiguous, because their meaning depend on which end of the link is being referenced. The convention in this document is that "input" and "output" are always being referenced to the master/scanner end of the link.

P.3.1 Glossary

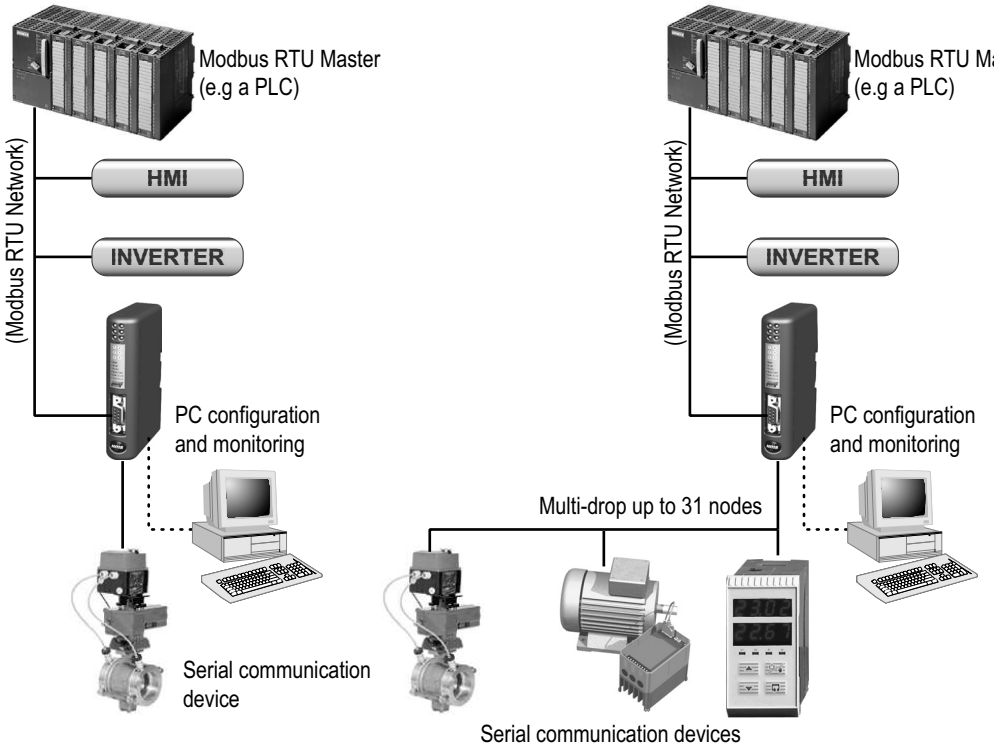
Term	Meaning
ABC	Anybus® Communicator™
ACM	Anybus Configuration Manager
Broadcaster	A protocol-specific node in the configuration that handles transactions destined to all nodes.
RTU	Modbus RTU
Command	A predefined transaction.
Configuration	List of configured nodes with transactions on the subnetwork.
Fieldbus	The higher level network to which the communicator is connected.
Fieldbus Control System	Fieldbus master
Frame Object	Low level entities which are used to describe the different parts of a Transaction.
Monitor	A tool for debugging the gateway and the network connections.
Node	A device in the configuration which defines the communication with a node on the subnetwork
Subnetwork	The network that is logically located on a subsidiary level with respect to the fieldbus, and to which the Anybus Communicator acts as a gateway.
Transaction	A generic building block that is used in the subnetwork configuration and defines the data that is sent and received on the subnetwork.
User	Person or persons responsible for installing the Anybus Communicator
Higher Level Network	In this case, Modbus RTU
Network	
Fieldbus	

P.4 Support

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

1. About the Anybus Communicator for Modbus RTU

The Anybus Communicator for Modbus RTU acts as a gateway between virtually any serial application protocol and a Modbus RTU-based network. Integration of industrial devices is enabled without loss of functionality, control and reliability, both when retro-fitting to existing equipment as well as when setting up new installations.



Single-Node Serial Sub Network **Multi-Node Serial Sub Network**

Subnetwork

The gateway can address up to 31 nodes, and supports the following physical standards:

- RS-232
- RS-422
- RS-485

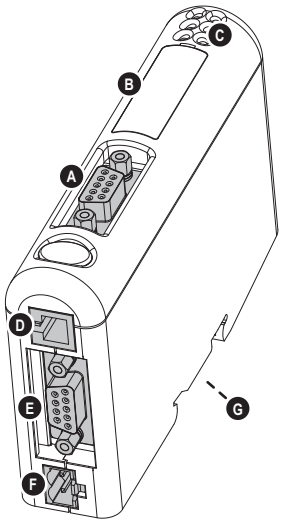
Modbus RTU Interface

Modbus RTU connectivity is provided through patented Anybus technology; a proven industrial communication solution used all over the world by leading manufacturers of industrial automation products.

- Galvanically isolated bus interface
- Coil and Register access
- RS-232 or RS-485 operation
- On-board configuration switches
- 1200... 57600bps operation

1.1 External View

For wiring and pin assignments, see "Connector Pin Assignments" on page 71.



A: Modbus RTU Connector

This connector is used to connect the gateway to the fieldbus.

See also...

- "Fieldbus Connector (Modbus-RTU)" on page 71

B: Configuration Switches

See also...

- "Configuration Switches" on page 12

C: Status LEDs

See also...

- "Status LEDs" on page 11

D: PC-connector

This connector is used to connect the gateway to a PC for configuration and monitoring purposes.

See also...

- "PC Connector" on page 72

E: Subnetwork Connector

This connector is used to connect the gateway to the serial sub-network.

See also...

- "Subnetwork Interface" on page 73

F: Power Connector

This connector is used to apply power to the gateway.

See also...

- "Power Connector" on page 71
- "Connector Pin Assignments" on page 71

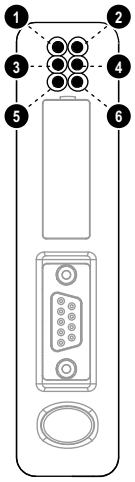
G: DIN-rail Connector

The DIN-rail mechanism connects the gateway to PE (Protective Earth).

See also...

- "Hardware Installation" on page 13
- "Connector Pin Assignments" on page 71

1.2 Status LEDs

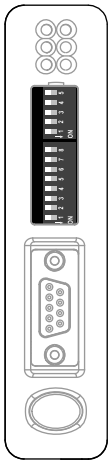


#	State	Status
1 - Bus Error	Off	Normal operation
	Red	Bus error; CRC mismatch >10%
2 - Bus Ready	Off	Not powered
	Green	Normal operation (bus ready)
	Red	Bus is offline (bus not ready)
3 - Processing	Off	Currently not processing query
	Green, flashing	Currently processing query
4 - Switch Status	Off	Normal operation
	Red	Invalid configuration switch setting
5 - Subnet Status[a]	Off	Power off
	Green, flashing	Running correctly, but one or more transaction error(s) have occurred
	Green	Running
	Red	Transaction error/timeout or subnet stopped
6 - Device Status	Off	Power off
	Alternating Red/Green	Invalid or missing configuration
	Green	Initializing
	Green, flashing	Running
	Red	Bootloader mode[b]
	Red, flashing	If the Device Status LED is flashing in a sequence starting with one or more red flashes, please note the sequence pattern and contact the HMS support department

a. This led turns green when all transactions have been active at least once. This includes any transactions using “change of state” or “change of state on trigger”. If a timeout occurs on a transaction, this led will turn red.

b. The gateway is in bootloader mode, and firmware must be restored in order for it to work properly. Start up the Anybus Configuration Manager and connect to the Anybus Communicator. Choose Tools/Options/Module. Click “Factory Restore” to restore firmware. See “Tools” on page 24.

1.3 Configuration Switches



The configuration switches determines the basic communication settings for the Modbus interface. Normally, these switches are covered by a plastic hatch. When removing the hatch, avoid touching the circuit boards and components. If tools are used to open the hatch, use caution.

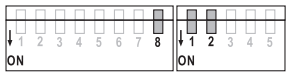
Note that these settings cannot be changed during runtime, i.e. the gateway must be restarted in order for any changes to have effect.

1.3.1 Node Address

Node Address	Sw. 1	Sw. 2	Sw. 3	Sw. 4	Sw. 5	Sw. 6	Sw. 7
(reserved)	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	OFF	ON	OF
...	...	...	...	...	...	...	...
126	ON	ON	ON	ON	ON	ON	OFF
127	ON	ON	ON	ON	ON	ON	ON

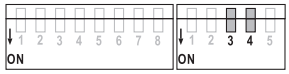
1.3.2 Baudrate Configuration

Baudrate	Sw. 8	Sw. 1	Sw. 2
(reserved)	OFF	OFF	OFF
1200 bps	OFF	OFF	ON
2400 bps	OFF	ON	OFF
4800 bps	OFF	ON	ON
9600 bps	ON	OFF	OFF
19200 bps (standard)	ON	OFF	ON
38400 bps	ON	ON	OFF
57600 bps	ON	ON	ON



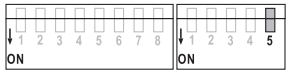
1.3.3 Parity & Stop Bits

Parity	Sw. 3	Sw. 4
(reserved)	OFF	OFF
No parity, 2 stop bits	OFF	ON
Even parity, 1 stop bit	ON	OFF
Odd parity, 1 stop bit	ON	ON



1.3.4 Physical Interface

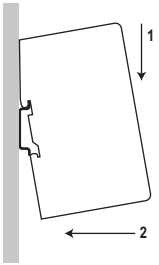
Interface Type	Sw. 5
RS-485	OFF
RS-232	ON



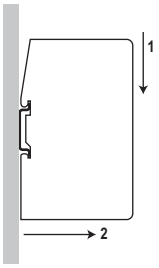
1.4 Hardware Installation

Perform the following steps when physically installing the Anybus Communicator module:

1. Snap the gateway on to the DIN-rail.
   The DIN-rail mechanism works as follows:



To snap the gateway *on*, first press it downwards (1) to compress the spring in the DIN-rail mechanism, then push it against the DIN-rail as to make it snap on (2)



To snap the gateway *off*, push it downwards (1) and pull it out from the DIN-rail (2), as to make it snap off from the DIN-rail

2. Connect the gateway to the Modbus RTU network
3. Set the Modbus RTU communication settings using the on-board switches
4. Connect the gateway to the serial subnetwork
5. Connect the gateway to a free COM-port on the PC via the PC-cable
6. Connect the power cable and apply power
7. Start the Anybus Configuration Manager program on the PC
   (The Anybus Configuration Manager software attempts to detect the serial port automatically. If not successful, select the correct port manually in the "Port"-menu)
8. Configure the gateway using the Anybus Configuration Manager and download the configuration

1.5 Software Installation

1.5.1 Anybus Configuration Manager

System requirements

- Pentium 133 MHz or higher
- 650 MB of free space on the hard drive
- 32 MB RAM
- Screen resolution 800 x 600 (16 bit color) or higher
- Microsoft Windows® 2000 / XP / Vista / 7 (32- or 64-bit)
- Internet Explorer 4.01 SP1 or newer (or any equivalent browser)

Installation

- **Anybus Communicator resource CD**
  - Insert the CD and follow the on-screen instructions.
  - If the installation does not start automatically: right-click on the CD drive icon and select "Explore" to show the contents of the CD. Locate the installation executable and double-click on it to start the installation, then follow the on-screen instructions.
- **From HMS website**
  - Download the latest version of Anybus Configuration Manager from www.anybus.com.
  - Unzip the archive on your computer and double-click on the installation executable.

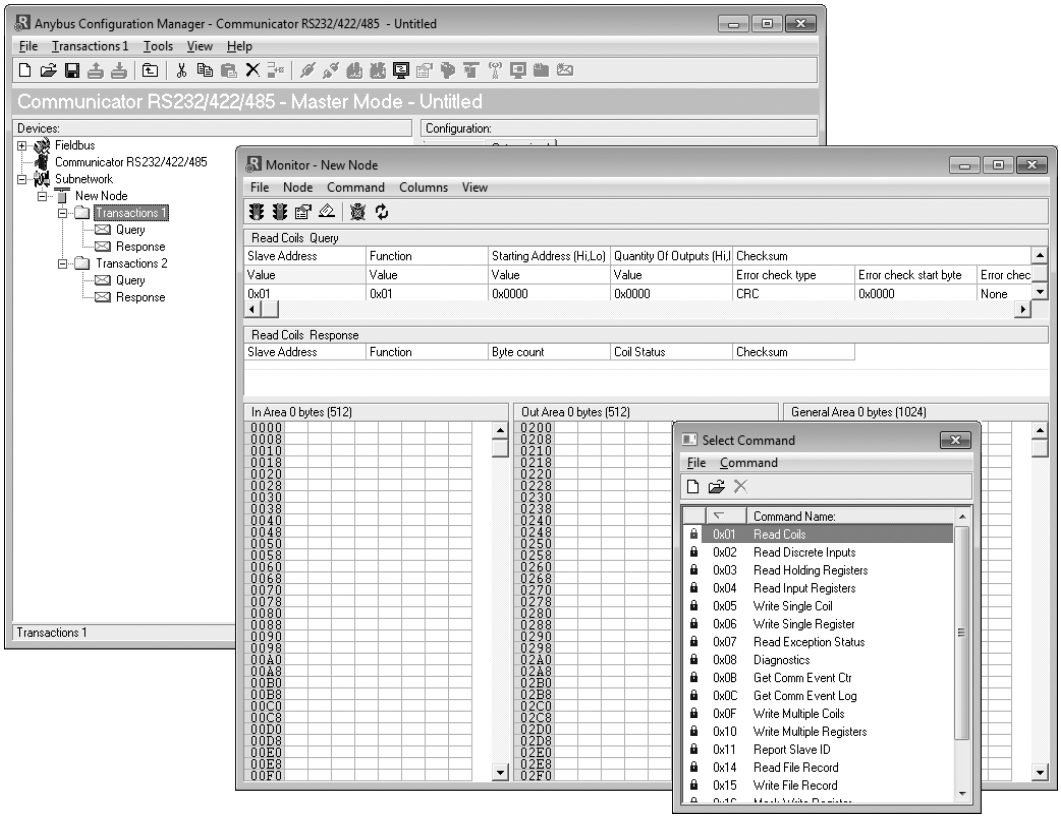
2. Basic Operation

2.1 General

The Anybus Communicator gateway is designed to exchange data between a serial subnetwork and a higher level network (in this case Modbus RTU). Unlike most other gateway devices of similar kind, it does not have a fixed protocol for the subnetwork, and can be configured to handle almost any form of serial communication.

The gateway can issue serial telegrams cyclically, on change of state, or based on trigger events issued by the control system of the higher level network (i.e. the fieldbus master or PLC). It can also monitor certain aspects of the subnetwork communication and notify the higher level network when data has changed.

An essential part of the Anybus Communicator package is Anybus Configuration Manager (ACM), a Windows-based application used to supply the gateway with a description of the sub-network protocol. No programming skills are required; instead, a visual protocol description-system is used to specify the different parts of the serial communication.

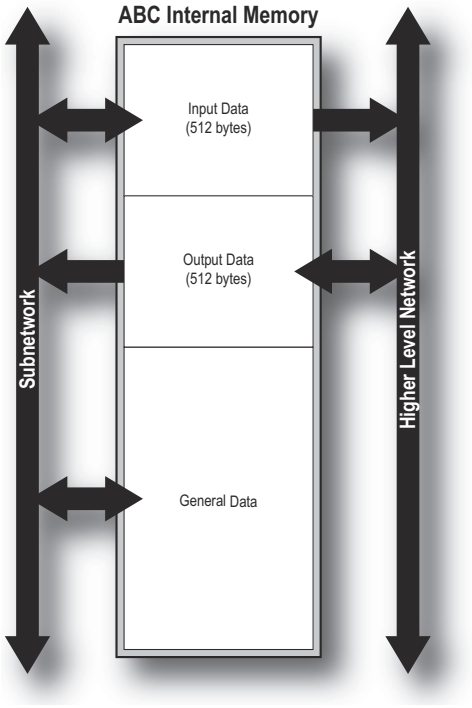


2.2 Data Exchange Model

Internally, the data exchanged on the subnetwork, and the data exchanged on the higher level network, resides in the same memory.

This means that in order to exchange data with the subnetwork, the higher level network simply reads and writes data to memory locations specified using the Anybus Configuration Manager. The very same memory locations can then be exchanged on the subnetwork.

The internal memory buffer is divided into three areas based on their function:



- **Input Data (512 bytes)**

  This area can be read by the higher level network (in this case Modbus RTU).

- **Output Data (512 bytes)**

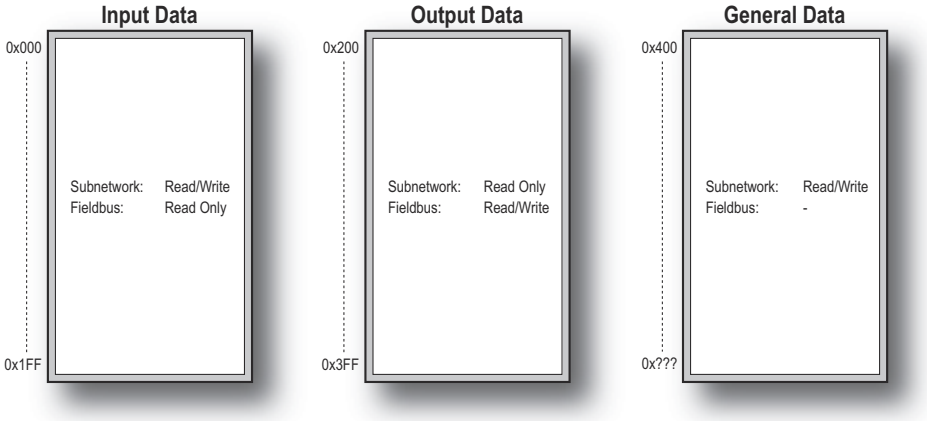
  This area can be read/written by the higher level network (in this case Modbus RTU).

- **General Data (Up to 1024 bytes)**

  This area cannot be accessed from the higher level network, but may be used for transfers between individual nodes on the subnetwork, or as a general "scratch pad" for data. The actual size of this area depends on the amount of data that is exchanged on the subnetwork. The gateway can handle up to 1024 bytes of general data.

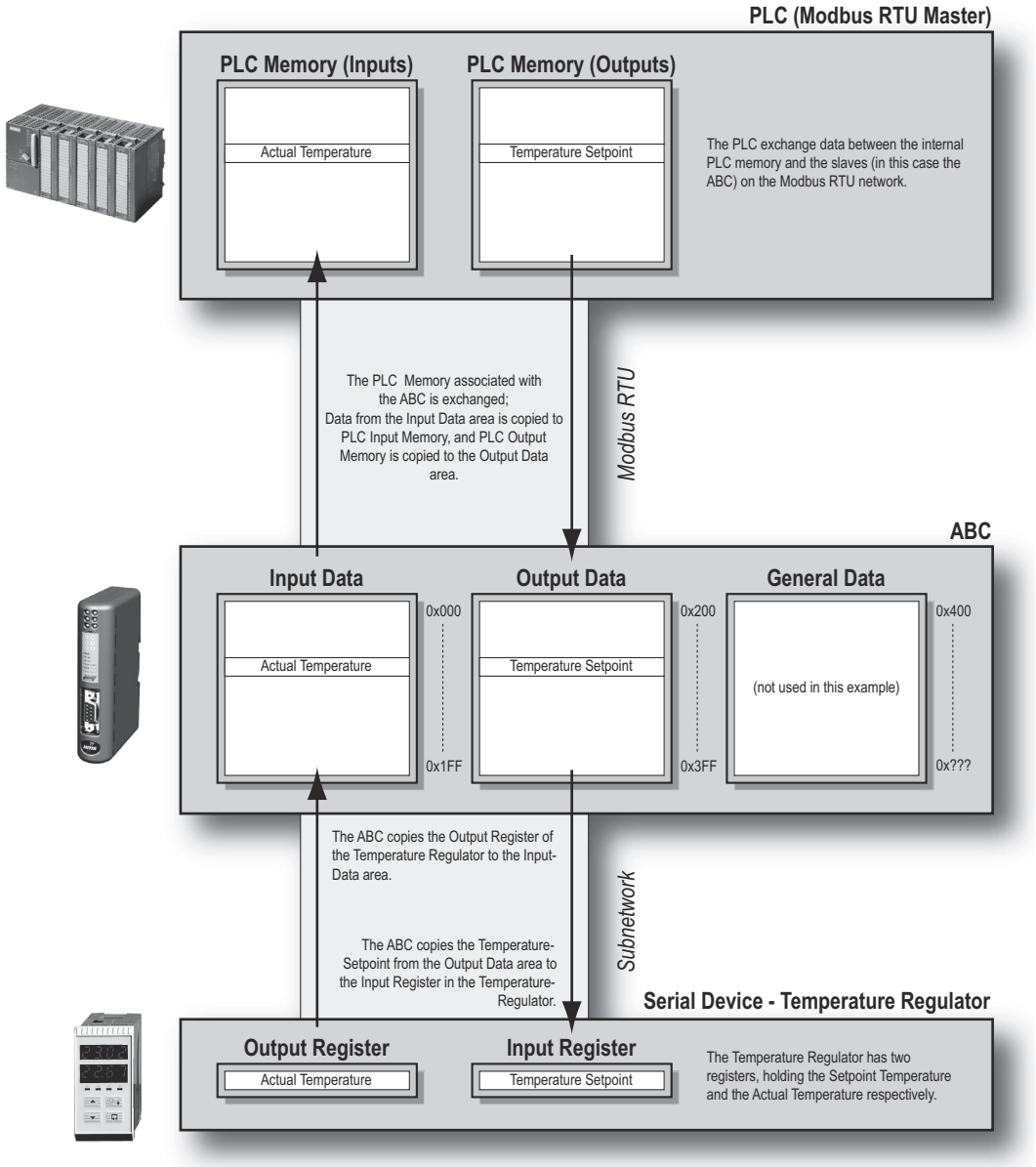
2.2.1 Memory Map

When building the subnetwork configuration using the Anybus Configuration Manager, the different areas described above are mapped to the memory locations (addresses) specified below.



2.2.2 Data Exchange Example

In the following example, a temperature regulator on the subnetwork exchanges information with a PLC on the higher level network, via the internal memory buffers in the gateway.



2.3 Subnetwork Protocol

2.3.1 Protocol Modes

The gateway features three distinct modes of operation regarding the subnetwork communication, called 'Master Mode', 'DF1 Master Mode' and 'Generic Data Mode'. Note that the protocol mode only specifies the basic communication model, not the actual subnetwork protocol.

- **Master Mode**

  In this mode, the gateway acts as a master on the subnetwork, and the serial communication takes place in a query-response fashion. The nodes on the network are not permitted to issue messages unless they have been addressed by the gateway first.

  For more information about this mode, see "Master Mode" on page 19.

- **Generic Data Mode**

  In this mode, there is no master-slave relationship between the subnetwork nodes and the gateway; any node on the subnetwork, including the gateway, may spontaneously produce or consume messages.

  For more information about this mode, see "Generic Data Mode" on page 20.

- **DF1 Master Mode**

  In this mode, the gateway acts as a master on the subnetwork, using the DF1 protocol. The serial communication takes place in a query-response fashion. For information about this mode, see "DF1 Protocol Mode" on page 49.

2.3.2 Protocol Building Blocks

The following building blocks are used in Anybus Configuration Manager to describe the subnetwork communication. How these blocks apply to the three protocol modes will be described later in this document.

- **Nodes**

  A node represents a single device on the subnetwork. Each node can be associated with a number of transactions, see below.

- **Transactions**

  A 'transaction' represents a complete serial telegram, and consists of a number of frame objects (below). Each transaction is associated with a set of parameters controlling how and when to use it on the subnetwork.

- **Commands**

  Commands are simply predefined transactions stored in the Anybus Configuration Manager. This simplifies common operations by allowing transactions to be stored and reused.

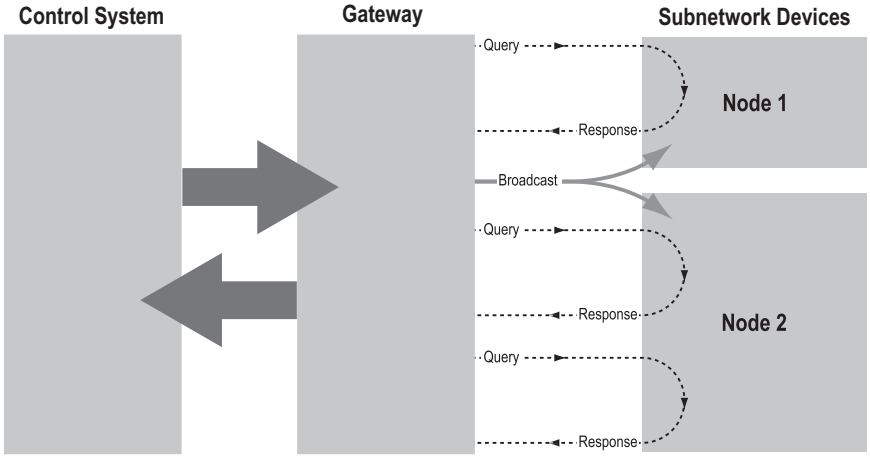
- **Frame Objects**

  Frame objects are low level entities used to compose transactions (see above). A frame object can represent a fixed value (a constant), a range of values (limit objects), a block of data or a calculated checksum.

2.3.3 Master Mode

In this mode, the communication is based on a query-response scheme; when the gateway issues a query on the subnetwork, the addressed node is expected to issue a response to that query. Nodes are not permitted to issue responses spontaneously, i.e. without first receiving a query.

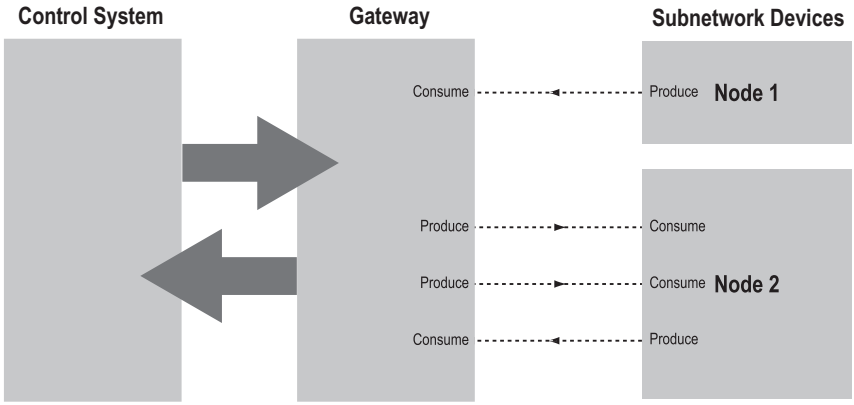
There is one exception to this rule; the broadcaster. Most protocols offer some way of broadcasting messages to all nodes on the network, without expecting them to respond to the broadcasted message. This is also reflected in the gateway, which features a dedicated broadcaster node.



In Master Mode, Anybus Configuration Manager comes preloaded with most commonly used Modbus RTU commands, which can conveniently be reached by right-clicking on a node in the Anybus Configuration Manager and selecting 'Insert New Command'. Note however that this does not in any way prevent other protocols based on the same query-response message-scheme to be implemented.

2.3.4 Generic Data Mode

In this mode, there is no master-slave relationship between the nodes on the subnetwork and the gateway. Any node, including the gateway, may spontaneously produce or consume a message. Nodes do not have to respond to messages, nor do they have to wait for a query in order to send one.



In the figure above, the gateway 'consumes' data that is 'produced' by a node on the subnetwork. This 'consumed' data can then be accessed from the higher level network. This also works the other way around; the data received from the higher level network is used to 'produce' a message on the subnetwork to be 'consumed' by a node.

2.3.5 DF1 Master Mode

Please refer to "DF1 Protocol Mode" on page 49.

2.4 Data Representation on Modbus RTU

2.4.1 General

The input and output data areas are mapped to Modbus registers 0... 1279 and Coils 0... 20479.

2.4.2 Supported Function Codes

The following function codes are supported:

Function Code	Modbus Function	Associated with Area(s)	No. of I/Os or Data Points per Command
1	Read Coil	Input and Output Data Area (0x000... 0x3FF)	1 - 2000 bits
2	Read Input Discretes		1 - 2000 bits
3	Read Holding Registers		1 - 125 registers
4	Read Input Registers		1 - 125 registers
5	Write Coil	Output Data Area (0x200... 0x3FF)	1 bit
6	Write Single Register		1 register
8	Diagnostics[a]	...	
15	Force Multiple Coils	Output Data Area (0x200... 0x3FF)	1 - 800 bits
16	Force Multiple Registers		1 - 800 registers
22	Mask Write Register		1 register
23	Read/Write Registers	Input and Output Data Area (0x000... 0x3FF)	125 registers read / 100 registers write

a. Subfunctions 0, 10, 12, 13 and 14 are supported. Refer to the Modbus Protocol Reference Guide, PI-MBUS-300 Rev. J for more information.

2.4.3 Coil & Register Map

The Input and Output Data areas are mapped to coils and registers as follows:

Register #	Coil #	Memory Location	Area	Comments
1	1... 16	0x000... 0x001	Input Data area	-
2	17... 32	0x002... 0x003		
...	...	...		
256	4081... 4096	0x1FE... 0x1FF		
257... 1024	4097... 16384	-	-	(reserved)
1025	16385... 16400	0x200... 0x201	Output Data area	-
1026	16401... 16416	0x202... 0x203		
...	...	...		
1279	20449... 20464	0x3FC... 0x3FD		
1280	20465... 20480	0x3FE... 0x3FF		

Note: Coils are mapped MSB first, i.e. coil 0 corresponds to bit 15 of register 0.

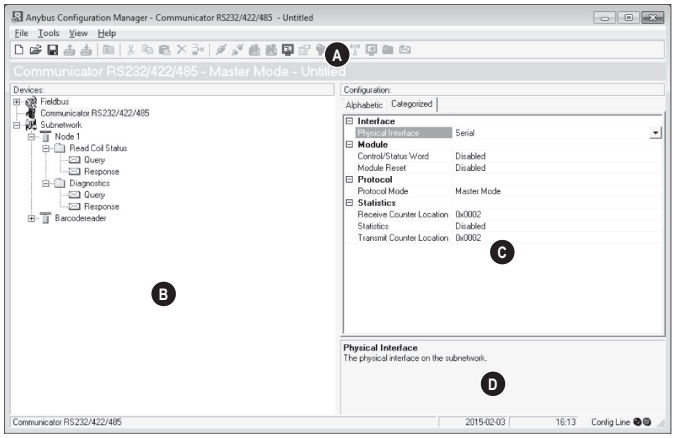
2.4.4 Supported Exception Codes

Exception Code	Name	Description
0x01	Illegal function	Function code not supported
0x02	Illegal data address	Invalid address in query
0x03	Illegal data value	Illegal data in request

3. Navigating ACM

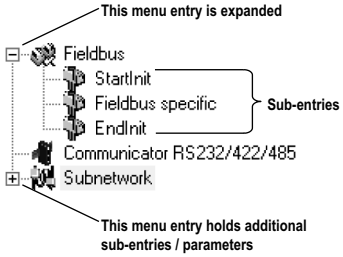
3.1 Main Window

The main window in ACM can be divided into 4 sections as follows:



- **A: Drop-down Menus & Tool Bar**

  The second drop-down menu from the left will change depending on the current context. The Tool Bar provides quick access to the most frequently used functions.



- **B: Navigation Section**

  This section is the main tool for selecting and altering different levels of the sub-network configuration.

  Entries preceded by a "+" holds further configuration parameters or "sub menus". To gain access to these parameters, the entry must be expanded by clicking "+".

  There are three main levels in the navigation window, namely Fieldbus, Communicator RS232/422/485, and Subnetwork.

  Right-clicking on entries in this section brings out additional selections related to that particular entry.

- **C: Parameter Section**

  This section holds a list of parameters or options related to the currently selected entry in the Navigation Section.

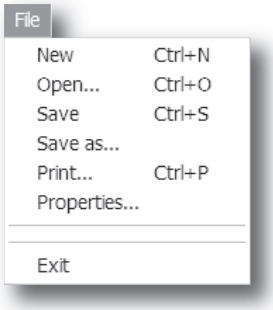
  The parameter value may be specified either using a selection box or manually, depending on the parameter itself. Values can be specified in decimal form (e.g. "42"), or in hexadecimal format (e.g. "0x2A").

- **D: Information Section**

  This section holds information related to the currently selected parameter.

3.1.1 Drop-down Menus

File



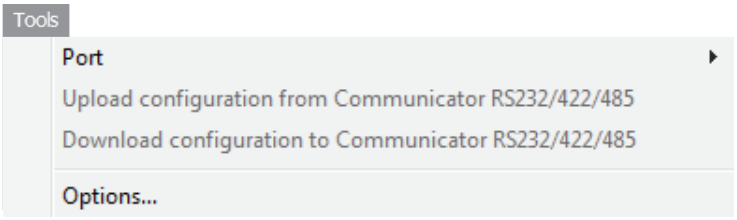
- **New**
  Create a new configuration.
  See also "Configuration Wizards" on page 64.
- **Open...**
  Open a previously created configuration.
- **Save**
  Save the current configuration.
- **Save As...**
  Save the current configuration under a new name.
- **Print...**
  Send details about the current configuration to a printer.
- **Properties...**
  Set the name and (optional) passwords for the configuration.

Item	Description
Select a Name for the Configuration	Enter a descriptive name for the new configuration
Enable Password	Enables password protection
Download Password(6)	Set passwords for downloading and uploading the configuration (max. 6 characters)
Upload Password(6)	

CAUTION: Always keep a copy of the password in a safe place. A lost password cannot be retrieved!

- **Exit**
  Close ACM.

Tools



- **Port**

  Select the COM-port used for the configuration of the gateway.

- **Upload configuration from Communicator RS232/422/485**

  Upload the configuration from the gateway to ACM.

- **Download configuration to Communicator RS232/422/485**

  Download the current configuration to the gateway.

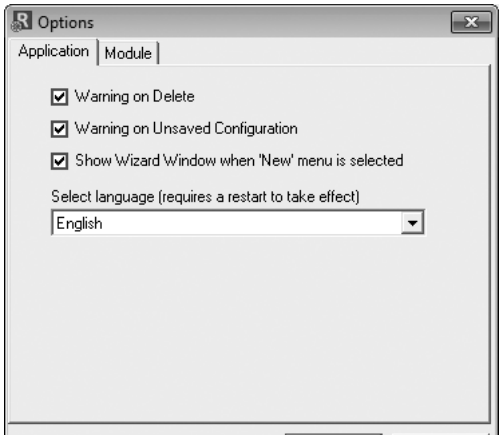
- **Start Logging**

  Start the Data Logger (see "Data Logger" on page 61).

  Note that when the Data Logger is active, this menu entry is changed to "Stop Logging".

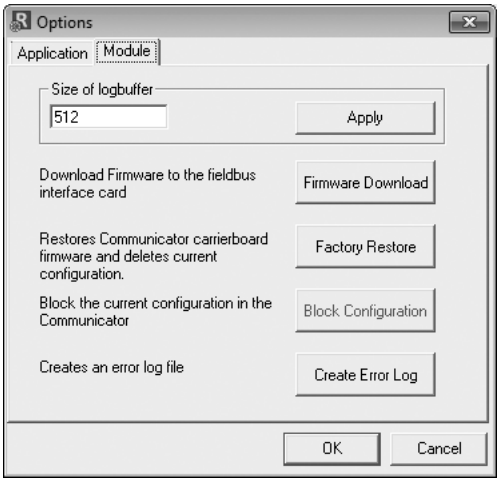
- **Options**

  This will open the following window:



Item	Description
Warning on Delete	A confirmation dialog is displayed each time something is deleted.
Warning on Unsaved Configuration	A confirmation dialog is displayed when closing ACM with unsaved data.
Show Wizard when "New" menu is selected	The Wizard is displayed each time a new configuration is created.
Select language	Selects which language to use. The new setting will be active the next time the program is launched.

Selecting the "Module" tab will reveal additional properties:



Item	Description
Size of logbuffer	By default, the Data Logger can log up to 512 entries in each direction. If necessary, it is possible to specify a different number of entries (valid settings range from 1...512). Click "Apply" to validate the new settings. See also "Data Logger" on page 61.
Firmware Download	Download firmware to the embedded fieldbus interface. **Warning: Use with caution.**
Factory Restore	Restores the gateway firmware to the original state (does not affect the embedded fieldbus interface).
Block Configuration	When selected, the downloaded configuration will not be executed by the gateway. **Warning: Use with caution.**
Create Error log	Creates an error log file

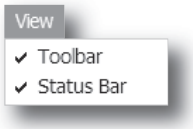
View

- **Toolbar**

  Enables/disables the toolbar icons at the top of the main window.

- **Status Bar**

  Enables/disables the status bar at the bottom of the main window.



Help

- **Contents/Search For Help On...**

  Opens a built-in browser window with a link to the Anybus support website.

- **About...**

  Displays general information about the gateway and the current version of ACM.