IntesisBox® Modbus Server

LON

User Manual

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Gateway for integration of LON systems into Modbus (RTU and TCP) systems.

Typical application:

Integration of **Daikin VRV** Air Conditioners into a Modbus enabled system (SCADA, BMS, PLC…).

The following models are available for this gateway, with the following **order codes**:

IBOX-MBS-LON-100
Basic model supporting connection up to 64 LON devices and 100 internal datapoints.

IBOX-MBS-LON-A
Basic model supporting connection up to 64 LON devices and 500 internal datapoints.

IBOX-MBS-LON-B
Extended model supporting connection up to 128 LON devices and 3000 internal datapoints.

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1. Description

1.1 Introduction

This document describes the integration of Modbus enabled systems with LON compatible protocol devices or systems using the gateway *IntesisBox®-Modbus Server LON*.

This document assumes that the user is familiar with Modbus and LON technology and technical terms.

From now on, and with the aim of easy the read of this document, the abbreviation "IntesisBox" is used instead of the full name IntesisBox®-Modbus Server LON.

The aim of this integration is to make accessible signals and resources of any LON based system from a system capable of "talking" Modbus protocol.

IntesisBox allows integrating LON devices, into a supervision/control/automation system "talking" Modbus (PLC, SCADA, Controller…), and in general into any device or system with a Modbus master (TCP or RTU) interface.

For this, IntesisBox acts as a LON device in its LON interface, reading/writing points of other LON device(s), and offering these point's values of other LON device(s) through its Modbus interface. The readings into the LON device(s) performed by IntesisBox are by continuous polling.

1.2 Functionality

Every one of the defined signals into IntesisBox is associated to a Modbus register address, with this, all the system is seen as a single Modbus slave unit from the Modbus system point of view.
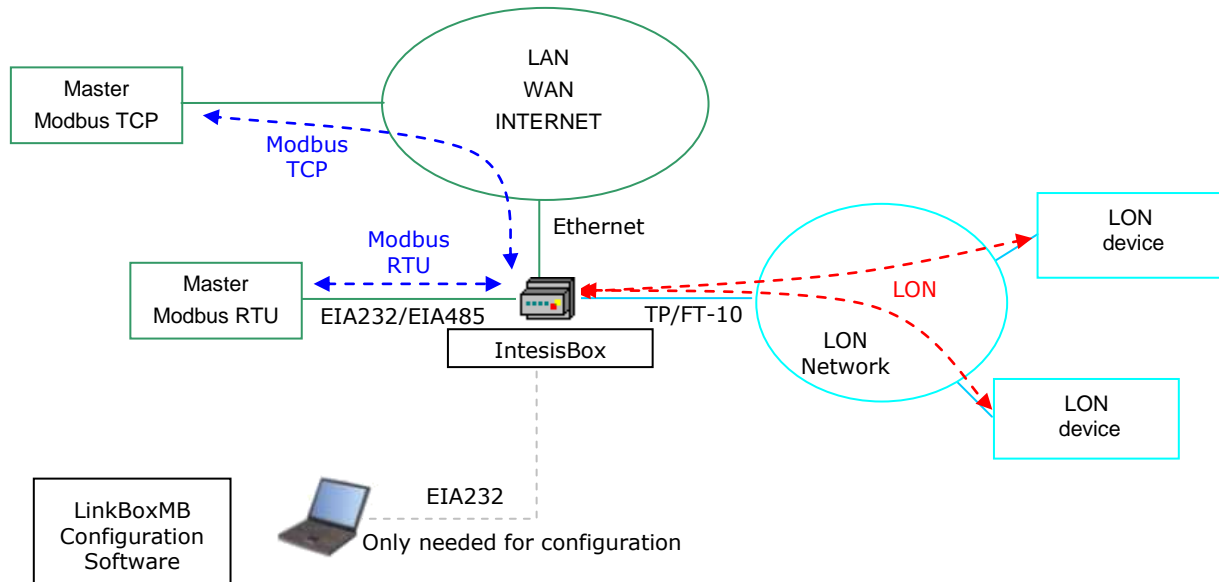
Integration of LON and Modbus using *IntesisBox Modbus Server - LON* gateway

The integration operation is as follow:

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

IntesisBox is a LON client device, this means that no LON points of IntesisBox can be accessed from other LON devices connected to the LON network (no bindings are allowed by IntesisBox), IntesisBox just offer in its Modbus interface a mirror of those remote LON device's points declared into it.

Every one of the mentioned points of the LON devices is associated to a *Modbus register address*, with this, all the LON system is seen as one single Modbus slave device.

When a change in any point (of type output or input/output) in the LON device is detected during the polling process, the new value received will be available from Modbus interface.

When a write is received from the Modbus master, of a Modbus register address associated to a LON point, a message is sent immediately to the corresponding LON device to perform the corresponding action.

From the Modbus system point of view, after the start up process, IntesisBox listen for any read or write request received from Modbus master. If it is a read request, IntesisBox serves the updated point's values in its memory. If it is a write request, it performs the writing of the remote LON device's point associated immediately.

1.3 Capacity of IntesisBox

Element	Tiny	Basic version	Extended version	Notes
Type of LON devices				Those supporting *Free Topology* channel (FT-10)
Number of Datapoints	100	500	3000	Maximum number of points (Modbus registers) that can be defined into IntesisBox. Each of them can contain an individual field from a LON network variable.
Supported number of LON devices	64	64	128	Maximum number of different LON devices that can be defined into IntesisBox (to read/write points into them).

There are two different models of *IntesisBox® Modbus Server - LON* with different capacity each one of them:

- Tiny, allowing integration of 100 points and up to 64 LON devices.
  Ref.: IBOX-MBS-LON-100

- Basic, allowing integration of 500 points and up to 64 LON devices.
  Ref.: IBOX-MBS-LON-A

- Extended, allowing integration of 3000 points and up to 128 LON devices.
  Ref.: IBOX-MBS-LON-B

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1.4   Typical applications

One very typical application of IntesisBox is the integration of Daikin VRV Air Conditioners into a Modbus enabled system (BMS, PLC, SCADA, Controller…). For this application, Daikin VRV system must be equipped with Daikin LON gateway (model DMS504B51), this Daikin gateway is normally commissioned by Daikin technical personnel, contact your nearest Daikin distributor for details.

If you are interested in this application consult ANNEXES section for more details about the configuration of IntesisBox for this application. You can also contact Intesis Software to obtain sample projects for IntesisBox, these sample projects contain specific signal tables for Daikin VRV system, with these sample projects the configuration of IntesisBox for this application becomes easy and quick, almost plug & play.

2. Modbus interface of IntesisBox

This section describes the Modbus part of the IntesisBox configuration and functionality. This section assumes the user is familiar with Modbus technology and technical terms.

2.1 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 port or the EIA485 port (if using Modbus RTU). To access the points and resources of the IntesisBox from a Modbus master device, you must specify as the Modbus register addresses, those configured inside IntesisBox corresponding to LON points. See details below in this document.

It can only be one Modbus Mode active simultaneously in IntesisBox, Modbus RTU or Modbus TCP.

2.2 Functions supported

This part is common for Modbus RTU and TCP.

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

The Modbus registers can be of 2 bytes (16 bits) or of 4 bytes (32 bits).
- For 2 bytes (16 bits) registers, its content is expressed always in MSB..LSB.
- For 4 bytes (32 bits) registers, its content (the way IntesisBox handles the byte order) can be one of 3 different options, configurable, see details below in this document (this is necessary because different Modbus master systems handle differently byte order of 32 bits registers).

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

2.3 Modbus RTU

Baud rate can be selected from 1200, 2400, 4800, 9600, 19200, 38400 and 56700. (Data Bits: 8, parity: none, Stop Bits: 1).

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).

2.4 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.

2.5 Address Map

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

2.6 Points definition

Every point defined in IntesisBox has the following Modbus features associated to it, that can be configured (optionally or mandatory depending on the feature):

Feature	Description
Format (Data coding) *	Data type to encode the signal's value. It will depend on the LON type of signal associated to it in every case. Possible values are: 16 bits unsigned, 16 bits signed, 16 bits signed * 10, 32 bits unsigned, 32 bits signed, 32 bits float.
Point *	It's the Modbus register address for the point.
R/W *	Type of signal. Always from the Modbus system point of view. Possible values are: R (read only signal), R/W (read/write signal).

* Configuration for this feature is mandatory.

3. LON interface

This section describes the LON part of the IntesisBox configuration and functionality. This section assumes the user is familiar with LON technology and technical terms.

3.1 Description

The LON systems are composed of devices connected to a network, the media and topology of the bus used to interconnect the different devices in the network can be of some different types, even devices connected to different media can coexist and communicate between them in the same LON network by the use of media converters (switches, routers…).

IntesisBox LON interface is compatible with *twisted pair free topology channel* (TP/FT-10) media, nowadays the most widely used media due to its robustness and the different topologies that can be used and mixed together.

All LON devices offer their internal datapoints (of input and output type) in the form of standardized data objects called *Standard Network Variable Types* (SNVTs), which assures total interoperability between LON devices. More specific data types used basically for configuration purposes of the LON devices are also defined by the standard (SCPTs), and even user defined data types (UNVT) can be implemented and used by any manufacturer in a LON device.

All the mentioned data types are also supported by IntesisBox.

Standard Network Variable Types (SNVTs) are named by convention with a prefix that indicates if it is an input variable (prefix *nvi*) or an output variable (prefix *nvo*).

A SNVT can be composed of one or more data fields, for example, one of the most used SNVTs is the type *switching*, this SNVT has two data fields: *value*, and *state*.

Many devices use this SNVT *switching* for basic ON/OFF operations, and for the device to accept a given operation (ON or OFF) you must write specific values in the field *state* but also in the field *value* at the same time. For example, when communicating with the Daikin LON interface DMS504B51, to switch ON the AC indoor unit number 1, you have to use the variable *nviOnOff_01* (of type switching), and the values to write in both fields can be the following:

Operation	Value	State
ON	1 - 255	1
OFF	0	1
OFF	Any (0 - 255)	0

Note that you must write into both fields of the variable to accomplish both operations, ON and OFF. This can be a great inconvenience to be done from systems like Modbus in which just an object of type switching (one single value is sent) is used for this kind of operations.

To solve this, special SNVT with filters have been incorporated to IntesisBox, using these special SNVTs with filters you can write into more than one field of the LON variable when you write just a single value from Modbus. See below an example of use of a special SNVT with filter called *SNVT_switch_filter_0_1* linked to the mentioned above variable *nviOnOff_01* of Daikin.

Operation	Modbus	SNVT_switch_filter_0_1	nviOnOff_0_1 Value	nviOnOff_0_1 State
OFF	0	0	0	0
ON	1	1	100	1

This way you only have to choose the right special SNVT with filter into the IntesisBox configuration table for this kind of LON variable and associate it to an individual Modbus register address.

See below in this document the list of special SNVTs with filters available in IntesisBox.

3.2 Points definition

Every point defined in IntesisBox has the following LON features associated to it:

Feature	Description
Device	LON device to which belongs the point, from a list of LON devices that can be defined into IntesisBox (up to 128). For each LON device defined, a virtual signal is created automatically in IntesisBox to inform about the communication with the LON device, this signal is available also from the Modbus interface like the rest of the points.
SNVT	SNVT number according to EIA-709 standard.
SNVT Name	SNVT Name, selectable from the list of all available SNVTs defined by EIA-709 standard, and also special SNVTs with filters explained above.
Idx	Index of the network variable inside the LON device.
RW	Indicates if the variable is of type input (W), output (R), or input/output (RW). *Note that an output variable in the LON device must be defined as R, to be read by the IntesisBox. And an input variable as W, to be written by the IntesisBox.*

4. LinkBoxMB. Configuration & monitoring tool for IntesisBox Modbus Server series

4.1 Introduction

LinkBoxMB is a Windows™ compatible software developed specifically to monitor and configure IntesisBox Modbus Server series. It is possible to configure all external protocols available for IntesisBox Modbus Server and to maintain different customer's configurations based on a LinkBoxMB project for every different installation. Maintaining always on hard disk a copy of the last configuration files for every external protocol and customer, that is to say for every project.

From LinkBoxMB, as well as configure the integration signals list and connection parameters for every external protocol, it is permitted to select the serial port to use to connect to IntesisBox and the use of some tools for monitoring and debugging de device. Some of these tools will be explained in this document but only some of them, the rest of available debugging tools and commands will not be explained here because they are for exclusive use under the recommendations of Intesis Software technical support.

LinkBoxMB allows configuring all IntesisBox Modbus Server series independently of the external system used. For every external system, LinkBoxMB has a specific configuration window. Periodically, new free versions of LinkBoxMB are released incorporating the latest developed integrations for external systems.

4.2 Project definition

The first step to do in LinkBoxMB for a new installation is to create the installation project giving a descriptive name to it. When you create a project, a new folder is created with the name of the project containing the configuration files needed depending on the external protocol selected for the project. It is strongly recommended that you create a new project for every installation, if not, overwriting of configuration files of previous installations using the same external protocol may occur, loosing the configuration data for those previous installations. The projects folder is located in AppFolder\ProjectsMB, where AppFolder is the installation folder of LinkBoxMB (by default C:\Program Files\Intesis\LinkBoxMB). Inside the projects folder, a new folder will be created for every project defined in LinkBoxMB with the files needed for the project.

When you open LinkBoxMB, the project selection window will appear inviting you to select a project or create a new one. A demo project for every external protocol supported is provided with the standard installation of LinkBoxMB. You can create a new project or select a demo project based on the external protocol desired, and create a new one from the demo one selected.
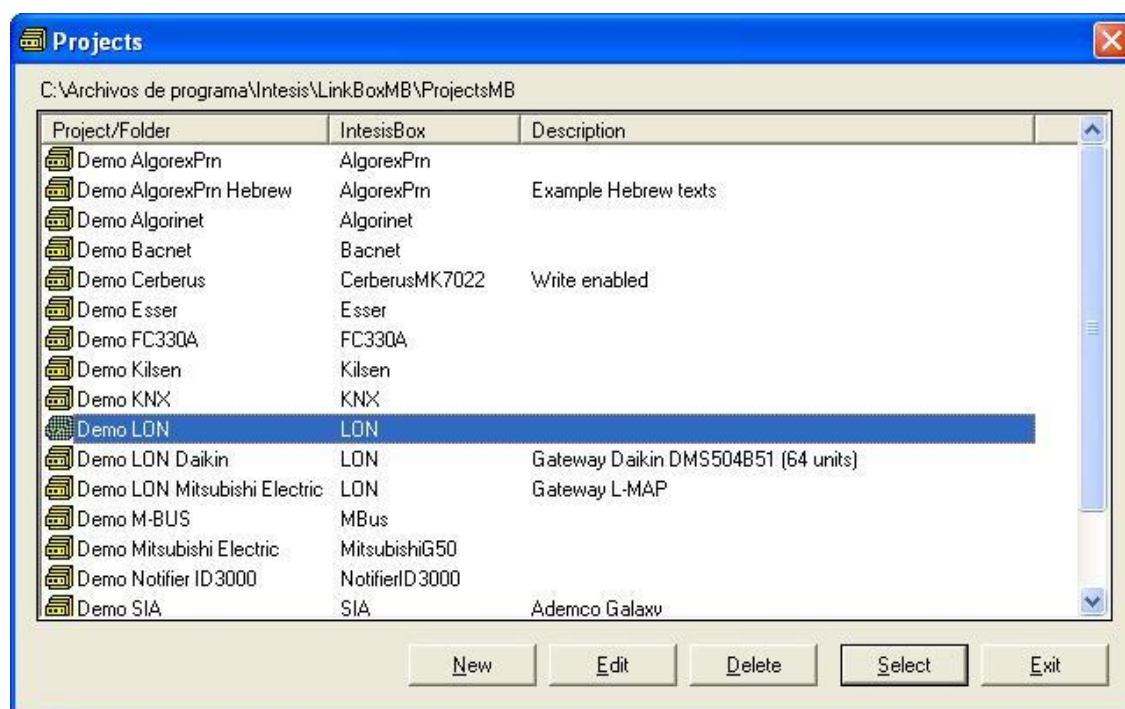

Project selection window

To create a new project, select a project using the same external protocol you want to use in the new project and click on *New* button. You will be prompted to create a copy of the selected project (useful for similar installations) or create a new one.

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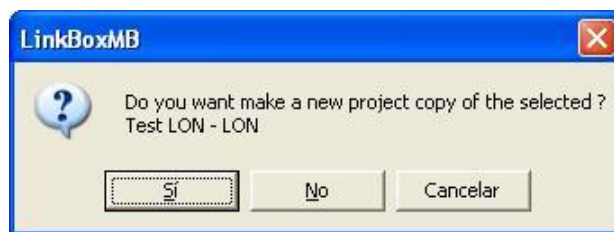
If you select *Yes* you will be prompted to specify a name and a description for the new project that will be based on the same external protocol than the selected one. If you select *No* you can specify a name, a description and an external protocol to use from the list of available external protocols.
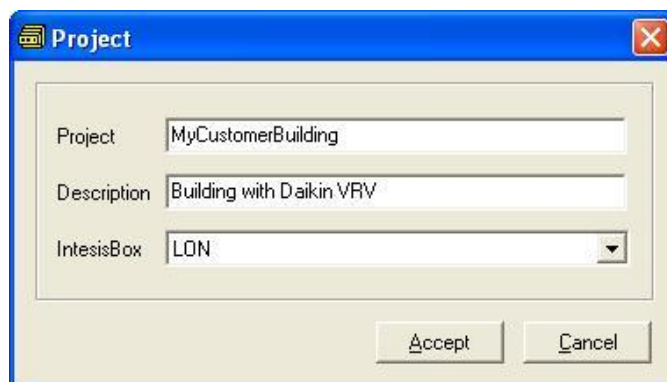
On *Accept*, a new folder will be created inside the projects folder with the name given to the project, this folder will contain the template configuration files if the project is a brand new one, or a copy of the configuration files if it is a copy of a selected one.

A description of the files created for a LON protocol based project can be found in section *Files* in this document.

From all the possibilities of LinkBoxMB, only changes in configuration for the integration and configuration file generation can be performed while disconnected from IntesisBox (working off-line), allowing you to do these tasks in the office more comfortably. Before any monitoring or downloading action to IntesisBox can be performed, the connection between IntesisBox and the PC running LinkBoxMB must be established (working on-line). To do so follow these steps:

1. Make sure IntesisBox is powered-up a correctly connected to the Modbus system via the Ethernet connection (Modbus TCP) or serial connection (Modbus RTU) and to the LON system via the LON Bus connection (consults details for connection and pin assignments in section *Connections* of this document).

2. Connect a free PC serial port to the IntesisBox serial port marked as *PC Console*. (Use the standard serial cable supplied with the device or a customer's cable following the pin assignments specified in section *Connections* in this document).

3. Select in LinkBoxMB the PC serial port used for the connection to IntesisBox. Use menu Configuration -> Connection.

4. Check the checkbox *off-line* under the menu bar (it will change automatically to *on-line*) and LinkBoxMB will ask for INFO about the IntesisBox connected to it via the serial connection, if the connection is ok then IntesisBox will respond with its identification (this can be monitored in the *IntesisBox Communication Console* window, as showed below).
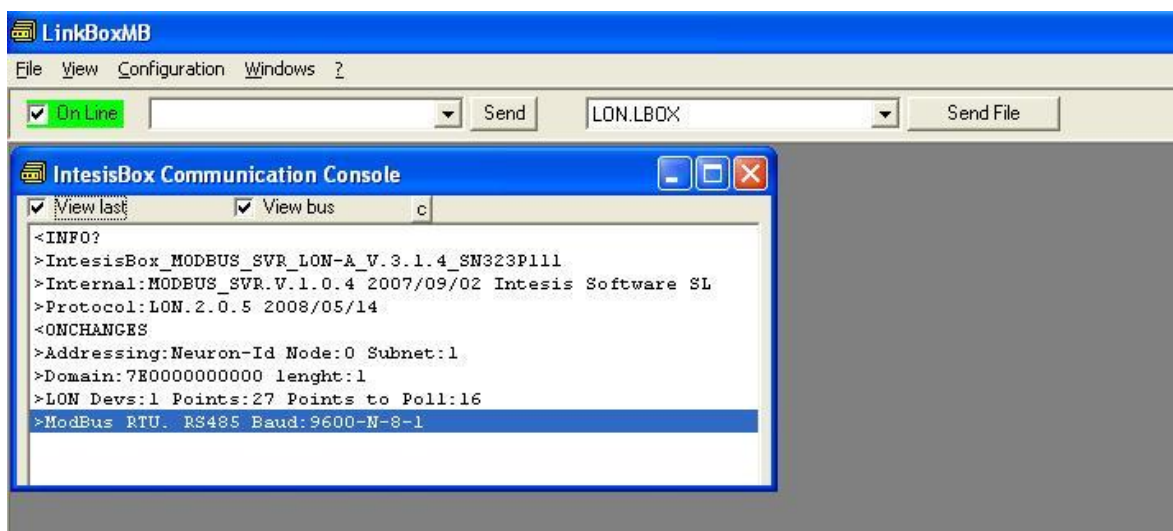
Once connected to IntesisBox, all the options of LinkBoxMB are fully operative.

To monitor the communication between IntesisBox and the Modbus master device, select the menu *View -> Bus -> Modbus*. The *Modbus communication Viewer* window will be opened. This window show in real time all the communication frames between IntesisBox and the Modbus master device as well as debugging messages referent to internal protocol (Modbus) sent by IntesisBox.
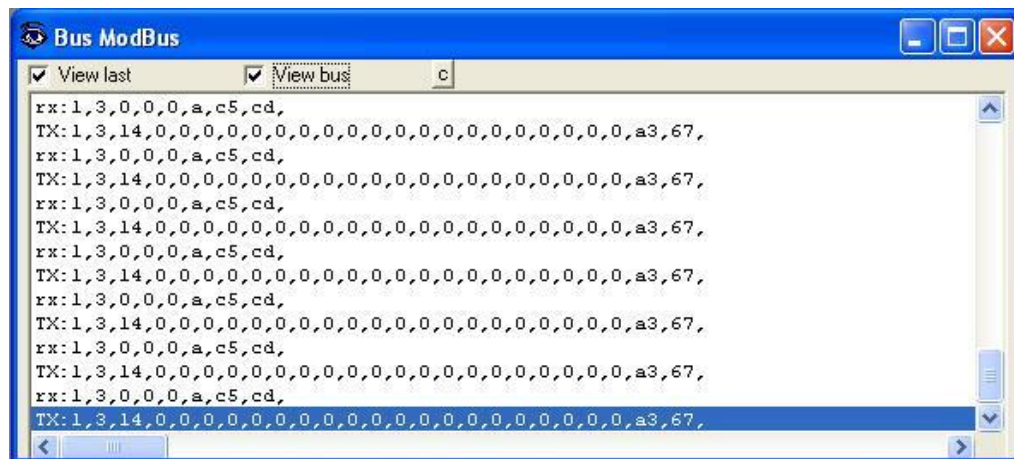
To monitor the communication between IntesisBox and the external system (LON in this case), select the menu *View -> Bus -> LON*. The *External protocol communication viewer* window will be opened. This window show in real time all the communication frames between IntesisBox and LON devices as well as debugging messages referent to external protocol (LON) sent by IntesisBox.
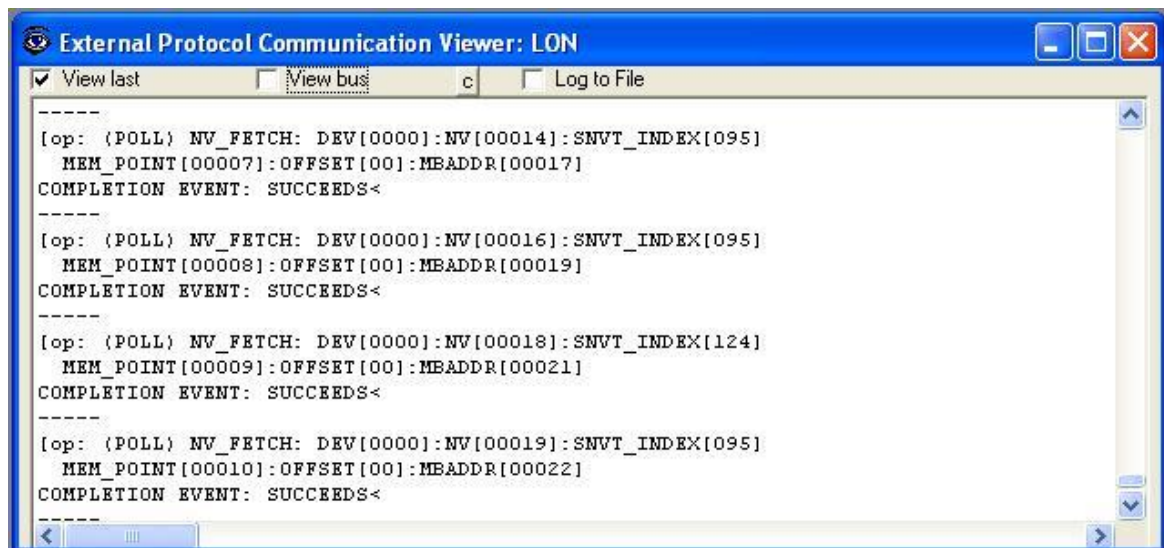
To configure the IntesisBox connection parameters and the signals list, select menu *Configuration -> IntesisBox*. The *LON Configuration* window will be opened.

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4.3 Connections configuration

Select the Connection tab to configure the connection parameters.

Two kinds of information are configured using this window, the parameters of the Modbus interface, and the parameters of the LON interface.

- Modbus side configuration parameters:

Modbus Interface Configuration

1. Select the type of connection desired (TCP or RTU).

If Modbus TCP is selected, then:

2. Enter the IP address for IntesisBox.
3. Enter the IP netmask for IntesisBox.
4. Enter the default router address to use by IntesisBox, leave blank if there is no need of router address.
5. Enter the TCP port to use, by default 502.

If Modbus RTU is selected, then:

6. Select the type of port to use (EIA232 or EIA485).
7. Select the baud rate to use.
8. Enter de parity value.
9. Enter the Modbus slave number for IntesisBox.
10. Byte order of 32 bits registers, it can be one of these three possibilities:

- b3b2b1b0 (H…L).
- b0b1b2b3 (L…H).
- b1b0b3b2.

This has been implemented because Modbus master devices handle 32 bits registers in these three different ways depending on manufacturer and model. If your Modbus master device does not read correctly the 32 bits registers of IntesisBox and you do not know the way byte order is handled, then just try the three possibilities (do not forget to send again the configuration to IntesisBox whenever you change it).

- LON interface configuration parameters:

A. LON interface configuration.

1. Enter the Domain number for IntesisBox into the LON network.

2. Enter the length in bytes of the Domain field.

3. Enter the Subnet number for IntesisBox into the LON network.

4. Enter the Node number for IntesisBox into the LON network.

5. Enter the type of addressing to use by IntesisBox to access the device: Neuron Id or Subnet/Node. If the devices are in an already commissioned LON network, then choose Subnet/Node here and enter the correct Subnet and Node numbers of the devices (this must be supplied by the LON integrator that has commissioned the network). If the devices are not commissioned, then choose Neuron Id here and enter the correct Neuron Id numbers of the devices. IntesisBox has embedded tools to scan and detect Neuron Id numbers of the LON devices connected to the network, and also to declare the devices as commissioned, avoiding this way the need of a commissioning tool like LonMaker. See details of use of these embedded tools below in this document.

6. Device's polling cycle time period.

7. Select the version of IntesisBox used.

   Remember you can identify the version used by the order code printed in the front label of IntesisBox:

   - **IBOX-MBS-LON-100**. Tiny model supporting up to 64 LON devices and 100 points.
   - **IBOX-MBS-LON-A**. Basic model supporting up to 64 LON devices and 500 points.
   - **IBOX-MBS-LON-B**. Extended model supporting up to 128 LON devices and 3000 points.

   You can identify also the model of IntesisBox by its identification given in response to an INFO command, it is something like this:

   IntesisBox_MBS_LON-**100**… -> this is the Tiny model.
   IntesisBox_MBS_LON-**A**… -> this is the basic model.
   IntesisBox_MBS_LON-**B**… -> this is the extended model.

8. If you check this, writing will be done in the LON bus on detect a change of value in the Modbus register writings, in other case writing will be done in LON when every Modbus writing happens.

9. List of LON devices to integrate. Check the devices you want to activate. Select a device to configure its properties.

For every LON device defined, these are the properties that must be entered (depending on selection of parameter 5:

10. Enter the Neuron Id (information on how to get it can be found in section 10.3)

   or

11. Enter the Subnet and Node number of the LON device.

12. Enter the device name (optional, just for identification purposes).

Intesis software

13. Use this button to define the number of LON devices to integrate. Remember the limitations: just 64 devices in IntesisBox basic model, and 128 devices in IntesisBox extended model.

4.4 Signals list

Select the Signals tab to configure the signals list (the IntesisBox internal datapoints).

Signals list
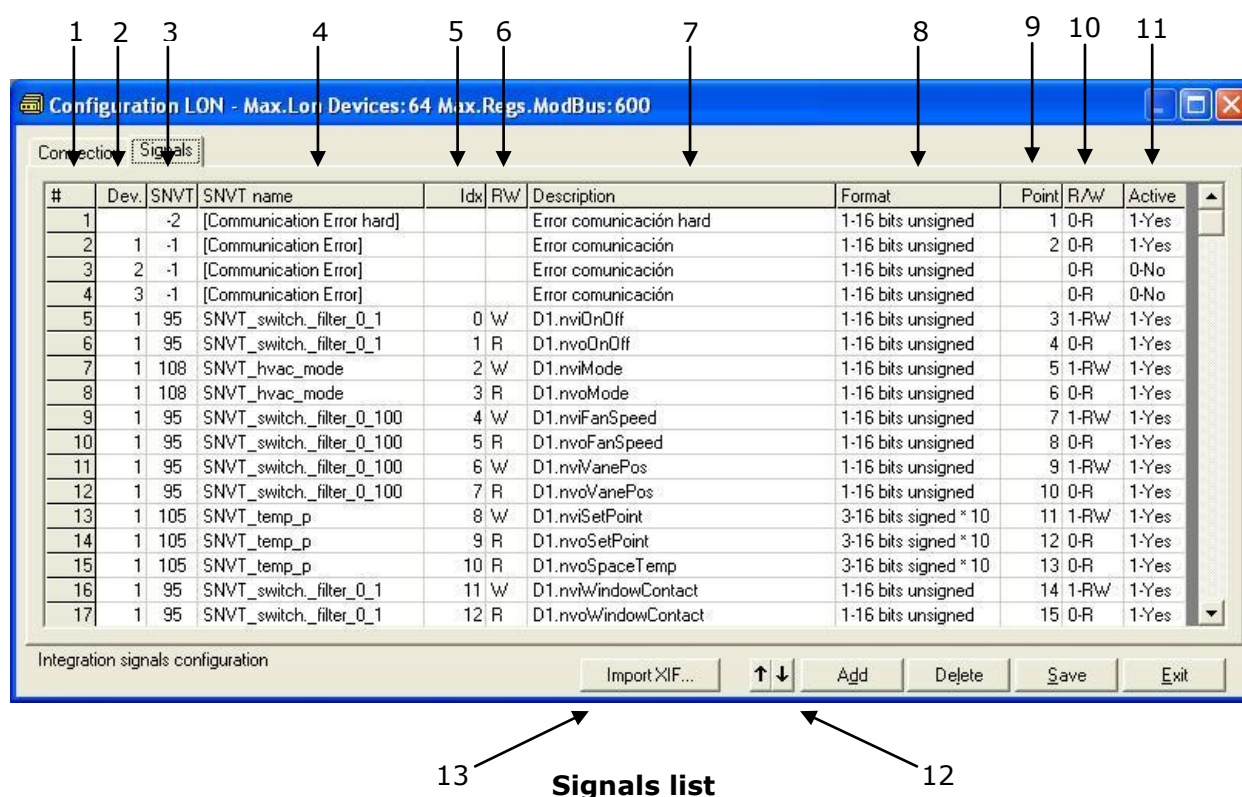
1. *#.* Signal's number (edit not permitted). Every row in the grid corresponds to a signal (point). Signals (rows in the grid) can be added or deleted selecting the desired row and clicking *Add* or *Delete* buttons. Deletion action can be executed for a single row or even for some consecutive rows, all the rows selected will be deleted. This column is used only to enumerate the rows in the grid (signals).

2. *Dev.* device number to which belongs the point. Referenced to the list of devices defined in *Connection Tab*. Note that this is the order number of the device (from top to bottom) in the devices list.

3. *SNVT.* SNVT Id number according to EIA-709 standard. Edit not permitted.

   The *Communication error* virtual signals have always a predefined special SNVT Id numbers -1 and -2.

4. *SNVT Name.* This is the SNVT to select for the point. Select the SNVT desired from a list of all standard SNVTs defined by Lon Mark International and a few special SNVTs with filter (their use explained in section 3.1), open this list by clicking the mouse right button over the column. Consult the documentation of the LON devices to integrate for details of which SNVT is used for every point into the device.

5. *Idx.* This is the index of the variable inside the LON device. Consult the device's documentation to obtain it.

6. *RW.* Indicates if the variable is of type input (W), output (R), or input/output (RW).

   Note that an output variable in the LON device must be defined as R, to be read by the IntesisBox. And an input variable as W, to be written by the IntesisBox.

7. *Description.* Signal's description. Used to describe the signal at user level.

8. *Format*. Modbus data format to encode this signal's value. Edit using the mouse right-button-click menu available on the column, as showed in the figure below, and select one of the possible values.


```
1-16 bits unsigned
2-16 bits signed
3-16 bits signed * 10
5-32 bits unsigned
6-32 bits signed
7-32 bits float
```

9. *Point.* Modbus register address for the point. **Note that every address entered here corresponds to a 16 bits register, if you select a format of 32 bits for the point, then it takes two consecutive addresses in the address map, this means that, for example, if you have one point with address *1* and a format of *32 bits float*, then address *2* can not be used for any other point, the subsequent free address to use will be *3*.**

You can enter directly the address desired individually in every row or auto enumerate for some consecutive rows, for this last proceed as follow.

- Select using the left mouse button (clicking and dragging) the *Point* field of all the rows in the list to which you want to automatically assign addresses (must be consecutive rows).

- Click right mouse button over the selected fields and select *Auto Enumeration* option from the pop-up menu that will appear.
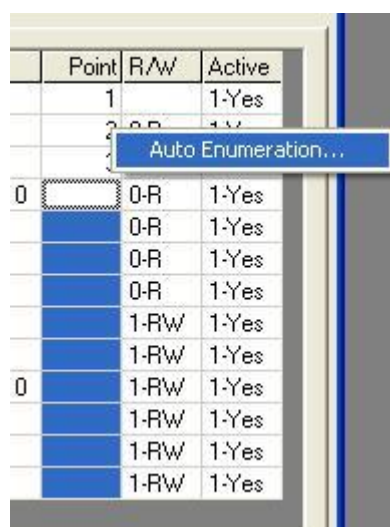
10. *R/W*. Signal type (from the Modbus system point of view). Edit not permitted. Possible values are *R* for read only signals or *R/W* for Read/write signals. This field will be automatically configured by LinkBoxMB according to the LON object type selected for the signal.

11. *Active*. Indicates if the signal is active or not for the integration. Possible values: 0-No, 1-Yes. Edit using the mouse right-button-click menu available on the column.

12. 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. (This can be done also using the key combinations *ALT+arrow up* or *ALT+arrow down* instead of up or down buttons).

13. *Import XIF*. Press this button in order to launch the embedded import tool of XIF files. With this tool, any XIF file of a LON device can be imported, and you will be able to select those variables to integrate, among all the available in the LON device, and import them into the datapoints table with an automatic fulfilment of the needed LON parameters of each datapoint. *Note that an automatic assignment of the most suitable SNVT or filter for each SNVT to import will be done by the tool, but in some cases it requires a manual fine tune after this automatic assignment of filter.*
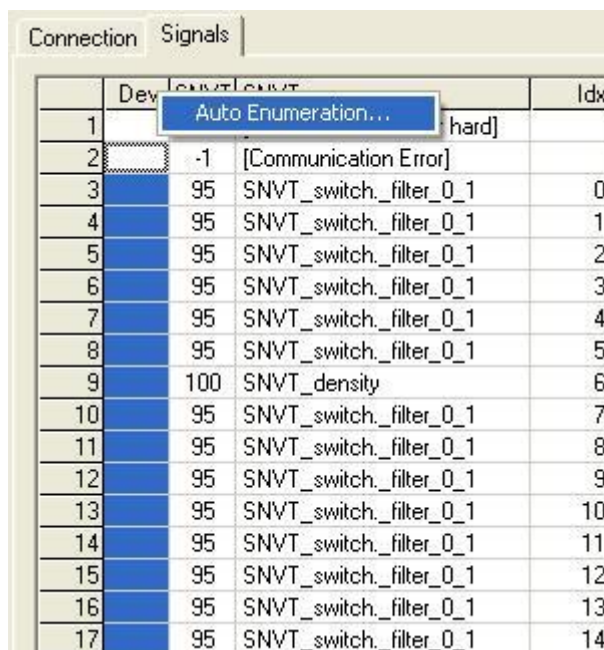
<u>Useful tips for a more quick and comfortable use and configuration of the signals table:</u>

The columns *SNVT Name, RW, Format* and *Active* can be modified selecting one or just more than one consecutive cells in the same column and using the contextual menu appearing with mouse right button click over the cells selected.

The columns *Idx, Description, and Point* can be also modified using mouse-left-button double-click over the desired cell.

In column *Dev* you can enter the desired value individually per cell or you can auto enumerate some consecutive cells, for this last follow these steps:
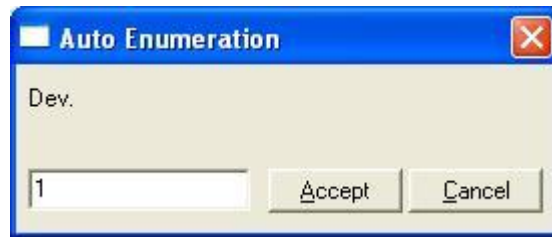
1. Select using the left mouse button (clicking and dragging) the *Dev* field of all the rows in the list to which you want to automatically assign values (must be consecutive rows).

2. Click right mouse button over the selected fields and select *Auto Enumeration* option from the pop-up menu that will appear.

3. Enter the first value to assign.

---

4. Enter the increment between consecutive assignments. For example selecting 0 for the first value and an increment of 1, the values generated will be 0, 1, 2, 3, 4... and so on. To assign the same value to all the rows (useful to assign the same Device number in the column *Dev* for some consecutive rows) just select the desired value and an increment of 0.

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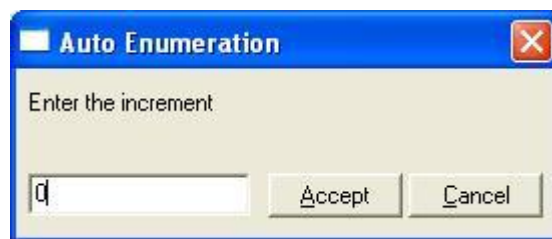
4.5 Sending the configuration to IntesisBox

When the configuration has been saved (button *Accept*) and the IntesisBox configuration binary file has been generated (remember to select yes when asked if you want to generate the IntesisBox file).
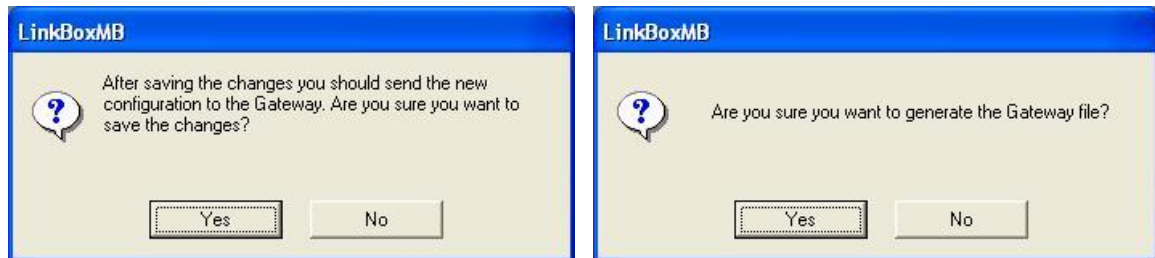
To save the configuration

After this, to send the configuration file to IntesisBox click on the button **Send File**. The process of file transmission can be monitored in the *IntesisBox Communication Console* window. If the file transmission is ok, IntesisBox will reboot automatically with the new configuration loaded.
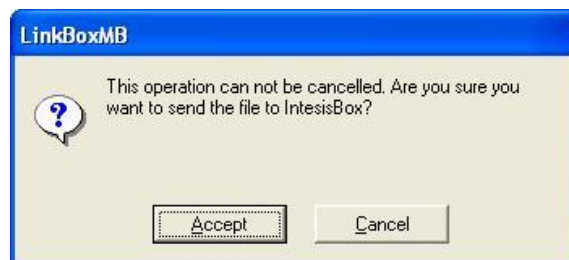
To send the file to IntesisBox

Remember that saving the configuration and generating the IntesisBox file only saves to the hard disk on the PC the configuration files. **Do not forget to send the configuration file to the IntesisBox using button *Send File.***

4.6 Signals viewer

Once IntesisBox is running with the correct configuration, to supervise the status of the configured signals, select menu *View -> Signals*. The Signals Viewer window will be opened. This window shows all the active IntesisBox signals with its main configuration parameters and its real time value in the column Value. After a reset of IntesisBox or after sending a configuration file to the IntesisBox, all the signal's values will be updated automatically in the signals viewer, in case you connect to the IntesisBox when it is already running, you should press the *Update* button to get updated values, press just once the button to update all the signals values, since that moment the signal values will be maintained updated until the connection is closed.

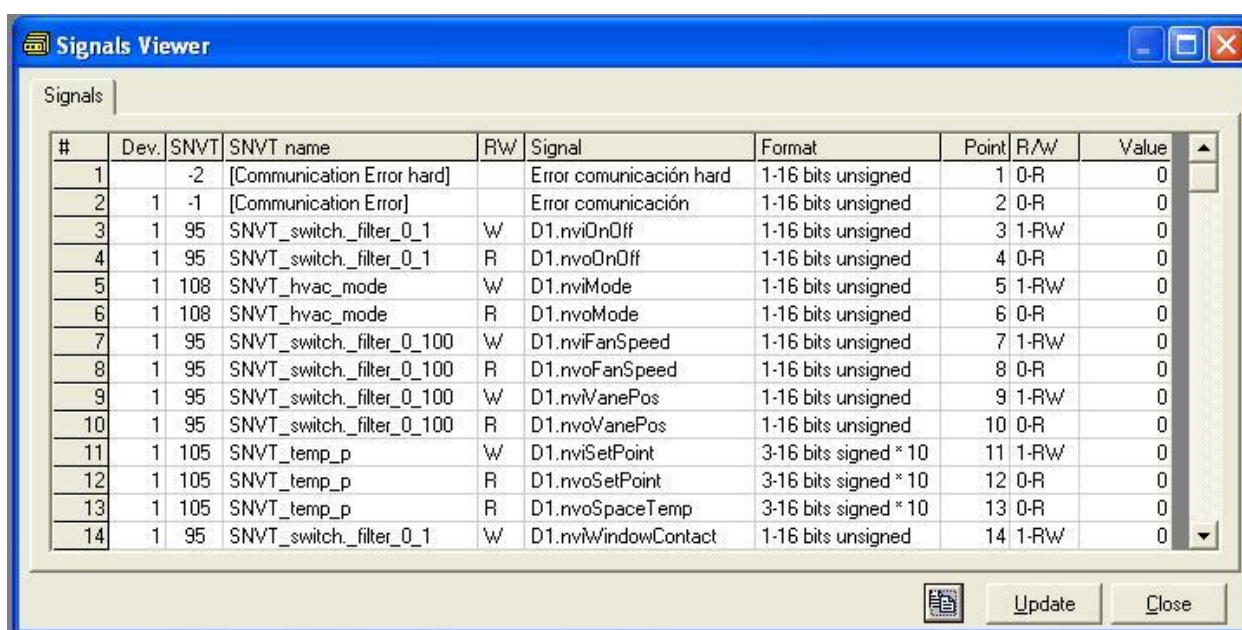| #	Dev.	SNVT	SNVT name	RW	Signal	Format	Point	R/W	Value
1		-2	[Communication Error hard]		Error comunicación hard	1-16 bits unsigned	1	0-R	0
2	1	-1	[Communication Error]		Error comunicación	1-16 bits unsigned	2	0-R	0
3	1	95	SNVT_switch._filter_0_1	W	D1.nviOnOff	1-16 bits unsigned	3	1-RW	0
4	1	95	SNVT_switch._filter_0_1	R	D1.nvoOnOff	1-16 bits unsigned	4	0-R	0
5	1	108	SNVT_hvac_mode	W	D1.nviMode	1-16 bits unsigned	5	1-RW	0
6	1	108	SNVT_hvac_mode	R	D1.nvoMode	1-16 bits unsigned	6	0-R	0
7	1	95	SNVT_switch._filter_0_100	W	D1.nviFanSpeed	1-16 bits unsigned	7	1-RW	0
8	1	95	SNVT_switch._filter_0_100	R	D1.nvoFanSpeed	1-16 bits unsigned	8	0-R	0
9	1	95	SNVT_switch._filter_0_100	W	D1.nviVanePos	1-16 bits unsigned	9	1-RW	0
10	1	95	SNVT_switch._filter_0_100	R	D1.nvoVanePos	1-16 bits unsigned	10	0-R	0
11	1	105	SNVT_temp_p	W	D1.nviSetPoint	3-16 bits signed * 10	11	1-RW	0
12	1	105	SNVT_temp_p	R	D1.nvoSetPoint	3-16 bits signed * 10	12	0-R	0
13	1	105	SNVT_temp_p	R	D1.nvoSpaceTemp	3-16 bits signed * 10	13	0-R	0
14	1	95	SNVT_switch._filter_0_1	W	D1.nviWindowContact	1-16 bits unsigned	14	1-RW	0

The signals viewer can be used although only one system is connected to the IntesisBox, *Modbus* or LON, and is very useful for supervision and test.

It is possible to force a specific value to any signal for test purposes, to do so just double click on the row and select the desired value and Accept in the Data Test window. If the signal is of type R or RW, then the value entered will be available to be read from Modbus master device, if the signal is of type RW, then the value entered will be sent to the LON system.
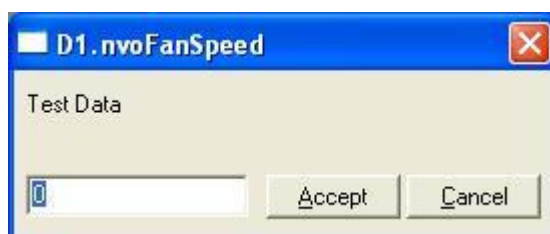
This tool is very useful to test any of the systems connected to IntesisBox, *Modbus* and LON without the need to actuate on the real signals.

The signals viewer window has a button to copy to the Windows Clipboard all the contents of the window (in tab separated text format).

URL	http://www.intesis.com
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4.7 System commands

LinkBoxMB includes an option to send to IntesisBox a set of system commands for debugging and control purposes; this list is available in the commands list as shown in the figure below. To send a command to IntesisBox just select it from the list, or type it with the correct format, and press *Enter* or click on button *Send*. IntesisBox will act accordingly with the command received; the process can be monitored in the IntesisBox Communication Console window. The use of some of these commands can be critical for IntesisBox normal functioning, having this in mind use only these commands following the recommendations of Intesis Software technical support. A list of the more commonly used commands and the way to use them will be returned by IntesisBox after sending the HELP command.

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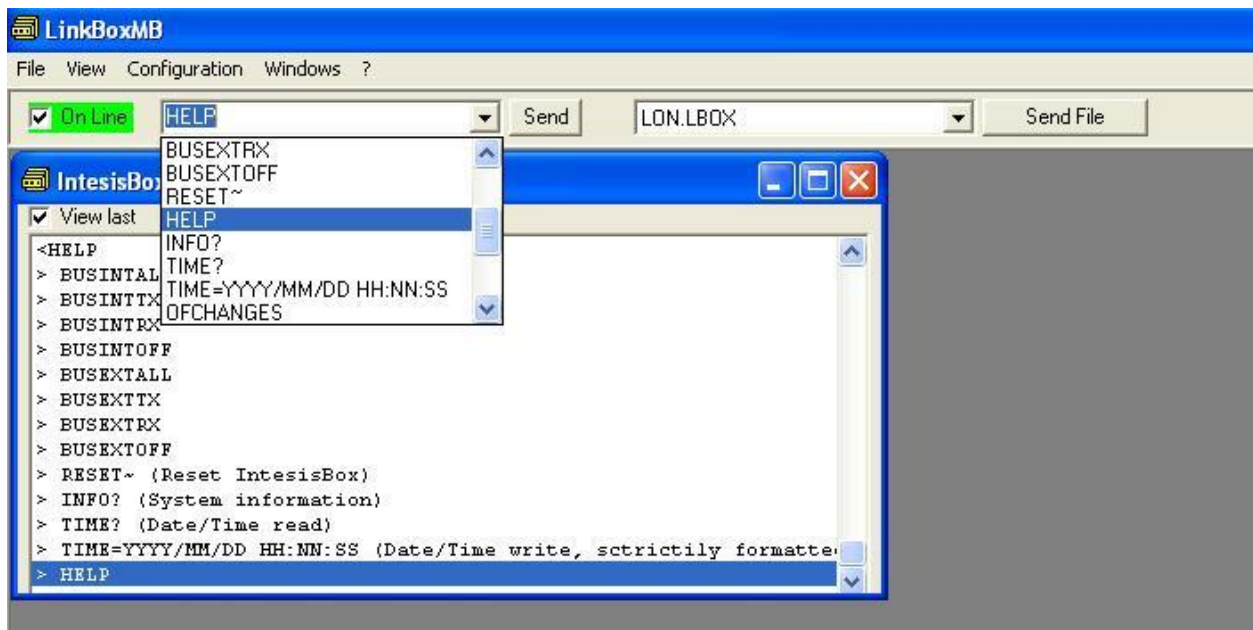
4.8   Files

LinkBoxMB saves the integration configuration in the following files inside the project folder:

PROJECT.INI	.ini file containing general information referent to the project
LON.INI	.ini file containing the information referent to the connection window and other special adjustments
LON.DAT	Text file (tab separated values) with the signals information (signals list). This file can be edited (with Excel for example) to change the configuration quicker and easier. Later on, when selecting *Configuration -> IntesisBox* in LinkBoxMB, if the changes have been made respecting the correct format, all the changes in the configuration done from Excel can be seen in the signals list.
LON.SNVT	File containing the SNVTs used in the project, the standard and the specific ones.
LON.LBOX	Binary file created from the information in the files described above. This is the file uploaded to the gateway.

It is strongly recommended to back up the project folder containing these files in external media, once the installation process is finished. This way you will be able to do future configuration changes in case of reinstallation of LinkBoxMB due, for example, to a failure of the hard disk in the PC where it was previously installed.

The configuration cannot be downloaded from the gateway to LinkBoxMB, only can be uploaded; the upload file LON.LBOX does not contain all the integration information, as for example the signals description.

4.9   Functionality considerations

IntesisBox returns some useful information about internal parameters in response to an INFO command:

> Referent to IntesisBox:
> - Firmware version and serial number.
> - Protocols versions.
> - IP address configured.
> - Net Mask configured.
> - Default Gateway configured.
>
> Referent to Modbus TCP:
> - Port configured.
>
> Referent to Modbus RTU:
> - Connection type.
> - Serial port settings.

* See *Release notes* of the latest firmware version for up to date information on IntesisBox Modbus Server - LON gateway and LinkBoxMB functionality.

5. Setup process and troubleshooting

5.1   Pre-requisites

It is necessary to have the Modbus master device operative and well connected to the Modbus port of IntesisBox, remember to respect the maximum of 15 meters cable distance if using EIA232 communication.

It is necessary to have the LON device or network operative and ready to be connected to the LON port of IntesisBox.

Connectors, connection cables, PC for LinkBoxMB, and other auxiliary material, if needed, are not supplied by Intesis Software for this standard integration. The items supplied by Intesis Software for this integration are:

- IntesisBox Modbus Server device with LON external protocol firmware loaded.
- LinkBoxMB software to configure IntesisBox.
- Console cable needed to download the configuration to IntesisBox.
- Product documentation.

If requested, Intesis Software also can supply:
- Standard plug-in powers supply 220Vac 50Hz to power IntesisBox (European plug type).

5.2   Setup procedure

1. Install LinkBoxMB on your laptop, use the setup program supplied for this and follow the instructions given by the Installation wizard.

2. Install IntesisBox in the desired installation site. The mounting 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 communication cable coming from the Modbus master device to the port marked as **Modbus** of IntesisBox (used EIA232, EIA485 or Ethernet port depending on the type of Modbus communication to use). (See details for this communication cable in section *Connections* of this document).

4. Connect the LON bus cable coming from the LON network to the port marked as **LON** of IntesisBox. (See details for this communication cable in section *Connections* of this document).

5. Power up IntesisBox. The supply voltage can be 9 to 30 Vdc or just 24 Vac. You can use also the standard plug-in power supply 220/125VAC-12VDC/300mA supplied with the device (if requested). If not, a power supply with a NEC Class 2 or Limited Power Source (LPS) and SELV rated is to be used. 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**.

Intesis software

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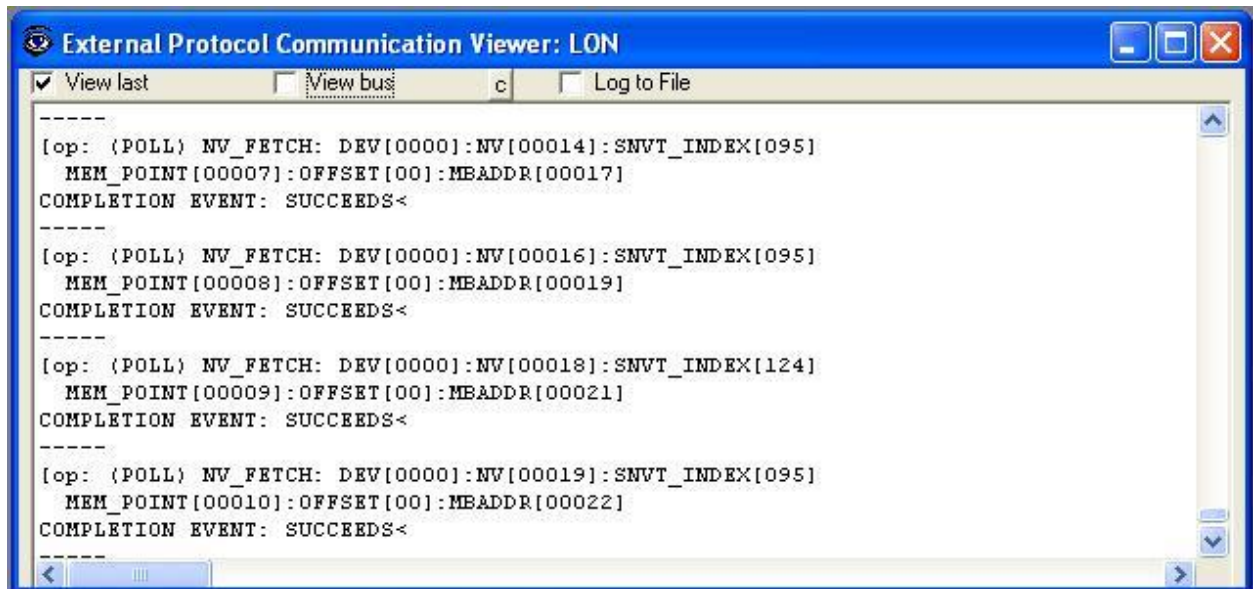Email | info@intesis.com
tel | +34 938047134

- The use of AC power supplies only if they are floating and not powering any other device.

6. Connect the communication cable coming from the serial port of your laptop PC to the port marked as **PC Console** of IntesisBox. (See details for this communication cable in section *Connections* of this document).

7. Open LinkBoxMB, create a new project selecting a copy of the one named **DEMO LON** and give it the name desired, select the serial port used to connect to IntesisBox (menu Configuration -> Connection) and switch working mode to *on-line* (checkbox *off-line/on-line*). The IntesisBox identification must appear in the *IntesisBox communication console* window as showed below.
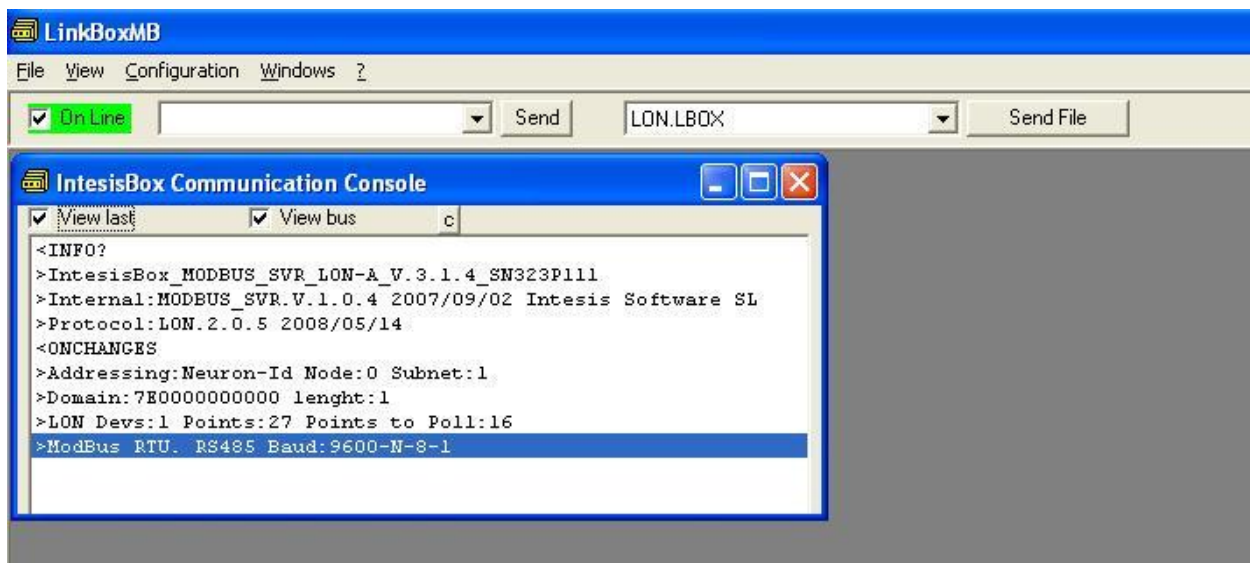
8. Modify the configuration as desired, save it and download the configuration file to IntesisBox as explained before.

9. Open the *Modbus Communication Viewer* window (menu View -> Bus -> Modbus) and check that there is communication activity, some TX frames and some other rx frames. This means that the communication with the Modbus master device is ok. In case there is no communication activity between IntesisBox and the Modbus master device check that it is operative, check the baud rate, and check also the communication cable used to connect both devices. (See details for this communication cable in section *Connections* of this document).
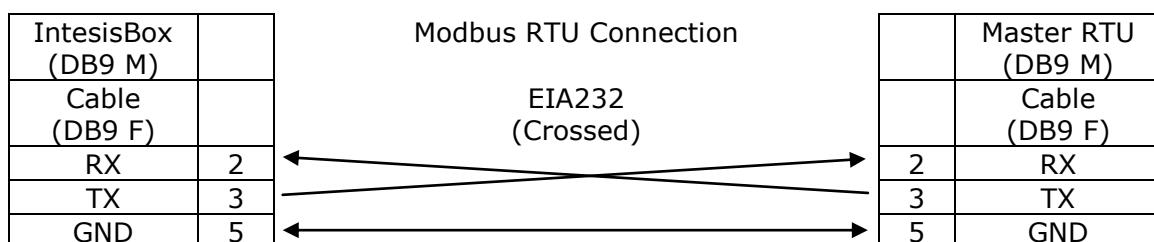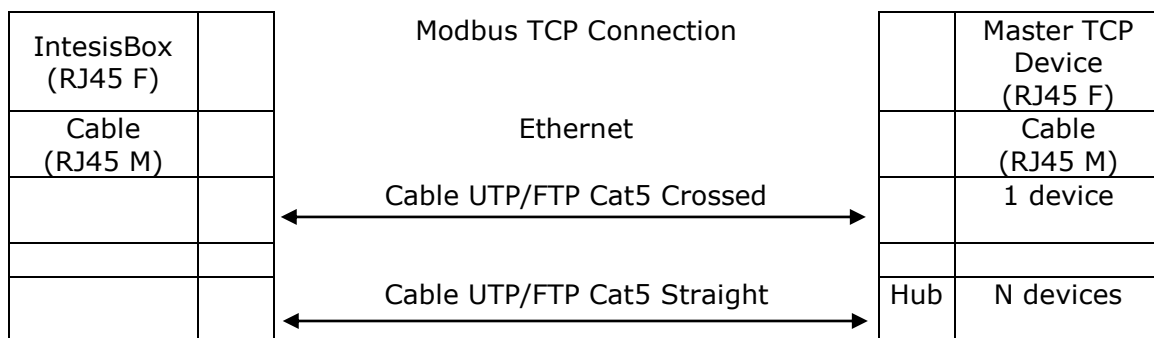
URL | http://www.intesis.com
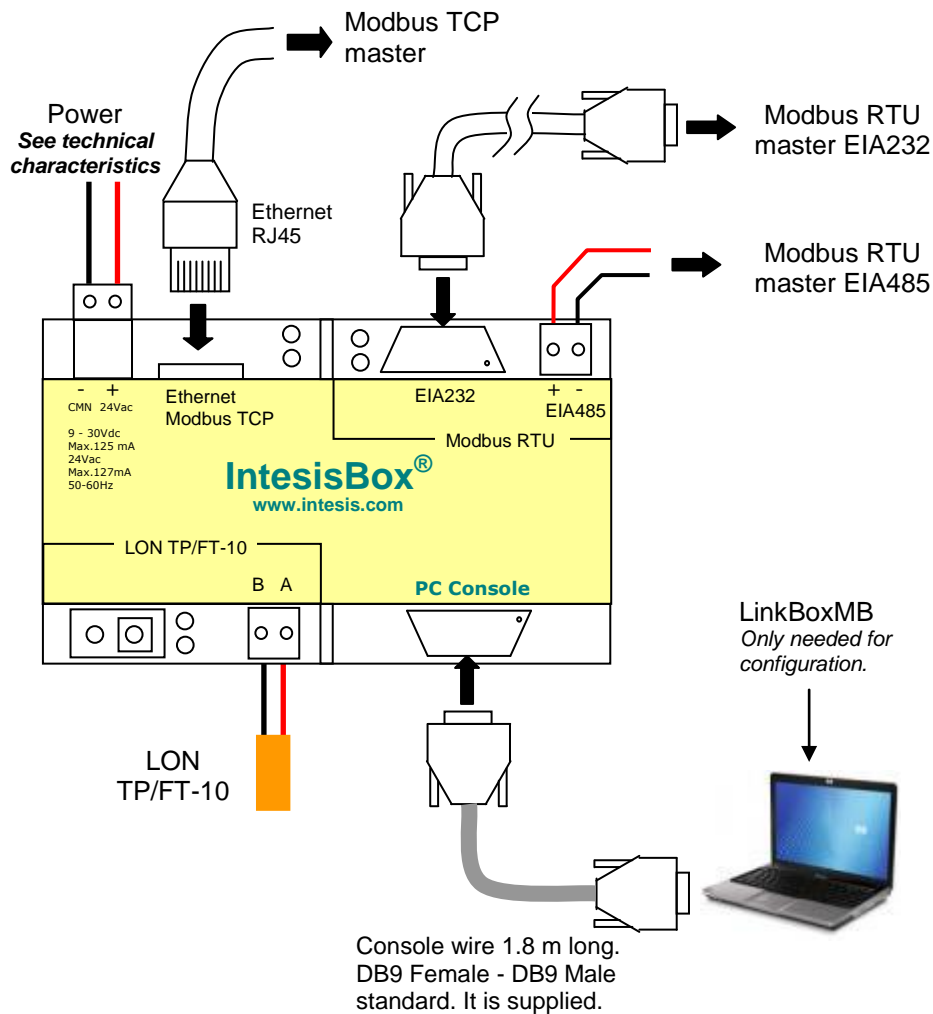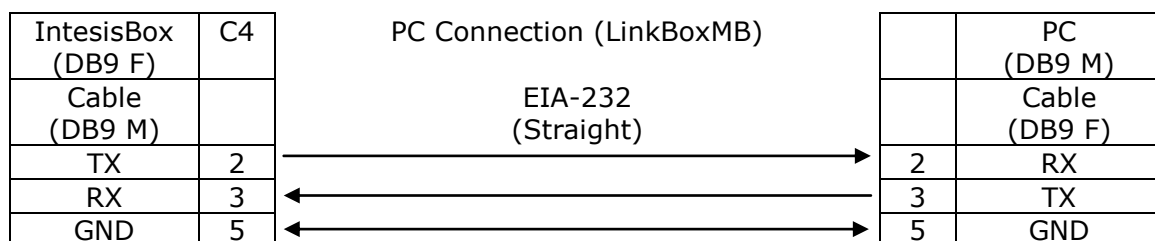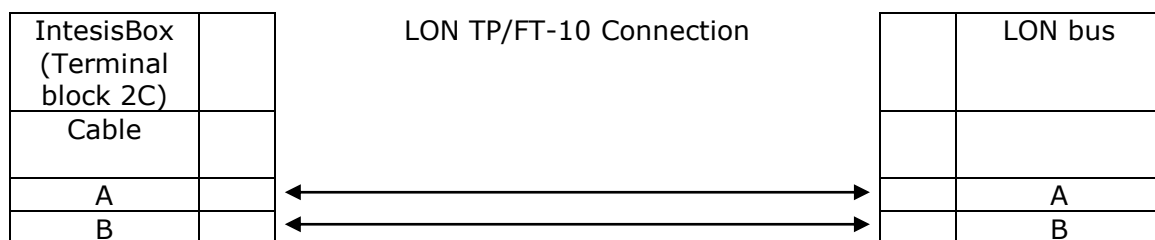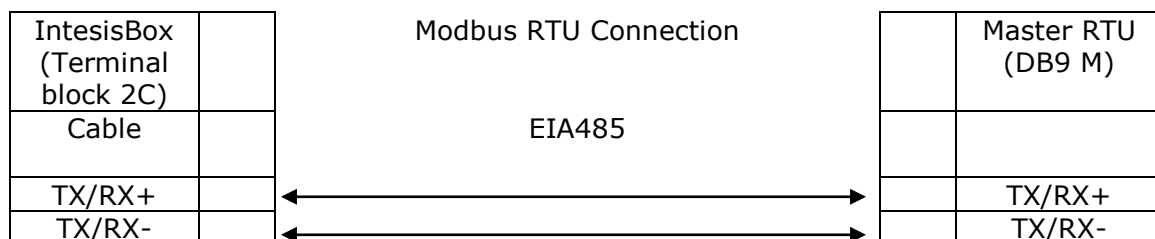Email | info@intesis.com
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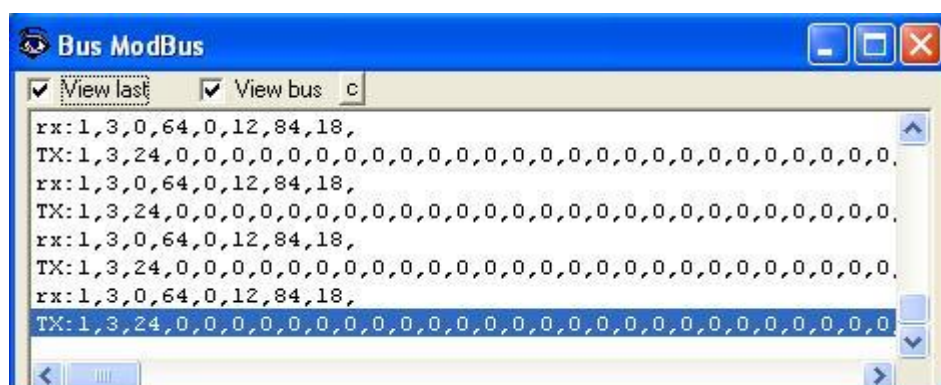
10. Open the *External Protocol Communication Viewer* window (menu View -> Bus -> LON) and check that there is communication activity, some frames as showed in the figure below. This means that the communication with the LON devices is ok.


```
External Protocol Communication Viewer: LON
☑ View last        ☐ View bus        c    ☐ Log to File

-----
[op: (POLL) NV_FETCH: DEV[0000]:NV[00014]:SNVT_INDEX[095]
  MEM_POINT[00007]:OFFSET[00]:MBADDR[00017]
COMPLETION EVENT: SUCCEEDS<
-----
[op: (POLL) NV_FETCH: DEV[0000]:NV[00016]:SNVT_INDEX[095]
  MEM_POINT[00008]:OFFSET[00]:MBADDR[00019]
COMPLETION EVENT: SUCCEEDS<
-----
[op: (POLL) NV_FETCH: DEV[0000]:NV[00018]:SNVT_INDEX[124]
  MEM_POINT[00009]:OFFSET[00]:MBADDR[00021]
COMPLETION EVENT: SUCCEEDS<
-----
[op: (POLL) NV_FETCH: DEV[0000]:NV[00019]:SNVT_INDEX[095]
  MEM_POINT[00010]:OFFSET[00]:MBADDR[00022]
COMPLETION EVENT: SUCCEEDS<
-----
```

In case there is no response from the LON devices to the frames sent by IntesisBox check that they are operative and reachable from the network connection used by IntesisBox, check the IntesisBox LON interface using any commercial LON browser connected to the same Ethernet network. See details for the communication cable between IntesisBox and LON system in section *Connections* of this document.

6. Connections

IntesisBox (RJ45 F)		Modbus TCP Connection		Master TCP Device (RJ45 F)
Cable (RJ45 M)		Ethernet		Cable (RJ45 M)
		Cable UTP/FTP Cat5 Crossed		1 device
		Cable UTP/FTP Cat5 Straight	Hub	N devices

IntesisBox (DB9 M)		Modbus RTU Connection			Master RTU (DB9 M)
Cable (DB9 F)		EIA232 (Crossed)			Cable (DB9 F)
RX	2			2	RX
TX	3			3	TX
GND	5			5	GND

IntesisBox (Terminal block 2C)		Modbus RTU Connection	Master RTU (DB9 M)	
Cable		EIA485		
TX/RX+		⟵————————⟶	TX/RX+	
TX/RX-		⟵————————⟶	TX/RX-	

IntesisBox (Terminal block 2C)		LON TP/FT-10 Connection	LON bus	
Cable				
A		⟵————————⟶	A	
B		⟵————————⟶	B	

IntesisBox (DB9 F)	C4	PC Connection (LinkBoxMB)		PC (DB9 M)
Cable (DB9 M)		EIA-232 (Straight)		Cable (DB9 F)
TX	2	————————⟶	2	RX
RX	3	⟵————————	3	TX
GND	5	⟵————————⟶	5	GND

7. LON interface specifications

LON supported channel: Free Topology (FT-10)

Configurable addressing options (on a 'per device' basis):
- Subnet / node
- Neuron-Id

Network variable sample rate:
- Below 60ms per network variable (each network variable may contain several fields, which will be mapped to different Modbus registers, if needed).

Supported network variable types:
- All standard network variable types published by LonMark International are directly supported by configuration tool, *LinkBoxMB*.
- Support for user-defined network variable types can be added in each case, by entering their definition in *LinkBoxMB*. In this case, following information needs to be provided:
  - Scale factors: *a*, *b* and *c*
  - Number of fields
  - Basic LON data type of each field

Supported basic LON data types

Basic LON data type	Description
Signed short	8-bit signed data
Unsigned short	8-bit unsigned data
Enum	8-bit unsigned data
Signed long	16-bit signed data
Unsigned long	16-bit unsigned data
Signed quad	32-bit signed data
Unsigned quad	32-bit unsigned data
Float	32-bit IEEE float
Bitfield	1 to 8-bit length unsigned bit field

8. Mechanical & Electrical characteristics
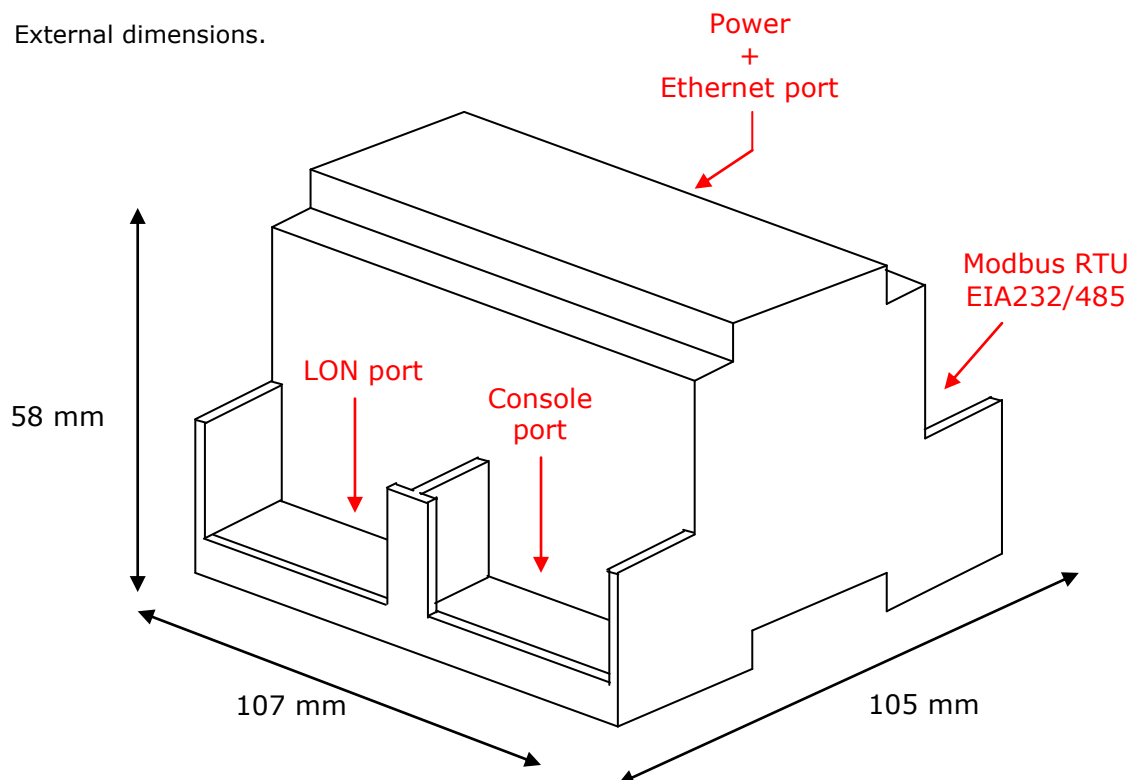

Enclosure	Plastic, type PC (UL 94 V-0). Dimensions: 107mm x 105mm x 58mm.
Colour	Light Grey. RAL 7035.
Power	9 to 30Vdc +/-10%, Max.: 125mA. 24Vac +/-10% 50-60Hz, Max.: 127mA Must use a NEC Class 2 or Limited Power Source (LPS) and SELV rated power supply. Plug-in terminal block for power connection (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 TCP port	1 x Ethernet 10Base-T (RJ45).
Modbus RTU ports	1 x Serial EIA232 (DB9 male DTE). SELV 1 x Serial EIA485 (Plug-in screw terminal block 2 poles). SELV
LON port	1 x LON (TP-FT/10) (plug-in terminal block 2 poles). TNV-1
LED indicators	1 x Power. 2 x Serial port (Modbus RTU) activity (Tx, Rx). 2 x LON port activity (Tx, Rx). 2 x Ethernet port link and activity (LNK, ACT). 1 x LON service.[1]
Push buttons	1 x LON service.[1]
Console port	EIA232. DB9 female (DCE). SELV
Configuration	Via console port.[2]
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

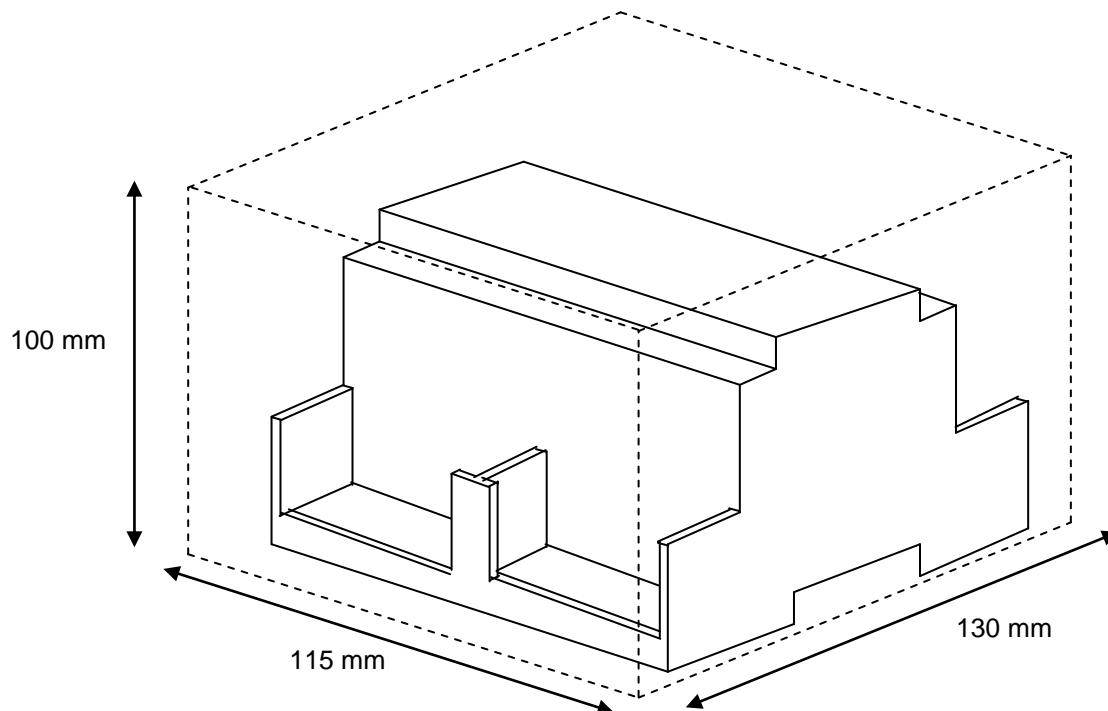[1] Not used for the moment. Reserved for future use.

[2] 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.

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9. Dimensions

External dimensions.

Power
+
Ethernet port

Modbus RTU
EIA232/485

LON port

Console
port

58 mm

107 mm

105 mm

Free space recommended to install the device, with spacing enough for external connections.
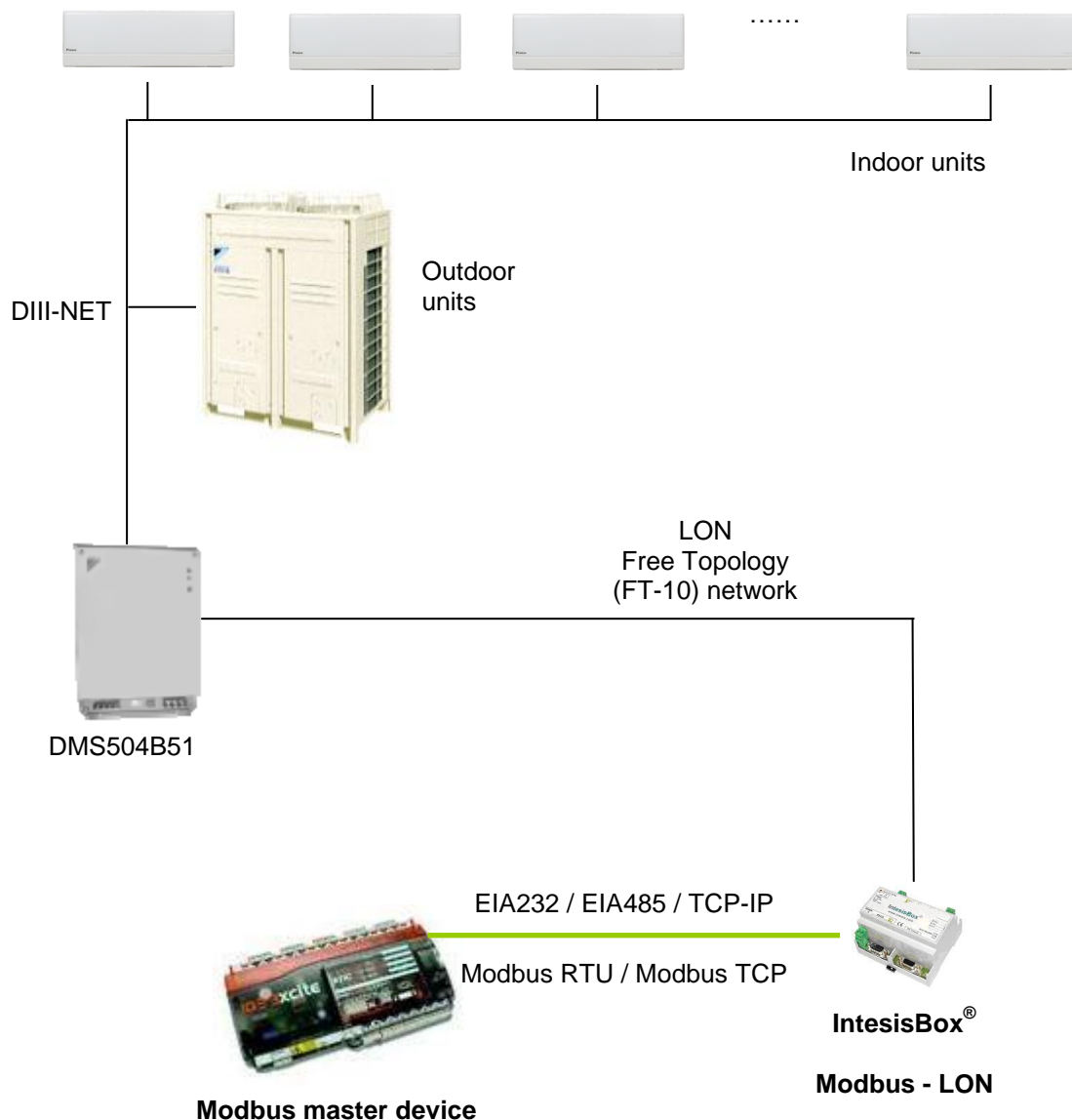
100 mm

115 mm

130 mm

10. Annexes

10.1 Integration of DAIKIN VRV air conditioning systems with Modbus

One of the main applications of *IntesisBox Modus Server - LON* is the integration of Daikin VRV air conditioning systems with Modbus building control systems.

For this application, Daikin VRV Air Conditioning system must be equipped with Daikin LON interface DMS-IF (model DMS504B51), this Daikin interface is normally commissioned by Daikin technical personnel, contact your nearest Daikin distributor for details.

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10.2 Daikin DMS504B51 LON Interface for Daikin Air Conditioning VRV system

This interface from Daikin allows connecting up to 64 VRVs. It is important to consult Daikin documentation to configure successfully the integration.

The signals available for every VRV internal unit are showed in the following list.

nvoOnOff_01 (Status OnOff: 0-Off, 1-On)
nvoHeatCool_01 (Status Mode: 0-Auto, 1-Heat, 3-Cool, 9-Vent)
nvoSetpoint_01 (Status SetPoint: 20..35ºC Cool, 15..30ºC Heat)
nvoSpaceTemp_01 (Status Temp: -10..50ºC)
nvoFanSpeed_01 (Status Fan: 50-Weak, 100-Strong)
nvoFiltersign_01 (Status Filter: 0-Ok, 1-Filter sign)
nvoFailure_01 (Status Fail: 0-Ok, 1-Fail)
nvoErrStatus_01 (Status Error Code: 0-No error,1..23114-Error)
nvoThermo_01 (Status Thermo: 0-Off, 1-On)
nvoWattmeter_01 (Status kwh)
nvoRejOnOff_01 (Status: 0-Permited, 1-Prohibited)
nvoRejMode_01 (Status: 0-Permited, 1-Prohibited)
nvoRejSetpoint_01 (Status: 0-Permited, 1-Prohibited)
nvoHvacExist_01 (Status: 0-No connection, 1-Ok, 2-Error communication)
nvoThermoOff_01 (Status ThermoOff: 0-Reset, 1-Set)
nviOnOff_01 (Status OnOff: 0-Off, 1-On)
nviHeatCool_01 (Command Mode: 0-Auto, 1-Heat, 3-Cool, 9-Vent)
nviSetpoint_01 (Status SetPoint: 20..35ºC Cool, 15..30ºC Heat)
nviFanSpeed_01 (Command Fan: 50-Weak, 100-Strong)
nviFSReset_01 (Command Filter Reset: 0..1 Reset Filter Sign)
nviRejOnOff_01 (Command: 0-Permited, 1-Prohibited)
nviRejMode_01 (Command: 0-Permited, 1-Prohibited)
nviRejSetpoint_01 (Command: 0-Permited, 1-Prohibited)
nviThermoOff_01 (Coomand ThermoOff: 0-Reset, 1-Set)

Note: In the Daikin system configuration, sometimes the VRVs are configured as masters and sometimes as slaves, the ones configured as slaves do not accept commands because they work in parallel with their masters.

If you are interested in this application, Intesis Software can provide you a sample project for LinkBoxMB, this sample project contain specific configuration to integrate Daikin VRV system, with these sample project the configuration and commissioning of the IntesisBox for this application becomes easy and quick.

The project is the following:

DEMO LON Daikin. 64 VRV units with all the signals.

Just copy this project into the projects folder of LinkBoxMB, create a copy of the project most suitable for your application and, after that, it will only be necessary to activate those signals needed for your integration and enter for them the corresponding Modbus parameters according to your Modbus installation.

Also available sample projects for other Air Conditioning brands (Mitsubishi Electric, Mitsubishi Heavy Industries, Toshiba, LG, Sanyo…).

10.3 How to setup LonWorks' device address in IntesisBox and how to declare LonWorks devices as commissioned using LinkBoxMB

LonWorks devices, as is the case of the DMS504B51 LON gateway for Daikin VRV systems, have a unique identifier called <u>Neuron ID</u> that is normally specified somewhere in the case or in the circuit board of the device, if you do not have the Neuron ID of your LonWorks device then you can get it using LinkBoxMB.

Additionally, any LonWorks device must be commissioned to start working, this is normally done using any LonWorks standard commissioning tool such as LonMaker. In case your LonWorks device is not commissioned and you do not have any LonWorks standard commissioning tool to do it, then you can use also LinkBoxMB and IntesisBox to do it in a single step, see the instructions below for details of both procedures.

Ensure following setup:

    -Connect the IntesisBox at LonWorks TP/FT-10 bus
    -Connect the IntesisBox PC console RS232 port to your PC
   -Power-on IntesisBox

Now follow these steps:

1. Start LinkBox application in your PC, and select suitable project

2. Go to menu *Configuration->Connection…* to select suitable COM port for PC console, and save it.
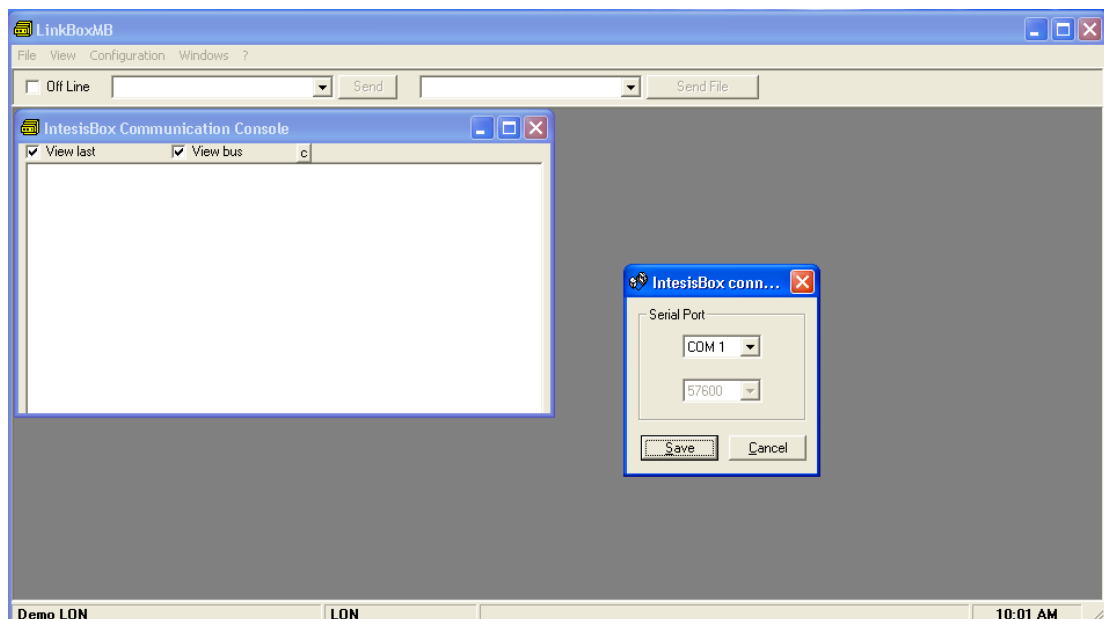
3. Click the checkbox next to *Offline* word below LinkBox Menu. It should change to Online, and some output must appear at *IntesisBox Communication Console* window.


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tel   +34 938047134
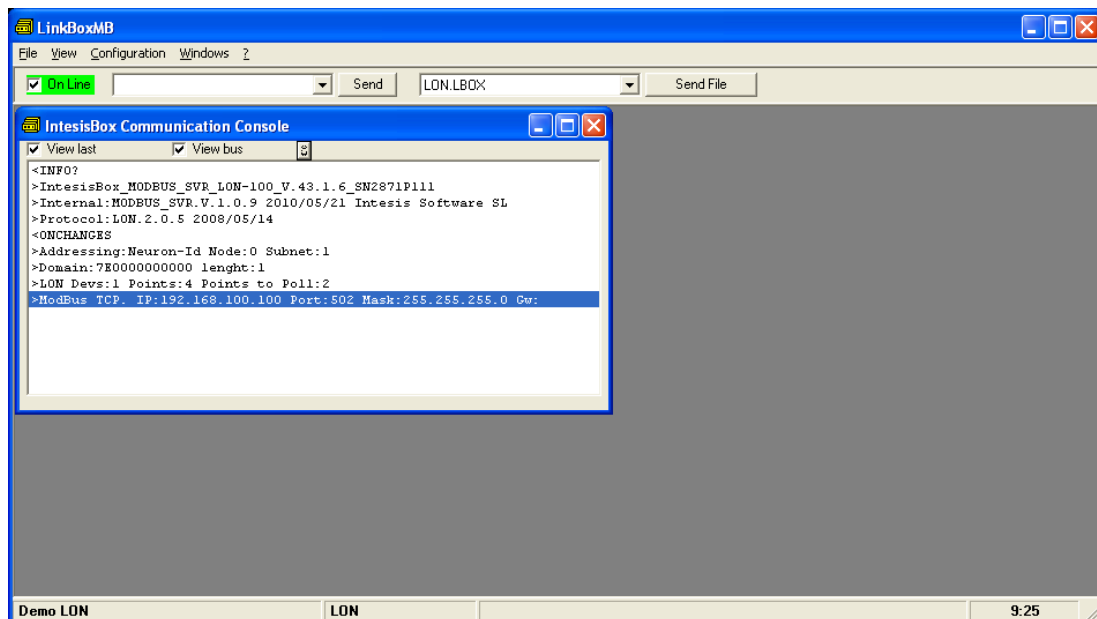
4. The LonWorks device you are to connect should have a so-called "*Service Pin Button*" accessible. Press it. This will send a device identification message (*Service Pin Message)* to IntesisBox, which will be shown in IntesisBox Communication Console:
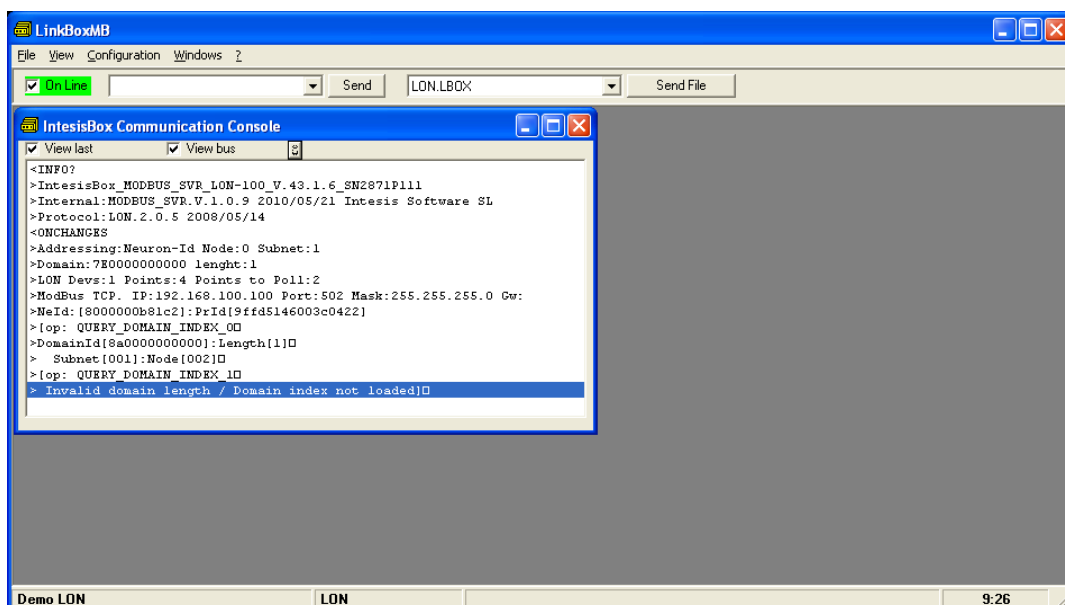

Output might differ depending on the configuration of the LonWorks device (i.e., if it has a configured domain or not).

5. In this message, the tag *NeId:[xxxxxxxxx]* poses as a unique identifier, in hexadecimal format (*Neuron Id*) for the LonWorks device we want to integrate. Note down this number, since we will need it in the configuration.
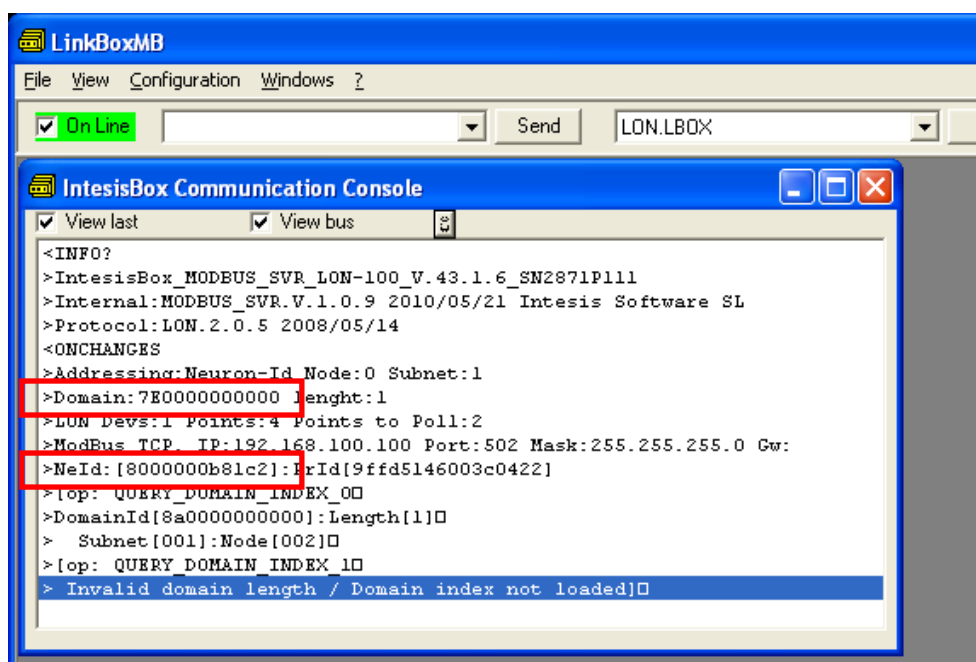
In the example above, Neuron Id is 8000000b81c2 and the domain is 7E

6. Alternatively, and only if a domain have been configured forehand (using Lon tools, as Lonmaker) all the neuron IDs can be found using the command DISC (write in in the command box and press send). For it to work the Domain configured in the Connection tab needs to be the same as the configured in the LON installation. Otherwise no neuron ID is going to be returned to the user. To set that check section 4.3
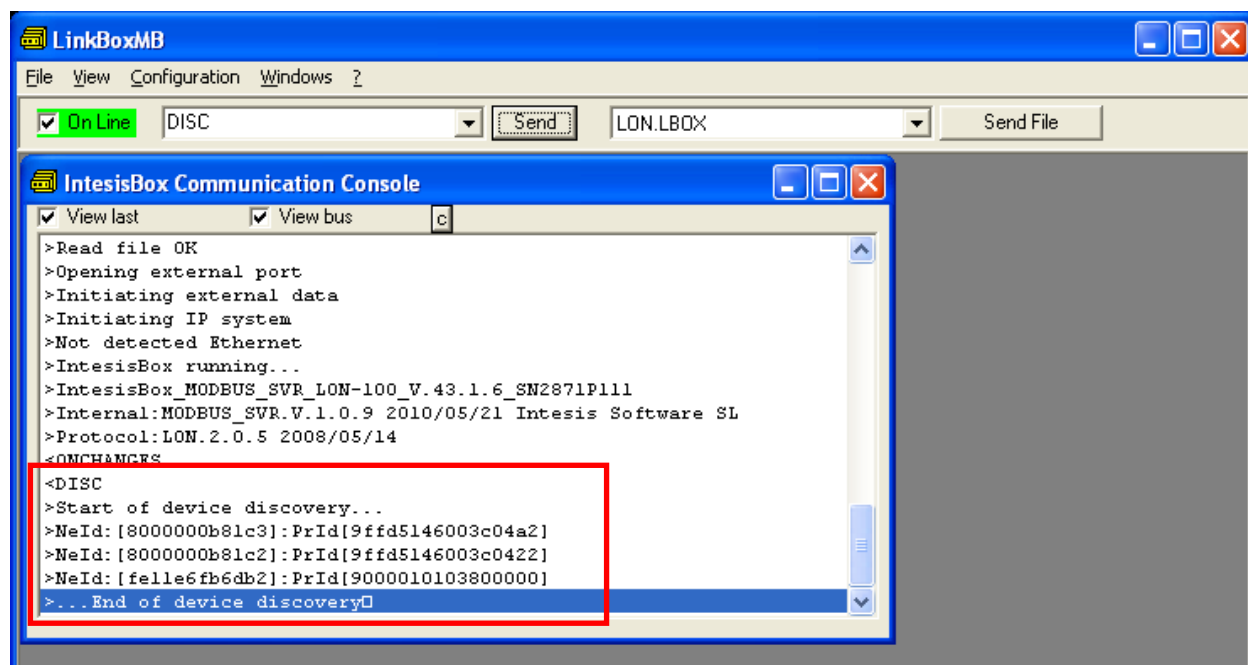

In order to load now this Neuron Id in project configuration, click *Configuration->IntesisBox.*
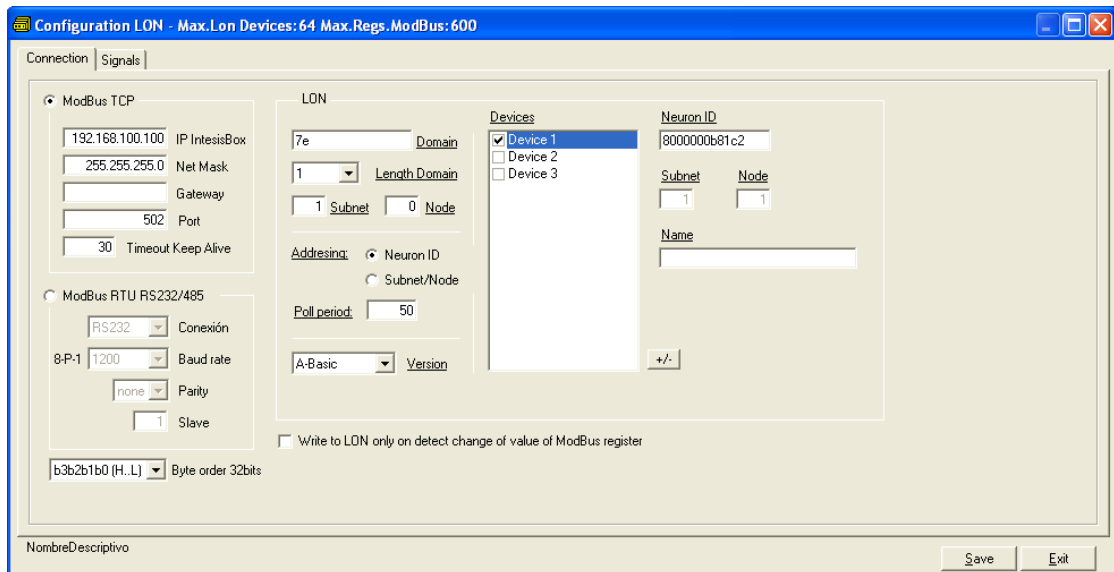
7. In it, ensure following settings for LonWorks:

    - IntesisBox LON (use this values if no LON configuration has been performed):
        o Domain: If it has been configured that value needs to be used (point 5 and 6 for more information). Otherwise any value is fine.
        o Length domain: 1 is fine
        o Subnet: 1 is fine
        o Node: 126 is fine
    - LON:
        o Select *Neuron-Id* as Addressing mode (default factory value)
        o Select Device 1 as the device for which the Neuron-Id is to be set.
        o Insert the Neuron-Id of the device, just as you noted it down
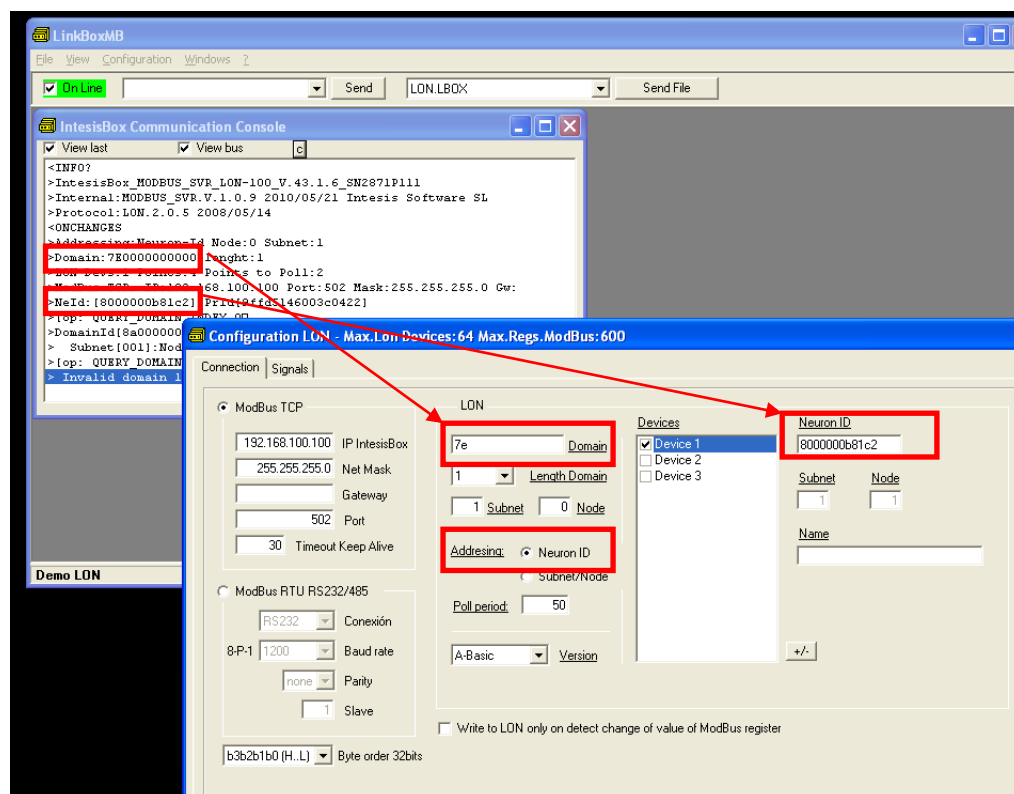
8. Click button Save and select Yes when asked if you want to save changes.

9. Once gateway configuration file is generated, click Send File in LinkBox main window
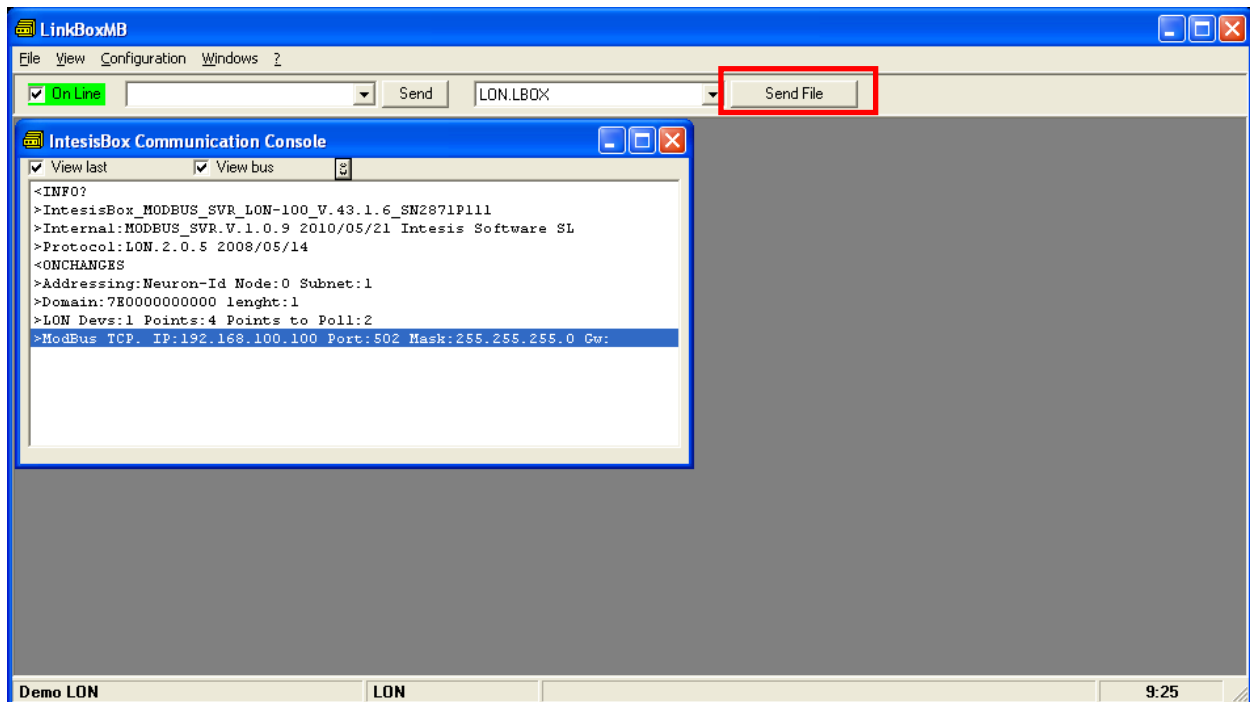

10. Once downloaded, we will check if communication at LonWorks side is properly working. Go to menu View->Bus->Lon. Something similar to this will appear:
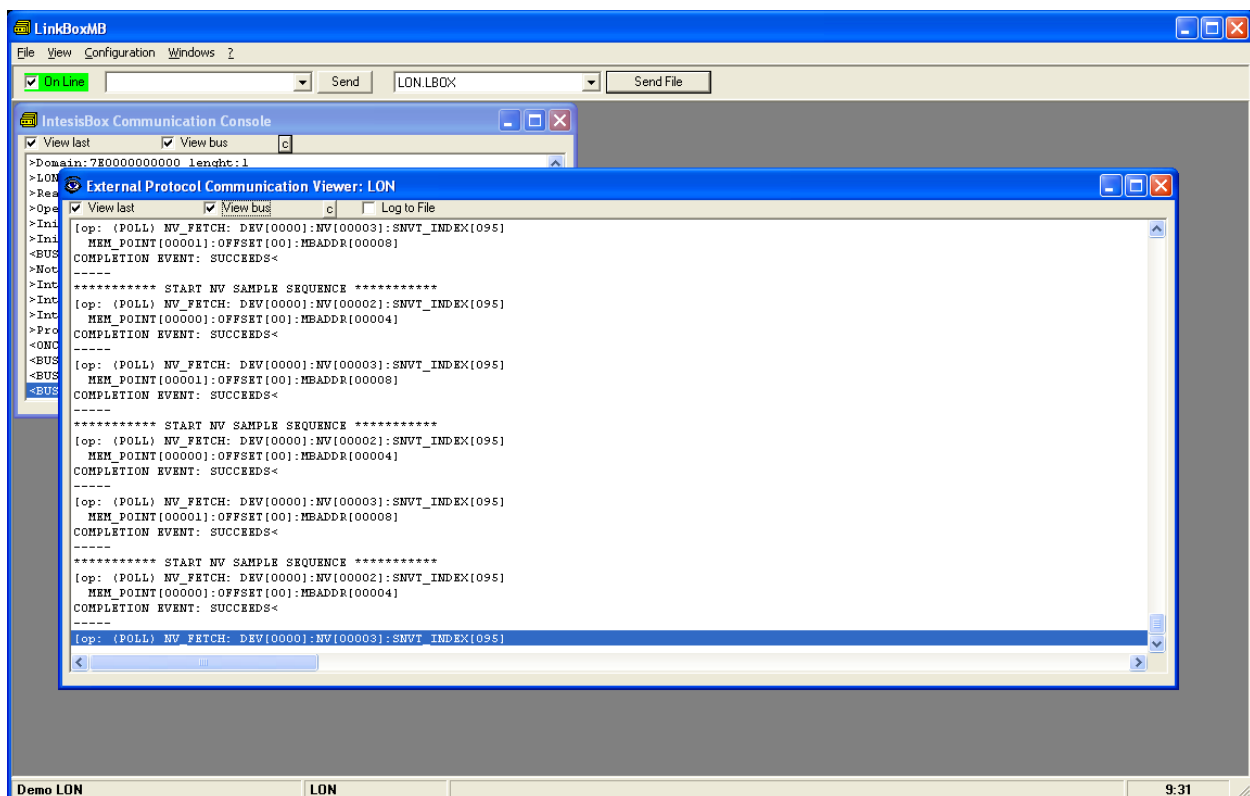

These pose as the query commands the IntesisBox is triggering to the LonWorks device being integrated.

Note that for each request (NV_FETCH request) there is a response from the device, represented by the COMPLETION EVENT: SUCCEEDS< keywords.

11. Finally, and solely in the case that your LonWorks device is placed in stand-alone (i.e. directly communicating with intesisBox and not integrated within a LonWorks network), you should declare the LonWorks device as commissioned. In order to do that, go to the textbox next to text "*Online*" below LinkBox menu, and type the command COMIT and press *Send*.
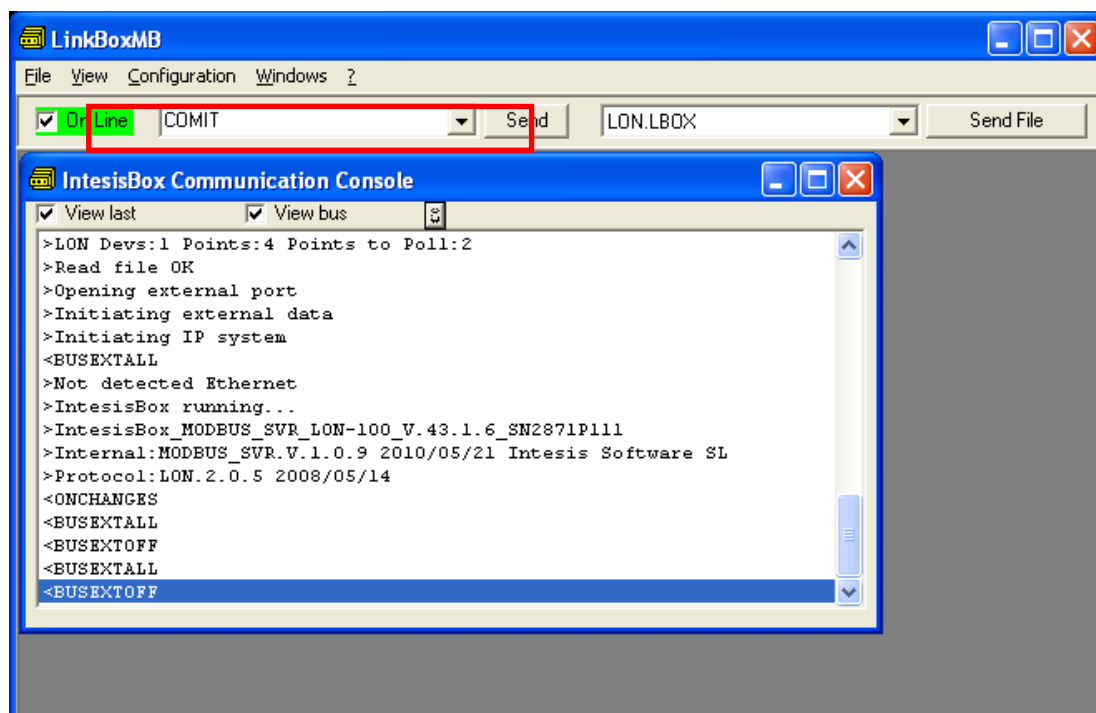
This will result in some text at IntesisBox Communication Console, similar to the one below:
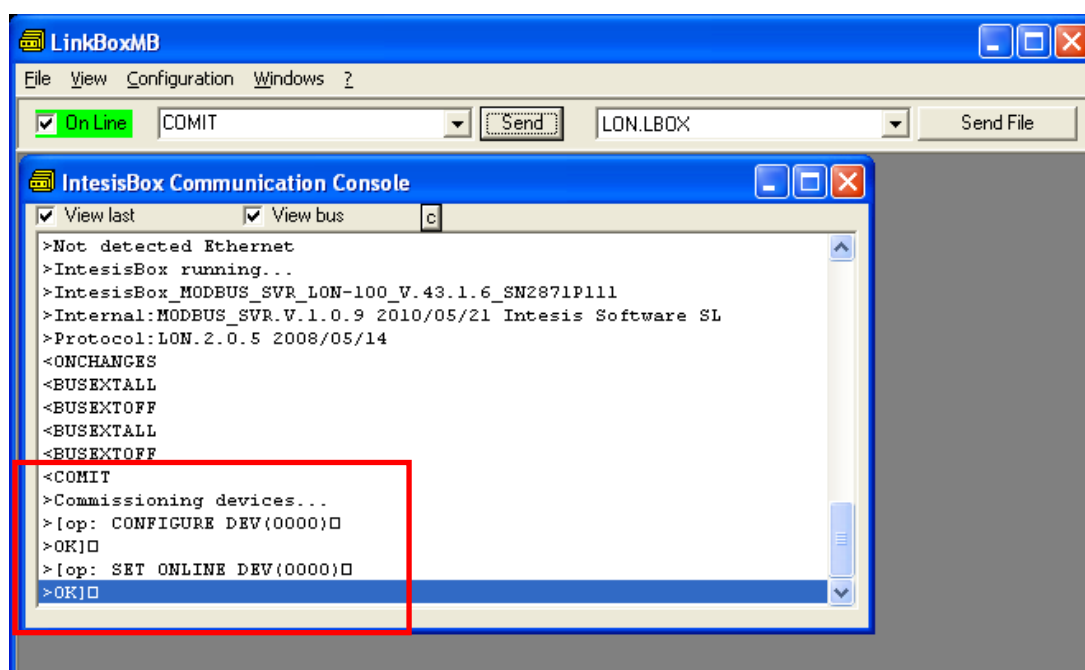
If all this process worked, now you are ready to communicate with your LonWorks device.

Intesis software