IntesisBox® BACnet/IP Server

Modbus RTU Master

User's manual

Issue Date: 17/12/2012

r14 eng

Intesis Software S.L.
Milà i Fontanals, 1 bis - 1º
08700 Igualada
Spain

Gateway for the integration of Modbus RTU slave devices into BACnet/IP control systems.

Models available for this gateway, with their following **Order codes**:

IBOX-BAC-MBRTU-100
Tiny model supporting connection to up to 254 Modbus slave devices and 110 internal datapoints.

IBOX-BAC-MBRTU-A
Basic model supporting connection to up to 254 Modbus slave devices and 500 internal datapoints.

IBOX-BAC-MBRTU-B
Extended model supporting connection to up to 254 Modbus slave devices and 3000 internal datapoints.

URL http://www.intesis.com
Email info@intesis.com
tel +34 938047134

INDEX

URL http://www.intesis.com
Email info@intesis.com
tel +34 938047134

1. Description

1.1 Introduction

This document describes the integration of Modbus RTU Master systems with BACnet ASHRAE 135 – 2001 Annex J - BACnet protocol compatible devices or systems using the gateway IntesisBox BACnet/IP Server - Modbus RTU Master.

This document assumes that the user is familiar with Modbus and BACnet/IP technology and technical terms.

From now on, and with the aim of easy the read of this document, the words "gateway" or "IntesisBox" are used instead of IntesisBox BACnet/IP Server - Modbus RTU Master. Any other use of the word "gateway" not meaning IntesisBox BACnet/IP Server - Modbus RTU Master will be specifically indicated.

The aim of this integration is to make accessible Modbus system signals and resources from a BACnet/IP based control system or device, as if it was a part of the own BACnet system and vice-versa. For this, the gateway acts as a BACnet/IP Server device in its BACnet interface, allowing other BACnet/IP devices to perform subscription (COV) requests, and also read and write its internal points. From the Modbus system point of view, IntesisBox simulates a Modbus master device, the readings of the Modbus slave device(s) is performed by IntesisBox by automatic continuous polling.

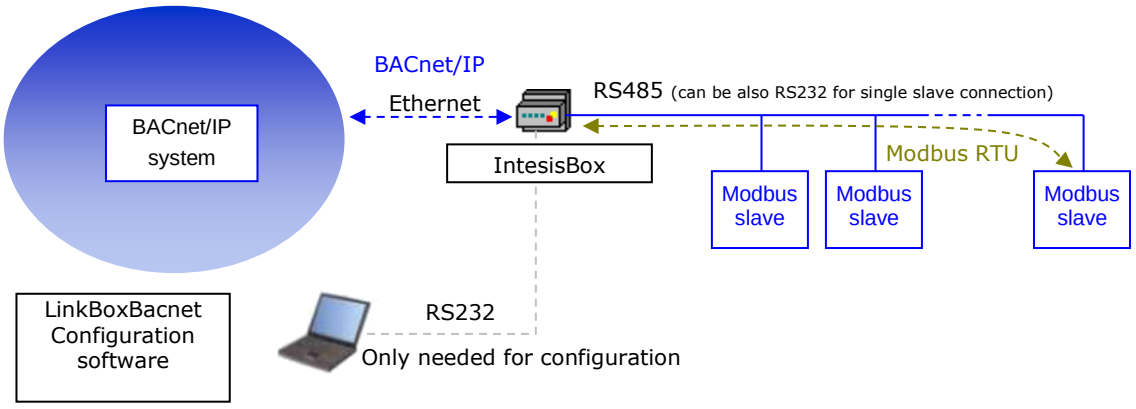


Figure 1.1 Integration of Modbus and BACnet/IP using *IntesisBox BACnet/IP Server - Modbus RTU Master* gateway

1.2 Functionality

The integration operation is as follow:

From the Modbus system point of view, after the start up process, IntesisBox reads continuously the points configured to be read in the Modbus slave devices, and updates in its memory all the values received from the Modbus system.

From the BACnet system point of view, after the start up process, the gateway listen for any subscription (COV) request, serves any polling request, or performs any writing request of its internal points received from BACnet system. The values received from BACnet are immediately written in the associated register of the corresponding Modbus slave device.

Every one of the Modbus registers in the slave devices is associated to a *BACnet object*, with this, all the Modbus system (all the slave devices) is seen as *a single BACnet device with many objects* from the BACnet system point of view, each object corresponding to a Modbus slave/register address.

When a new value is read from Modbus for a given register, the new value is updated in the gateway's memory and, if this signal is associated to a BACnet active subscription then the new value will be sent to the subscripted BACnet device(s).

In the continuous polling of the Modbus devices, if a non response of the Modbus device is detected, the corresponding virtual signal inside IntesisBox will be activated indicating communication error with the Modbus device. These virtual signals indicating communication status in real time with the Modbus devices are also accessible from BACnet, like the rest of the points of IntesisBox.

1.3 Capacity of IntesisBox

Element	Tiny version	Basic version	Extended version	Notes
Type of BACnet devices				Only those supporting BACnet/IP.
Number of BACnet points	110	500	3000	Maximum number of points that can be defined in the virtual BACnet device inside the gateway.
Number of BACnet subscribers	8	8	8	Maximum number of BACnet subscribers accepted by the gateway.
Number of BACnet subscriptions (COV) requests	220	1000	6000	Maximum number of BACnet subscriptions (COV) requests accepted by the gateway.
Type of Modbus slave devices				Those supporting Modbus *protocol*. Communication over RS485 network (2-Wire) or RS232 point to point.
Modbus Slave devices	254	254	254	Maximum number of Modbus slave devices allowed by IntesisBox.

There are different models of *IntesisBox BACnet/IP Server - Modbus RTU Master,* with different capacity every one of them.

- Tiny model supporting connection to up to 110 internal data points.
  Ref.: IBOX-BAC-MBRTU-100.
- Basic model supporting connection to up to 500 internal data points.
  Ref.: IBOX-BAC-MBRTU-A.
- Extended model supporting connection to up to 3000 internal data points.
  Ref.: IBOX-BAC- MBRTU-B.

2. Interfaces

This section gives the reader an idea on how a Modbus system/installation is integrated with IntesisBox BACnet. It is not meant to provide an in-depth explanation on how BACnet or Modbus technology work as understanding the protocol principles is assumed throughout this document.

The IntesisBox behaves as a regular BACnet device inside the BACnet system integrating all the KNX devices. Note that each datapoint defined on IntesisBox will have two associated data types:

- One data-type, related to the BACnet/IP protocol of the IntesisBox
- And another data-type, related to Modbus side of IntesisBox

Conversions of data values from Modbus to BACnet/IP data-types (and vice versa) are internally performed at application level of IntesisBox, and keeping the highest possible level of precision, with the restrictions of the data-type itself. Further detail on behavior and data-types of the BACnet/IP and Modbus interfaces of IntesisBox is given in the following sections.

All configuration of IntesisBox BACnet is done using software tool *LinkBoxBacnet*. This tool, covered in depth in section 5, is used to define the Modbus and BACnet related parameters on each of the datapoints defined in IntesisBox.

2.1 BACnet

The IntesisBox integrates all the Modbus devices in a single BACnet device. The communication with the other BACnet devices is done via the Ethernet port of the gateway which implements the BACnet ASHRAE 135 – 2001 Annex J - BACnet protocol.

The supported BACnet Objects and Building Blocks can be found in the PICS document available on the web:

http://www.intesis.com/pdf/IntesisBox_BACnet_IP_Server_Modbus_RTU_master_PICS.pdf

Configuration of all BACnet/IP parameters of IntesisBox and their links to Modbus using LinkBoxBacnet software tool is covered in section 5.1.

2.2 Modbus

Modbus RTU communication is characterised by the co-existence of just one master and one or more slave devices in a given network, all of them interconnected, and every slave with a unique address into the network. Different types of networks and network topologies are allowed. The more commonly used for Modbus RTU communication are: point to point communication using RS232, and point to multipoint communication using RS485 (2-wire or 4-wire).

IntesisBox acts as the master in the Modbus network, and the other Modbus devices connected to the network must be always slave devices. Up to 254 slave devices can be defined in IntesisBox. The types of networks supported by IntesisBox are:

- RS485 2-wire (up to 254 slave devices are allowed by IntesisBox, thus up to 254 slave devices in the same RS485 network can be integrated with just one IntesisBox, installing additional line repeaters where necessary).

- RS232 (for single slave integration).

Modbus slave devices are normally characterised by their communication parameters (baud rate, data bits, parity), some of them sometimes configurable depending on the device, and their predefined *registers address map*, this address map specifies the address, type and characteristics of every internal point (commonly called *register*) of the Modbus slave device, these registers being accessible using Modbus RTU protocol.

Communication parameters of IntesisBox's Modbus interface (baud rate, data bits, stop bits, parity) are fully configurable to adapt to any slave device. Of course IntesisBox and all the slave devices connected to the Modbus network must use the same communication parameters.

Modbus RTU protocol defines different types of function codes to use to read/write different type of registers that can be found in Modbus devices, and also different data formats to encode values. All these are explained in section 5.1.2

Also the data encoding used for 16 bits registers (big-endian or little-endian) can be configured in IntesisBox's Modbus interface. This is the byte order for data encoding (MSB..LSB or LSB..MSB). This data encoding, although is specified as big-endian in Modbus protocol specification, it varies depending on manufacturer/type of slave device.

All this gives great flexibility to integrate a wide range of Modbus slave devices that can be found in the market.

3. Quick Setup

1. Install LinkBoxBacnet. Details in section 5
2. Install IntesisBox in the desired installation site (DIN rail mounting inside a metallic industrial cabinet connected to ground is recommended).
3. Power up and connect the communication cables. Details in section 4.
4. Open LinkBoxBacnet, open a project or create a new one. Details in section 5.
5. Connect to the IntesisBox (details in section 5).
6. (optional) Configure the IntesisBox. Details in section 5.1.
7. Check if there is communication in both BACnet and Modbus buses (section 5)
8. The IntesisBox is ready to be used in your system.

4. Connection

The device uses a standard enclosure allowing DIN EN60715 TH35 rail mounting. Its plastic meets standard PC UL 94 V0.

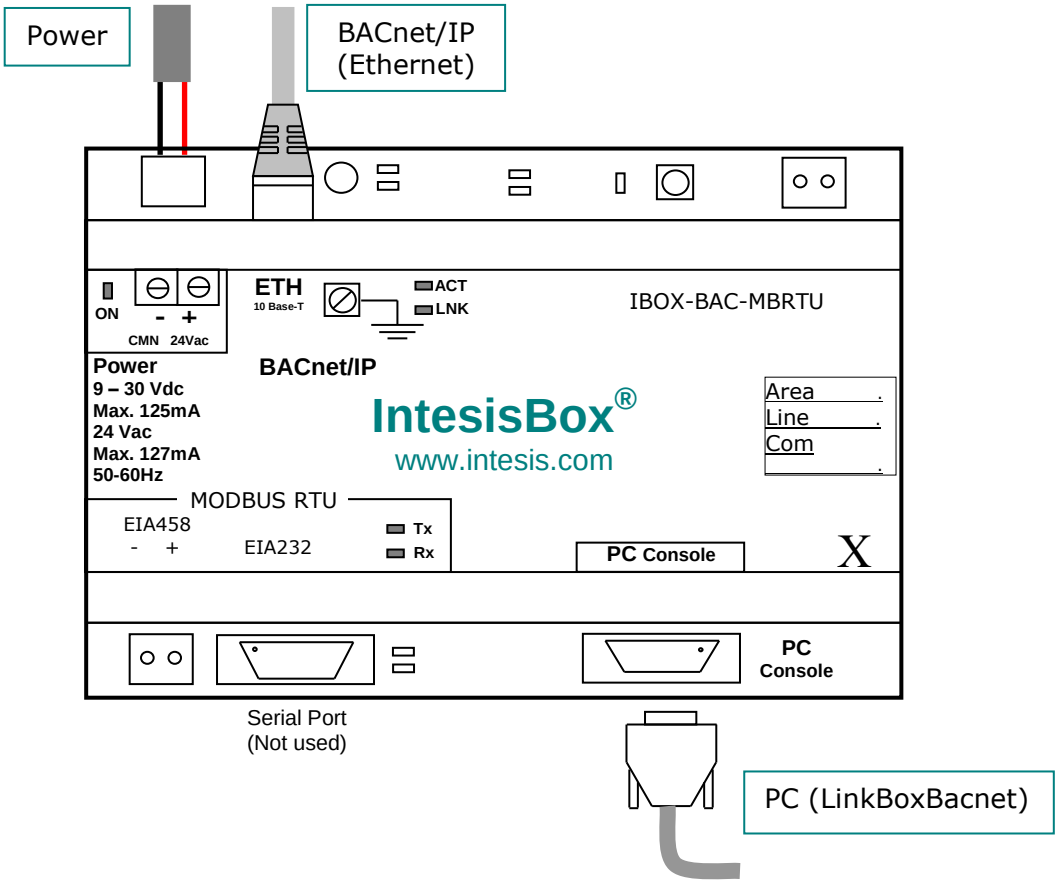


Figure 4.1 Device connection diagram

Ensure proper space for all connectors when mounted.

The items supplied by Intesis Software for this integration are:

- IntesisBox BACnet/IP Server - Modbus RTU Master hardware
- Console cable. Standard DB9F-DB9M cable 1.8 meter long.
- Installation sheet, containing a link to the LinkBoxBacnet software and this manual.

4.1 Power device

The first step to perform is to power up the device. To do so a power supply working with any of the voltage range allowed is needed (check section 6). Once connected the ON led (Figure 4.1) will turn on.

WARNING! In order to avoid earth loops that can damage the gateway and/or any other equipment connected to it, we strongly recommend:

- The use of DC power supplies, floating or with the negative terminal connected to earth. **Never use a DC power supply with the positive terminal connected to earth**.
- The use of AC power supplies only if they are floating and not powering any other device.

4.2 Connect to Modbus

Connect the communication cable coming from the Modbus network to the port marked as Modbus of IntesisBox (Figure 4.1). Two methods to connect to the Modbus network can be used:

- The RS485 port if the network is RS485 2-wire. Connect the + and the – to the respective ports in the slave devices (polarity matters)

- The RS232 port if the connection is point to point to one single slave.

IntesisBox			Modbus RTU slave[1]
DB9 M		RS-232	DB9 F
TX	3	→	RX
RX	2	←	TX
GND	5	↔	GND

Table 4.1 Modbus RS232 cable pinout

How to check if there is communication with the Modbus bus is explained in the LinkBoxBacnet Manual (section 5).

4.3 Connect to BACnet

Connect the communication cable coming from the network hub or switch to the ETH port (Figure 4.1) of IntesisBox. The cable to be used depends on where the IntesisBox is being connected:

- Connecting directly to a BACnet/IP device: crossover Ethernet UTP/FTP CAT5 cable

- Connecting to a hub or switch of the LAN of the building: a straight Ethernet UTP/FTP CAT5 cable

In case there is no response from the BACnet devices to the frames sent by IntesisBox, check that they are operative and reachable from the network connection used by IntesisBox. Check the IntesisBox Ethernet interface sending Pings to its IP address using a PC connected to the same Ethernet network.

4.4 Connect to PC (LinkBoxBacnet)

This action allows the user to have access to configuration and monitoring of the device (more information can be found in the LinkBoxBacnet User Manual [section 5]). Two methods to connect to the PC can be used:

[1] Check your Modbus device's user's manual provided by its respective manufacturer to know more details about pinout.

- Ethernet: Using the ETH port (Figure 4.1) of IntesisBox. How to check connectivity is explained in section 4.3.

- Serial cable: To connect the device to the PC the serial cable supplied should be plugged to the PC console port (Figure 4.1).
  The cable is a RS-232 straight cable and its pinout is at explained in Table 4.2.

IntesisBox			PC	
DB9 M		RS-232 (Straight)	DB9 F	
TX	2	→	2	RX
RX	3	←	3	TX
GND	5	↔	5	GND

Table 4.2 Configuration serial cable pinout

5. LinkBoxBacnet. Configuration & monitoring of IntesisBox BACnet series

How to install and use the LinkBoxBacnet is explained in its Manual. It can be found in the installation folder (if the Software is already installed) or it can be downloaded from the link that can be found in the installation sheet supplied with the IntesisBox.

In this section only the specific project configuration for IntesisBox BACnet/IP Server - Modbus RTU Master is going to be explained.

The External Protocol in this IntesisBox is Modbus

5.1 Project configuration

To configure the integration connection parameters, and the points list, click on *Config* in the *Button Bar (*Figure 5.1*).* The Modbus *Configuration* window will be opened. For integrations with a large number of points an alternative CSV based configuration method is explained in the LinkBoxBacnet Manual.

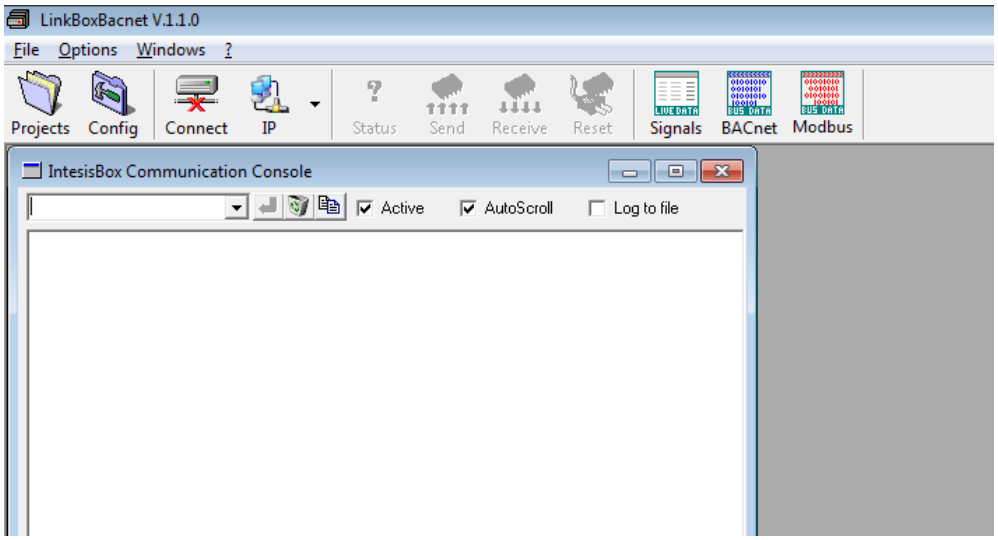


Figure 5.1 Menu and Button Bar in LinkBoxBacnet

5.1.1 Connection configuration

Two subsets of information are configured using this window, the BACnet/IP parameters of the IntesisBox, and the parameters of the Modbus interface.

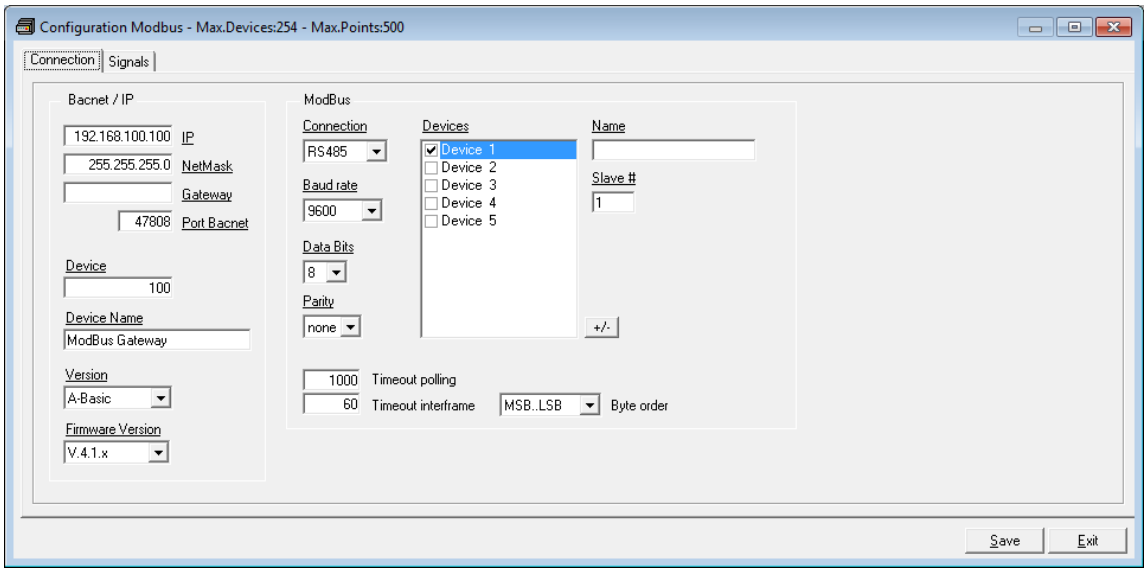


Figure 5.2 Configuration: Connection Tab

BACnet/IP interface configuration parameters:

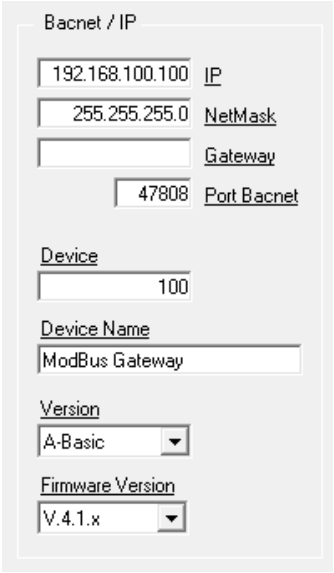


Figure 5.3 BACnet/IP interface Configuration

- **IP:** Enter the IP address for the gateway (supplied by the network administrator).
- **NetMask**: Enter the IP NetMask for the gateway (supplied by the network administrator).
- **Gateway:** Enter the Default Gateway address (router address) in case the gateway (IntesisBox) is in a different sub network than other BACnet devices (supplied by the network administrator). Leave blank if there is no need of router address.
- **BACnet Port:** Enter the BACnet port number used by the gateway (by default 47808, which is BAC0).

- **Device**: Enter the BACnet device number for the gateway (must be unique inside the BACnet system).
- **Device Name:** Select the BACnet device name for the gateway (by default "Modbus Gateway"). This name will be collected by BACnet browsers among others.
- **Version:** Select the gateway model used: tiny,basic or extended. You can check the gateway model in the identification given by the device when it connects to LinkBoxBacnet, it appears in the IntesisBox Communication Console window once connected to the gateway

  IntesisBox_Bacnet_Modbus-**100**… → Tiny model
  IntesisBox_Bacnet_Modbus-**A**… → Basic model
  IntesisBox_Bacnet_Modbus-**B**… → Extended model

- **Frimware version:** select the gateway firmware version. If not done correctly the configuration is not going to work

Modbus interface configuration parameters:

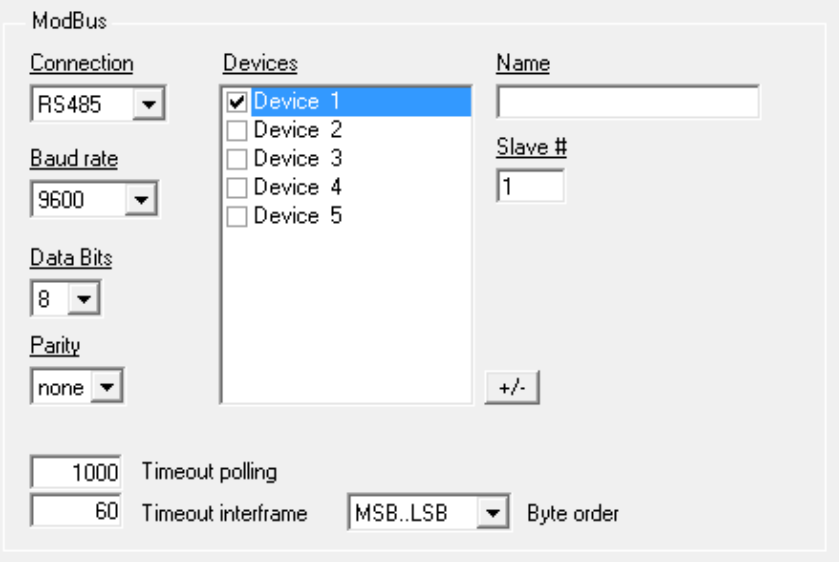


Figure 5.4 Modbus interface Configuration

- **Connection:** Type of connection used (RS232 or RS485).
- **Baud Rate:** Baud rate used for the communication.
- **Data Bits:** Data bits used.
- **Parity:** Parity used.
- **Timeout polling:** Timeout (in milliseconds) between two consecutive polling cycles.
- **Timeout interframe:** Inter-frame timeout (in milliseconds), some devices need inter-frame delay to communicate properly. Increase this timeout if you experience communication problems with slaves.
- **Byte order** (Modbus endianism)**:** Byte order for data fields inside Modbus telegrams (LSB..MSB or MSB..LSB). It will depend on the slaves, consult the slave

documentation for details. If unknown just try the two possible choices and see if the read values make sense. This affects to all data fields of all slaves defined.

- **Devices:** List of Modbus slave devices to communicate to. Check the devices you want to activate. Select a device to configure its properties.
- **+/- :** Use this button to define the number of Modbus slave devices to communicate to (Up to 254 devices)

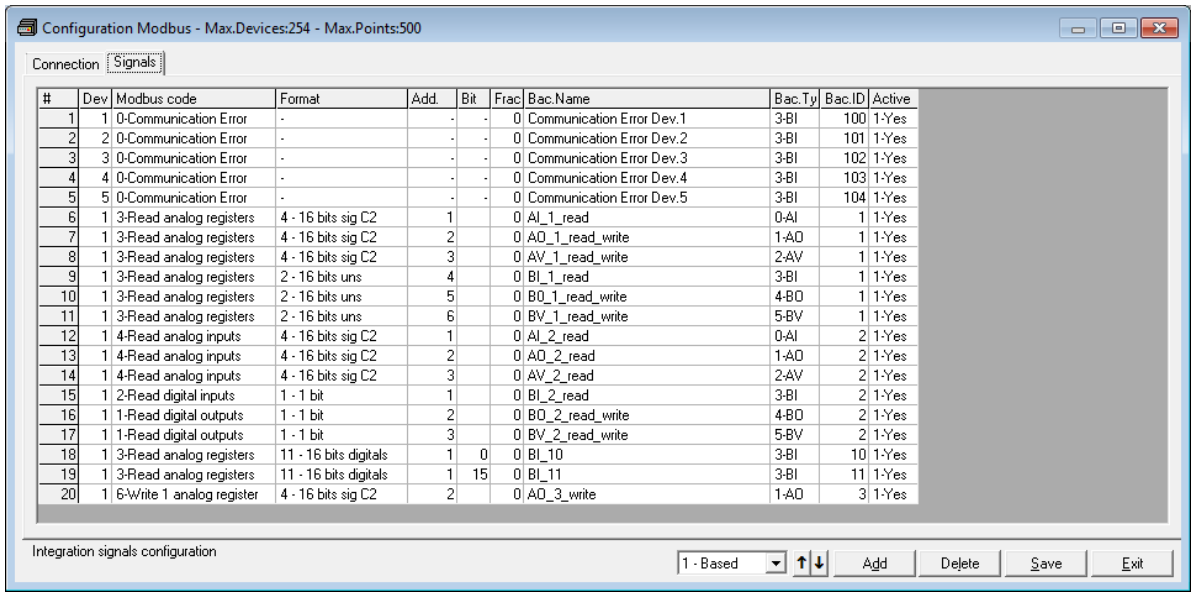
For every Modbus device defined, the following properties must be entered:

- **Name:** Enter the device name (optional, just for identification purposes).
- **Slave #:** Enter the slave number configured in the Modbus device.

5.1.2 Signals configuration

Select the Signals tab (Figure 5.5) to configure the signals list (the IntesisBox internal points). More information about the meaning of the columns can be found in the tables below.

Every row in the grid corresponds to a signal (point). Signals (rows in the grid) can be added or deleted selecting the desired row and clicking Add or Delete buttons. Multiple consecutive rows can be deleted too.



#	Dev	Modbus code	Format	Add.	Bit	Frac	Bac.Name	Bac.Ty	Bac.ID	Active
1	1	0-Communication Error	-	-	-	0	Communication Error Dev.1	3-BI	100	1-Yes
2	2	0-Communication Error	-	-	-	0	Communication Error Dev.2	3-BI	101	1-Yes
3	3	0-Communication Error	-	-	-	0	Communication Error Dev.3	3-BI	102	1-Yes
4	4	0-Communication Error	-	-	-	0	Communication Error Dev.4	3-BI	103	1-Yes
5	5	0-Communication Error	-	-	-	0	Communication Error Dev.5	3-BI	104	1-Yes
6	1	3-Read analog registers	4 - 16 bits sig C2	1		0	AI_1_read	0-AI	1	1-Yes
7	1	3-Read analog registers	4 - 16 bits sig C2	2		0	AO_1_read_write	1-AO	1	1-Yes
8	1	3-Read analog registers	4 - 16 bits sig C2	3		0	AV_1_read_write	2-AV	1	1-Yes
9	1	3-Read analog registers	2 - 16 bits uns	4		0	BI_1_read	3-BI	1	1-Yes
10	1	3-Read analog registers	2 - 16 bits uns	5		0	BO_1_read_write	4-BO	1	1-Yes
11	1	3-Read analog registers	2 - 16 bits uns	6		0	BV_1_read_write	5-BV	1	1-Yes
12	1	4-Read analog inputs	4 - 16 bits sig C2	1		0	AI_2_read	0-AI	2	1-Yes
13	1	4-Read analog inputs	4 - 16 bits sig C2	2		0	AO_2_read	1-AO	2	1-Yes
14	1	4-Read analog inputs	4 - 16 bits sig C2	3		0	AV_2_read	2-AV	2	1-Yes
15	1	2-Read digital inputs	1 - 1 bit	1		0	BI_2_read	3-BI	2	1-Yes
16	1	1-Read digital outputs	1 - 1 bit	2		0	BO_2_read_write	4-BO	2	1-Yes
17	1	1-Read digital outputs	1 - 1 bit	3		0	BV_2_read_write	5-BV	2	1-Yes
18	1	3-Read analog registers	11 - 16 bits digitals	1	0	0	BI_10	3-BI	10	1-Yes
19	1	3-Read analog registers	11 - 16 bits digitals	1	15	0	BI_11	3-BI	11	1-Yes
20	1	6-Write 1 analog register	4 - 16 bits sig C2	2		0	AO_3_write	1-AO	3	1-Yes

Figure 5.5 Signal list

# (Signal's number)	
Description	Enumeration of the rows in the grid (signals). If clicked on them the whole row will be selected (↑↓ to be used to delete/add rows)
Restrictions	Cannot be edited

Dev	
Description	Device number to which belongs the point. Referenced to the list of devices defined in *Connection Tab (*Figure 5.4*)*
Values	From 1 to 254
Edit mode	Text edit or AutoEnumeration
Comments	This is not the slave number configured in the Modbus device itself, it is just the order of the device (from top to bottom) in the devices list

Modbus *Code*	
Description	Modbus function code to be used by IntesisBox to read, to write or to read/write the point in the slave device.
Values	0- Communication Error 1- Read digital outputs 2- Read digital inputs 3- Read analog registers 4- Read analog inputs 5- Write 1 digital output 6- Write 1 analog register 7- Write multiple digital output *8*- Write multiple analog registers
Restrictions	For *Read only* points function codes 1, 2, 3 or 4 can be used For *write only points*, function codes 5, 6, 15 or 16 can be used For *read/write points*, see section 5.1.3
Edit mode	Single / Multiple Values selection.
Comments	*Consult documentation of Modbus device(s) to integrate for information about function codes supported to read/write their internal points.*

Format	
Description	Modbus data format for the point.

Values	*Generic:* 1. 1 bit. 2. 16 bits uns: 16 bits unsigned. 3. 16 bits sig: 16 bits signed. The MSbit represents the sign. 4. 16 bits sig C2:16 bits signed (two's complement). 5. 32 bits uns: 32 bits unsigned. 6. 32 bits sig: 32 bits signed. 7. 32 bits sig C2: 32 bits signed (two's complement). 8. 32 bits IEEE: IEEE Standard for Floating-Point Arithmetic (IEEE 754). 9. 32 bits IEEE inv: 32 bits IEEE inverted (LSB..MSB). 10. 32 bits IEEE Winv: 32 bits IEEE word inverted (LSW..MSW). *Device Specific:* 11. 16 bits digital: Bit coded into 16 bits register. 12. 32 bits Mod10K uns: Integer N as 2 16-bit integers A and B. where N= (A * 10.000) + B 13. 48 bits Mod10K uns: Integer N as 3 16-bit integers A, B and C where N= (A * 10.000^2) +(B * 10.000) + C 14. 64 bits Mod10K uns: Integer N as 4 16-bit integers A, B, C and D where N= (A * 10.000^3) + (B * 10.000^2) +(C * 10.000) + D 15. 32 bits Mod10K sig: as the unsigned but the MSb represents the sign. 16. 48 bits Mod10K sig: as the unsigned but the MSb represents the sign. 17. 64 bits Mod10K sig: as the unsigned but the MSb represents the sign. 18. 32 bits Mod10K ION: to be used with ION devices. 19. 32 bits ION sig: to be used with ION devices. 20. 32 bits Invertomatic: to be used with Invertomatic devices. *21.* MSB*100 + LSB. *22.* 32 bits uns Winv: 32 bits unsigned word inverted (LSW..MSW). *23.* 32 bits sig C2 Winv: 32 bits signed (two's complement).word inverted (LSW..MSW).
Restrictions	1 bit format can only be used with digital Modbus codes (1,2,5 and 6) All the other formats cannot be used with the abovementioned codes
Edit mode	Single / Multiple Values selection.
Comments	Formats 1 to 9 are generic Modbus data formats while formats 10 to 20 are *Device specific*. *Consult documentation of Modbus device(s) to integrate for information about Modbus data format of the points desired to integrate.*
Address	
Description	It's the Modbus register address to use by IntesisBox to read/write the point into the Modbusdevice.
Edit mode	Text edit or AutoEnumeration

Comments	*Consult documentation of Modbus device(s) to integrate for information about register addresses of the points desired to integrate.*

Bit	
Description	Bit used inside the Modbus register to encode the digital value for the point. IntesisBox allows bit decoding from generic 16 bits input/holding Modbus registers. Bit coding into 16 bit input/holding Modbus registers is used for some devices to encode digital values into this type of registers.
Values	0 to 15
Restrictions	Only used with Format=11 (16 bits digital) and Code= 3 or 4 (read holding/input registers). To decode more than one of the bits of the 16 bits register all the decoding rows should be grouped together in the table
Edit mode	Text edit

Frac	
Description	Fractional part to consider for the point's value when read/write. Some devices encode for example temperature values (integer + fractional part) in common 2-bytes Modbus registers (using data format 16 bits signed two's complement for example); the problem of using 2-bytes registers is that no fractional part can be encoded. To avoid this problem, the real value in the device is sent multiplied by 10 as just integer part (a real value of 25.1 will be sent as 251). For this kind of points for example you can specify a value of 1 in *Frac* column. Then the value decoded by IntesisBox from the slave will be divided by 10, and the value will be multiplied by 10 before writing to the slave, thus will be the real value in the device (including integer and fractional part).
Edit mode	Text edit or AutoEnumeration

Bac.Name	
Description	BACnet object name for the signal. This name is included into the BACnet's *Object_name* property for the point and it will be collected by any BACnet explorer.
Restrictions	Maximum 30 characters
Edit mode	Text edit
Comments	Recommended to give a descriptive name to each point with indication of the Modbus slave/register associated

Bac.Type

Description	BACnet object type for the signal.
Values	• AI = Analog Input. • AO = Analog Output. • AV = Analog Value. • DI = Digital Input. • DO = Digital Output. • DV = Digital Value. • MI = Multistate Input. • MO = Multistate Output. • MV = Multistate Value.
Edit mode	Single / Multiple Values selection.
Comments	Edit using the mouse right-button-click pop-up menu

Bac.ID	
Description	BACnet object instance number for the point. It can be manually entered by the user or can be automatically assigned by LinkBoxBacnet when saving the configuration (section 5.1.4)
Restrictions	All the object instance numbers for objects of the same type must be different
Edit mode	Text edit or AutoEnumeration
Comments	It is recommended to let LinkBoxBacnet assign automatically object instance numbers for the points

Active	
Description	Indicates if the signal is active or not for the integration
Values	• 0: Not active • 1: Active
Edit mode	Text edit or AutoEnumeration

0 / 1 based register	
Description	Some Modbus devices use 0-based register addresses (also referred as Jbus), while others use 1-based register addresses (also referred as Modbus), in the Modbus communication (for 1-based devices, the register address 100 is specified as 99 in the Modbus communication frames). Select *0-Based* if your Modbus devices use 0-based address map (like PLCs), or select *1-Based* if your Modbus devices use 1-based address map.

↑↓	
Description	Buttons to move the selected row (or rows) up or down inside the grid. To move up or down inside the grid a single row or a group of consecutive rows, just select the row or rows using the left button of the mouse and push the desired up or down button.
Comments	This can be done also using the key combinations *ALT+arrow up* or *ALT+arrow down* instead of up or down buttons

Add	
Description	Button that adds a row under the selected one.

Delete	
Description	Buttons to delete the selected row (or rows).

Save	
Description	Save the configuration (details in section 5.1.4)

Exit	
Description	Exits the configuration window (details in section 5.1.4)

5.1.3 How to configure read/write points

First of all is important to take into account that different names for Modbusfunction codes, are used in technical literature depending on the manufacturer of the Modbus device. The following table shows the equivalence between nomenclature for function codes, used by Intesis Software in IntesisBox and the used in Modbus protocol specification.

Function code	IntesisBox	Modbus protocol specification
01	Read digital outputs	Read Coils
02	Read digital inputs	Read Discrete Inputs
03	Read analog registers	Read Holding Registers
04	Read analog inputs	Read Input Registers
05	Write 1 digital output	Write Single Coil
06	Write 1 analog register	Write Single Register
15	Write multiple digital outputs	Write Multiple Coils
16	Write multiple analog registers	Write Multiple Registers

Given a point in a Modbus slave device, if this point allows to be read and written, different Modbus function codes must be used for read and for write actions (consult the slave documentation for details of what function codes must be used for read and for write). Use the following criteria for configuration of this kind of points in IntesisBox:

1. If the Modbus function code to use for read is *03* and the function code to use for write is *06* (which is very common), then select the function code *3-Read analog registers* in column Modbus *Code* and select a BACnet Type *Output* or *Value* for the point (i.e. AO, AV, BO, BV, MO, MV). With this, IntesisBox will use function code 03 for read the point in every polling cycle, and whenever a new value for the point is received from BACnet, the new value will be written in the Modbus slave device using function code 06.

2. If the Modbus function code to use for read is *01* and the function code to use for write is *05* (which is also very common), then select the function code *1-Read digital outputs* in column Modbus *Code* and select a BACnet Type *Output* or *Value* for the point (i.e. AO, AV, BO, BV, MO, MV). With this, IntesisBox will use function code 01 for read the point in every polling cycle, and whenever a new value for the point is received from BACnet, the new value will be written in the Modbus slave device using function code 05.

3. If the Modbus function code to use for read and the function code to use for write are different than 01-05 or 03-06 (sometimes found with specific devices), then you have to declare two points in IntesisBox to perform the read and the write separately. The way to configure this is better explained using an example.

   Imagine you have a device, in which a given analog point (register address 100 for example) of type read/write must be read using function code 03, and must be write using function code 16.

   To be able to read and write this Modbus point from BACnet, you must define two separate points into IntesisBox, one for read and one for write like the following:

Nb	Dev	Modbus Code	Format	Add.	Bit	Frac	Bac.Name	Bac.Type	Bac.ID	Active
1	1	3-Read analog registers	4 - 16 bits sig C2	100		0	AI - example of Read Modbus point	0 -AI	0	1-Yes
2	1	16-Write multiple analog registers	4 - 16 bits sig C2	100		0	AO - example of Write Modbus point	1-AO	0	1-Yes

The important configuration parameters to obtain the desired functionality are highlighted in green colour, the rest of configuration parameters are irrelevant in this example. Note that both points must have the same Modbus Address and the same Modbus Format.

URL http://www.intesis.com
Email info@intesis.com
tel +34 938047134

5.1.4 Saving the configuration

When the configuration of the project is finished follow the next steps:

1. Click the button *Save.* Once accepted the pop-up message, that will save the project in the folder on hard disk (more information in LinkBoxBacnet Manual).

2. You will be prompted to generate the configuration file to be sent to the gateway,

    a. If *YES* is selected, the binary file (Modbus.LBOX) containing the configuration for the gateway will be generated and saved also into the project folder.

    b. If *NO* is selected the binary file needs to be created before following the next steps. To do so open the Configuration window (section 5.1) and restart from step 1

3. A pop-up message will show up asking if you want to **preserve the Object instance numbers. BE CAREFUL** using this feature.

    a. If ***NO*** is selected all the object instance numbers for the points will be automatically reconstructed and thus loosing previous instance numbers, if defined. **ONLY** USE this option **for a brand new configuration** not previously running in the gateway and therefore not yet integrated into the BACnet system

    b. Select **Yes** for configurations **previously running** in the gateway and **already integrated into the BACnet system** that had been extended with a few more points that **must respect the previously defined object instance numbers**. All the points with object instance numbers defined will be respected. LinkBoxBacnet will automatically assign object instance numbers to ones without it.

4. As the final step, a pop-up message will ask if you want to see the BACnet points list report, If you select *Yes,* a text file called *Modbus- BACNET OBJECT LIST.TXT* will be generated and saved into the project folder containing a report of all the point's BACnet information (for informative purposes at user level). The file will be also opened in the notepad, it looks like this:

ObjIdent	ObjType	OInst	ObjName
00000000	0-AI	0000	AI_1_read
00000001	0-AI	0001	AI_2_read
04194304	1-AO	0000	AO_1_read_write
04194305	1-AO	0001	AO_2_read
04194306	1-AO	0002	AO_3_write
08388608	2-AV	0000	AV_1_read_write
08388609	2-AV	0001	AV_2_read
12582912	3-BI	0000	Communication Error Dev.1
12582913	3-BI	0001	BI_1_read
12582914	3-BI	0002	BI_2_read
12582915	3-BI	0003	BI_10
12582916	3-BI	0004	BI_11
16777216	4-BO	0000	B0_1_read_write
16777217	4-BO	0001	BO_2_read_write
20971520	5-BV	0000	BV_1_read_write
20971521	5-BV	0001	BV_2_read_write

5. Once in the configuration window again, click on exit. The configuration is ready to be sent to the IntesisBox (check LinkBoxBacnet Manual)

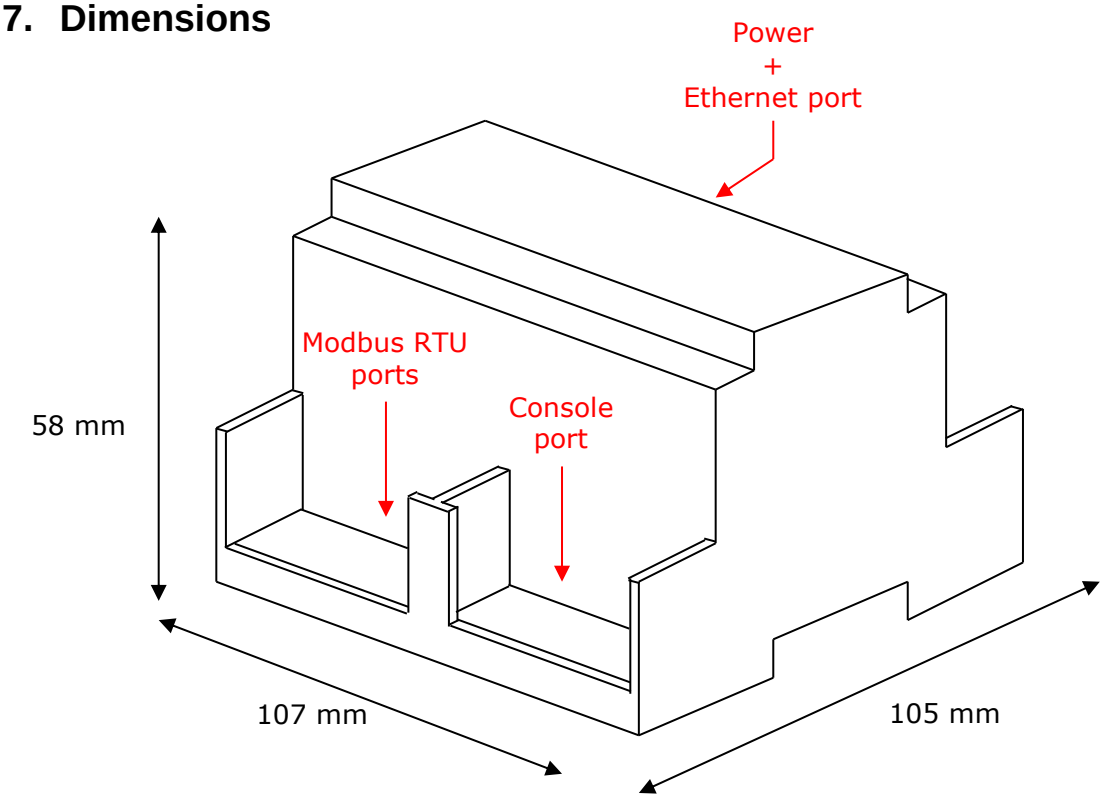
The configuration cannot be received from the gateway to* LinkBoxBacnet*, it can only be sent.

6. Mechanical & electrical characteristics

Enclosure	Plastic, type PC (UL 94 V-0). Dimensions: 107mm x 105mm x 58mm.
Colour	Light Grey. RAL 7035.
Power	9 to 30Vdc +/-10%, Max.: 125mA. 24Vac +/-10% 50-60Hz, Max.: 127mA Must use a NEC Class 2 or Limited Power Source (LPS) and SELV rated power supply. Plug-in terminal block for power connection (2 poles).
Terminal wiring (for power supply and low-voltage signals)	Per terminal: solid wires or stranded wires (twisted or with ferrule) 1 core: 0.5mm^2… 2.5mm^2 2 cores: 0.5mm^2… 1.5mm^2 3 cores: not permitted
Mounting	Wall. DIN rail EN60715 TH35.
Modbus RTU ports	1 x Serial EIA232 (DB9 male DTE). SELV 1 x Serial EIA485 (Plug-in screw terminal block 2 poles). SELV
BACnet/IP port	1 x Ethernet 10Base-T (RJ45).
LED indicators	1 x Power. 2 x Modbus RTU port activity (Tx, Rx). 2 x Ethernet port link and activity (LNK, ACT).
Console port	EIA232. (DB9 female connector, DCE). SELV
Configuration	Via console port[1] or Ethernet
Firmware	Allows upgrades via console port.
Operational temperature	0°C to +70°C
Operational humidity	5 to 95%, non condensing
Protection	IP20 (IEC60529).
RoHS conformity	Compliant with RoHS directive (2002/95/CE).
Norms and standards	CE conformity to EMC directive (2004/108/EC) and Low-voltage directive (2006/95/EC) EN 61000-6-2 EN 61000-6-3 EN 60950-1 EN 50491-3

[1] Standard cable DB9male-DB9female 1,8 meters long is supplied with the device for connection to a PC COM port for configuring and monitoring the device. The configuration software, compatible with Windows® operating systems, is also supplied.

7. Dimensions



Free space recommended to install the device into a cabinet (wall or DIN rail mounting), with space enough for external connections: