IntesisBox® Modbus Server

KNX

User Manual

r1.1 eng
Issue date: 05/2018

Intesis
Member of the HMS group

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2/18

Gateway for the integration of KNX TP-1 (EIB) installations into Modbus RTU and/or Modbus TCP enabled monitoring and control systems.

Order code:

IBMBSKNX1000000, 100 points version
IBMBSKNX2500000, 250 points version
IBMBSKNX6000000, 600 points version
IBMBSKNX1K20000, 1200 points version
IBMBSKNX3K00000, 3000 points version

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1 Description

1.1 *Introduction*

This document describes the integration of KNX installations into Modbus RTU and Modbus TCP systems using the *IntesisBox Modbus Slave – KNX* gateway.

The aim of this integration is to make accessible a KNX TP-1 installation from a Modbus control system or device, as if it was a part of the own KNX TP-1 (EIB) system and vice-versa.

For this, IntesisBox acts as a Modbus TCP server or Modbus RTU slave device in its Modbus interface, allowing read/write points from the Modbus client device(s), and offering this point's values through its KNX interface, acting in the KNX system as one more KNX device of the system.

Configuration is carried out using the configuration software IntesisBox® MAPS.

This document assumes that the user is familiar with KNX and Modbus technologies and their technical terms.
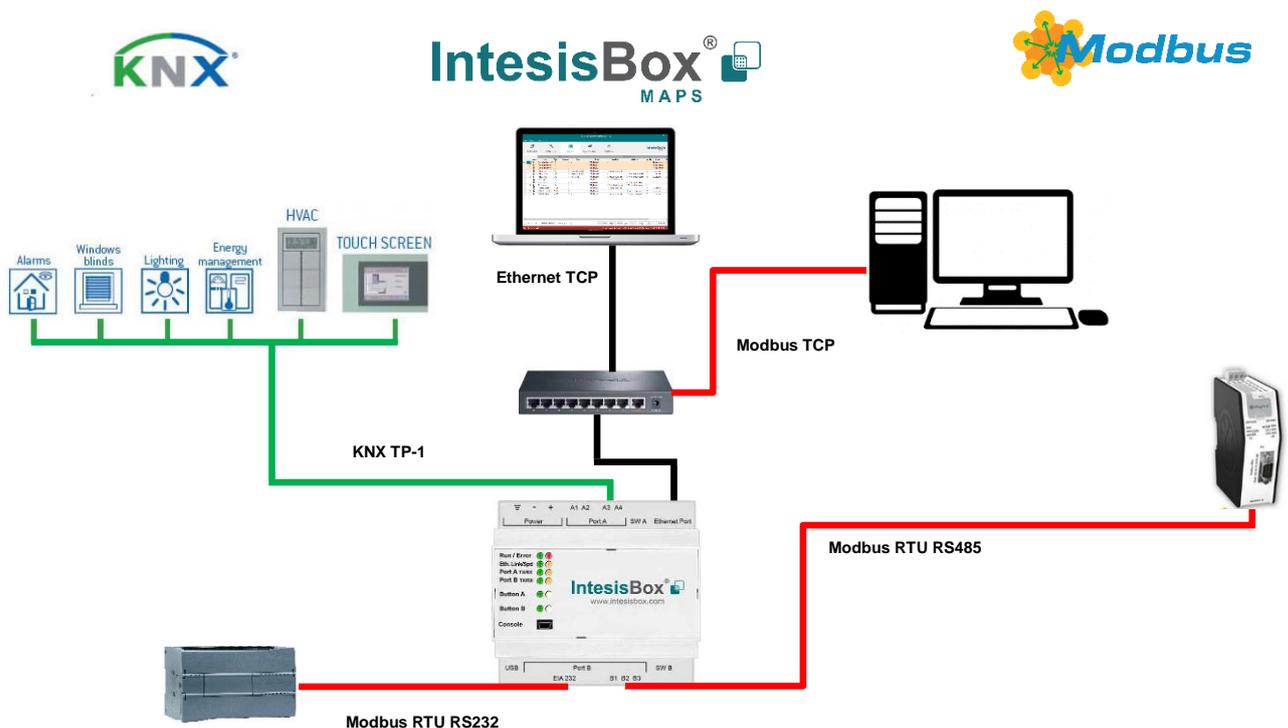
**Integration of KNX TP-1 devices or installations into
Modbus RTU Master or Modbus TCP Clients
control and monitoring systems**

1.2 *Functionality*

From the KNX system point of view, in the start-up process of the gateway and also after a detection of a KNX bus reset, the gateway polls the KNX signals configured to be updated in this situation and maintain the received values in memory to be served to the Modbus system when requested. It also listens for any KNX telegram related to the internal points configured in it and acts accordingly to the configuration of the related point.

From the Modbus system point of view, after the start up process, the gateway listens for any read or write request, and serves any read request or performs any writing request of its internal points received from Modbus system. The values received from Modbus become available to be read by the KNX system and vice-versa.

Every one of the mentioned Modbus points is associated to a KNX group address. With this, all the Modbus system is seen as one more KNX device from the KNX system point of view, with the same configuration and operation characteristics.

When a change in any Modbus point occurs, a WRITE telegram is sent to the associated Group Address in the KNX bus. See details in section.

When a telegram is received from a KNX Group address associated to a Modbus point, a message is sent immediately to the corresponding Modbus device to perform the corresponding action.

1.3 *Gateway's capacity*

IntesisBox capacity is listed below:

Element	100 version	250 version	600 version	1200 version	3000 version	Notes
Number of KNX Communication Objects	100	250	600	1200	3000	Maximum number of KNX Communication Objects that can be defined.
Number of KNX Main Group Addresses	100	250	600	1200	3000	Maximum number of KNX Main Group Addresses to be used
Number of KNX Associations	200	500	1200	2400	6000	Maximum number of KNX Associations
Type of Modbus Master devices	Modbus RTU (EIA485 or EIA232) Modbus TCP					Those supporting Modbus *protocol*. Communication over TCP/IP and RTU
Number of Modbus Master devices	1 Master device per RTU Node Up to 6 TCP connections					Number of Modbus Master devices supported by the device

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2   KNX interface

In this section, a common description for all IntesisBox KNX series gateways is given from the point of view of KNX system, which is called from now on *external system.* The Modbus system is also called from now on *internal system.*

2.1   *Description*

IntesisBox KNX interface connects directly to the KNX TP-1 bus and performs as any another device in the KNX system, with the same configuration and operational characteristics as other KNX devices.

Internally, the circuit part connected to the KNX bus is opto-isolated from the rest of the electronics.

IntesisBox KNX interface receives, manages and sends all the telegrams related to its configuration to the KNX bus.

On receiving WRITE telegrams of KNX Group Addresses associated to internal datapoints, the corresponding messages are sent to the internal system (Modbus) to maintain both systems synchronised in every moment.

When a change in a signal of the external system is detected, a WRITE telegram is sent to the KNX bus (addressed with the Group Address associated to the corresponding Group Object), in order to maintain both systems synchronised at every moment.

The status of the KNX bus is checked continuously and, if a bus drop-down is detected, for example due to a failure in the bus power supply, after the KNX bus is restored again, IntesisBox will send READ telegrams on all group objects marked with *"Ri"*. The behaviour of each individual point into IntesisBox is determined by the flags configured for the point. See details in section 2.2.

2.2   *Points definition*

Every internal datapoint to define has the following KNX properties:

Property	Description
Description	Descriptive information about the Communication Object or Signal.
Signal	Signal's Description. Only for informative purposes, allows identifying the signal comfortably.
DPT	It is the KNX data type used to code the signal's value. It will depend on the type of signal associated in the external system in every case. In some integrations, it is selectable, in others it is fixed due to the intrinsic characteristics of the signal.
Group	It is the KNX group to which the point is associated. It is also the group to which the read (R), write (W), transmit (T), update (U) and read on init (Ri) flags are applied. It is the sending group.
Listening addresses	They are the addresses that can write on the group object, apart of the main group address.
R	Read. If this flag is activated, READ telegrams of this group address will be accepted.
Ri	Read on Init. If this flag is activated, the object will trigger corresponding READ request (on associated group address) on initialization.
W	Write. If this flag is activated, WRITE telegrams on this group object will be accepted.
T	Transmit. If this flag is activated, when the group object value changes, due to a change in the external system, a WRITE telegram of the associated group address will be sent to the KNX bus.
U	Update. If this flag is activated, UPDATE telegrams (response to READ telegrams) on this group object will be accepted.
Active	If activated, the point will be active in IntesisBox, if not, the behaviour will be as if the point is not defined. This allows deactivating points without the need of delete them for possible future use.

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3   Modbus interface

3.1   *Description*

IntesisBox acts as a slave device in its Modbus interface, this interface can be the Ethernet port (if using Modbus TCP), or the EIA232/EIA485 ports (if using Modbus RTU). To access the points and resources of the IntesisBox from a Modbus master device, you must specify as Modbus register addresses, those configured inside IntesisBox corresponding to KNX signals. See details below in this document.

The IntesisBox can have Modbus RTU mode active, Modbus TCP mode active, or both modes active at the same time.

3.2   *Functions supported*

This part is common for Modbus TCP & RTU.

Modbus functions 01 and 02 (*coils and digital input registers*) can be used to read Modbus registers.

Modbus functions 03 and 04 (*read holding registers* and *read input registers*) can be used to read Modbus registers.

Modbus functions 05 and 15 (*Single digital Holding Registers* and *Write Multiple Holding Registers*) can be used to write Modbus registers.

Modbus functions 06 and 16 (*Single Multiple Holding Registers* and *Write Multiple Holding Registers*) can be used to write Modbus registers.

If *poll records* are used to read or write more than one register, it is necessary that the range of addresses requested contains valid addresses; if not the corresponding Modbus error code will be returned.

All the registers are of 2 bytes, even if they are associated to signals of type bit in the external system, and its content is expressed in MSB..LSB.

Modbus error codes are fully supported; they will be sent whenever a non-valid Modbus action or address is required.

3.3   *Modbus RTU*

Baud rate can be selected from 1200, 2400, 4800, 9600, 19200, 38400, 56700 and 115200.
Data Bits:8
Parity can be selected from: none, even, odd.
Stop Bits:1 and 2.

Modbus slave number can be configured. Physical connection (EIA232 or EIA485) can also be selected.

Only the lines RX, TX and GND of the EIA232 connector are used (TX/RX+ and TX/RX- for EIA485).

3.4   *Modbus TCP*

The TCP port to use can be configured (by default 502 is used).

The IP address, subnet mask and default router address to use by IntesisBox can be also configured.

3.5   *Address Map*

The Modbus address map is fully configurable; any point in the IntesisBox can be freely configured with the desired Modbus register address.

3.6 *Points definition*

Every point defined in the gateway has the Modbus *Format, Point and R/W* features associated to it that can be configured. These features are explained in section 5.2.4.

Each point defined in IntesisBox has the following Modbus features associated to it:

Feature	Description
#Bits	**One of the following bit lengths can be used:** • 1 bit • 16 bits • 32 bits
Data Coding Format	**One of the following Modbus data coding formats can be used:** • 16/32 unsigned. • 16/32 bits signed (one's complement – C1). • 16/32 bits signed (two's complement – C2). • 16/32 bits Float. • 16/ bits Bitfields. • Error comm
Function code	**One of the following Modbus function codes can be used:** • 1- Read Coils. • 2- Read Discrete Inputs. • 3- Read Holding Registers. • 4- Read Input Registers. • 5- Write Single Coil. • 6- Write Single Register. • 15- Write Multiple Coils. • 16- Write Multiple Registers.
Byte Order	• Big Endian • Little Endian • Word Inverted Big Endian • Word Inverted Little Endian
Register Address	The Modbus register address inside the slave device for the point.
Bit inside the register	Bit inside the Modbus register (optional). The gateway allows bit decoding from generic 16 bits input/holding Modbus registers. *Bit coding into 16 bits input/holding Modbus registers is used for some devices to encode digital values into this type of registers, being these registers normally accessible using Modbus function codes 3 and 4 (read holding/input registers).*
Read/Write	0: Read 1: Write 2: Read / Write

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4   Connections

Find below information regarding the IntesisBox connections available.
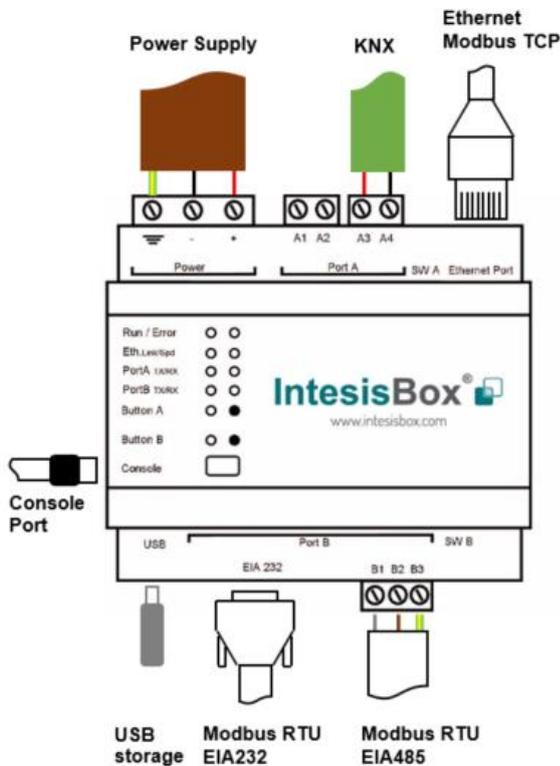
Power Supply
Must use NEC Class 2 or Limited Power Source (LPS) and SELV rated power supply.

If using DC power supply:
Respect polarity applied of terminals (+) and (-). Be sure the voltage applied is within the range admitted (check table below). The power supply can be connected to earth but only through the negative terminal, never through the positive terminal.

If using AC power supply:
Make sure the voltage applied is of the value admitted (24 Vac). Do not connect any of the terminals of the AC power supply to earth, and make sure the same power supply is not supplying any other device.

Ethernet / Modbus TCP
Connect the cable coming from the IP network to the connector ETH of the gateway. Use an Ethernet CAT5 cable. If communicating through the LAN of the building, contact the network administrator and make sure traffic on the port used is allowed through all the LAN path. DHCP is enabled by default. When disabled, default IP is 192.168.100.246.

PortA / KNX
Connect the KNX TP1 bus to connectors A3 (+) and A4 (-) of gateway's PortA. Respect the polarity

PortB / Modbus RTU
Connect the EIA485 bus to connectors B1 (B+), B2 (A-) and B3 (GND) of gateway's PortB. Respect the polarity.

Remember the characteristics of the standard EIA485 bus: maximum distance of 1200 meters, maximum 32 devices connected to the bus, and in each end of the bus it must be a termination resistor of 120 Ω. The gateway has an internal bus biasing circuit that incorporates the termination resistor. If you install the gateway in one of the ends of the bus, then do not install an additional termination resistor in that end.

Connect the serial cable EIA232 coming from the external serial device to the EIA232 connector of gateway's PortB. This is a DB9 male (DTE) connector in which only the lines TX, RX and GND are used. Details of the pinout can be seen in the user's manual. Respect the maximum distance of 15 meters.

Console Port
Connect a mini-type B USB cable from your computer to the gateway to allow communication between the Configuration Software and the gateway. Remember that Ethernet connection is also allowed. Check the user manual for more information.

USB
Connect a USB storage device (not a HDD) if required. Check the user manual for more information.

Ensure proper space for all connectors when mounted (see section 7).

4.1   *Powering the device*

A power supply, working with any of the voltage range allowed, is needed (check section 6). Once connected the RUN led (Figure above) 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   *Connection to KNX*

Connect the communication cable coming from the KNX network hub, or switch, to the ETH port (Figure above) of IntesisBox.

In case there is no response from the KNX installation, or KNX devices, to the frames sent by IntesisBox, check that they are operative and reachable from the network connection used by IntesisBox.

Check as well if there is a line coupler that it is not filtering the telegrams from/to the IntesisBox.

4.3   *Connection to Modbus*

4.3.1   **Modbus TCP**

Connect the communication cable coming from the KNX TP-1 network to the KNX port of IntesisBox. The cable to be used shall be a straight Ethernet UTP/FTP CAT5 cable.

4.3.2   **Modbus RTU**

Connect the communication cable coming from the Modbus network to the port marked as Modbus of IntesisBox. Connect the EIA485 bus to connectors B2 (+), B1 (-) and A1 or A2 (SNGD), or to connectors B1 (-), B2 (+) and B3 (SNGD) of gateway's PortB. Respect the polarity.

Remember the characteristics of the standard EIA485 bus: maximum distance of 1200 meters, maximum 32 devices connected to the bus, and in each end of the bus it must be a termination resistor of 120 Ω. The gateway has an internal bus biasing circuit that incorporates the termination resistor. If you install the gateway in one of the ends of the bus, then do not install an additional termination resistor in that end.

Connect the serial cable EIA232 coming from the external serial device to the EIA232 connector of gateway's PortB. This is a DB9 male (DTE) connector in which only the lines TX, RX and GND are used. Details of the pinout can be seen in the user's manual. Respect the maximum distance of 15 meters.

4.4   *Connection to the configuration tool*

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

- **Ethernet:** Using the Ethernet port of IntesisBox.

- **USB:** Using the console port of IntesisBox, connect a USB cable from the console port to the PC.

5 Set-up process and troubleshooting

5.1 *Pre-requisites*

It is necessary to have a KNX installation, device or interface operative and well connected to the corresponding KNX port of IntesisBox and a Modbus RTU slave or Modbus TCP client connected to their corresponding ports as well.

Connectors, connection cables, PC to use the configuration tool and other auxiliary material, if needed, are not supplied by Intesis Software SLU for this standard integration.

Items supplied by Intesis Software SLU for this integration are:

- IntesisBox gateway.
- Link to download the configuration tool.
- Product documentation.

5.2 *IntesisBox MAPS. Configuration & monitoring tool for IntesisBox KNX series*

5.2.1 Introduction

IntesisBox MAPS is a Windows® compatible software developed specifically to monitor and configure IntesisBox KNX series.

The installation procedure and main functions are explained in the *IntesisBox MAPS User Manual*. This document can be downloaded from the link indicated in the installation sheet supplied with the IntesisBox device or in the product website at www.intesisbox.com

In this section, only the specific case of Modbus to KNX systems will be covered.

Please check the IntesisBox MAPS user manual for specific information about the different parameters and how to configure them.

5.2.2 Connection

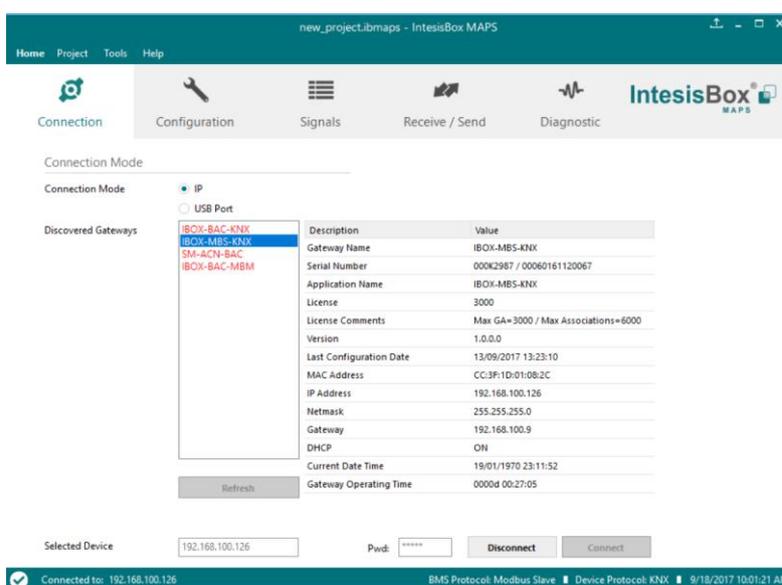To configure the IntesisBox connection parameters press on the **Connection** button in the *menu bar*.

Figure 5.1 MAPS connection

5.2.3 Configuration tab

Select the **Configuration** tab to configure the connection parameters. Three subsets of information are shown in this window: General (Gateway general parameters), KNX (KNX interface configuration) and Modbus Client (Modbus interface parameters).
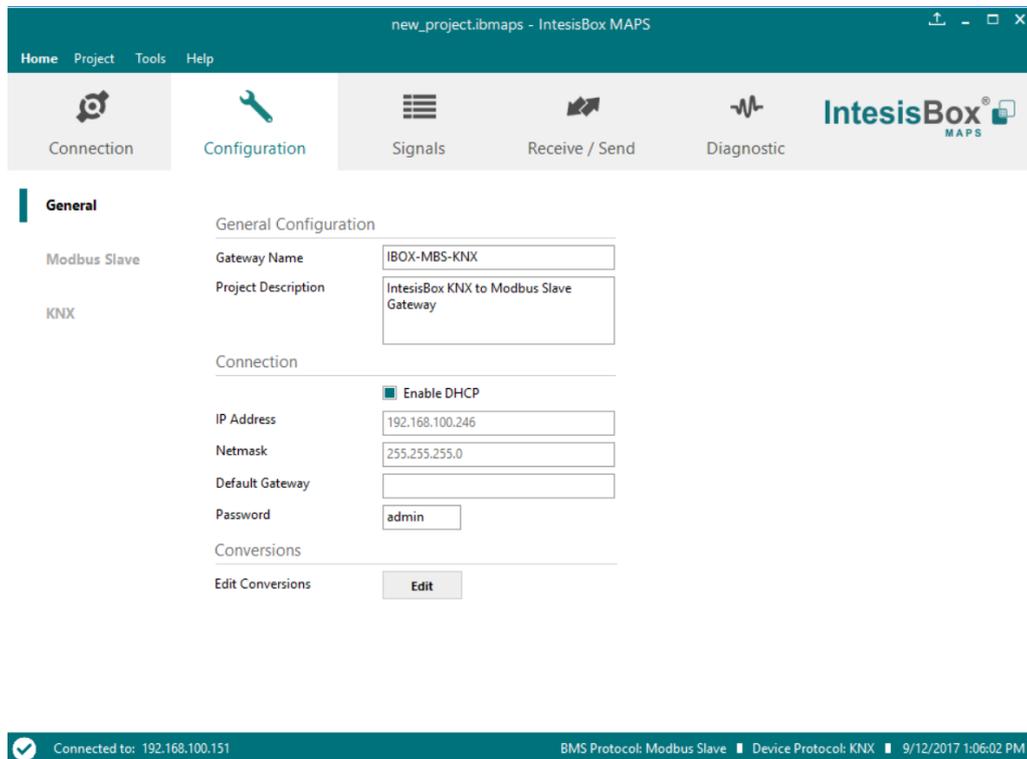

Figure 5.2 IntesisBox MAPS configuration tab

5.2.4 Signals

All available objects, Object Instances, its corresponding Modbus register and other main parmaters, are listed in the signals tab. More information on each parameter and how to configure it can be found in the IntesisBox MAPS user manual.
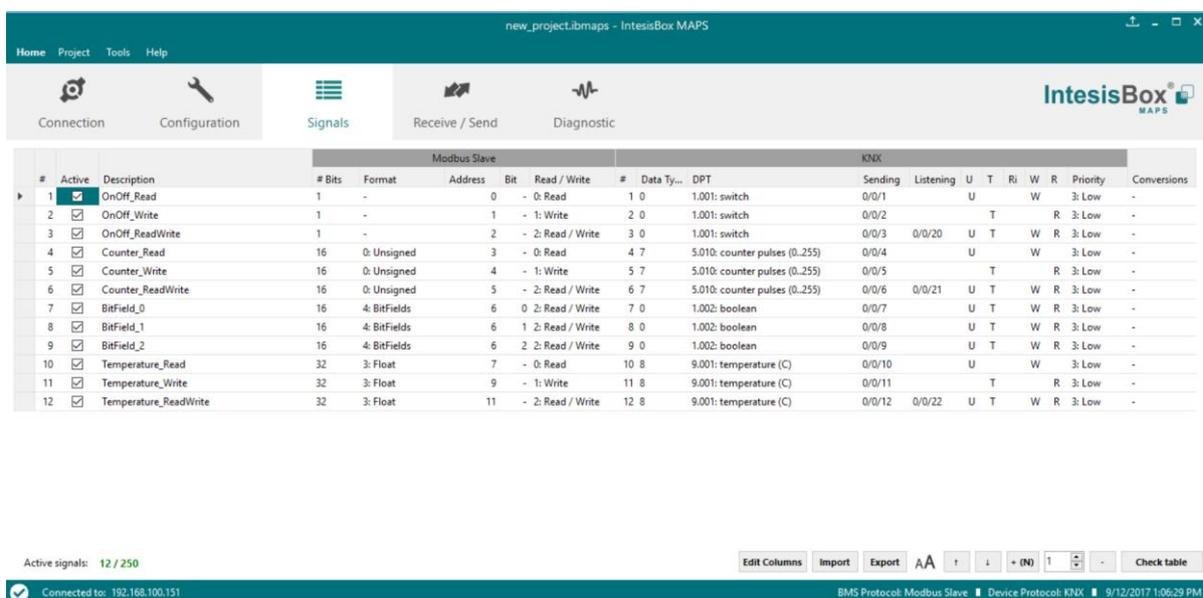

Figure 5.3 IntesisBox MAPS Signals tab

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5.2.5 Sending the configuration to IntesisBox

When the configuration is finished, follow the next steps.

1.- Click on **Save** button to save the project to the project folder on your hard disk (more information in IntesisBox MAPS User Manual).

2.- You will be prompted to generate the configuration file to be sent to the gateway.
a.- If **Yes** is selected, the file containing the configuration for the gateway will be generated and saved also into the project folder.

b.- If **NO** is selected, remember that the file with the project needs to be generated before the IntesisBox starts to work as expected.

3.- Press the **Send File** button to send the file to the IntesisBox device. The process of file transmission can be monitored in the IntesisBox Communication Console window. IntesisBox will reboot automatically once the new configuration is loaded.
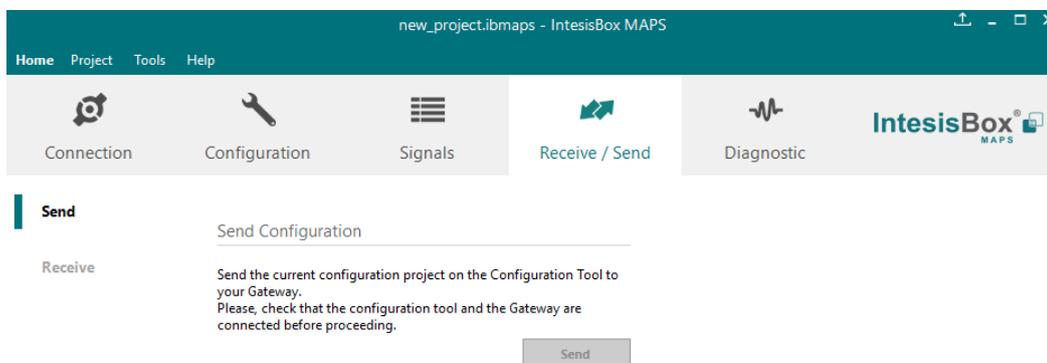

Figure 5.4 IntesisBox MAPS Receive/Send tab

After any configuration change, do not forget to send the configuration file to the IntesisBox using button Send File.

5.2.6 Diagnostic

To help integrators in the commissioning tasks and troubleshooting, the Configuration Tool offers some specific tools and viewers.

In order to start using the diagnostic tools, connection with the Gateway is required.

The Diagnostic section is composed by two main parts: Tools and Viewers.

- **Tools**
Use the tools section to check the current hardware status of the box, log communications into compressed files to be sent to the Support Team, change the Diagnostic panels' view or send commands to the gateway.

- **Viewers**
In order to check the current status, viewer for the Internal and External protocols are available. It is also available a generic Console viewer for general information about communications and the gateway status and finally a Signals Viewer to simulate the BMS behavior or to check the current values in the system.
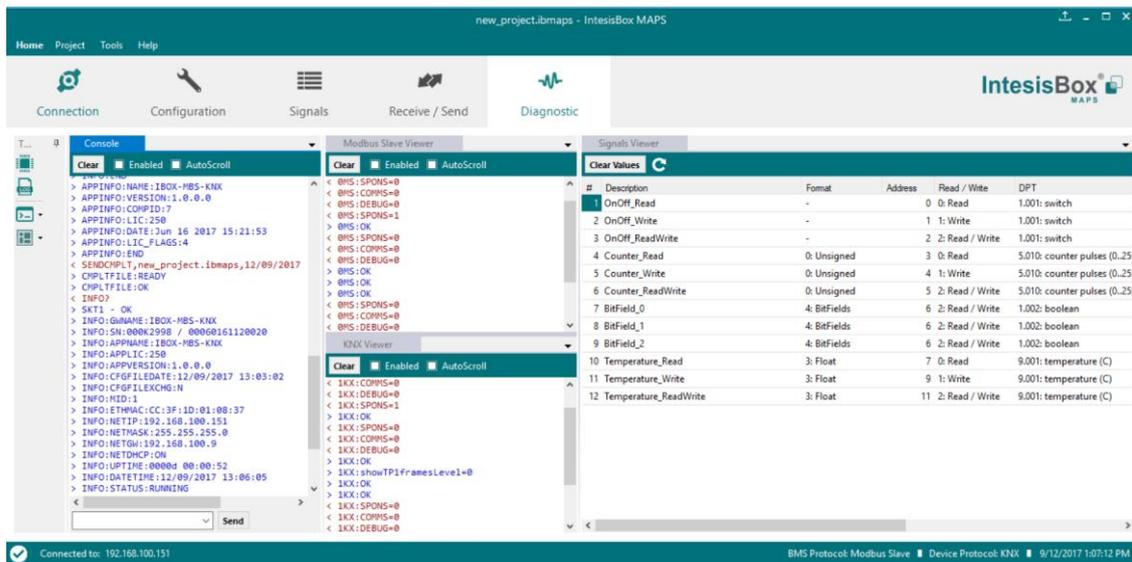
Figure 5.5 Diagnostic

More information about the Diagnostic section can be found in the Configuration Tool manual.

5.3   *Set-up procedure*

1. Install IntesisBox MAPS on your laptop, use the set-up program supplied for this and follow the instructions given by the Installation wizard.

2. Install IntesisBox in the desired installation site. Installation can be on DIN rail or on a stable not vibrating surface (DIN rail mounted inside a metallic industrial cabinet connected to ground is recommended).

3. Connect the KNX communication cable coming from the KNX network to the port marked as Port A on IntesisBox (More details in section 0).

4. If using, Modbus RTU, connect the communication cable coming from the EIA485/EIA232 port of the Modbus RTU installation to the port marked as Port B of IntesisBox (More details in section 0).

    If using, Modbus TCP, connect the communication cable coming from the Ethernet port of the Modbus TCP installation to the port marked as Port B of IntesisBox (More details in section 0).

5. Power up IntesisBox. The supply voltage can be 9 to 30 Vdc or just 24 Vac. Take care of the polarity of the supply voltage applied.

    WARNING! In order to avoid earth loops that can damage IntesisBox 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.

6. If you want to connect using IP, connect the Ethernet cable from the laptop PC to the port marked as Ethernet of IntesisBox (More details in section 0).

    If you want to connect using USB, connect the USB cable from the laptop PC to the port marked as Console of IntesisBox (More details in section 0).
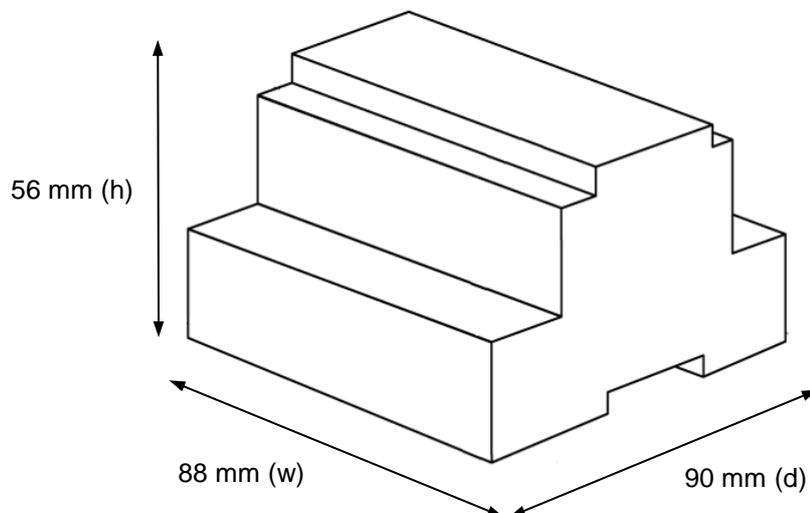
7. Open IntesisBox MAPS, create a new project selecting a copy of the one named **IBOX-MBS-KNX**.

8. Modify the configuration as desired, save it and download the configuration file to IntesisBox as explained in the IntesisBox MAPS user manual.

9. Visit the Diagnostic section and check that there is communication activity, some TX frames and some other RX frames. This means that the communication with the KNX installation and Modbus Master devices is OK. In case there is no communication activity between IntesisBox and the KNX and/or Modbus devices, check that those are operative: check the baud rate, the communication cable used to connect all devices and any other communication parameter.

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6   Electrical & Mechanical Features

Enclosure	Plastic, type PC (UL 94 V-0) Net dimensions (dxwxh): 90x88x56 mm Recommended space for installation (dxwxh): 130x100x100mm Color: Light Grey. RAL 7035	**Battery**	Size: Coin 20mm x 3.2mm Capacity: 3V / 225mAh Type: Manganese Dioxide Lithium
Mounting	Wall. DIN rail EN60715 TH35.	**Console Port**	Mini Type-B USB 2.0 compliant 1500VDC isolation
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	**USB port**	Type-A USB 2.0 compliant Only for USB flash storage device *(USB pen drive)* Power consumption limited to 150mA *(HDD connection not allowed)*
Power	1 x Plug-in screw terminal block (3 poles) 9 to 36VDC +/-10%, Max.: 140mA. 24VAC +/-10% 50-60Hz, Max.: 127mA Recommended: 24VDC	**Push Button**	Button A: Check the user manual Button B: Check the user manual
		Operation Temperature	0°C to +60°C
Ethernet	1 x Ethernet 10/100 Mbps RJ45 2 x Ethernet LED: port link and activity	**Operational Humidity**	5 to 95%, no condensation
Port A	1 x KNX TP-1 Plug-in screw terminal block orange (2 poles) 2500VDC isolation from other ports KNX power consumption: 5mA Voltage rating: 29VDC 1 x Plug-in screw terminal block green (2 poles) Reserved for future use	**Protection**	IP20 (IEC60529)
		LED Indicators	10 x Onboard LED indicators 2 x Run (Power)/Error 2 x Ethernet Link/Speed 2 x Port A TX/RX 2 x Port B TX/RX 1 x Button A indicator 1 x Button B indicator
Switch A **(SWA)**	1 x DIP-Switch for PORT A configuration: Reserved for future use		
PORT B	1 x Serial EIA232 (SUB-D9 male connector) Pinout from a DTE device 1500VDC isolation from other ports (except PORT B: EIA485) 1 x Serial EIA485 Plug-in screw terminal block (3 poles) A, B, SGND (Reference ground or shield) 1500VDC isolation from other ports *(except PORT B: EIA232)*		
Switch B **(SWB)**	1 x DIP-Switch for serial EIA485 configuration: Position 1: **ON:** 120 Ω termination active **Off:** 120 Ω termination inactive Position 2-3: **ON:** Polarization active **Off:** Polarization inactive		

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7   Dimensions

56 mm (h)

88 mm (w)   90 mm (d)

Recommended available space for its installation into a cabinet (wall or DIN rail mounting), with space enough for external connections.

100 mm (h)

100 mm (w)   130 mm (d)