

BACnet:M-Bus BACnet:Modbus Modbus:M-Bus

Kara Gateway

User's MANUAL



Kara Systems

www.karasystems.eu

Version: 2.2.40

USER'S MANUAL

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1 GENERAL INFORMATION

1.1 M-Bus

M-Bus (Meter-Bus) is a European standard (EN 13757-2 physical and link layer, EN 13757-3 application layer) for the remote reading of gas or electricity meters. M-Bus is also usable for other types of consumption meters. The M-Bus interface is made for communication on two wires, making it very cost effective.

The M-Bus was developed to fill the need for a system for the networking and remote reading of utility meters, for example to measure the consumption of gas or water in the home. This bus fulfills the special requirements of remotely powered or battery driven systems, including consumer utility meters. When interrogated, the meters deliver the data they have collected to a common master, such as a hand-held computer, connected at periodic intervals to read all utility meters of a building.

1.2 Modbus

Modbus is a serial communications protocol published by Modicon in 1979 for use with its programmable logic controllers (PLCs). It has become a de facto standard communications protocol in industry, and is now a commonly available means of connecting industrial electronic devices.

Modbus allows for communication between many devices connected to the same network, for example a system that measures temperature and humidity and communicates the results to a computer. Modbus supports communication over EIA-485, EIA-232 and Ethernet TCP/IP

1.3 BACnet

BACnet is a communications protocol for building automation and control networks. It is an ASHRAE, ANSI, and ISO standard protocol.

BACnet was designed to allow communication of building automation and control systems for applications such as heating, ventilating, and air-conditioning control, lighting control, access control, and fire detection systems and their associated equipment. The BACnet protocol provides mechanisms for computerized building automation devices to exchange information, regardless of the particular building service they perform.

Gateway supports BACnet/IP and BACnet/Ethernet protocols.

1.4 Kara BACnet/Modbus/M-Bus Gateway

The Kara gateway converts the following protocols:

- ✓ M-Bus >> BACnet
- ✓ M-Bus >> Modbus
- ✓ Modbus >> BACnet

1.4.1 M-Bus to BACnet Gateway

This gateway converts M-Bus meter records to BACnet Analog-Input objects.

The connection to BACnet is done over Ethernet LAN BACnet/IP or BACnet/Ethernet. To connect the gateway to M-Bus you need a Level Converter to convert the EIA-232(optional EIA-485) connection to M-Bus physical Bus.

1.4.2 M-Bus to Modbus-Server

Every M-Bus meter record can be converted to a Modbus 32 Bit Float holding register. The Modbus Server has to be enabled in the "Modbus Server Configuration.

1.4.3 Modbus-Client to BACnet

If the checkbox "As BACnet Object" is not activated, the records will be converted like shown here:

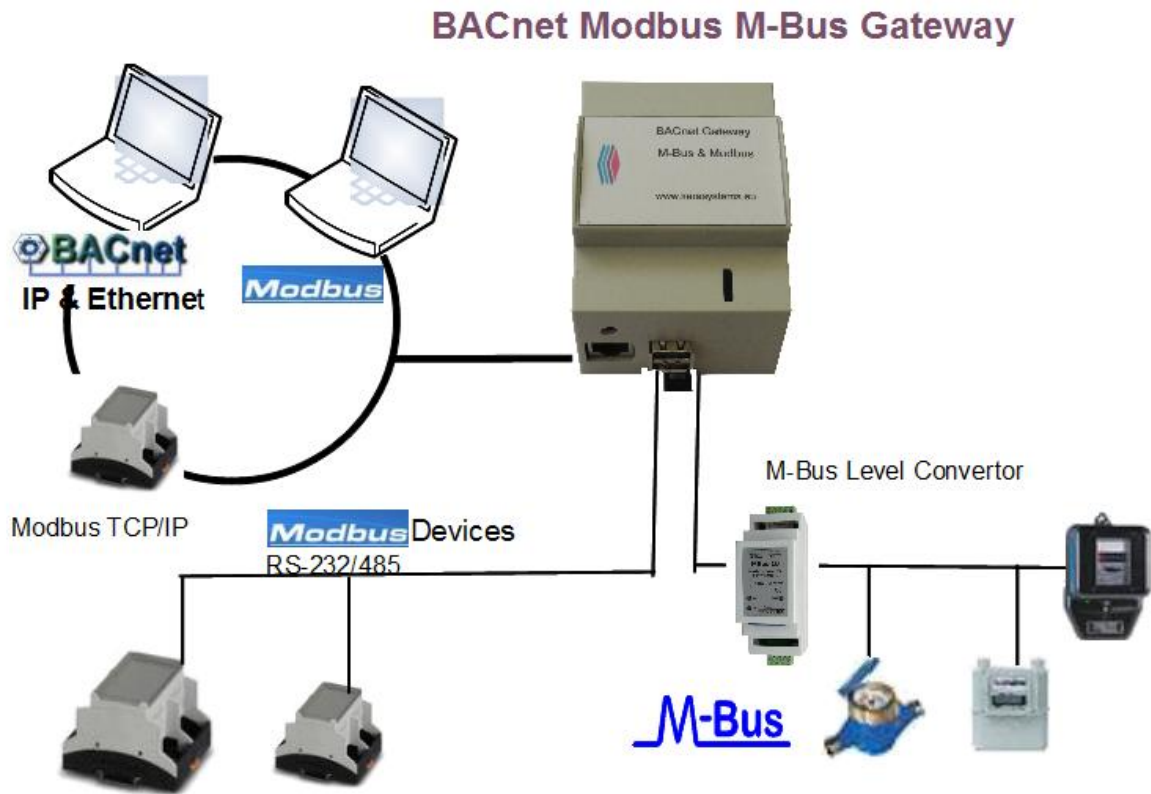
Modbus	BACnet
Coil	Binary Output
Input Discrete	Binary Input
Input Register	Analog Input
Holding Register	Analog Output

If the checkbox "As BACnet Object" is activated, the records will be converted like shown here:

Coil	Binary Value
Input Discrete	Binary Value
Input Register	Analog Value
Holding Register	Analog Value

Optionaly all Modbus types can be converter to BACnet Values objects respectively. The Modbus Holding register and input register support five data formats, Integer 16, Integer 32, Integer 32 Swapped, Float and Float Swapped. Modbus device can be connected to LAN (TCP/IP). RS-232 or RS-485 interfaces

1.4.4 Scenario



The scenario shows an overview of the involved components.

2 HARDWARE

The Device is based on a 32 Bit ARM processor running at 1.2Ghz.

Features:

- One 10/100 Mbps Ethernet
- One RS-232
- Optionally one additionally RS-485 interface
- External 5V power supply
- Ultra-low power consumption, less than 5 Watts
- System cooling: passive
- Din Rail Case

Dimensions: 74.5 x 92 x 65 mm

Regulation: CE Class A, FCC Class A

Operation Temperature: 0 to 70C(32 to 158F)

2.1 Serial Port

The RS-232 comes with a DB9 Jack.

Pinning of DB9 connectors: Pin	Jack	Usage
2	RXD	Receive from Level convertor
3	TXD	Send to Level Convertor
4	-	Unused
5	GND	Ground potential
7	RTS	Handshake unused
8	CTS	Always active

The RS-232 cable can be connected directly to a Level Convertor such as PW20 from www.relay.de.

The default RS232 port is `/dev/ttyAMA0`. If you are using a USB to RS232 set the port to `/dev/ttyUSB0`.

2.2 RS485 Port (optional)

The RS485 is an optional board. The port name for RS485 is `/dev/ttyRPC0`. This board has also an RS232 and power supply connector.

Connection of the RS485 Board seen from top:

RS 232			RS 485			Power	
TX	RX	GND	B (Data +)	A (Data -)	GND	+5V	GND



3 INSTALLATION

3.1 Ethernet LAN

Before connecting the Kara BACnet Gateway to your target LAN you have to configure the Network Configuration of the device by connecting the device to an install network see Step 1.



Step 1:

Connect the gateway with an Ethernet cable direct to a Workstation and set the workstation IP number to 192.168.2.1.



Step 2:

Open the browser on the workstation and enter the following URL:

http://192.168.2.127

The Kara BACnet Gateway configuration is protected with a user name and password, so you will be prompted a dialog to enter the user name and password.

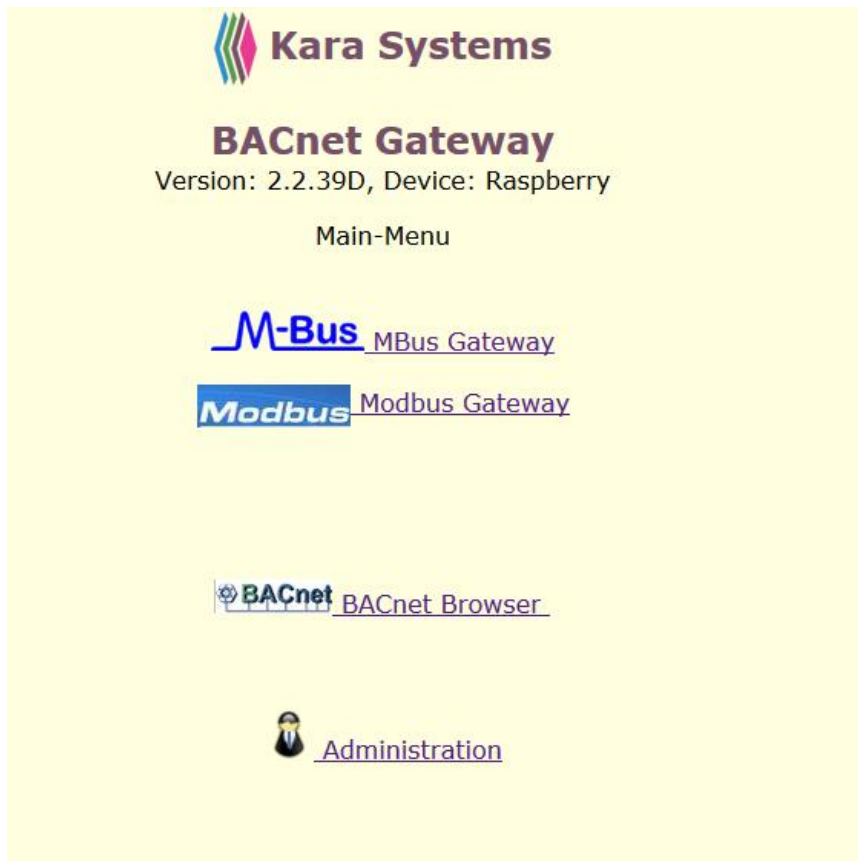
The user name is **admin**.

The default password is **password**.



Please change the default password!

You will stay logged in till you close the browser.



Click on “Administration” and then on “Network Configuration”



Step 3:

Configure the Network Configuration of the target LAN.

Network Configuration

Attention: If you change any of these settings, it is possible that Gateway can not be reached any more!
Logged in User: admin

Network Configuration	
Hostname:	KaraGateway
IP-Address:	192.168.2.127
Subnetmask:	255.255.255.0
Default gateway:	192.168.2.1
Domain Name Server:	192.168.2.1
Default Domain:	
Mac Address:	f0:ad:4e:00:09:db

Save

Date-Time Synchronization	
Device Date-Time:	Sonntag, 17. April 2011 20:19:37
Browser Date-Time :	Sonntag, 17. April 2011 20:20:53

Synchronize

Host Name:

Enter the name for the device

IP-Address:

Enter the IP number for the device for the target LAN.

Subnet-mask:

The IP Mask of the Target LAN. For example 255.255.0.0

Default gateway:

The default IP number of the IP-Gateway/Router of the target LAN

Domain Name Server:

The DNS Server of your target LAN, if required

Default Domain:

This field can be left empty



Step 4:

Click on “Save” and click on “BACnet Configuration”


Proceed in next chapter

3.2 BACnet Configuration



Step 5:

Before connecting the device to the target LAN you have to configure the BACnet Configuration.



BACnet Configuration

Configuration

BACnet Network Type	<input type="text" value="BACnet/IP"/>	
BACnet Device Instance	<input type="text" value="2271"/>	
BACnet Device Name	<input type="text" value="Kara BACnetGateway"/>	
Max APDU	<input type="text" value="1476"/>	default=1476
Broadcast I-am every	<input type="text"/>	munites

BBMD Registration

IP Number	Port	IP Network Mask	
<input type="text"/>	<input type="text" value="47808"/>	<input type="text" value="255.255.255.255"/>	<input type="text"/>

3.2.1 BACnet Device Instance:

This is a unique BACnet Device Identifier. Please consult your BACnet Administrator to get a unique Instance number.



ATTENTION: If this Device Instance is not unique on the BACnet LAN, other BACnet devices may fail to operate

3.2.2 BACnet Broadcast Management Device (BBMD)

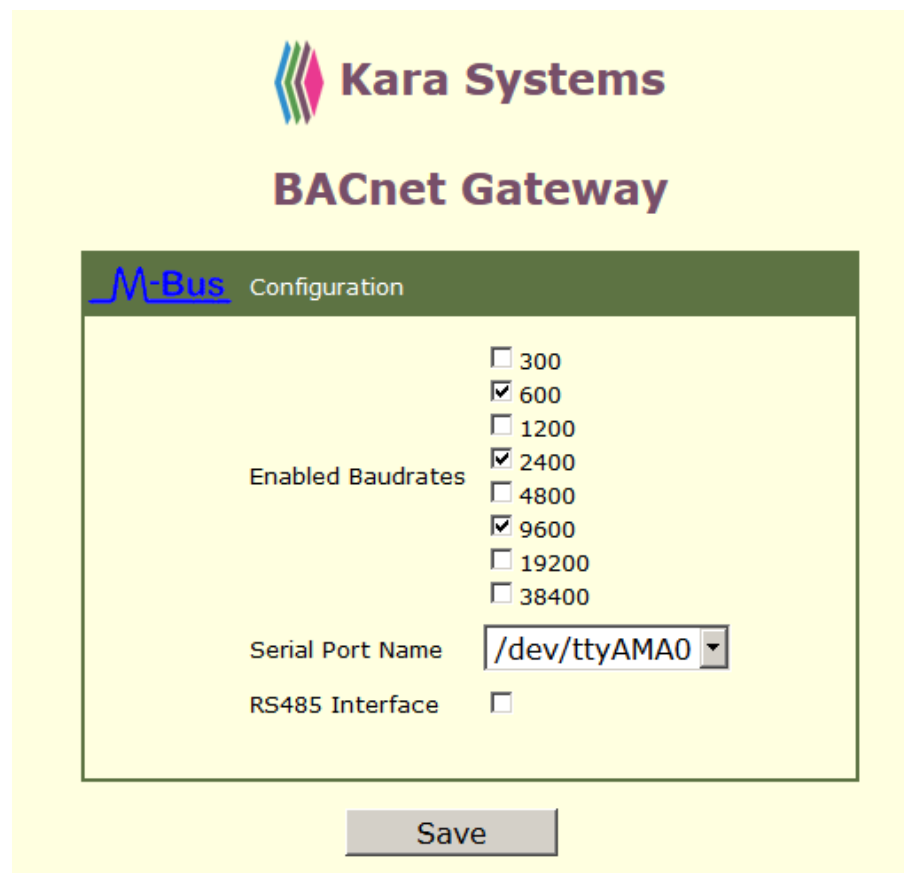
If the “BACnet Workstation Operator “ or other BACnet device which needs to establish a bind with the “M-Bus:BACnet Gateway” is located on a different IP sub-network, you have to register the device IP number in the “BBMD Registration dialog”. The default port is 47808 (bac0 in hexadecimal). Enter the new IP Number in the “IP Number Field” and click on save to register this remote device IP number.

3.3 BACnet Objects

BACnet Objects are not automatically included. By M-Bus Gateway you have to select the checkbox “to BACnet” for the particular meter record or records.

For Modbus Gateway select the check box “to BACnet” in the modbus object configuration. The BACnet Instance number and type is done automatically.

3.4 M-Bus Configuration



The screenshot shows the Kara Systems BACnet Gateway configuration interface. At the top, the Kara Systems logo and "BACnet Gateway" title are displayed. Below this is a window titled "M-Bus Configuration". Inside the window, there is a list of "Enabled Baudrates" with checkboxes next to each value: 300, 600, 1200, 2400, 4800, 9600, 19200, and 38400. The checkboxes for 600, 2400, and 9600 are checked. Below the list is a "Serial Port Name" field with a dropdown menu showing "/dev/ttyAMA0". At the bottom of the window is an "RS485 Interface" checkbox, which is unchecked. A "Save" button is located below the configuration window.

3.4.1 Enable Baud rates for M-Bus:

M-Bus supports multiple baud rates for different meters. Here you can multiple select the Baud rates used on your M-Bus. If you select all Baud rates the Scan will take longer to complete.

3.4.2 Serial Port Name:

The default setting is “ttyAMA0”. If you are using a USB to RS-232 converter then choose “ttyUSB0”..



Step 6:

Now click “Save” and return to the “Main Menu” and click on “Reboot Device”.

Your browser will display an error message that the connection to the device did failed. This is because now the device has a new IP number.

Now you can unplug the device from the Install network and plug the device to the target network. Installation is ready.

4 METER READINGS

The Meter Reading Dialog shows a list of all meters found on the M-Bus. Meters are detected by doing a scan on the M-Bus. The device starts a scan after a switch on or after a reboot. You can start a scan manually by clicking on the button “Start Scan”

Addr	Ident.	Baud	Manu.	Version	Medium	Status	State	Value	Units	Description	To BACnet	Records	Edit
02	05185001	2400	REL	65	Electricity	80	OK	297.000	Kilowatt-Hours	Energy Watt		6	
03	05185002	2400	REL	65	Gas	80	OK	349.000	Cubic-Meters	Volume		6	
04	00199902	2400		0	Electricity	0	Inactive	0.000	Watt-Hours	Energy Watt		6	
05	00200001	2400		0	Electricity	0	Inactive	0.000	Watt-Hours	Energy Watt		6	
06	00200002	2400		0	Electricity	0	Inactive	0.000	Watt-Hours	Energy Watt		6	
08	33725629	2400		0	Heat Outlet	0	Inactive	0.000	Watt-Hours	Energy Watt		11	
09	33725660	2400		0	Heat Outlet	0	Inactive	0.000	Watt-Hours	Energy Watt		11	
10	33725666	2400		0	Heat Outlet	0	Inactive	0.000	Watt-Hours	Energy Watt		11	
11	33725672	2400		0	Heat Outlet	0	Inactive	0.000	Watt-Hours	Energy Watt		11	
12	33743017	2400		0	Heat Outlet	0	Inactive	0.000	Watt-Hours	Energy Watt		11	
13	33702813	2400		0	Heat Outlet	0	Inactive	0.000	Watt-Hours	Energy Watt		11	

Addr: is the primary Meter Address

Ident: is the Meter identification number, which should be unique.

Baudrate: is the baudrate used for this meter.

Manu.: is the Manufacture 3 letter code

Version: is the software Version of the M-Bus slave meter software

Status: Definition of the Meter Status

Bit	Meaning
0 (LSB)	Error
1	Application Busy
2	Power Low
3	Permanent Error
4	Temporary Error
5	Specific to Manufacture
6	Specific to Manufacture
7	Specific to Manufacture

State: could be one of the following
OK

Inactive: meter is not responding

Communication Error:

Collision Detection: Two meters are responding for same address, check meter addresses

Send Error: check RS232 cabling

Wrong Command: Incorrect Data received

Wrong Start Character: Incorrect Data received

Message too short: Incorrect Data received, a meter on the M-Bus could be damaged

Wrong length: protocol Error

Wrong Checksum: Check Baudrate and cable lengths

M-Bus Status Error: means that the Meter signals an error in the Meter status field

Value: Value of the default record set in the meter configuration

Units: Value of the default record set in the meter configuration

Description: description of the default record set in the meter configuration

To BACnet: a List of record numbers which are converted to BACnet Analog Input

The first number is the meters record number and the second number is the BACnet Instance number.

Records: see Meter Records

4.1 Export to Excel

If you want to export the meter list to Excel click on “Export to Excel” then open the file with Microsoft Excel.

4.2 Scanning Meters

To detect new meters on M-Bus the M-Bus:BACnet Gateways performs a scan on all primary M-Bus addresses for all baudrates selected and then make a secondary scan on meter Identification numbers for all baudrates selected. Meter found on secondary scan has a primary address of 253.



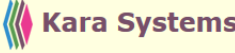
Attention

The meters Identification Number must be unique for all meters.

Clicking on “Start Scan” will show the scan status.

Meters found will be listed in the M-Bus Meter Reading dialog. The Meters found are saved and will get an Inactive Status if they are switched off.


4.3 Meter Configuration



M-Bus Edit Meter: Meter 02-05185001

Mbus Address:	2
Name:	Meter 02-05185001
Reading Interval (minutes):	5
Convert All Records to BACnet:	<input type="checkbox"/>
Baudrate:	2400
Default Record No:	01-Energy Watt ~ 02-05185001-00 - Kilowatt-Hours

Save Next >> << Back Delete Meter

 [back to Meter List](#)

Delete ALL Meters Set Interval To ALL Meters

4.3.1 Reading Interval:

Meters are read periodically. You can set the reading interval in minutes for a specific meter or you can set this interval for all meters by clicking on the “Set Interval for ALL Meters”. The default value is one minute.

4.3.2 Record No:

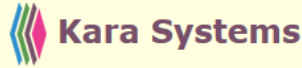
This is the record number which its values will be displayed in the “Meter Reading List” dialog.

4.3.3 Delete Meter:

If a meter is removed from the M-Bus you can delete this meter by click on this button. The meter is attached at the M-Bus again and you perform a scan the meter will be included again with default settings.

4.4 Meter Records

There are two types of M-Bus Meters, those who support a fixed record data and those who support variable record data. The fixed records can send up to two meter records where the variable record protocol can send many records. The Meter Record dialog displays all records received from the meter and their data respectively. Here you can select which record will be converted to a BACnet Analog Object.



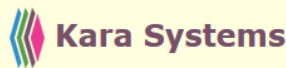
Records for Meter: Meter 02-05185001

No.	Value	Unit	Description	Function	Sub-Unit	Storage No.	Tariff	BACnet Inst.	Modbus Addr.	Edit
1	0.000	Kilowatt-Hours	Energy Watt	Inst.	0	0	0	0	0	
2	00.Jan.2000 00:00	Win	No-Units	Time Point	Inst.	0	0	0		
3	00.Jan.2000	No-Units	Time Point	Inst.	0	0	0			
4	0.000	Kilowatt-Hours	Energy Watt	Inst.	0	0	0		2	
5	00.Jan.2000	No-Units	Time Point	Inst.	0	0	0			
6		No-Units	Manu. Specific	Inst.	0	0	0			

The “Next >>” and “<< Back” buttons will show the records of the next or previous meter in the list respectively.

4.5 Edit Records

Every single meter's record can be configured in this dialog.



M-Bus Editing Meter: Meter 02-05185001, Record No: 1

To BACnet Object:	<input checked="" type="checkbox"/>
Modbus-Address (Even Addresses. Type float):	<input type="text" value="0"/>
Unit:	<input type="text" value="{Default}"/>

[To Record List](#)

[To Meter List](#)

4.5.1 To BACnet Object

If set, this record will be converted to a BACnet Analog Input Object. The record will be assigned the next available BACnet object instance starting from zero. The BACnet instance number will be assigned to this record till you detach this record again from BACnet. The instance assigned will be displayed in the meter list.

4.5.2 Modbus Address

If this is set to 0 or higher, then this record will be converted to Modbus holding register. The holding register has a "Float" format and needs always two Modbus addresses. The address for the record must always be even values.

4.5.3 Unit

The BACnet gateway automatically converts the M-Bus units to BACnet Units respectively. This is the {default} value. But you can select any other BACnet Unit from the list.

5 MODBUS

5.1 Adding Modbus Objects

Before add modbus objects you have to add first the modbus device.

Name	Connection	Address	Status	Objects	Edit
Device TCP	TCP/IP :502	192	Inactive	2	
Serial Device	Baud: 9600 Partiy: Even	1	Comm-Error	1	

Total Devices: 2

Click on “Add New Device” to add a device.

To add a modbus object, list the devices and click on the device’s objects.



You can list all Modbus objects configured or all Objects which belong to one particular device.

6 THE BACNET BROWSER

The Gateway has an integrated BACnet Browser. It shows only objects connected to this gateway.

The screenshot shows the BACnet Browser interface. On the left, there is a tree view under 'Kara BACnetGateway' with categories: Analog-Input (containing Meter 02-05185001-01, Meter 02-05185001-02, Meter 03--01, and inputRe), Binary-Output (containing Meter 02-05185001-01), Device (containing Kara BACnetGateway), and Notification-Class (containing notify). On the right, the 'BACnet Objects' section features 'Refresh' and 'Export' buttons, and a 'Sort by: status' dropdown. Below this is a table of objects:

Name	Type	Instance	Gateway	Description	Value	Status
inputRe	Analog-Input	3	modbus	Modbus Device=MobbusDevice, Object Address=0	0.0	Fault
Meter 02-05185001-01	Analog-Input	0	mbus	Energy Watt ~ 02-05185001-00	757.0	OK
Meter 03--01	Analog-Input	1	mbus	Volume ~ 03-05185002-00	1035.00	OK
Meter 02-05185001-02	Analog-Input	2	mbus	Time Point ~ 02-05185001-01	214748368.0	OK

Below the table, it states 'Total BACnet Objects: 4'.

On the left side the BACnet browser shows a tree of all the BACnet Objects grouped in object-type. When you click on an element on the tree an object list or a configuration dialog is displayed on the right hand side.

7 RECOVERY

A recovery procedure is needed if for some reason you forgot the admin-password of the network IP number. The recovery procedure will reset the admin-password to “password”, the network IP number to “192.168.2.127”, Subnet Mask to “255.255.255.0” and the default gateway IP to “192.168.2.1”.

Follow the following step to recover the device:

1. Format a USB memory stick with FAT32 format
2. On the USB memory stick create a subdirectory with the name “_rescue_”
3. Download the file *recovery.enc* from <http://www.karasystems.eu/downloads/BACnetGateway/recover.enc> and copy file in the _rescue_ directory.
4. Switch off and insert the USB memory stick
5. Switch on the gateway.
6. Wait for at least 30 seconds and after it should be able to connect the browser to 192.168.2.127
7. The password is now “password”, change the password.
8. Ready

8 BACNET SPECIFICATIONS

The M-Bus:BACnet Gateway is a BACnet Application Specific Controller (B-ASC)
The selected M-Bus Meter Records will converted to BACnet Analog Objects

A B-ASC intended for use in a specific application and supports limited programmability. It enables specification of the following:

- Ability to provide the values of any of its BACnet objects
- Ability to allow modification of some or all of its BACnet objects by another device Management
- Ability to respond to queries about its status
- Ability to respond to requests for information about any of its objects
- Ability to respond to communication control messages
- Ability for Change-Of-Value subscription
- Ability to generate Alarm and Event Notification
- No Trending
- No Scheduling

The Device will support following BACnet Features:

BIBB = BACnet INTEROPERABILITY BUILDING BLOCKS

- BIBB-Data Sharing-ReadProperty-B (DS-RP-B)
- BIBB - Data Sharing-ReadPropertyMultiple-B (DS-RPM-B)
- BIBB - Data Sharing-WriteProperty-B (DS-WP-B)
- BIBB - Data Sharing-COV-B (DS-COV-B)
- BIBB - Device Management-Dynamic Device Binding-B (DM-DDB-B)
- BIBB - Device Management-Dynamic Object Binding-B (DM-DOB-B)
- BIBB - Device Management-DeviceCommunicationControl-B (DM-DCC-B)
- BIBB - Device Management-UTCTimeSynchronization-B (DM-UTC-B)
- BIBB - Device Management-TimeSynchronization-B (DM-TS-B)
- BIBB - Alarm and Event-Notification Internal-B (AE-N-I-B)
- BIBB - Alarm and Event-ACK-B (AE-ACK-B)
- BIBB - Device Management-Object Creation and Deletion-B (DM-OCD-B)
(only for Notification Class Object)

Supporter Objects:

- Device
- Binary Inputs and Output for modbus coils and discrete Inputs
- Analog Inputs and Outputs for Meter readings, modbus registers and holding registers
- Notifications Class

Optionally:

- BIBB - Device Management-Virtual Terminal-B (DM-VT-B)

The device supports following Object Types:

- Device
- Analog Inputs
- Notification Class

6.1 BACnet Object Name

The BACnet Analog Object created will get a default name as below:

Object Name:

XX_YYYYYYYY_ZZ

Where:

XX	is the Meter primary Address
YYYYYYYY	is the Meter Identification number
ZZ	is the record number

8.1 6.2 BACnet Services Supported

The M-Bus:BACnet Gateway supports following Services:

- Read Property Service
- Read Property Multiple Service
- Write Property Service (support for priorities)
- TimeSynchronization Service
- UTCTimeSynchronization Service
- Subscribe-COV Service
- ConfirmedEventNotification Service
- Subscribe-COV-Property Service
- Who-Is and I-Am Services
- Who-Has and I-Have Services
- Create Object (for Notification Class Object)
- Delete Object
- Get EventInformation

- Get Alarm Summary

Optionally:

- VT-Open Service
- VT-Close Service
- VT-Data Service

8.2 6.3 BACnet specific Object Properties

Property Identifier	Property Type	Name	Description
1002	Unsigned	Meter Address	The Meter Address for this Record
1003	Unsigned	Identification	The Meter Identification number
1004	Unsigned	Baudrate	The Baudrate used for this meter
1005	Enumerated	Manufacture	Manufacture of Meter
1006	Unsigned	Version	Software Version of Meter
1007	Enumerated	Medium	One of Gas, Water, Electricity etc...
1008	Bit_String	Meter Status	Meter Status
1009		Reserved	
1010	Enumeration	Meter Error	Meter error
1011	Unsigned	RecordNo	Is the record number of the meter for this object
1101	Enumerated	Modbus connection Type	0=Serial, 1 = TCP/IP
1102	Unsigned	Slave Address	
1103	String Octet	TCP/IP Number	
1104	Unsigned	Object Address	