Modbus Server

Panasonic VRF Air Conditioning

Gateway for the integration of Panasonic VRF systems into Modbus (RTU and TCP) systems

USER MANUAL

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Connecting Devices

Important User Information

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Gateway for the integration of Panasonic VRF systems into Modbus (RTU and TCP) systems.

ORDER CODE	LEGACY ORDER CODE
INMBSPAN016O000	PA-AC-MBS-16
INMBSPAN064O000	PA-AC-MBS-64
INMBSPAN128O000	PA-AC-MBS-128

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1. Description

1.1. Introduction

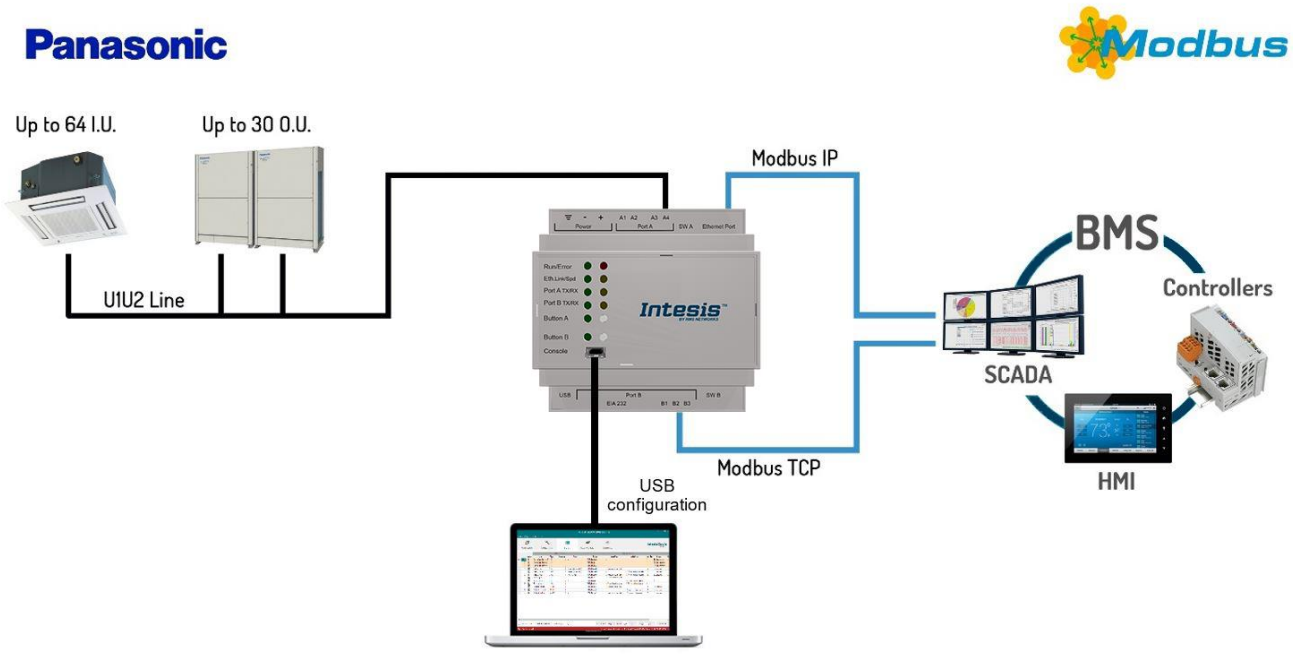
This document describes the integration of Panasonic VRF air conditioning systems into Modbus compatible devices and systems using the Intesis Modbus Server to *Panasonic VRF* communication gateway.

The aim of this integration is to monitor and control Panasonic air conditioning systems, remotely, from a Control Center using any commercial SCADA or monitoring software that includes a Modbus Master driver (RTU and/or TCP). To do it so, Intesis performs as a Modbus Server, allowing poll and write requests from any Modbus master device.

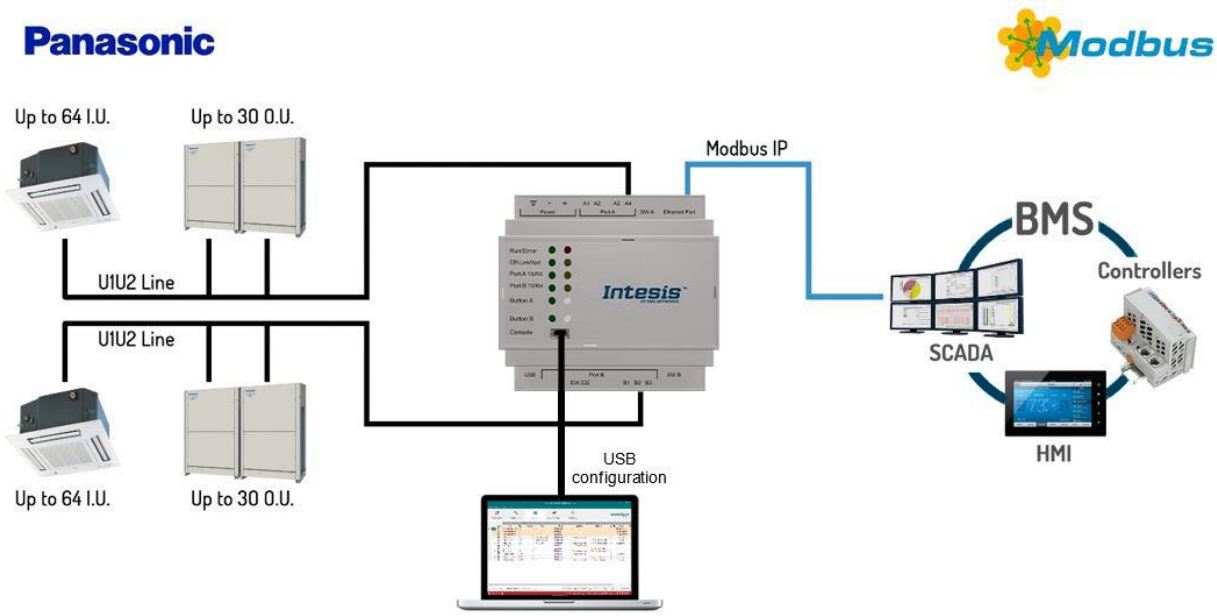
Intesis makes available the Panasonic air conditioning system indoor units' datapoints through independent Modbus registers.

Up to 128 indoor units supported, depending on product version.

This document assumes that the user is familiar with Modbus and Panasonic technologies and their technical terms.



Integration of Panasonic's compatible systems into Modbus RTU and Modbus TCP systems.
1 Panasonic lines can be connected



Integration of Panasonic's compatible systems into Modbus TCP systems.
2 Panasonic liness can be connected

1.2. Functionality

Intesis™ continuously monitors Panasonic VRF network for all configured signals and keeps the updated status of all of them in its memory, ready to be served when requested from the Modbus master.

Commands toward the indoor units are permitted.

Each indoor unit is offered as a set of MBS registers.

Element	Registers supported
Outdoor Unit	• Status
Indoor Unit	• Status • Command • Communication status
General signals (all units)	• Command

1.3. Capacity of Intesis

Element	Max.	Notes
Number of indoor units	128*	Number of indoor units that can be controlled through Intesis

* There are different models of *Intesis MBS – Panasonic VRF* each one with different capacity. The table above shows the capacity for the top model (with maximum capacity).

Their order codes are:

- INMBSPAN016O000, Model supporting up to 16 indoor units.
- INMBSPAN064O000, Model supporting up to 64 indoor units.
- INMBSPAN128O000, Model supporting up to 128 indoor units.

2. Modbus interface

In this section, a common description for all Intesis Modbus series gateways is given, from the point of view of Modbus system which is called from now on *internal system.* Connection with the Panasonic VRF system is also called from now on *external system*.

2.1. 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.

Configuration of poll records is possible between Modbus addresses 0 and 20000. Addresses that are not defined in section 2.2 (Modbus map of the device) are read-only and will always report 0.

Modbus error codes are supported, they will be sent whenever a non-valid Modbus address is queried.

All registers are 16-bit signed integer, in standard Modbus Big Endian (MSB/LSB) format.

Intesis supports Modbus RTU and Modbus TCP and both interfaces can be used simultaneously (for 16 and 64 versions).

2.2. Modbus RTU

Both EIA485 and EIA232 physical layers are supported. Only the lines RX, TX and GND of the EIA232 connector are used (TX and RX for EIA485).

Baud rate can be selected between 1200, 2400, 4800, 9600, 19200, 38400, 56700 and 115200. Parity (none, even or odd) and stop bits (1 or 2) can be selected as well.

Modbus slave number must be configured and the physical connection (RS232 or RS485) can also be selected.

2.3. Modbus TCP

TCP port to use (default is 502) and keep alive period must be configured.

IP settings of Intesis (DHCP status, own IP, net mask and default gateway) must be configured as well.

2.4. Modbus Address Map

Modbus address from the formula is expressed in link layer format. This is, first register address is 0.

Modbus Address First Address is 0	Read /Write	Register/signal name	Possible values
OCCUPANCY SIGNALS			
0	R/W	Occupancy Cool Setpoint (x10)	-15…60ºC 4…140ºF
1	R/W	Occupancy Heat Setpoint (x10)	-15...60ºC 4…140ºF
2	R/W	Unoccupancy Cool Setpoint (x10)	-15...60ºC 4…140ºF
3	R/W	Unoccupancy Heat Setpoint (x10)	-15...60ºC 4…140ºF
4	R/W	Occupancy Continuous Check	0-Disabled, 1-Enabled
5	R/W	Unoccupancy Deadband Action	0-Off, 1-Current mode
GENERAL SIGNALS (all units)			
6	W	On (all the units)	1-Set all the units On
7	W	Off (all the units)	1-Set all the units Off
8	W	Operation Mode Auto (all the units)	1-Set Auto Mode
9	W	Operation Mode Heat (all the units)	1-Set Heat Mode
10	W	Operation Mode Dry (all the units)	1-Set Dry Mode
11	W	Operation Mode Fan (all the units)	1-Set Fan Mode
12	W	Operation Mode Cool (all the units)	1-Set Cool Mode
13	W	Fan Speed Auto (all the units)	1-Set Fan Speed Auto
14	W	Fan Speed Low (all the units)	1-Set Fan Speed Low
15	W	Fan Speed Mid (all the units)	1-Set Fan Speed Med
16	W	Fan Speed High (all the units)	1-Set Fan Speed High
17	W	Vanes Position Stop (all the units)	1-Set Vanes Position Stop
18	W	Vanes Position 1 (all the units)	1-Set Vanes Position 1
19	W	Vanes Position 2 (all the units)	1-Set Vanes Position 2
20	W	Vanes Position 3 (all the units)	1-Set Vanes Position 3
21	W	Vanes Position 4 (all the units)	1-Set Vanes Position 4
22	W	Vanes Position 5 (all the units)	1-Set Vanes Position 5
23	W	Vanes Swing (all the units)	1-Set Vanes to Swing
24	W	Temperature Setpoint (all units) (x10ºC/ºF)	16..30°C
OUTDOOR UNITS SIGNALS			
([OU][1] * 25) + (([L] - 1) * 10000) + 7000) + 0	R	Communication Error OU	0-No error, 1-Error

[1] Where ***[OU]*** is the outdoor unit number. Values from 1 to 30.

Modbus Address First Address is 0	Read /Write	Register/signal name	Possible values
([OU] * 25) + (([L] - 1) * 10000) + 7000) + 1	R/W	Demand Limit. Ratio	0..200 % - 255-No limit
([OU] * 25) + (([L] - 1) * 10000) + 7000) + 2	R	High Pressure Sensor (x10)	Bar
([OU] * 25) + (([L] - 1) * 10000) + 7000) + 3	R	Low Pressure Sensor (x10)	Bar
([OU] * 25) + (([L] - 1) * 10000) + 7000) + 4	R	Compressor 1 Operation Time	0…16777215 hours
([OU] * 25) + (([L] - 1) * 10000) + 7000) + 5	R	Compressor 2 Operation Time	0…16777215 hours
([OU] * 25) + (([L] - 1) * 10000) + 7000) + 6	R	Compressor 3 Operation Time	0…16777215 hours
INDOOR UNITS SIGNALS			
([IU][2] * 100) + (([L][3] - 1) * 10000) + 0	R/W	On/Off	0-Off, 1-On
([IU] * 100) + (([L] - 1) * 10000) + 1	R/W	Operation Mode	0-Auto, 1-Heat, 2-Dry. 3-Fan, 4-Cool, 5-AutoHeat, 6-AutoCool
([IU] * 100) + (([L] - 1) * 10000) + 2	R/W	Fan Speed	0-Auto, 1-Low, 2-Low+, 3-Med, 4-Med+, 5-High
([IU] * 100) + (([L] - 1) * 10000) + 3	R/W	Vane Position	0-Stop, 1-Pos1...5-Pos5, 10-Swing
([IU] * 100) + (([L] - 1) * 10000) + 4	R/W	Temperature Setpoint (x10ºC)	16…30°C
([IU] * 100) + (([L]- 1) * 10000) + 5	R	Ambient Temperature (x10ºC)	-35…92,5ºC -31…198,5ºF
([IU] * 100) + (([L]- 1) * 10000) + 6	W(T)	Wired Remote Controller	0-Body sensor, 1-Remote controller sensor
([IU] * 100) + (([L]- 1) * 10000) + 7	R/W	Discharge Setpoint Temperature Cool (x10ºC)	-10…10ºC 13…50ºF
([IU] * 100) + (([L]- 1) * 10000) + 8	R/W	Discharge Setpoint Temperature Heat (x10ºC)	-10…10ºC 13…50ºF
([IU] * 100) + (([L]- 1) * 10000) + 9	R	Discharge Current Temperature (x10ºC)	-35…92,5ºC -31…198,5ºF
([IU] * 100) + (([L]- 1) * 10000) + 10	R	Heat Exchanger Temperature (x10)	-1...26ºC 30...79ºF
([IU] * 100) + (([L]- 1) * 10000) + 11	R	Heat Setpoint Up Limit (x10)	-35...92,5ºC -31…198,5ºF
([IU] * 100) + (([L]- 1) * 10000) + 12	R	Heat Setpoint Low Limit (x10)	-35…92,5ºC -31…198,5ºF
([IU] * 100) + (([L]- 1) * 10000) + 13	R	Cool Setpoint Up Limit (x10)	-35…92,5ºC -31…198,5ºF
([IU] * 100) + (([L]- 1) * 10000) + 14	R	Cool Setpoint Low Limit (x10)	-35…92,5ºC -31…198,5ºF
([IU] * 100) + (([L]- 1) * 10000) + 15	R	Dry Setpoint Up Limit (x10)	-35…92,5ºC -31…198,5ºF
([IU] * 100) + (([L]- 1) * 10000) + 16	R	Dry Setpoint Low Limit (x10)	-35…92,5ºC -31…198,5ºF
([IU] * 100) + (([L]- 1) * 10000) + 17	R	Auto Setpoint Up Limit (x10)	-35…92,5ºC -31…198,5ºF
([IU] * 100) + (([L]- 1) * 10000) + 18	R	Auto Setpoint Low Limit (x10)	-35…92,5ºC -31…198,5ºF
([IU] * 100) + (([L]- 1) * 10000) + 19	R	Unit error code	0-No error, X-Error (0…255)

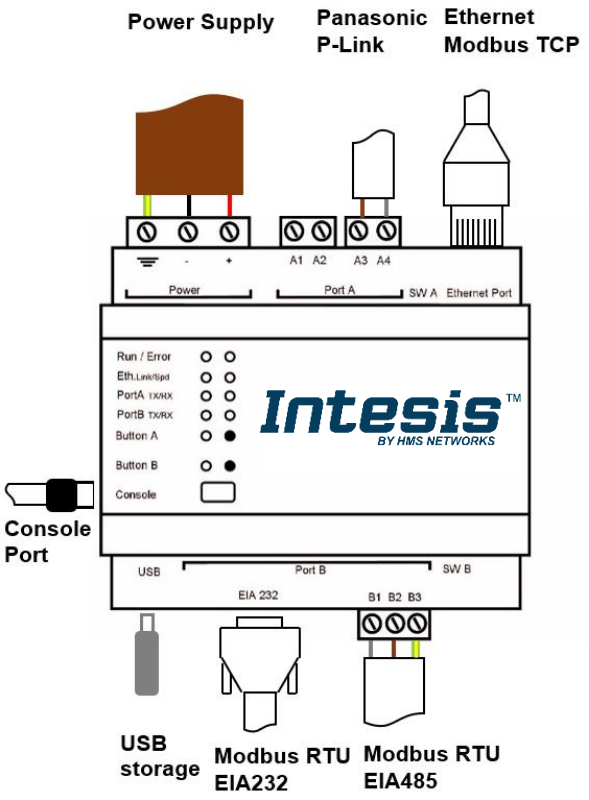
2 Where ***[IU]*** is the indoor unit number. Values from 1 to 64.
[3] Where ***[L]*** is the Panasonic line in use. Posible values are 1 or 2.

Modbus Address First Address is 0	Read /Write	Register/signal name	Possible values
([IU] * 100) + (([L]- 1) * 10000) + 20	R	Filter Alarm	0-Normal, 1-Alarm
([IU] * 100) + (([L]- 1) * 10000) + 21	W(T)	Filter Alarm reset	1-Reset
([IU] * 100) + (([L]- 1) * 10000) + 22	R	Communication Error IU	0-No error, 1-Error
([IU] * 100) + (([L]- 1) * 10000) + 23	R/W	Allow On/Off from remote controller	0-Allow, 1-Not allow
([IU] * 100) + (([L]- 1) * 10000) + 24	R/W	Allow Mode from remote controller	0-Allow, 1-Not allow
([IU] * 100) + (([L]- 1) * 10000) + 25	R/W	Allow Setpoint from remote controller	0-Allow, 1-Not allow
([IU] * 100) + (([L]- 1) * 10000) + 26	R	Unit type	0-Not defined, 1-TBD, 2-GHP, 3-PAC, 4-VRF
([IU] * 100) + (([L]- 1) * 10000) + 27	R/W	Occupancy	1-Occupied, 2-Unoccupied, 3-Disable
([IU] * 100) + (([L]- 1) * 10000) + 28	RW	Modbus ambient temperature (x10)	ºC/ºF
([IU] * 100) + (([L]- 1) * 10000) + 29	R	AC Real Temperature Setpoint (x10)	ºC/ºF
([IU] * 100) + (([L]- 1) * 10000) + 30	R	Consumption Yesterday (kWh)	kWh
([IU] * 100) + (([L]- 1) * 10000) + 31	R	Consumption Today (kWh)	kWh
([IU] * 100) + (([L]- 1) * 10000) + 32	R	Consumption Total (kWh)	kWh

3. Connections

3.1. Connections for 16 and 64 versions (INMBSPAN016O000 and INMBSPAN064O000)

Find below information regarding the Intesis 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/IP / Console (UDP & 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 (check the gateway user manual for more information). Default IP is 192.168.100.246. DHCP is enabled by default.

PortA / P-Link Panasonic
Connect the P-Link terminals of Panasonic Outdoor Unit to the connectors A3 and A4 of gateway's PortA. There is no polarity to be respected.

PortB / Modbus-RTU RS485
Connect the EIA485 bus to connectors B1 (B+), B2 (A-) and B3 (SNGD) of gateway's PortB. Respect the polarity.

***Note for PortB**: 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. Bus biasing and termination resistor for EIA485 can be enabled for PortB by means of a dedicated DIP:*

SW1:
***ON:** 120 Ω termination active*
***OFF:** 120 Ω termination inactive.*
SW2+3:
***ON:** Polarization active*
***OFF:** Polarization inactive.*

If the gateway is installed in one bus end, make sure that termination is active.

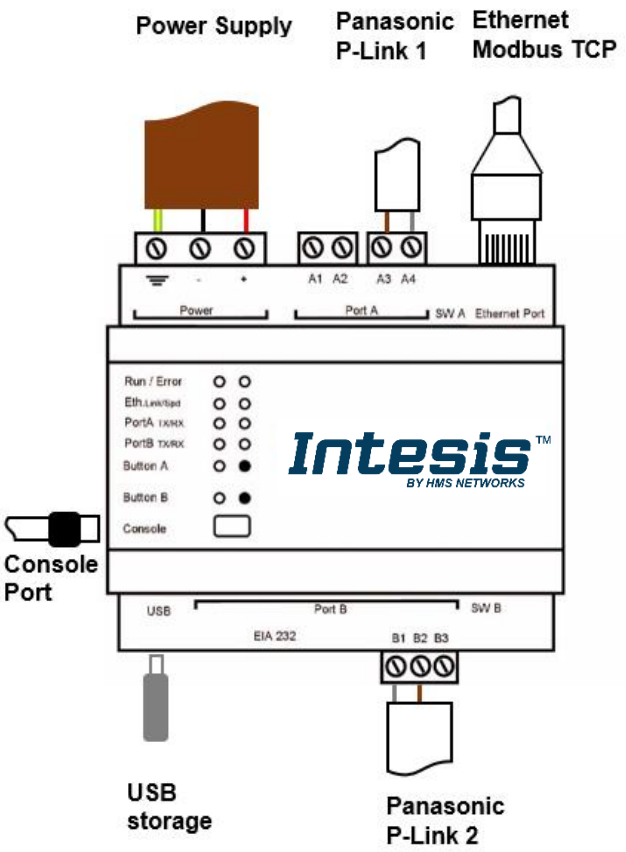
Console Port
Connect a mini-type B USB cable from your computer to the gateway to allow communication between the Configuration Software and the gateway. Remember that Ethernet connection is also allowed. Check the user manual for more information.

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

Ensure proper space for all connectors when mounted (see 6 DIMENSIONS).

3.2. Connections for 128 version (INMBSPAN128O000)

Find below information regarding the Intesis 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/IP / Console (UDP & 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 (check the gateway user manual for more information). With factory settings, after powering up the gateway, DHCP will be enabled for 30 seconds. After that time, if no IP is provided by a DHCP server, the default IP 192.168.100.246 will be set.

PortA / P-Link 1 Panasonic
Connect the P-Link terminals of Panasonic Outdoor Unit to the connectors A3 and A4 of gateway's PortA. There is no polarity to be respected.

PortB / P-Link 2 Panasonic
Connect the P-Link terminals of Panasonic Outdoor Unit to the connectors B1 and B2 of gateway's PortA. There is no polarity to be respected.

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 HDD) if required. Check the user manual for more information.

Ensure proper space for all connectors when mounted (see 6 DIMENSIONS).

3.3. 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 5 ELECTRICAL & MECHANICAL FEATURES). Once connected the ON led will turn on.

WARNING! 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.

3.4. Connect to Panasonic VRF installation

Use the PortA connector in the top corner of the Intesis device to connect P-Link bus to the Intesis. Remember to follow all safety precautions indicated by Panasonic.

Connect the Panasonic P-Link bus to connectors A3 and A4 of gateway's PortA. Bus is not sensitive to polarity.

For the product version supporting 128 units (INMBSPAN128O000), connect the Panasonic P-Link 2 bus to connectors B1 and B2 of gateway PortB. Bus is not sensitive to polarity.

3.5. Connection to Modbus

3.5.1. Modbus TCP

The gateways Ethernet port connection is used for Modbus TCP communication. Connect the communication cable coming from the network hub or switch to the Ethernet port of Intesis. The cable to be used shall be a straight Ethernet UTP/FTP CAT5 cable.

TCP port to use (default 502) and keep alive period must be configured.
IP settings of the gateway (DHCP status, own IP, netmask and default gateway) must be configured as well.

3.5.2. Modbus RTU (only for INMBSPAN016O000 and INMBSPAN064O000)

Connect the communication cable coming from the motbus network to the port marked as Port B of the Intesis. Connect the EIA485 bus 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 (without repeaters) 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. Bus biasing and termination resistor for EIA485 can be enabled for PortB by means of a dedicated DIP switch.

3.6. Connection to Modbus TCP/IP (Energy meters)

Use the Ethernet connector to communicate with the Modbus Energy meters.

Once the Energy meters are connected, running and tested, make sure they are available from the Intesis device LAN network/IP before going to the next step.

3.7. Connection to PC (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 Intesis.
- **USB:** Using the console port of Intesis, connect a USB cable from the console port to the PC.

4. Set-up process and troubleshooting

4.1. Pre-requisites

It is necessary to have the Modbus RTU or TCP master/client device (BMS side device) operative and properly connected to the corresponding port of the gateway and the Panasonic VRF installation connected to their corresponding ports as well.

Connectors, connection cables, PC for the Configuration Tool usage and other auxiliary material, if needed, are not supplied by Intesis for this standard integration.

Items supplied by HMS Networks for this integration are:

- Intesis gateway.
- Link to download the configuration tool.
- USB Console cable to communicate with Intesis.
- Product documentation.

4.2. Intesis MAPS. Configuration & monitoring tool for Intesis Modbus series

4.2.1. Introduction

Intesis MAPS is a Windows® compatible software developed specifically to monitor and configure Intesis new generation gateways.

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

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

Please check the Intesis MAPS User Manual for specific information about the different parameters and how to configure them.

4.2.2. Connection

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

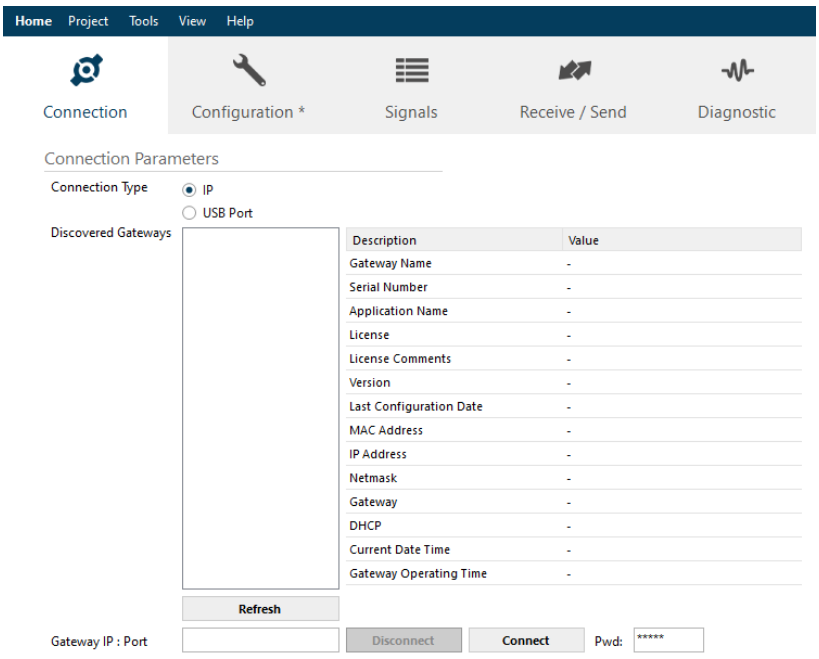


Figure 4.1 MAPS connection

4.2.3. Configuration tab

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

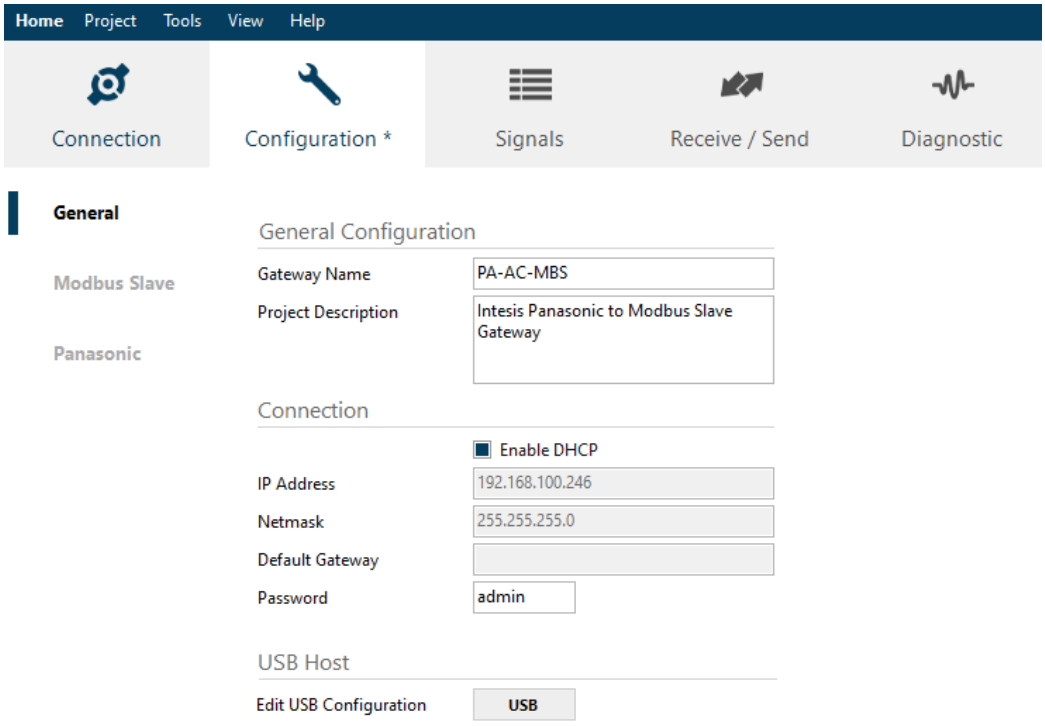


Figure 4.2 Intesis MAPS configuration tab

4.2.4. Modbus Slave configuration

Set parameters of Modbus Slave interface of Intesis.

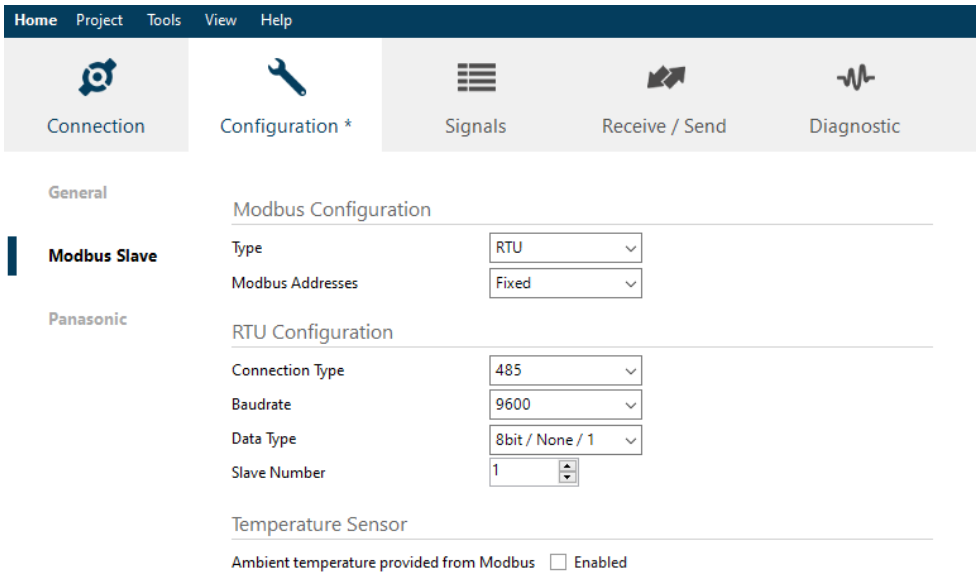


Figure 4.3 Intesis MAPS Modbus configuration tab

1. **Modbus Configuration**

1.1. Modbus type selection. Select RTU, TCP or simultaneous RTU and TCP communication.

2. **TCP Configuration.**

2.1. Modbus TCP Port: Modbus TCP communication port setting. Default port 502.

2.2. Keep Alive. Set the time of inactivity to send a keep Alive message. Default 10 minutes.

3. **RTU Configuration.**

3.1. RTU bus connection type. Select the RTU connection type serial bus RS485 or 232.

3.2 Baudrate. Set the RTU bus communication speed. Default: 9600 bps.

- Available values: 1200, 2400, 4800, 9600,19200, 38400, 57600, 115200 bps.

3.3 Data Type. Set the Data-bit/parity/stop-bit. Default: 8bit/None/1.

- Available selection: 8bit/None/1, 8bit/Even/1, 8bit/Odd/1, 8bit/None/2.

3.4 Slave Number. Set the Modbus Slave address. Default slave address: 1.

- Valid address: 1…255.

3.5 Ambient temperature provided from Modbus. This option enables a Modbus register to receive an ambient temperature from Modbus to regulate the AC unit using Virtual Temperature function.

Case 1: Temperature setpoint IS NOT provided from Modbus. (Checkbox deactivated).

In this case, the user setpoint is directly applied to the AC unit. Setpoint control and ambient temperature is based on the following registers:

([IU] * 100) + (([L] - 1) * 10000) + 4	**R/W**	**Temperature Setpoint (x10ºC)**	**16…30°C**
([IU] * 100) + (([L]- 1) * 10000) + 5	**R**	**Ambient Temperature (x10ºC)**	**-35…92,5ºC -31…198,5ºF**

- **Register 4: Temperature Setpoint (x10)**

This register can write the desired user setpoint and will be updated with the current setpoint in the AC unit at any time.

- **Register 5: Ambient temperature (x10)**

This register can be read only and will inform about the ambient temperature measured by the AC unit temperature probe, which usually corresponds with the temperature measured in the return path. See AC settings for further information.

Case 2: Temperature setpoint IS provided from Modbus (use Virtual temperature) (Checkbox activated)

This feaure is provided to be used only in the following cases:

- There is no setpoint control from BMS or centralized system in parallel to the Intesis device.
- There is no setpoint control from RC, infrared remote or any other AC optional which allow setpoint management.

Considerning these sentences, the resulting system is that in which the setpoint control is only performed through the Intesis gateway.

Enabling this feature will add two additional Modbus temperature registers to the previous list:

([IU] * 100) + (([L] - 1) * 10000) + 4	R/W	Temperature Setpoint (x10ºC)	16…30°C
([IU] * 100) + (([L]- 1) * 10000) + 5	R	Ambient Temperature (x10ºC)	-35…92,5ºC -31…198,5ºF
([IU] * 100) + (([L]- 1) * 10000) + 28	**RW**	**Modbus ambient temperature (x10)**	**ºC/ºF**
([IU] * 100) + (([L]- 1) * 10000) + 29	**R**	**AC Real Temperature Setpoint (x10)**	**ºC/ºF**

- **Register 4: Temperature Setpoint (x10)**

This register can write the desired user setpoint but now this register will not be updated with the current setpoint in the AC unit. This way, reading this register in the Case 2 will report the last setpoint temperature set in this Modbus register.

- **Register 5: Ambient temperature (x10)**

This register has the same meaning than Case 1.

- **Register 28: Modbus ambient temperature (x10)**

This register can receive a temperature value coming from Modbus. This value is used to calculate a real setpoint for the AC unit using the below expression.

- **Register 29: AC Real Temperature setpoint (x10)**

This register will report the real AC setpoint temperature at any time. This is the value calculated in the below expression.

In Case 2, user setpoint temperature (register 4) is not directly applied to the indoor unit but modified using the **Virtual Temperature formula.** This way, the real setpoint applied to the AC unit follows the next expression:

$$\boldsymbol{Real\ AC\ Setp = AC\ Amb\ Temp - (Modbus\ Amb\ Temp - Modbus\ Setp\ Temp)}$$, where:

- Real AC Setp (AC Real Temperature Setpoint) is register 29.
- AC Amb Temp (Ambient Temperature) is register 5.
- Modbus Amb Temp (Modbus ambient temperature) is register 28.
- Modbus Setp Temp (Temperature Setpoint) is register 4.

Example: in a certain installation, we have the following data:

- *Ambient temperature measured in a Modbus temperature probe = 23ºC (register 28).*
- *User demands, from a Modbus thermostat, a setpoint = 25ºC (register 4).*
- *The AC unit is measuring in the return path a temperature = 24ºC (register 5).*

Following this example and considering the sytem working in heating mode, the real AC temperature setpoint (register 29) applied to the AC is:

Real AC Setp (ºC) = 24 – (23 – 25) = 24 – (–2) = 24 + 2 = 26 ºC

Basically, Virtual Temperature function modifies the setpoint temperature set from Modbus in register 4 making possible to use a Modbus temperature probe as a reference (register 28) for the AC control loop.
The idea of the Virtual Temperature is to keep the room temperature difference (in Modbus) and apply it to the AC control loop by modifying the setpoint.
This value is recalculated constantly adapting the temperature difference to the AC control loop so the lower temperature delta in Modbus result in a lower temperature delta applied to the AC unit and the opposite (the higher…the higher).

4.2.5. Panasonic configuration

Set parameters for connection with Panasonic's installation.

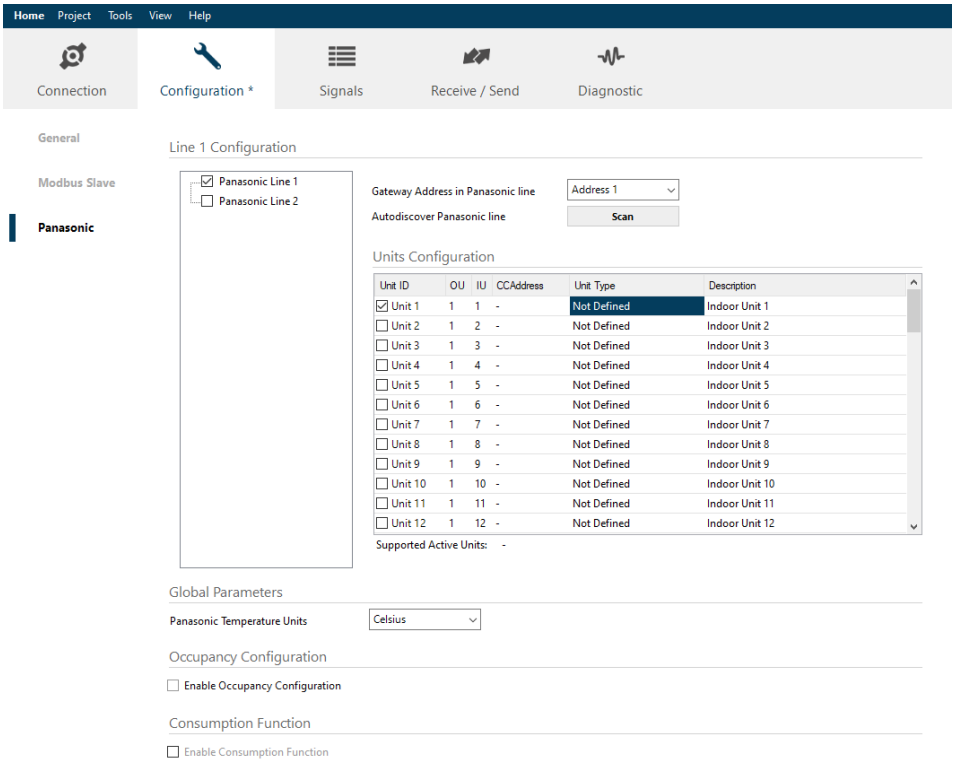


Figure 4.4 Intesis MAPS Panasonic configuration tab

Line configuration section

Each line of Panasonic needs to be addressed by using the parameter "**Gateway Address in Panasonic line".** There are 2 addresses reserved for the gateway in the Panasonic bus: address 1 and address 2.
Note that only the version of 128 units allows the connection to 2 Panasonic lines simultaneously. The 16- and 64-unit versions will only support the configuration of the "Panasoni Line 1".
In **Units Configuration** section you need to enter, for each unit:

- **Unit ID**. If it's active (checkbox at Unit xx), ranging from 1 to 64 indoor units that will be integrated (maximum number of units will depend on Intesis model)
- **OU address**. Address 1…64 of Outdoor Unit in Panasonic P-Link bus.
- **IU address**. Address 1…64 of Unit in Panasonic P-Link bus.
- **Unit type.** Type will default to 'Not Defined'. When units have been detected after scan, it can be one of the following: TBD, GHP, PAC and VRF
- **Description**. Descriptive name to easy identification of the unit (for example, 'living room floor 1 unit', etc).

Additional to manual entry of each unit, autodiscover of present units in a P-Link installation is possible. To do so, click button **Scan**. Following window will appear:

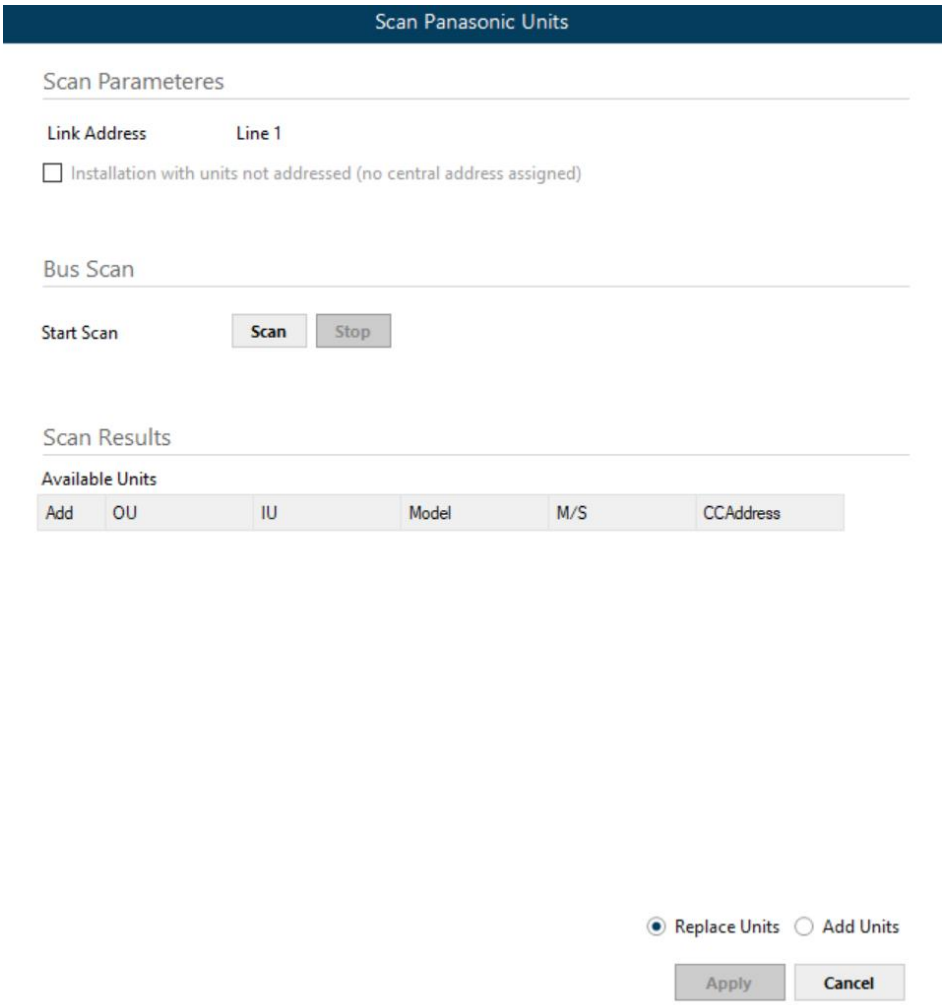


Figure 4.5 Intesis MAPS Scan Panasonic Units window

Scan parameters:
There are 2 different types of Scan to be applied. By default, the fastest one is defined since it is assumed that Panasonic units (indoor units and outdoor units) have been addressed. However, and only in case the units do not have an address assigned, the parameter **"Installation with units not addressed (no central address assigned)"** must be selected.

Please take into consideration that when the installation is not addressed, the scan process might take longer than the standard scan (up to 60 min). To decrease this time, it is highly recommended to reduce the OU range to be scanned as much as possible:

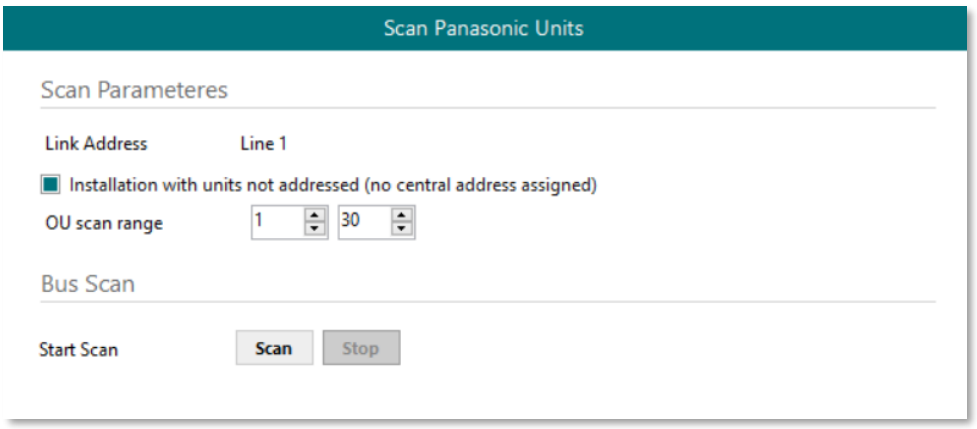


Figure 4.6 Intesis MAPS Long Scan Panasonic Units window

By pressing **Scan** button, connected Panasonic P-Link bus will be scanned for available units. Error window will appear if there is a problem in the connection with P-Link bus (units not powered, bus not connected, …).

A progress bar will appear during the scan, which will take up to a few minutes. After scan is complected, detected units will be shown in available units as follows:

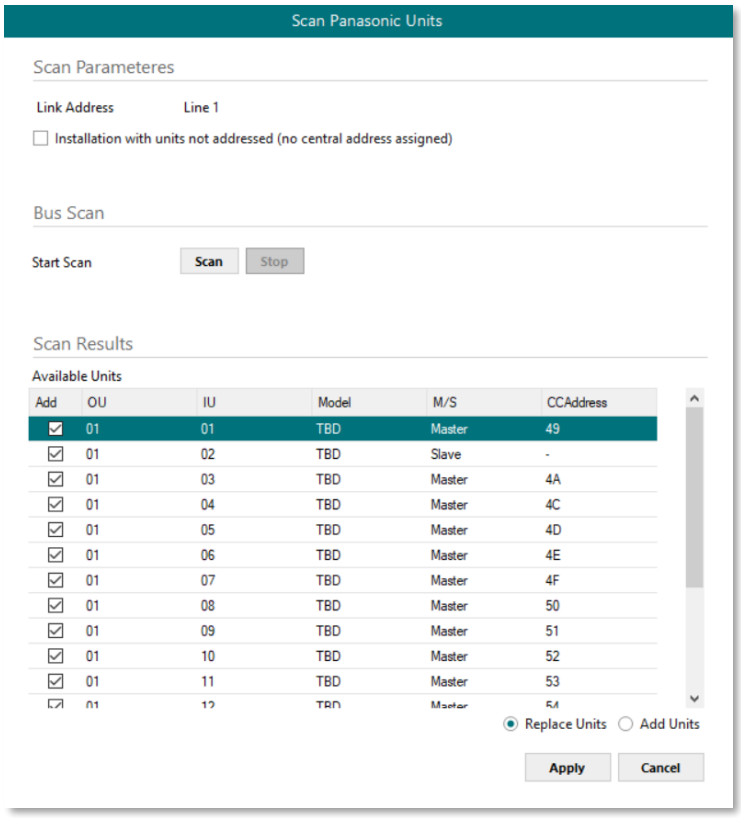


Figure 4.7 Intesis MAPS Scan Panasonic Units window with scan results

Select with its checkbox units to add (or replace) in installation, according to selection **Replace Units** / **Add Units**. After units to be integrated are selected, click button **Apply**, and changes will appear in previous **Units Configuration** window.

Global Parameters:

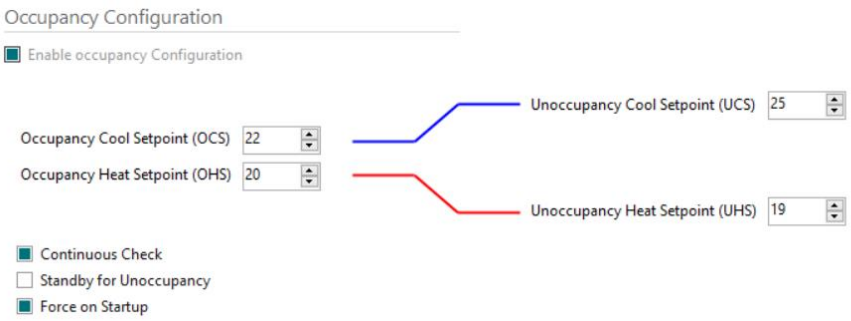
In this section it is possible to select the temperature units for monitoring of the temperature signals available in the gateways, Celsius (ºC) or Fahrenheit (ºF).

Occupancy Function

Each indoor unit has its own occupancy signal. Remember that this signal needs to be feed by an external presence sensor which indicates if there is presense or not (occupancy). This signal is processed directly in the Intesis gateway.

To enable the use of this function, check the parameter “Enable occupancy Configuration” available in Panasonic configuration tab.

This functionality modifies 3 parameters from the AC system: Setpoint, Mode and On/Off.



1. ***Occupancy/Unoccupancy Cool Setpoint (OCS/UCS)*:** Default value for setpoint temperature to be set when Occupancy/Unoccupancy is enabled and current mode is cool. UCS must always be greater or equal to OCS. Difference between OCS and OHS must be greater or equal to 2ºC/4ºF. It can be changed later through ModBus (*Occ_Cool_setpoint and Unocc_Cool_Setpoint ModBus registers*) and newer value will persist.
2. ***Occupancy/Unoccupancy Heat Setpoint (OHS/UHS)*:** Default value for setpoint temperature to be set when Occupancy/Unoccupancy is enabled and current mode is heat. UHS must always be smaller or equal to OHS. Difference between OCS and OHS must be greater or equal to 2ºC/4ºF. It can be changed later through ModBus (*Occ_Heat_setpoint and Unocc_Heat_Setpoint ModBus registers*) and newer value will persist.
3. **Continous check:** This checkbox is used to determine if the gateway will check the occupancy conditions constantly (check) or not (unchecked) by default. That means that with the the checkbox active, conditions are checked on each change of the temperature too, while if unchecked, this is only checked when the occupancy status changes. This check option can be changed later through ModBus (*Occ_ContinousCheck ModBus registers*) and newer value will persist.
4. **Standby for Unoccupancy:** This checkbox determines the action to be taken while the ambient temperature is in between the deadband. If unchecked, indoor unit will turn off and if checked will reamin on. It can be changed later through ModBus (Unocc_DeadbandAcion *ModBus registers*) and newer value will persist.
5. **Force on startup:** If checked, values set in the configuration screen will be loaded after a reset. If unchecked, last values selected (as it can be changed through *ModBus registers*) will be loaded after reset.

Note that the default units are in ªC and when changing from Celsius to Fahrenehit and vice versa all values are set to its default values.

When **occupancy mode is active** (there is presence in the room), according to current room temperature, **mode**, **setpoint** and **on/off** will be set to:

Condition	Setpoint	Mode	On/Off
Room temperature > OCS	Current OCS value	Cool	On
Room temperature < OHS	Current OHS value	Heat	On
OCS < Room temperature > OHS	OCS/OHS depending on current mode (If Fan or Dry mode is active, no setpoint is sent)	Current mode	On

When **unoccupancy mode is active** (there is no presence in the room), according to current room temperature, **mode**, **setpoint** and **on/off** will be set to:

Condition	Setpoint	Mode	On/Off
Room temperature > OCS	Current UCS value	Cool	On
Room temperature < OHS	Current UHS value	Heat	On
OCS < Room temperature > OHS	UCS/UHS depending on current mode (If Fan or Dry mode is active, no setpoint is sent)	Current mode	On (Deadband action =1)
			Off (Deadband action =0)

These checks will be done each time the indoor unit occupancy status is changed and each time the room temperature changes if ***check continuously*** checkbox is checked.

The configuration set on the occupany tab is applied from the very first moment the occupancy signal is enabled until the user changes the setpoint, mode or the On/Off signal, which disables occupancy functionality.

Consumption function

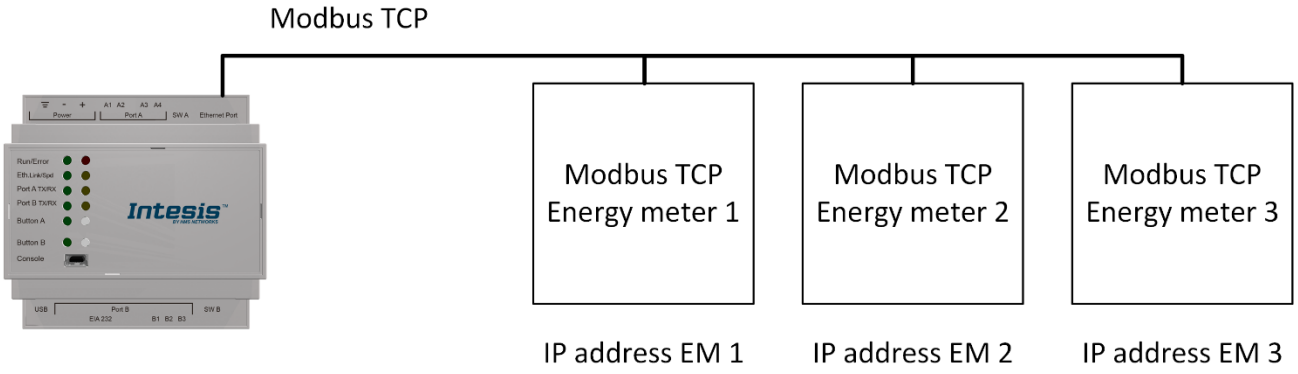
The consumption function will allow to monitor the energy consumption in kWh of the configured indoor untis. Once the function is enabled, the following signals become active for each indoor unit:

54	☑	Consumption Yesterday (kWh)	16	0: Unsigned	130	- 0: Read	Unit 1 - Indoor Unit 1	1	1	Line 1
55	☑	Consumption Today (kWh)	16	0: Unsigned	131	- 0: Read	Unit 1 - Indoor Unit 1	1	1	Line 1
56	☑	Consumption Total (kWh)	16	0: Unsigned	132	- 0: Read	Unit 1 - Indoor Unit 1	1	1	Line 1

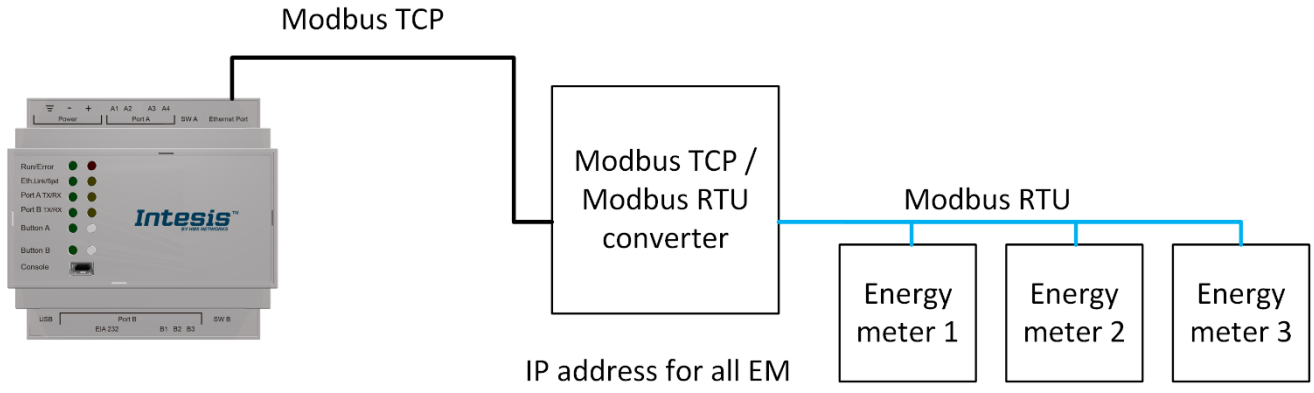
In this section it is possible to configure and link up to three Modbus Energy Metters with the Panasonic system.

Modbus TCP and Modbus RTU meters may be used. Consider that using Modbus RTU meters needs a Modbus RTU/TCP conversor in order to make them reacheable from the Intesis device.

Scheme 1: Modbus TCP Energy meters



Scheme 2: Modbus RTU Energy meters with Modbus TCP/RTU converter



Before continuing with this section, it is recommended to configure Panasonic system in advanced and setup and test the Modbus energy meters.

Once the above is completed, the recommended steps configuration for the energy meters in Maps are:

1) Enable consumption function and click in *Edit* button:

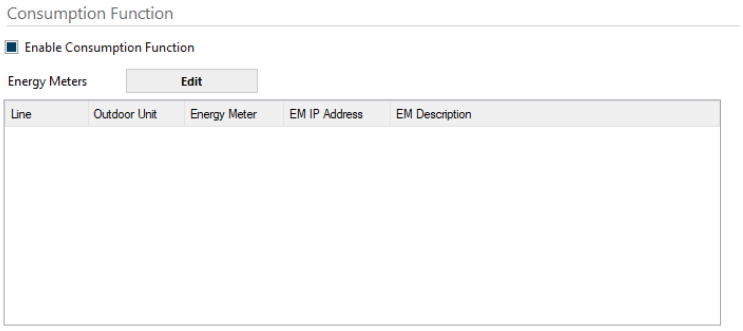


Figure 4.8 Consumption function settings

It will display this pop-up window:

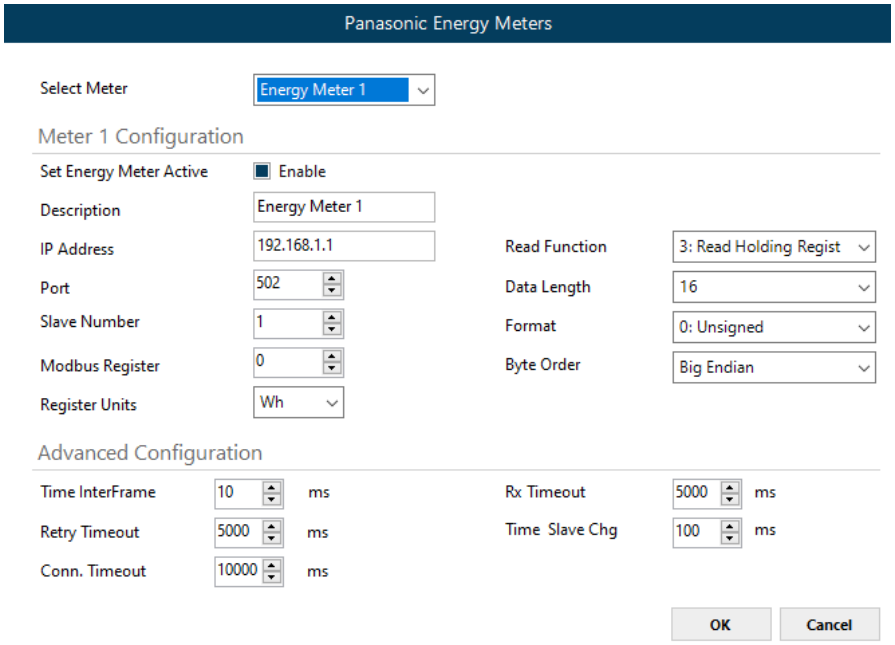


Figure 4.9 Energy meters configuration window

It is possible to configure up to three energy meters using the selector at the top.

2) Energy meter configuration
The settings for the meters are:

Settings related to the installation:

- **Set energy meter active**. It enables/disables the energy meter.
- **Description.** Internal description for the meter.
- **IP Address.** IP address where the energy meter is located.
- **Port.** Port for the Modbus TCP/IP connection. 502 port by default.
- **Slave number.** Slave Modbus address of the energy meter (**1 to 254**).

Settings related to the energy meter:

- **Modbus register (active energy imported).** Modbus register to read (**1 to 3000**).
- **Register units.** Units of the energy: **Wh / kWh**.
- **Read function.** Modbus Read function to use with this register. Functions **3: Read Holding Registers** and function **4: Read Input Registers** are supported.
- **Data length.** Set the length of the data. (16, 32 or 64 data bits).
- **Format.** Set the data format: **0: Unsigned / 1: Signed (C2) / 2: Signed (C1) / 3: Float**.
- **Byte order.** Set the data byte order: **Big Endian / Little Endian / Word Inv BE / Word Inv LE**.

In addition to these settings, it is possible to modify some Modbus parameters to adapt the Modbus communication to every installation. Usually, these settings should be left by default for a proper communication with the meter.

Figure 4.10 Detail for the Modbus configuration settings

Once this part is concluded, close the window using OK button to save the changes.

3) Assign energy meters to the Panasonic outdoor units.

The link between the meters and the Panasonic system is done in the next table:

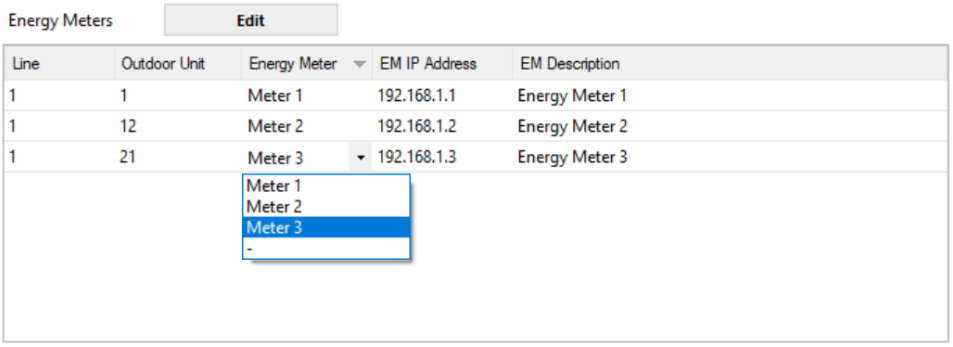


Figure 4.11 Energy meters table. Link between Modbus meter and Panasonic unit

To display the Panasonic outdoor units in this part of the configuration they must exist in Line 1 / Line 2 Configuration.

4.2.6. Signals

All available Modbus registers, its corresponding description and other main parmaters are listed in the signals tab.

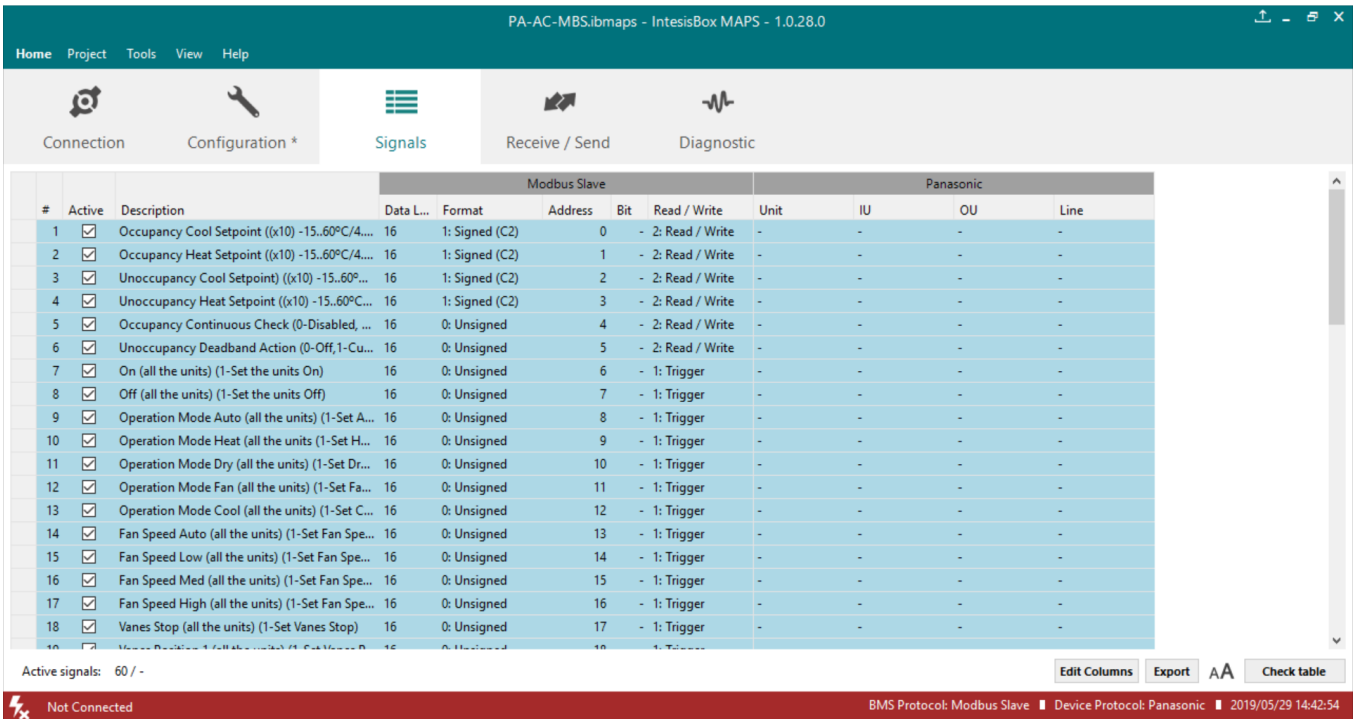


Figure 4.12 Intesis MAPS Signals tab

4.2.7. Sending the configuration to Intesis

When the configuration is finished, follow the next steps.

1.- Save the project (Menu option ***Project->Save***) on your hard disk (more information in Intesis MAPS User Manual).

2.- Go to tab '**Receive / Send**' of MAPS, and in **Send** section, press ***Send*** button. Intesis will reboot automatically once the new configuration is loaded.

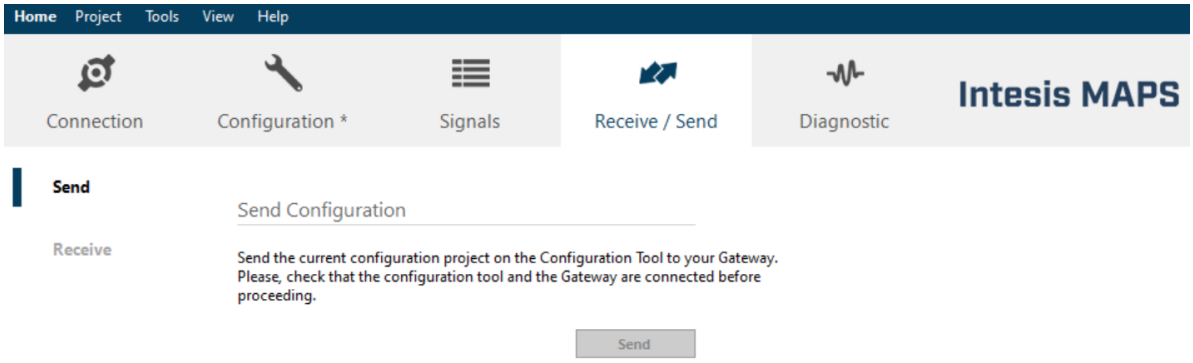


Figure 4.13 Intesis MAPS Receive/Send tab

After any configuration change, do not forget to send the configuration file to the Intesis using the Send button in the Receive / Send section.

4.2.8. Diagnostic

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

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, change the Diagnostic panels' view or send commands to the gateway.

- **Viewers**
  To check the 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.

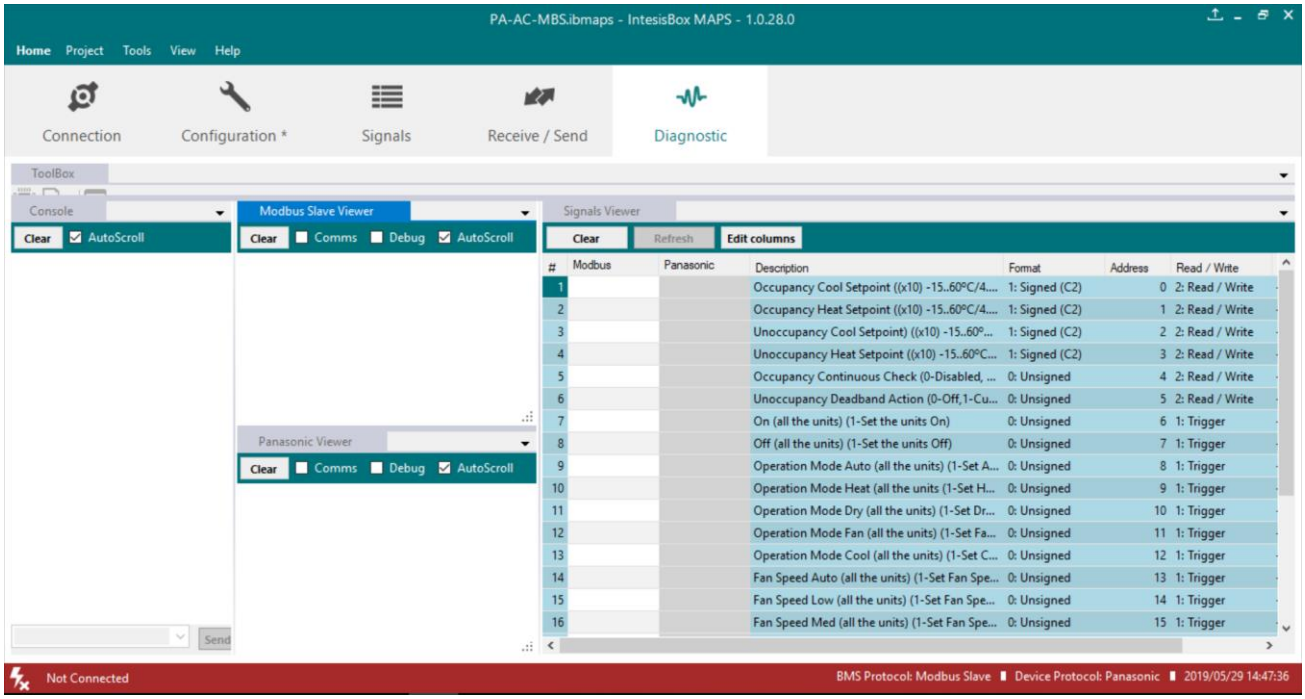


Figure 4.14 Diagnostic

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

4.2.9. Set-up procedure

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

2. Install Intesis 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. If using **Modbus RTU**, connect the communication cable coming from the EIA485 port of the Modbus RTU installation to the port marked as Port B of Intesis. **Not available for INMBSPAN128O000**. More details in 3 CONNECTIONS.

   If using, **Modbus TCP**, connect the communication cable coming from the Ethernet port of the Modbus TCP installation to the port marked as Ethernet Port of Intesis. More details in 3 CONNECTIONS.

4. Connect the communication cable coming from the **Panasonic VRF** installation to the port marked as Port A of Intesis.

   If connecting a second **Panasonic VRF** installation, connect it to the port marked as Port B. **Only available for INMBSPAN128O000**. More details in 3 CONNECTIONS.

5. Power up Intesis. The supply voltage can be 9 to 36 Vdc or just 24 Vac. Take care of the polarity of the supply voltage applied.

   WARNING! To avoid earth loops that can damage Intesis 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 Intesis. More details in 3 CONNECTIONS.

   If you want to connect using USB, connect the USB cable from the laptop PC to the port marked as Console of Intesis. More details in 3 CONNECTIONS.

7. Open Intesis MAPS, create a new project selecting a copy of the one named **INMBSPAN---O000**.

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

9. Visit the Diagnostic section, enable COMMS () and check that there is communication activity, some TX frames and some other RX frames. This means that the communication with the Centralized Controller and Modbus Master devices is OK. In case there is no communication activity between Intesis and the Centralized Controller 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.

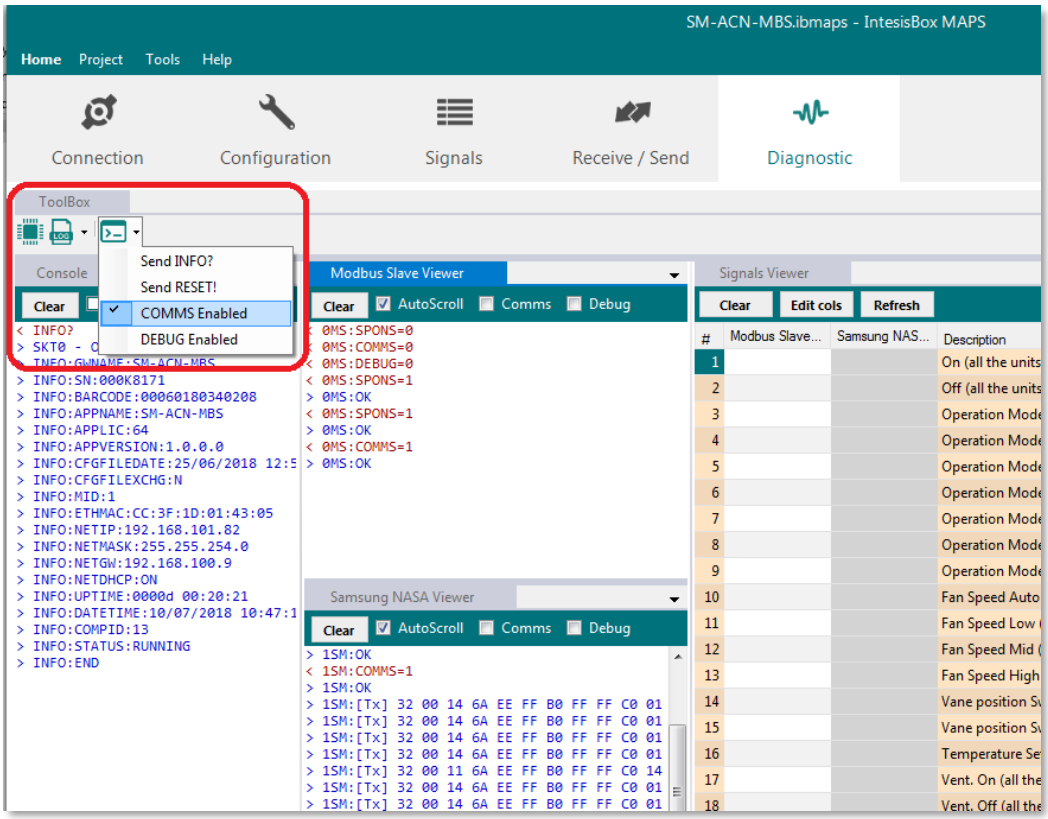


Figure 4.15 Enable COMMS

5. Electrical & Mechanical Features

5.1. Intesis ModBus Server for Panasonic 16 and 64 units

Enclosure	Plastic, type PC (UL 94 V-0) Net dimensions (dxwxh): 90x88x56 mm Recommended space for installation (dxwxh): 130x100x100mm Color: Light Grey. RAL 7035
Mounting	Wall. DIN rail EN60715 TH35.
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 If cables are more than 3.05 meters long, Class 2 cable is required.
Power	1 x Plug-in screw terminal block (3 poles) 9 to 36VDC +/-10%, Max.: 140mA. 24VAC +/-10% 50-60Hz, Max.: 127mA Recommended: 24VDC
Ethernet	1 x Ethernet 10/100 Mbps RJ45 2 x Ethernet LED: port link and activity
Port A	1 x P-Link Plug-in screw terminal block orange (2 poles) 1500VDC isolation from other ports 1 x Plug-in screw terminal block green (2 poles) Reserved for future use
Switch A (SWA)	1 x DIP-Switch for EIA485 configuration: Reserved for future use
PORT B	1 x Serial EIA232 (SUB-D9 male connector) *Not used* 1 x Serial EIA485 Plug-in screw terminal block (3 poles) A, B, SGND (Reference ground or shield) 1500VDC isolation from other ports
Switch B (SWB)	1 x DIP-Switch for serial EIA485 configuration: Position 1: **ON:** 120 Ω termination active **Off:** 120 Ω termination inactive (default) Position 2-3: **ON:** Polarization active **Off:** Polarization inactive (default)

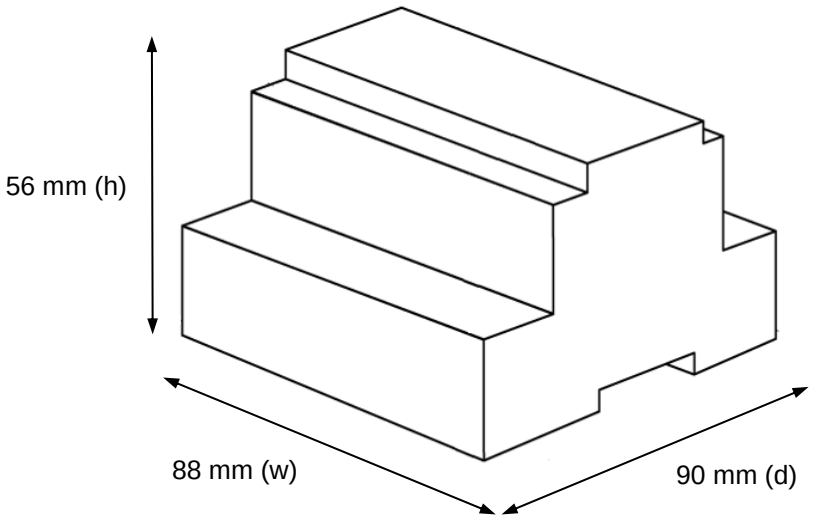
Battery	Size: Coin 20mm x 3.2mm Capacity: 3V / 225mAh Type: Manganese Dioxide Lithium
Console Port	Mini Type-B USB 2.0 compliant 1500VDC isolation
USB port	Type-A USB 2.0 compliant Only for USB flash storage device *(USB pen drive)* Power consumption limited to 150mA *(HDD connection not allowed)*
Push Button	Button A: Not used Button B: Not used
Operation Temperature	0°C to +60°C
Operational Humidity	5 to 95%, no condensation
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

5.2. Intesis ModBus Server for Panasonic 128 units

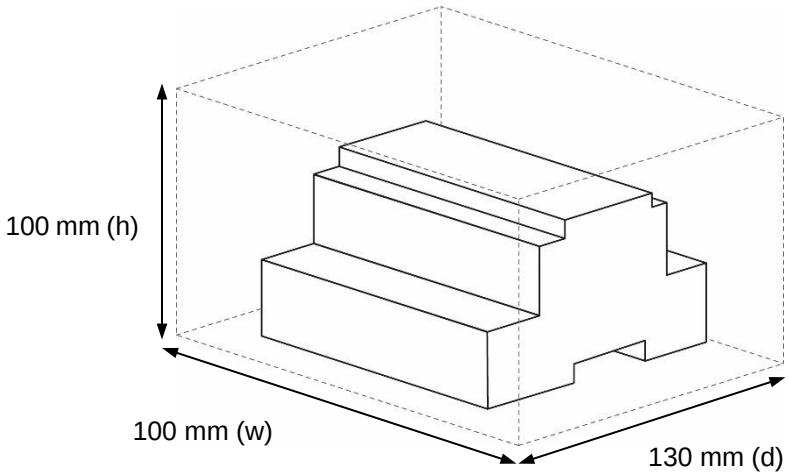
Enclosure	Plastic, type PC (UL 94 V-0) Net dimensions (dxwxh): 90x88x56 mm Recommended space for installation (dxwxh): 130x100x100mm Color: Light Grey. RAL 7035
Mounting	Wall. DIN rail EN60715 TH35.
Terminal Wiring (for power supply and low-voltage signals)	Per terminal: solid wires or stranded wires (twisted or with ferrule) 1 core: 0.5mm^2… 2.5mm^2 2 cores: 0.5mm^2… 1.5mm^2 3 cores: not permitted If cables are more than 3.05 meters long, Class 2 cable is required.
Power	1 x Plug-in screw terminal block (3 poles) 9 to 36VDC +/-10%, Max.: 140mA. 24VAC +/-10% 50-60Hz, Max.: 127mA Recommended: 24VDC
Ethernet	1 x Ethernet 10/100 Mbps RJ45 2 x Ethernet LED: port link and activity
Port A	1 x P-Link 1 Plug-in screw terminal block orange (2 poles) 1500VDC isolation from other ports 1 x Plug-in screw terminal block green (2 poles) Reserved for future use
Switch A (SWA)	1 x DIP-Switch for EIA485 configuration: Reserved for future use
PORT B	1 x Serial EIA232 (SUB-D9 male connector) *Not used* 1 x P-Link 2 Plug-in screw terminal block orange (2 poles) 1500VDC isolation from other ports
Switch B (SWB)	1 x DIP-Switch for serial EIA485 configuration: Reserved for future use

Battery	Size: Coin 20mm x 3.2mm Capacity: 3V / 225mAh Type: Manganese Dioxide Lithium
Console Port	Mini Type-B USB 2.0 compliant 1500VDC isolation
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)*
Push Button	Button A: Not used Button B: Not used
Operation Temperature	0°C to +60°C
Operational Humidity	5 to 95%, no condensation
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

6. Dimensions



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



7. AC Unit Types compatibility

The gateway is compatible with Panasonic VRF units belonging to ECOi, ECOg and PACi series.

8. Error codes for Indoor and Outdoor Units

This list contains all possible values shown in Modbus register for “Error Code” for each indoor unit and outdoor unit.

It must be taken into account that Outdoor Units are only able to reflect a single error for each indoor / outdoor unit in the system. Thus, a unit having two or more active errors from that list will only report a single error code – the one of the first error that has been detected.

Error Code	Error in Control Panel	Error category	Error Description
0	N/A	N/A	No active error
1	A01	GHP Engine Issues	GHP - Engine oil pressure fault
2	A02		GHP - Engine oil level fault
3	A03		GHP - Engine over speed
4	A04		GHP - Engine under speed
5	A05		GHP - Ignition power supply failure
6	A06		GHP - Engine start up failure
7	A07		GHP - Fuel gas valve failure
8	A08		GHP - Engine stalled
9	A09		GHP - Engine overload
10	A10		GHP - High exhaust gas temp
11	A11		GHP - Engine oil level failure
12	A12		GHP - Throttle actuator fault
13	A13		GHP - Fuel gas valve adjustment failure
14	A14		GHP - Engine oil pressure sensor fault
15	A15		GHP - Starter power output short circuit
16	A16		GHP - Starter motor locked
17	A17		GHP - Starter current (CT) coil failed
19	A19		GHP - Wax Valve (3 Way) fault
20	A20		GHP - Cooling water temp high
21	A21		GHP - Cooling water level fault
22	A22		GHP - Cooling water pump fault
23	A23		GHP - Engine crank angle sensor failure
24	A24		GHP - Engine cam angle sensor failure
25	A25		GHP - Clutch fault
26	A26		GHP - Misfire
27	A27		GHP - Catalyst temperature fault
28	A28		GHP - Generator fault
29	A29		GHP - Converter fault
30	A30		GHP - Fuel gas pressure low
33	C01	Central Controller Issues	Duplicated setting of control address
34	C02		Central control number of units mis-matched
35	C03		Incorrect wiring of central control
36	C04		Incorrect connection of central control
37	C05		System Controller fault, error in transmitting comms signal, i/door or o/door unit not working, wiring fault
38	C06		System Controller fault, error in receiving comms signal, i/door or o/door unit not working, wiring fault, CN1 not connected correctly
44	C12		Batch alarm by local controller
48	C16		Transmission error from adaptor to unit
49	C17		Reception error to adaptor from unit
50	C18		Duplicate central address in adaptor
51	C19		Duplicate adaptor address
52	C20		Mix of PAC & GHP type units on adaptor
53	C21		Memory fault in adaptor
54	C22		Incorrect address setting in adaptor
55	C23		Host terminal software failure

Error Code	Error in Control Panel	Error category	Error Description
56	C24		Host terminal hardware failure
57	C25		Host terminal processing failure
58	C26		Host terminal communication failure
60	C28		Reception error of S-DDC from host terminal
61	C29		Initialization failure of S-DDC
63	C31		Configuration change detected by adaptor
65	E01	Addressing and Communication Problems	Remote control detecting error from indoor unit, Address not set/Auto address failed. Check interconnecting wiring etc. Re-address system.
66	E02		Remote detecting error from indoor unit,
67	E03		Indoor unit detecting error from remote,
68	E04		Indoor seeing error from outdoor. Qty of i/d units connected are less than qty set. Check; all i/d units are ON, reset turn off all units wait 5min power up
69	E05		Indoor unit detecting error from outdoor unit, Error in sending comms signal
70	E06		Outdoor unit detecting error from indoor unit, Error in receiving comms signal
71	E07		Outdoor unit detecting error from indoor unit, Error in sending comms signal
72	E08		Incorrect setting indoor/controller, Indoor address duplicated
73	E09		Incorrect setting indoor/controller, Remote address duplicated or IR wireless controller not disabled
74	E10		Indoor unit detecting error from 'option' plug, Error in sending comms signal
75	E11		Indoor unit detecting error from 'option' plug, Error in receiving comms signal
76	E12		Auto addressing failed, Auto address connector CN100 shorted during auto addressing
77	E13		Indoor unit failed to send signal to remote controller
78	E14		Setting Failure, Duplication of master indoor units
79	E15		Auto addressing failed, Number of indoor units connected are less than number set
80	E16		Auto addressing failed, Number of indoor units connected are more than number set
81	E17		Group control wiring error, Main indoor unit not sending signal for sub indoor units
82	E18		Group control wiring error, Main indoor unit not receiving signal for sub indoor units
84	E20		Auto addressing failed, No indoor units connected
88	E24		Auto addressing failed, Error on sub outdoor unit
89	E25		Auto addressing failed, Error on outdoor unit address setting
90	E26		Auto addressing failed, Quantity of main and sub outdoor units do not correspond to the number set on main outdoor unit P.C.B.
93	E29		Auto addressing failed, Sub outdoor unit not receiving comms for main outdoor unit
95	E31		Between units, Comms failure with MDC, does E31 remain after power is re-instated? If so replace PCB. & power PCB
97	F01	Sensor Faults	Indoor Heat Exch inlet temp sensor failure (E1)
98	F02		Indoor Heat Exch freeze temp sensor failure (E2)
99	F03		Indoor Heat Exch outlet temp sensor failure (E3)
100	F04		Outdoor Discharge temp sensor failure (TD) or (DISCH1)
101	F05		Outdoor Discharge temp sensor failure (DISCH2)
102	F06		Outdoor Heat Exch temp sensor failure (C1) or (EXG1)
103	F07		Outdoor Heat Exch temp sensor failure (C2) or (EXL1)
104	F08		Outdoor Air temp sensor failure (TO)

Error Code	Error in Control Panel	Error category	Error Description
106	F10		Indoor inlet temp sensor failure
107	F11		Indoor outlet temp sensor failure
108	F12		Outdoor Intake sensor failure (TS)
109	F13		GHP - Cooling water temperature sensor failure
112	F16		Outdoor High pressure sensor failure
113	F17		GHP - Cooling water temperature sensor fault
114	F18		GHP - Exhaust gas temperature sensor fault
116	F20		GHP Clutch coil temperature fault
119	F23		Outdoor Heat Exch temp sensor failure (EXG2)
120	F24		Outdoor Heat Exch temp sensor failure (EXL2)
125	F29		Indoor EEPROM error
126	F30		Clock Function (RTC) fault
127	F31		Outdoor EEPROM error
129	H01	Compressor Issues	Compressor Fault, Over current (Comp1)
130	H02		Compressor Fault, Locked rota current detected (Comp1)
131	H03		Compressor Fault, No current detected (Comp1)
133	H05		Compressor Fault, Discharge temp not detected (Comp1)
134	H06		Compressor Fault, Low Pressure trip
135	H07		Compressor Fault, Low oil level
136	H08		Compressor Fault, Oil sensor Fault (Comp1)
139	H11		Compressor Fault, Over current (Comp2)
140	H12		Compressor Fault, Locked rota current detected (Comp2)
141	H13		Compressor Fault, No current detected (Comp2)
143	H15		Compressor Fault, Discharge temp not detected (Comp2)
149	H21		Compressor Fault, Over current (Comp3)
150	H22		Compressor Fault, Locked rota current detected (Comp3)
151	H23		Compressor Fault, No current detected (Comp3)
153	H25		Compressor Fault, Discharge temp not detected (Comp3)
155	H27		Compressor Fault, Oil sensor fault (Comp2)
156	H28		Compressor Fault. Oil sensor (connection failure)
159	H31		Compressor Fault. IPM trip (IMP current on temperature)
193	L01	Incorrect Settings	Setting Error, Indoor unit group setting error
194	L02		Setting Error, Indoor/outdoor unit type/model miss-matched
195	L03		Duplication of main indoor unit address in group control
196	L04		Duplication of outdoor unit system address
197	L05		2 or more controllers have been set as 'priority' in one system - shown on controllers set as 'priority'
198	L06		2 or more controllers have been set as 'priority' in one system - shown on controllers not set as 'priority'
199	L07		Group wiring connected on and individual indoor unit
200	L08		Indoor unit address/group not set
201	L09		Indoor unit capacity code not set
202	L10		Outdoor unit capacity code not set
203	L11		Group control wiring incorrect
205	L13		Indoor unit type setting error, capacity
207	L15		Indoor unit paring fault
208	L16		Water heat exch unit setting failure
209	L17		Miss-match of outdoor unit with different refrigerant
210	L18		4-way valve failure
211	L19		Water heat exch unit duplicated address
213	L21		Gas type setup failure
225	P01	Indoor Unit Problems	Indoor unit fault, Fan motor thermal overload
226	P02		Outdoor unit fault, Compressor motor thermal overload, over or under voltage