

# Modbus RTU (EIA-485) Interface for Panasonic and Sanyo air conditioners

Compatible with ECOi and PACi line models

## USER MANUAL

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## Modbus RTU (EIA-485) Interface for Panasonic and Sanyo air conditioners

### Compatible with ECOi and PACi line models

| ORDER CODE      | LEGACY ORDER CODE |
|-----------------|-------------------|
| INMBSPAN001R000 | PA-RC2-MBS-1      |

## Important User Information

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## 1. Presentation

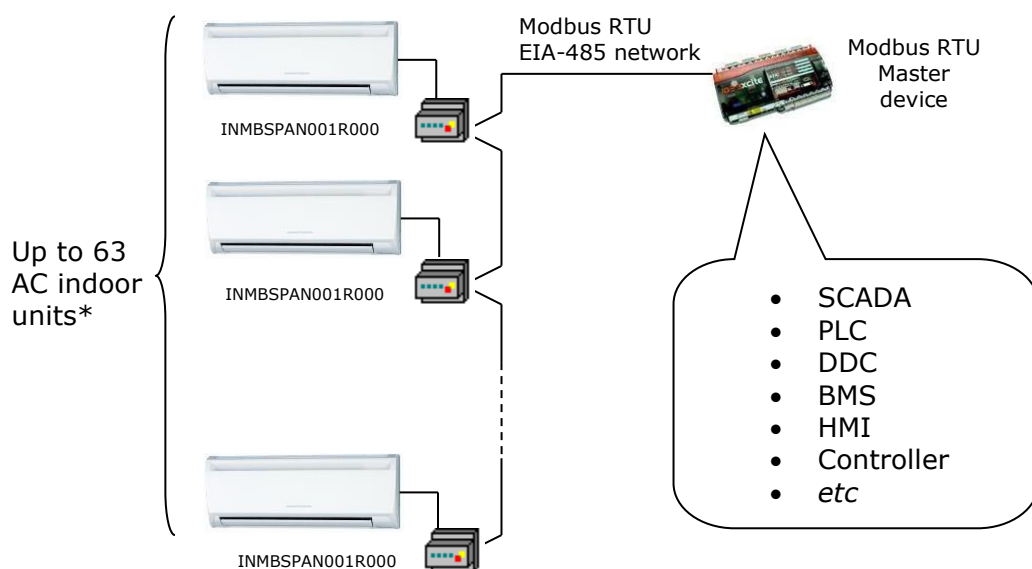


The INMBSPAN001R000 interfaces allow a complete and natural integration of **Panasonic** and **Sanyo** air conditioners into Modbus RTU (EIA-485) networks.

Compatible with all models of ECOi and PACi line

Reduced dimensions. 93 x 53 x 58 mm // 3.7" x 2.1" x 2.3"

- Quick and easy installation.  
*Mountable on DIN rail, wall, or even inside the indoor unit of AC.*
- External power not required.
- Direct connection to Modbus RTU (EIA-485) networks. Up to 63 INMBSPAN001R000 devices can be connected in the same network.  
*INMBSPAN001R000 is a Modbus slave device.*
- Direct connection to the AC indoor unit. Up to 16 AC indoor units can be connected to INMBSPAN001R000, controlling them as one (not individually).
- Configuration from both on-board DIP-switches and Modbus RTU.
- Total Control and Supervision.
- Real states of the AC unit's internal variables.
- Allows simultaneous use of the AC's remote controls and Modbus RTU.



\* Up to 63 Intesis devices can be installed in the same Modbus RTU bus. However, depending on the configured speed, the installation of Modbus Repeaters may be required

## 2. Connection

The interface comes with a plug-in terminal block of 2 poles to establish direct connection with the AC indoor unit. It comes as well with a plug-in terminal block of 2 poles to establish direct connection with the Modbus RTU EIA-485 network.

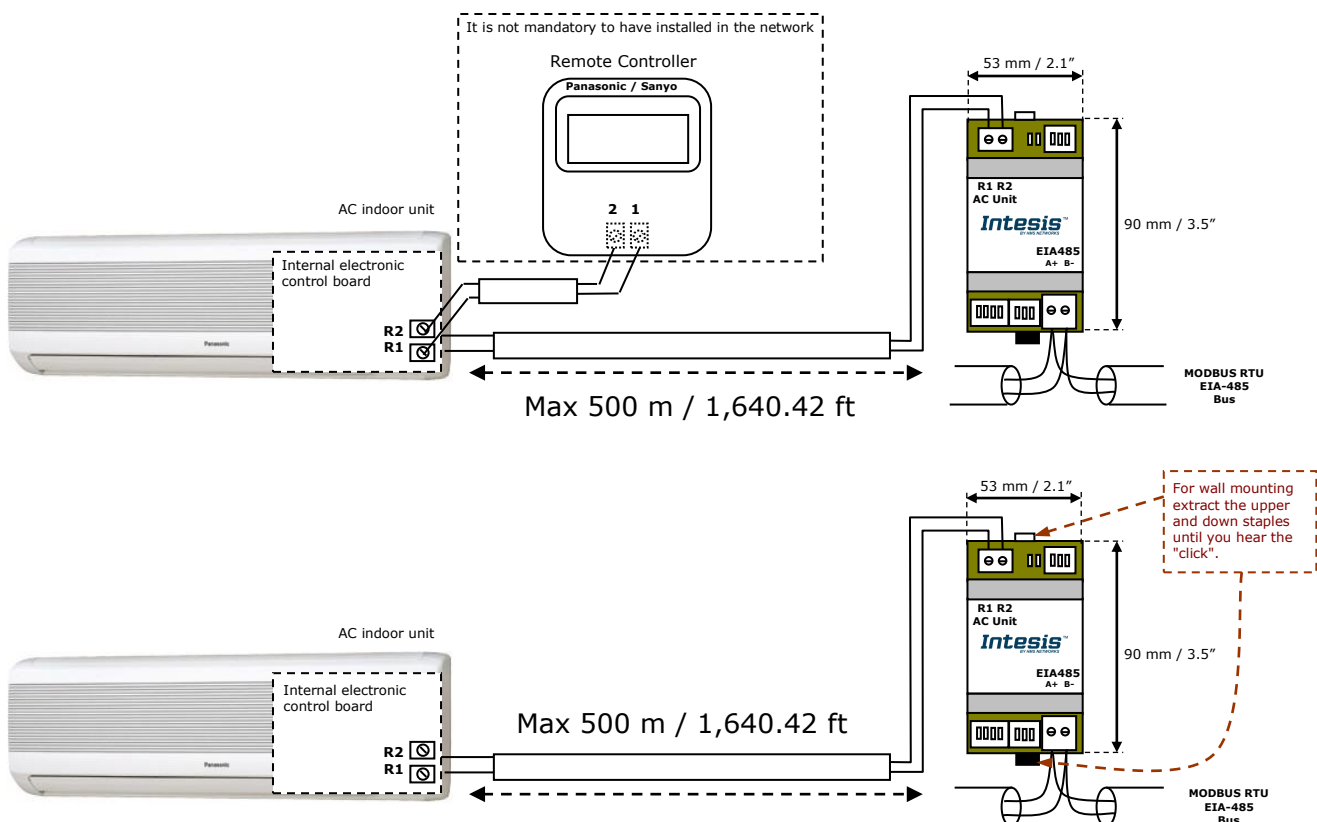
### 2.1 Connect to the AC indoor unit

The INMBSPAN001R000 connects directly to the Panasonic R1R2 Bus, which is not provided within the interface. The recommended connection methods are the following ones (details in Figure 2.1):

- **Wired remote control available. It is not recommended to install more than 1 Remote Controller in the bus R1R2.**
- **No remote control available**

Maximum R1R2 bus length is 500 meters / 1,640.42 ft. The bus has no polarity sensitivity.

**Important:** If a wired remote controller of the AC manufacturer is connected in the same bus, communication may shut down.



**Figure 2.1** INMBSPAN001R000 connection diagram

## 2.2 Connection to the EIA-485 bus

Connect the EIA-485 bus wires to the plug-in terminal block of INMBSPAN001R000 and keep the polarity on this connection (A+ and B-). Make sure that the maximum distance to the bus is 1,200 meters (3,937 ft). Loop or star typologies are not allowed in the case of the EIA-485 bus. A terminator resistor of 120Ω must be present at each end of the bus to avoid signal reflections. The bus needs a fail-safe biasing mechanism (see section 4.6 for more details).

## 3. Quick Start Guide


1. Disconnect the air conditioning from the Mains Power.
2. Attach the interface next to the AC indoor unit (wall mounting) following the instructions of the diagram below or install it inside the AC indoor unit (respect the safety instructions given).
3. Connect the R1R2 bus between the interface and the AC indoor unit following the instructions of the diagram. Screw each bare cable end in the corresponding R1R2 terminals of each device.
4. Connect the EIA-485 bus to the connector *EIA485* of the interface.
5. Close the AC indoor unit.
6. Check the DIP-Switch configuration of the Intesis interface and make sure it matches the current installation's parameters:

By default, the interface is set to:

- Modbus Slave Address → 1
- Modbus baud rate → 9600 bps



These parameters can be modified from SW4 and SW3 DIP-Switches.

All other switch positions are set at low level (Off position ) by default.

**NOTE:** All changes on the DIP-Switch configuration require a system power cycle to be applied.

7. Connect the AC system to Mains Power.

**IMPORTANT:** The Intesis interface requires to be connected to the AC unit (powered) to start communicating.

## 4. Modbus Interface Specification

### 4.1 Modbus physical layer

INMBSPAN001R000 implements a Modbus RTU (Slave) interface, to be connected to an EIA-485 line. It performs 8N2 communication (8 data bits, no parity and 2 stop bit) with several available baud rates (2400 bps, 4800 bps, 9600 bps -default-, 19200 bps, 38400 bps, 57600 bps, 76800 bps and 115200 bps). It also supports 8N1 communication (8 data bits, no parity and 1 stop bit).

**NOTE:** The gateway automatically detects the communication type (8N2 or 8N1) and sets itself accordingly. No action is needed.

### 4.2 Modbus Registers

All registers are type "16-bit unsigned Holding Register" and they use the *Modbus big endian* notation.

#### 4.2.1 Control and status registers

| Register Address<br>(protocol address) | Register Address<br>(PLC address) | R/W | Description                                                                                                                                                                                                                                        |
|----------------------------------------|-----------------------------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                                      | 1                                 | R/W | AC unit On/Off <ul style="list-style-type: none"> <li>0: Off</li> <li>1: On</li> </ul>                                                                                                                                                             |
| 1                                      | 2                                 | R/W | AC unit Mode <sup>1</sup> <ul style="list-style-type: none"> <li>0: Auto</li> <li>1: Heat</li> <li>2: Dry</li> <li>3: Fan</li> <li>4: Cool</li> </ul>                                                                                              |
| 2                                      | 3                                 | R/W | AC unit Fan Speed <sup>1</sup> <ul style="list-style-type: none"> <li>0: Auto</li> <li>1: Low</li> <li>2: Mid</li> <li>3: High</li> </ul>                                                                                                          |
| 3                                      | 4                                 | R/W | AC unit Vane Position <sup>1</sup> <ul style="list-style-type: none"> <li>0: Auto</li> <li>1: POS1 (Horizontal)</li> <li>2: POS2 (Horizontal)</li> <li>3: POS3 (Med)</li> <li>4: POS4 (Vert)</li> <li>5: POS5 (Vert)</li> <li>10: Swing</li> </ul> |
| 4                                      | 5                                 | R/W | AC unit Temperature Setpoint <sup>1,2,3</sup> <ul style="list-style-type: none"> <li>-32768 (Initialization value)</li> <li>16..32°C (°C/x10°C)</li> <li>61..90°F</li> </ul>                                                                       |

<sup>1</sup> Available values will depend on the AC unit mode. Check the AC unit model functions in its user manual to know the possible values for this register.

<sup>2</sup> Magnitude for this register can be adjusted to Celsius x 10°C, Celsius x 100°C (default) or Fahrenheit. See section 0 for more information.

<sup>3</sup> It is not possible turn to x10 the value shown in Fahrenheit.



| Register Address<br>(protocol address) | Register Address<br>(PLC address) | R/W | Description                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------|-----------------------------------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5                                      | 6                                 | R/W | AC unit Temperature reference <sup>1,2,3,4</sup> <ul style="list-style-type: none"> <li>-32768: Initialization value. Value invalid, which comes from the IU's sensor. If the value that is shown in register 22 (23 PLC) is valid, the address is going to take this value.</li> <li>Ranges are specific from Manufacturer (°C/x10°C/°F)</li> </ul>   |
| 6                                      | 7                                 | R/W | Window Contact <ul style="list-style-type: none"> <li>0: Closed (Default)</li> <li>1: Open</li> </ul>                                                                                                                                                                                                                                                  |
| 7                                      | 8                                 | R/W | INMBSPAN001R000 Disablement <sup>5</sup> <ul style="list-style-type: none"> <li>0: INMBSPAN001R000 enabled (Default)</li> <li>1: INMBSPAN001R000 disabled</li> </ul>                                                                                                                                                                                   |
| 8                                      | 9                                 | R/W | AC Remote Control Disablement <sup>5</sup> <ul style="list-style-type: none"> <li>0: Remote Control enabled (Default)</li> <li>1: Remote Control disabled</li> </ul>                                                                                                                                                                                   |
| 9                                      | 10                                | R/W | AC unit Operation Time <sup>5</sup> <ul style="list-style-type: none"> <li>0..65535 (hours). Counts the time the AC unit is in "On" state.</li> </ul>                                                                                                                                                                                                  |
| 10                                     | 11                                | R   | AC unit Alarm Status <ul style="list-style-type: none"> <li>0: No alarm condition</li> <li>1: Alarm condition</li> </ul>                                                                                                                                                                                                                               |
| 11                                     | 12                                | R   | Error Code <sup>6</sup> <ul style="list-style-type: none"> <li>0: No Error active</li> <li>65535 (-1): Error in the communication of INMBSPAN001R000 with the AC unit</li> <li>Any other error present, see the table at the end of this document.</li> </ul>                                                                                          |
| 22                                     | 23                                | R/W | Indoor unit's ambient temperature from external sensor (at Modbus side) <sup>4,7</sup> <ul style="list-style-type: none"> <li>-32768: Initialization value. No temperature is being provided from an input sensor. There's no input sensor.</li> <li>Other: (°C/x10°C/°F)</li> </ul>                                                                   |
| 23                                     | 24                                | R   | AC setpoint temperature <sup>1,2,3,4,7</sup> <ul style="list-style-type: none"> <li>When no external temperature is provided, this read-only register will have the same value as register 5 (PLC addressing). In all cases, it will show the current setpoint in the indoor unit.</li> <li>Ranges specific from Manufacturer (°C/x10°C/°F)</li> </ul> |
| 24                                     | 25                                | R   | Current AC max setpoint <sup>1,2,3,4</sup> <ul style="list-style-type: none"> <li>-32768 (Initialization value)</li> <li>Ranges are specific from Manufacturer (°C/x10°C/°F)</li> </ul>                                                                                                                                                                |
| 25                                     | 26                                | R   | Current AC min setpoint <sup>1,2,3,4</sup> <ul style="list-style-type: none"> <li>-32768 (Initialization value)</li> <li>Ranges are specific from Manufacturer (°C/x10°C/°F)</li> </ul>                                                                                                                                                                |

<sup>4</sup> The temperature's value shown has decimal precision(x0,5°C)

<sup>5</sup> This value is stored in non-volatile memory

<sup>6</sup> See section 7 for possible error codes and their explanation

<sup>7</sup> See section 4.2.3 for more information

| Register Address<br>(protocol address) | Register Address<br>(PLC address) | R/W | Description                                                                                                                                                                                                                            |
|----------------------------------------|-----------------------------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31                                     | 32                                | R   | Status (feedback) <ul style="list-style-type: none"> <li>0: Not active (Default value)</li> <li>1: Active (A window is open)</li> </ul>                                                                                                |
| 37                                     | 38                                | R   | Auto Mode <ul style="list-style-type: none"> <li>0: Auto</li> <li>1: Heat</li> <li>2: Dry</li> <li>3: Fan</li> <li>4: Cool</li> </ul>                                                                                                  |
| 40                                     | 41                                | R   | Window contact ON/OFF Disabling <ul style="list-style-type: none"> <li>0: Window contact is not disabling option On/Off at this moment (Default value)</li> <li>1: Window contact is disabling option On/Off at this moment</li> </ul> |
| 44                                     | 45                                | R   | Filter status <ul style="list-style-type: none"> <li>0: Off (Default value)</li> <li>1: Lit</li> </ul>                                                                                                                                 |
| 65                                     | 66                                | R   | Input reference temp. (feedback) <sup>1,2,3,4</sup> <ul style="list-style-type: none"> <li>-32768 (Initialization value)</li> <li>Any: (°C/x10°C/°F)</li> </ul>                                                                        |
| 66                                     | 67                                | R   | Return Path temperature <sup>1,2,3,4</sup> <ul style="list-style-type: none"> <li>-32768 (Initialization value)</li> <li>Any: (°C/x10°C/°F)</li> </ul>                                                                                 |
| 97                                     | 98                                | R/W | Block Periodic Sendings <sup>5,8,9</sup> <ul style="list-style-type: none"> <li>0: Non-blocked (Default value)</li> <li>1: Blocked</li> </ul>                                                                                          |
| 4001                                   | 4002                              | R   | Indoor Unit Master Force Thermo Off <sup>10</sup> <ul style="list-style-type: none"> <li>0: No Limit</li> <li>1: Thermo Forced Off</li> </ul>                                                                                          |
| 4002                                   | 4003                              | R   | Indoor Unit Master Error Code <sup>10</sup> <ul style="list-style-type: none"> <li>0: No Error active</li> <li>65535 (-1): Communication Error</li> <li>Any other error present, check the Manual of the Indoor Unit.</li> </ul>       |
| 4003                                   | 4004                              | R   | Indoor Unit Master Setpoint Temp. <sup>1,2,3,4,10</sup> <ul style="list-style-type: none"> <li>-32768 (Initialization value)</li> <li>Any: (°C/x10°C/°F)</li> </ul>                                                                    |
| 4004                                   | 4005                              | R   | Indoor Unit Master Room Temp. <sup>1,2,3,10</sup> <ul style="list-style-type: none"> <li>-32768 (Initialization value)</li> <li>Any: (°C/x10°C/°F)</li> </ul>                                                                          |
| 4011                                   | 4012                              | R   | Indoor Unit Slave Force Thermo Off <sup>10</sup> <ul style="list-style-type: none"> <li>0: No Limit</li> <li>1: Thermo Forced Off</li> </ul>                                                                                           |
| 4012                                   | 4013                              | R   | Indoor Unit Slave Error Code <sup>10</sup> <ul style="list-style-type: none"> <li>0: No Error active</li> <li>65535 (-1): Communication Error</li> <li>Any other error present, check the Manual of the Indoor Unit.</li> </ul>        |

<sup>8</sup> If the register is configured as "0:Non-blocked", all commands received from Modbus will be sent to the AC system. If "1: Blocked", commands from Modbus will only be sent to the AC system if they differ from the previous value.

<sup>9</sup> This register applies on firmware version 2.3 onwards

<sup>10</sup> Check Section 4.2.4 to know more about the applications of Master/Slave on indoor units.

| Register Address<br>(protocol address) | Register Address<br>(PLC address) | R/W | Description                                                                                                                                                        |
|----------------------------------------|-----------------------------------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4013                                   | 4014                              | R   | Indoor Unit Slave Setpoint Temp. <sup>1,2,3,4,10</sup> <ul style="list-style-type: none"> <li>-32768 (Initialization value)</li> <li>Any: (°C/x10°C/°F)</li> </ul> |
| 4014                                   | 4015                              | R   | Indoor Unit Slave Room Temp. <sup>1,2,3,4,10</sup> <ul style="list-style-type: none"> <li>-32768 (Initialization value)</li> <li>Any: (°C/x10°C/°F)</li> </ul>     |

## 4.2.2 Configuration Registers

| Register Address<br>(protocol address) | Register Address<br>(PLC address) | R/W | Description                                                                                                                                                                                                                 |
|----------------------------------------|-----------------------------------|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13                                     | 14                                | R/W | "Open Window" switch-off timeout <sup>11</sup> <ul style="list-style-type: none"> <li>0..30 (minutes)</li> <li>Factory setting: 30 (minutes)</li> </ul>                                                                     |
| 14                                     | 15                                | R   | Modbus RTU baud-rate <ul style="list-style-type: none"> <li>2400bps</li> <li>4800bps</li> <li>9600bps (Default value)</li> <li>19200bps</li> <li>38400bps</li> <li>57600bps</li> <li>76800bps</li> <li>115200bps</li> </ul> |
| 15                                     | 16                                | R   | Modbus Slave Address <ul style="list-style-type: none"> <li>1..63</li> </ul>                                                                                                                                                |
| 21                                     | 22                                | R   | Max number of fan speeds                                                                                                                                                                                                    |
| 43                                     | 44                                | W   | Filter reset <ul style="list-style-type: none"> <li>1: Reset</li> </ul>                                                                                                                                                     |
| 48                                     | 49                                | R   | Switch value                                                                                                                                                                                                                |
| 49                                     | 50                                | R   | Device ID: 0x1500                                                                                                                                                                                                           |
| 50                                     | 51                                | R   | Software version                                                                                                                                                                                                            |
| 67                                     | 68                                | R   | Number of Indoor Units connected                                                                                                                                                                                            |
| 81                                     | 82                                | R   | Error address <ul style="list-style-type: none"> <li>Provides the indoor unit's number which is showing the error</li> </ul>                                                                                                |
| 82                                     | 83                                | R/W | Outdoor Demand Rate DV <ul style="list-style-type: none"> <li>0x00: Thermo Off</li> <li>0xFF: No limit (Normal operation)</li> <li>40..150: Operating range of the equipment (Current's magnitude (A))</li> </ul>           |
| 83                                     | 84                                | R   | Outdoor Demand Rate Max Value <sup>12</sup>                                                                                                                                                                                 |
| 84                                     | 85                                | R   | Outdoor Demand Rate Min Value <sup>12</sup>                                                                                                                                                                                 |
| 99                                     | 100                               | W   | Reset <ul style="list-style-type: none"> <li>1: Reset</li> </ul>                                                                                                                                                            |
| 1150                                   | 1151                              | R/W | Machine Mode <ul style="list-style-type: none"> <li>0: Normal (default value)</li> <li>1: Autochangeover</li> <li>2: Limited setpoint</li> </ul>                                                                            |

<sup>11</sup> Once window contact is open, a count-down to switch off the AC Unit will start from this configured value.

<sup>12</sup> This value is shown as portions of 100%. Check the explanation in Section 4.2.4 of this document

|      |      |     |                                                                       |
|------|------|-----|-----------------------------------------------------------------------|
| 1151 | 1152 | R/W | Machine Threshold Cool <sup>13</sup><br>▪ Default value: 26°C/79°F    |
| 1152 | 1153 | R/W | Machine Threshold Heat <sup>13</sup><br>▪ Default value: 21°C/70°F    |
| 1153 | 1154 | R/W | Machine Min Setpoint Cool <sup>14</sup><br>▪ Default value: 24°C/75°F |
| 1154 | 1155 | R/W | Machine Max Setpoint Cool <sup>14</sup><br>▪ Default value: 28°C/82°F |
| 1155 | 1156 | R/W | Machine Min Setpoint Heat <sup>14</sup><br>▪ Default value: 19°C/66°F |
| 1156 | 1157 | R/W | Machine Max Setpoint Heat <sup>14</sup><br>▪ Default value: 23°C/73°F |
| 4000 | 4001 | R   | Indoor Unit Master Address <sup>10</sup>                              |
| 4010 | 4011 | R   | Indoor Unit Slave Address <sup>10</sup>                               |

### 4.2.3 Considerations on Temperature Registers

- **AC unit temperature setpoint (R/W)**

(register 4 – in Protocol address / register 5 – in PLC address):

This is the adjustable temperature setpoint value that must be required by the user.

This register can be read (Modbus function 3 or 4) or written (Modbus functions 6 or 16).

A remote controller connected to the Panasonic/Sanyo indoor unit will report the same temperature setpoint value as this register.

- **AC unit temperature reference (R)**

(register 5 – in Protocol address / register 6 – in PLC address):

This register reports the temperature that is currently used by the Panasonic/Sanyo indoor unit as the reference of its own control loop.

If the value on register 22 is valid (different from 0x8000), it will report the value from this register. If not, it will show the indoor unit reference's temperature.

It is a read-only register (Modbus functions 3 or 4).

- **AC unit external temperature reference (R/W)**

(register 22 – in Protocol address / register 23 – in PLC address):

This register reports the temperature from an external sensor in the Modbus side. If valid value is received, the Modbus register will indicate a 0x8000 value.

This register can be read (Modbus function 3 or 4) or written (Modbus functions 6 or 16).

- **Current setpoint in AC indoor unit (R)**

(register 23 – In Protocol address / register 24 – in PLC address):

This register will show the same value as in register 4 (protocol address). The reference temperature from the remote controller is sent directly to the AC unit to be applied in the control loop.

It is a read-only register (Modbus functions 3 or 4).

<sup>13</sup> Only applies when Machine Mode is set to 1 (Autochangeover).

<sup>14</sup> Custom limits. These registers only apply when Machine Mode is set to 2 (Limited setpoint).

Moreover, notice that temperature's values of all these four registers are expressed according to the temperature's format configured through its onboard DIP-Switches (See Section 4.3) These following formats are possible:

- **Celsius value:** Value in Modbus register is the temperature value in Celsius (i.e. a value "22" in the Modbus register must be interpreted as 22°C).
- **Decicelsius value:** Value in Modbus register is the temperature value in decicelsius (i.e. a value "220" in the Modbus register must be interpreted as 22.0°C).
- **Fahrenheit value:** Value in Modbus register is the temperature value in Fahrenheit (i.e. a value "72" in the Modbus register must be interpreted as 72°F (~22°C)).

#### 4.2.4 Special behavior – Outdoor demand rate

This feature is related to a kind of control that allows to obtain a more accurate feedback of supply air's temperature based on the current system's performance and condition. It is as well a feature related to the integration in the smart building control's system with the gateway. (For example, in case that it could exist already some smart electric price's schedules, when the electricity's price varies during all day).

The feature of the Outdoor demand rate is related as well to the feature Master/Slave of the AC system from Panasonic/Sanyo.

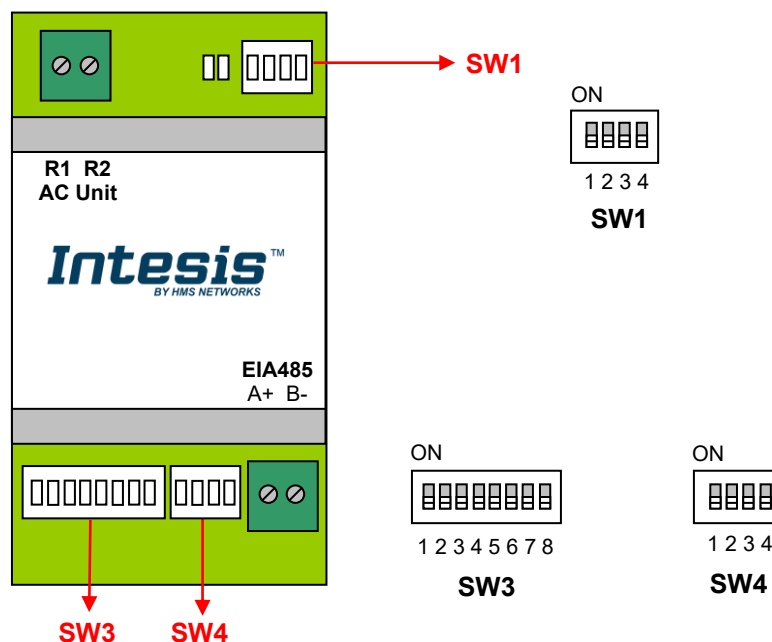
The roles Master/Slave of the indoor units are related to the features Back Up and Rotation Function. To apply these functions properly, two independent indoor units (each one belongs to a different AC system) must be connected together (in pairs) and name one indoor unit as Master and the other one as Slave.

Once each indoor unit had been named, it's necessary to verify that each one of the two indoor units match with the Modbus registers properly. The registers with Master category belong to the indoor unit named as Master and the registers with Slave category belong to the indoor unit named as Slave.

The three registers related to the Outdoor Demand Rate can be read and written. These ones are configurable thanks to a Remote Controller from Panasonic/Sanyo with Back Up and Rotation Function.

### 4.3 DIP Switch Configuration Interface

All the configuration values on INMBSPAN001R000 can be written and read from Modbus interface. Otherwise, some of them can also be setup from its on-board DIP switch interface. The device has DIP switches SW1, SW3 and SW4 on the following locations:







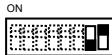





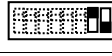

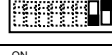

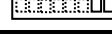

The following tables apply to the interface's configuration through DIP switches:

#### SW1 – AC indoor unit's features

| SW1-P1..4 | Description                                       |
|-----------|---------------------------------------------------|
|           | Outdoor Demand rate not activated (Default value) |
|           | Outdoor Demand rate activated                     |
|           | Not used (Default value)                          |
|           | Not used                                          |
|           | Not used (Default value)                          |
|           | Not used                                          |
|           | Not used (Default value)                          |
|           | Not used                                          |







**Table 4.1** SW1: AC indoor unit's features

**SW3/SW4** – Baud rate configuration

| SW3-P7..8                                                                         | SW4-P3                                                                            | Description             |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------|
|  |  | 2400bps                 |
|  |  | 4800bps                 |
|  |  | 9600bps (Default value) |
|  |  | 19200bps                |
|  |  | 38400bps                |
|  |  | 57600bps                |
|  |  | 76800bps                |
|  |  | 115200bps               |

































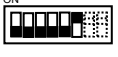


























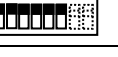




**Table 4.2** SW3-SW4: Modbus baud rate

**SW4** – Degrees/Decidegrees (x10), temperature magnitude (°C/°F) and EIA-485 termination resistor.

| SW4-P1..2-4                                                                         | Description                                                                              |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
|  | Temperature values in Modbus register are represented in degrees (x1) (Default value)    |
|  | Temperature values in Modbus register are represented in decidegrees (x10)               |
|  | Temperature values in Modbus register are represented in Celsius degrees (Default value) |
|  | Temperature values in Modbus register are represented in Fahrenheit degrees              |
|  | EIA-485 bus without termination resistor (Default value)                                 |
|  | Internal termination resistor of 120Ω connected to EIA-485 bus                           |

**Table 4.3** SW4: Temperature and termination resistor configuration

**SW3** – Modbus Slave address

| Add | SW3-P1..6                                                                           | Add | SW3-P1..6                                                                           | Add | SW3-P1..6                                                                           | Add | SW3-P1..6                                                                             | Add | SW3-P1..6                                                                             |
|-----|-------------------------------------------------------------------------------------|-----|-------------------------------------------------------------------------------------|-----|-------------------------------------------------------------------------------------|-----|---------------------------------------------------------------------------------------|-----|---------------------------------------------------------------------------------------|
| 0   |    | 13  |    | 26  |    | 39  |    | 52  |    |
| 1   |    | 14  |    | 27  |    | 40  |    | 53  |    |
| 2   |    | 15  |    | 28  |    | 41  |    | 54  |    |
| 3   |    | 16  |    | 29  |    | 42  |    | 55  |    |
| 4   |    | 17  |    | 30  |    | 43  |    | 56  |    |
| 5   |    | 18  |    | 31  |    | 44  |    | 57  |    |
| 6   |    | 19  |    | 32  |    | 45  |    | 58  |    |
| 7   |    | 20  |    | 33  |    | 46  |    | 59  |    |
| 8   |   | 21  |   | 34  |   | 47  |   | 60  |   |
| 9   |  | 22  |  | 35  |  | 48  |  | 61  |  |
| 10  |  | 23  |  | 36  |  | 49  |  | 62  |  |
| 11  |  | 24  |  | 37  |  | 50  |  | 63  |  |
| 12  |  | 25  |  | 38  |  | 51  |  |     |                                                                                       |

**Table 4.4** SW3: Modbus slave address



## 4.4 Implemented Functions

INMBSPAN001R000 implements the following standard Modbus functions:

- 3: Read Holding Registers
- 4: Read Input Registers
- 6: Write Single Register
- 16: Write Multiple Registers (Despite this function is allowed, the interface does not allow to write operations on more than 1 register with the same request, this means that length field should be always be 1 when this function is being used in case of writing)

## 4.5 Device LED indicator

The device includes two LED indicators to show all the possible operational states. In the following table there are written the indicators which can be performed and their meaning.

### L1 (green LED)

| Device status               | LED indication | ON / OFF Period       | Description                                        |
|-----------------------------|----------------|-----------------------|----------------------------------------------------|
| During not normal operation | LED blinking   | 500ms ON / 500ms OFF  | Communication error                                |
| During normal operation     | LED flashing   | 100ms ON / 1900ms OFF | Normal operation (configured and working properly) |

### L2 (red LED)

| Device status               | LED indication | ON / OFF Period   | Description   |
|-----------------------------|----------------|-------------------|---------------|
| During not normal operation | LED Pulse      | 3sec ON / --- OFF | Under voltage |

### L1 (green LED) & L2 (red LED)

| Device status               | LED indication             | ON / OFF Period      | Description     |
|-----------------------------|----------------------------|----------------------|-----------------|
| During normal operation     | LED Pulse                  | 5sec ON / --- OFF    | Device Start-up |
| During not normal operation | LED alternatively blinking | 500ms ON / 500ms OFF | EEPROM failure  |

## **4.6 EIA-485 bus. Termination resistors and Fail-Safe Biasing mechanism**

EIA-485 bus requires a 120Ω terminator resistor at each end of the bus to avoid signal reflections.

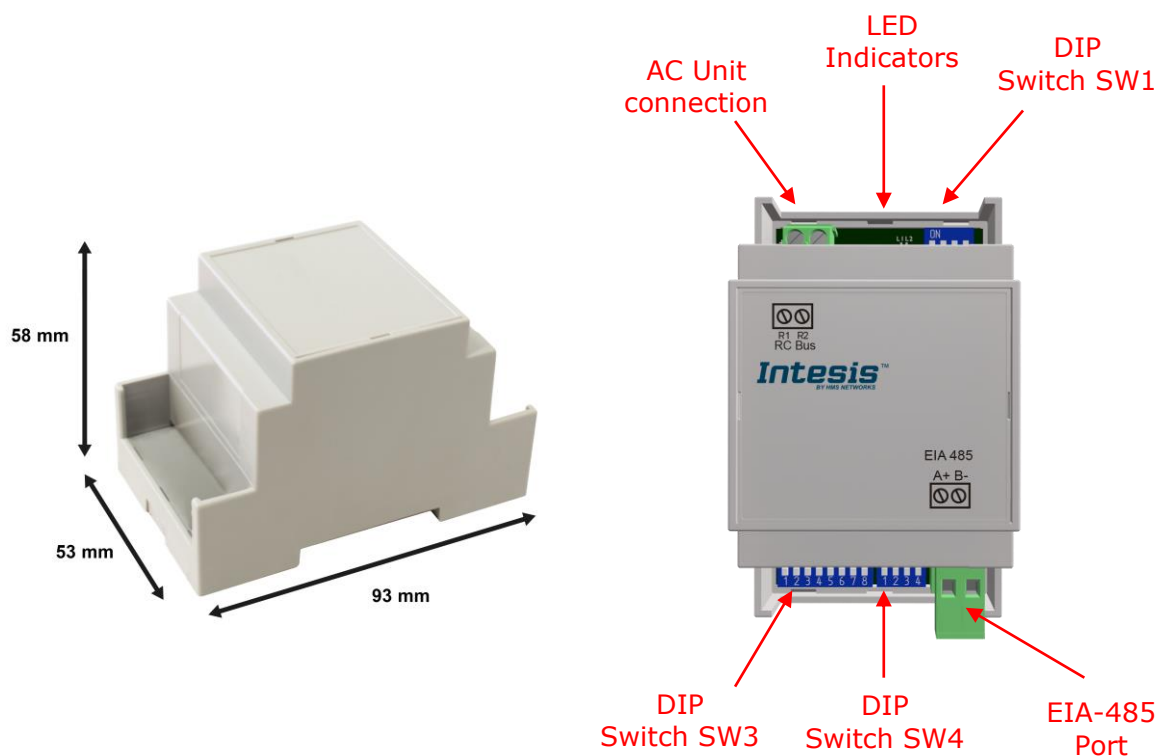
In order to prevent fail status detected by the receivers, which are "*listening*" the bus, when all the transmitters' outputs are in three-state (high impedance), it is also required a fail-safe biasing mechanism. This mechanism provides a safe status (a correct voltage level) in the bus when all the transmitters' outputs are in three-state. This mechanism must be supplied by the Modbus Master.

The INMBSPAN001R000 device includes an on-board terminator resistor of 120Ω that can be connected to the EIA-485 bus by using DIP-switch SW4.

Some Modbus RTU EIA-485 Master devices can provide also internal 120Ω terminator resistor and/or fail-safe biasing mechanism (Check the technical documentation of the Master device connected to the EIA-485 network in each case).

## 5. Mechanical and electrical features

|                                              |                                                                                                                                                                                                               |                       |                                      |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------|
| Enclosure                                    | Plastic, type PC (UL 94 V-0)<br>Net dimensions (dxwxh):<br>93 x 53 x 58 mm / 3.7" x 2.1" x 2.3"<br>Color: Light Grey. RAL 7035                                                                                | Operation Temperature | 0°C to +60°C                         |
| Weight                                       | 85 g.                                                                                                                                                                                                         | Stock Temperature     | -20°C to +85°C                       |
| Mounting                                     | Wall<br>DIN rail EN60715 TH35.                                                                                                                                                                                | Operational Humidity  | <95% RH, non-condensing              |
| Terminal Wiring<br>(for low-voltage signals) | For terminal: solid wires or stranded wires<br>(twisted or with ferrule)<br>1 core: 0.5mm <sup>2</sup> ... 2.5mm <sup>2</sup><br>2 cores: 0.5mm <sup>2</sup> ... 1.5mm <sup>2</sup><br>3 cores: not permitted | Stock Humidity        | <95% RH, non-condensing              |
| Modbus RTU port                              | 1 x Serial EIA485 Plug-in screw terminal block (2 poles):<br>A, B<br>Compatible with Modbus RTU EIA-485 networks                                                                                              | Isolation voltage     | 1500 VDC                             |
| AC unit port                                 | 1 x R1R2 bus Plug-in screw terminal block (2 poles):<br>R1, R2<br>Compatible with Panasonic/Sanyo networks                                                                                                    | Isolation resistance  | 1000 MΩ                              |
| Switch 1 (SW1)                               | 1 x DIP-Switch for AC features                                                                                                                                                                                | Protection            | IP20 (IEC60529)                      |
| Switch 3 (SW3)                               | 1 x DIP-Switch for Modbus RTU settings                                                                                                                                                                        | LED indicators        | 2 x Onboard LED - Operational status |
| Switch 4 (SW4)                               | 1 x DIP-Switch for extra functions                                                                                                                                                                            |                       |                                      |



## **6. List of supported AC Unit Types.**

A list of Panasonic and Sanyo indoor unit model references compatible with INMBSPAN001R000 and their available features can be found in:

Panasonic:

[https://www.intesis.com/docs/compatibilities/inxxxpan001rx00\\_compatibility](https://www.intesis.com/docs/compatibilities/inxxxpan001rx00_compatibility)

Sanyo:

[https://www.intesis.com/docs/compatibilities/inxxxpan001rx00\\_sanyo\\_compatibility](https://www.intesis.com/docs/compatibilities/inxxxpan001rx00_sanyo_compatibility)

## 7. Error Codes

| ErrorCode | Error CodeM | Error in RC | Error Category            | Error Description                           |
|-----------|-------------|-------------|---------------------------|---------------------------------------------|
| 0         | N/A         | N/A         | INMBSPAN001R000           | No active error                             |
| 01        | A01         | A01         | GHP Engine Issues         | GHP - Engine oil pressure fault             |
| 02        | A02         | A02         |                           | GHP - Engine oil level fault                |
| 03        | A03         | A03         |                           | GHP - Engine over speed                     |
| 04        | A04         | A04         |                           | GHP - Engine under speed                    |
| 05        | A05         | A05         |                           | GHP - Ignition power supply failure         |
| 06        | A06         | A06         |                           | GHP - Engine start up failure               |
| 07        | A07         | A07         |                           | GHP - Fuel gas valve failure                |
| 08        | A08         | A08         |                           | GHP - Engine stalled                        |
| 09        | A09         | A09         |                           | GHP - Engine overload                       |
| 0A        | A10         | A10         |                           | GHP - High exhaust gas temp                 |
| 0B        | A11         | A11         |                           | GHP - Engine oil level failure              |
| 0C        | A12         | A12         |                           | GHP - Throttle actuator fault               |
| 0D        | A13         | A13         |                           | GHP - Fuel gas valve adjustment failure     |
| 0E        | A14         | A14         |                           | GHP - Engine oil pressure sensor fault      |
| 0F        | A15         | A15         |                           | GHP - Starter power output short circuit    |
| 10        | A16         | A16         |                           | GHP - Starter motor locked                  |
| 11        | A17         | A17         |                           | GHP - Starter current (CT) coil failed      |
| 13        | A19         | A19         |                           | GHP - Wax Valve (3 Way) fault               |
| 14        | A20         | A20         |                           | GHP - Cooling water temp high               |
| 15        | A21         | A21         |                           | GHP - Cooling water level fault             |
| 16        | A22         | A22         |                           | GHP - Cooling water pump fault              |
| 17        | A23         | A23         |                           | GHP - Engine crank angle sensor failure     |
| 18        | A24         | A24         |                           | GHP - Engine cam angle sensor failure       |
| 19        | A25         | A25         |                           | GHP - Clutch fault                          |
| 1A        | A26         | A26         |                           | GHP - Misfire                               |
| 1B        | A27         | A27         |                           | GHP - Catalyst temperature fault            |
| 1C        | A28         | A28         |                           | GHP - Generator fault                       |
| 1D        | A29         | A29         |                           | GHP - Converter fault                       |
| 1E        | A30         | A30         |                           | GHP - Fuel gas pressure low                 |
| 21        | C01         | C01         | Central Controller Issues | Duplicated setting of control address       |
| 22        | C02         | C02         |                           | Central control number of units mis-matched |

|    |     |     |                                       |                                                                                                                                                              |
|----|-----|-----|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23 | C03 | C03 |                                       | Incorrect wiring of central control                                                                                                                          |
| 24 | C04 | C04 |                                       | Incorrect connection of central control                                                                                                                      |
| 25 | C05 | C05 |                                       | System Controller fault, error in transmitting comms signal, i/door or o/door unit not working, wiring fault                                                 |
| 26 | C06 | C06 |                                       | System Controller fault, error in receiving comms signal, i/door or o/door unit not working, wiring fault, CN1 not connected correctly                       |
| 2C | C12 | C12 |                                       | Batch alarm by local controller                                                                                                                              |
| 30 | C16 | C16 |                                       | Transmission error from adaptor to unit                                                                                                                      |
| 31 | C17 | C17 |                                       | Reception error to adaptor from unit                                                                                                                         |
| 32 | C18 | C18 |                                       | Duplicate central address in adaptor                                                                                                                         |
| 33 | C19 | C19 |                                       | Duplicate adaptor address                                                                                                                                    |
| 34 | C20 | C20 |                                       | Mix of PAC & GHP type units on adaptor                                                                                                                       |
| 35 | C21 | C21 |                                       | Memory fault in adaptor                                                                                                                                      |
| 36 | C22 | C22 |                                       | Incorrect address setting in adaptor                                                                                                                         |
| 37 | C23 | C23 |                                       | Host terminal software failure                                                                                                                               |
| 38 | C24 | C24 |                                       | Host terminal hardware failure                                                                                                                               |
| 39 | C25 | C25 |                                       | Host terminal processing failure                                                                                                                             |
| 3A | C26 | C26 |                                       | Host terminal communication failure                                                                                                                          |
| 3C | C28 | C28 |                                       | Reception error of S-DDC from host terminal                                                                                                                  |
| 3D | C29 | C29 |                                       | Initialization failure of S-DDC                                                                                                                              |
| 3F | C31 | C31 |                                       | Configuration change detected by adaptor                                                                                                                     |
| 41 | E01 | 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.                   |
| 42 | E02 | E02 |                                       | Remote detecting error from indoor unit,                                                                                                                     |
| 43 | E03 | E03 |                                       | Indoor unit detecting error from remote,                                                                                                                     |
| 44 | E04 | 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 |
| 45 | E05 | E05 |                                       | Indoor unit detecting error from outdoor unit, Error in sending comms signal                                                                                 |
| 46 | E06 | E06 |                                       | Outdoor unit detecting error from indoor unit, Error in receiving comms signal                                                                               |
| 47 | E07 | E07 |                                       | Outdoor unit detecting error from indoor unit, Error in sending comms signal                                                                                 |
| 48 | E08 | E08 |                                       | Incorrect setting indoor/controller, Indoor address duplicated                                                                                               |
| 49 | E09 | E09 |                                       | Incorrect setting indoor/controller, Remote address duplicated or IR wireless controller not disabled                                                        |
| 4A | E10 | E10 |                                       | Indoor unit detecting error from 'option' plug, Error in sending comms signal                                                                                |

|    |     |     |               |                                                                                                                                |
|----|-----|-----|---------------|--------------------------------------------------------------------------------------------------------------------------------|
| 4B | E11 | E11 |               | Indoor unit detecting error from 'option' plug, Error in receiving comms signal                                                |
| 4C | E12 | E12 |               | Auto addressing failed, Auto address connector CN100 shorted during auto addressing                                            |
| 4D | E13 | E13 |               | Indoor unit failed to send signal to remote controller                                                                         |
| 4E | E14 | E14 |               | Setting Failure, Duplication of master indoor units                                                                            |
| 4F | E15 | E15 |               | Auto addressing failed, Number of indoor units connected are less than number set                                              |
| 50 | E16 | E16 |               | Auto addressing failed, Number of indoor units connected are more than number set                                              |
| 51 | E17 | E17 |               | Group control wiring error, Main indoor unit not sending signal for sub indoor units                                           |
| 52 | E18 | E18 |               | Group control wiring error, Main indoor unit not receiving signal for sub indoor units                                         |
| 54 | E20 | E20 |               | Auto addressing failed, No indoor units connected                                                                              |
| 58 | E24 | E24 |               | Auto addressing failed, Error on sub outdoor unit                                                                              |
| 59 | E25 | E25 |               | Auto addressing failed, Error on outdoor unit address setting                                                                  |
| 5A | E26 | 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. |
| 5D | E29 | E29 |               | Auto addressing failed, Sub outdoor unit not receiving comms for main outdoor unit                                             |
| 5F | E31 | E31 |               | Between units, Comms failure with MDC, does E31 remain after power is re-instated? If so replace PCB. & power PCB              |
| 61 | F01 | F01 | Sensor Faults | Indoor Heat Exch inlet temp sensor failure (E1)                                                                                |
| 62 | F02 | F02 |               | Indoor Heat Exch freeze temp sensor failure (E2)                                                                               |
| 63 | F03 | F03 |               | Indoor Heat Exch outlet temp sensor failure (E3)                                                                               |
| 64 | F04 | F04 |               | Outdoor Discharge temp sensor failure (TD) or (DISCH1)                                                                         |
| 65 | F05 | F05 |               | Outdoor Discharge temp sensor failure (DISCH2)                                                                                 |
| 66 | F06 | F06 |               | Outdoor Heat Exch temp sensor failure (C1) or (EXG1)                                                                           |
| 67 | F07 | F07 |               | Outdoor Heat Exch temp sensor failure (C2) or (EXL1)                                                                           |
| 68 | F08 | F08 |               | Outdoor Air temp sensor failure (TO)                                                                                           |
| 6A | F10 | F10 |               | Indoor inlet temp sensor failure                                                                                               |
| 6B | F11 | F11 |               | Indoor outlet temp sensor failure                                                                                              |
| 6C | F12 | F12 |               | Outdoor Intake sensor failure (TS)                                                                                             |
| 6D | F13 | F13 |               | GHP - Cooling water temperature sensor failure                                                                                 |
| 70 | F16 | F16 |               | Outdoor High pressure sensor failure                                                                                           |
| 71 | F17 | F17 |               | GHP - Cooling water temperature sensor fault                                                                                   |
| 72 | F18 | F18 |               | GHP - Exhaust gas temperature sensor fault                                                                                     |

|    |     |     |                    |                                                                                                              |
|----|-----|-----|--------------------|--------------------------------------------------------------------------------------------------------------|
| 74 | F20 | F20 |                    | GHP Clutch coil temperature fault                                                                            |
| 77 | F23 | F23 |                    | Outdoor Heat Exch temp sensor failure (EXG2)                                                                 |
| 78 | F24 | F24 |                    | Outdoor Heat Exch temp sensor failure (EXL2)                                                                 |
| 7D | F29 | F29 |                    | Indoor EEPROM error                                                                                          |
| 7E | F30 | F30 |                    | Clock Function (RTC) fault                                                                                   |
| 7F | F31 | F31 |                    | Outdoor EEPROM error                                                                                         |
| 81 | H01 | H01 | Compressor Issues  | Compressor Fault, Over current (Comp1)                                                                       |
| 82 | H02 | H02 |                    | Compressor Fault, Locked rota current detected (Comp1)                                                       |
| 83 | H03 | H03 |                    | Compressor Fault, No current detected (Comp1)                                                                |
| 85 | H05 | H05 |                    | Compressor Fault, Discharge temp not detected (Comp1)                                                        |
| 86 | H06 | H06 |                    | Compressor Fault, Low Pressure trip                                                                          |
| 87 | H07 | H07 |                    | Compressor Fault, Low oil level                                                                              |
| 88 | H08 | H08 |                    | Compressor Fault, Oil sensor Fault (Comp1)                                                                   |
| 8B | H11 | H11 |                    | Compressor Fault, Over current (Comp2)                                                                       |
| 8C | H12 | H12 |                    | Compressor Fault, Locked rota current detected (Comp2)                                                       |
| 8D | H13 | H13 |                    | Compressor Fault, No current detected (Comp2)                                                                |
| 8F | H15 | H15 |                    | Compressor Fault, Discharge temp not detected (Comp2)                                                        |
| 95 | H21 | H21 |                    | Compressor Fault, Over current (Comp3)                                                                       |
| 96 | H22 | H22 |                    | Compressor Fault, Locked rota current detected (Comp3)                                                       |
| 97 | H23 | H23 |                    | Compressor Fault, No current detected (Comp3)                                                                |
| 99 | H25 | H25 |                    | Compressor Fault, Discharge temp not detected (Comp3)                                                        |
| 9B | H27 | H27 |                    | Compressor Fault, Oil sensor fault (Comp2)                                                                   |
| 9C | H28 | H28 |                    | Compressor Fault. Oil sensor (connection failure)                                                            |
| 9F | H31 | H31 |                    | Compressor Fault. IPM trip (IMP current on temperature)                                                      |
| C1 | L01 | L01 | Incorrect Settings | Setting Error, Indoor unit group setting error                                                               |
| C2 | L02 | L02 |                    | Setting Error, Indoor/outdoor unit type/model mismatched                                                     |
| C3 | L03 | L03 |                    | Duplication of main indoor unit address in group control                                                     |
| C4 | L04 | L04 |                    | Duplication of outdoor unit system address                                                                   |
| C5 | L05 | L05 |                    | 2 or more controllers have been set as 'priority' in one system - shown on controllers set as 'priority'     |
| C6 | L06 | L06 |                    | 2 or more controllers have been set as 'priority' in one system - shown on controllers not set as 'priority' |
| C7 | L07 | L07 |                    | Group wiring connected on and individual indoor                                                              |



|    |     |     |                      |                                                                                                                                  |
|----|-----|-----|----------------------|----------------------------------------------------------------------------------------------------------------------------------|
|    |     |     |                      | unit                                                                                                                             |
| C8 | L08 | L08 |                      | Indoor unit address/group not set                                                                                                |
| C9 | L09 | L09 |                      | Indoor unit capacity code not set                                                                                                |
| CA | L10 | L10 |                      | Outdoor unit capacity code not set                                                                                               |
| CB | L11 | L11 |                      | Group control wiring incorrect                                                                                                   |
| CD | L13 | L13 |                      | Indoor unit type setting error, capacity                                                                                         |
| CF | L15 | L15 |                      | Indoor unit paring fault                                                                                                         |
| D0 | L16 | L16 |                      | Water heat exch unit setting failure                                                                                             |
| D1 | L17 | L17 |                      | Miss-match of outdoor unit with different refrigerant                                                                            |
| D2 | L18 | L18 |                      | 4-way valve failure                                                                                                              |
| D3 | L19 | L19 |                      | Water heat exch unit duplicated address                                                                                          |
| D5 | L21 | L21 |                      | Gas type setup failure                                                                                                           |
| D9 | L25 | L25 |                      | Indoor unit, hydrokit model, Unmatched remote controller                                                                         |
| E1 | P01 | P01 | Indoor Unit Problems | Indoor unit fault, Fan motor thermal overload                                                                                    |
| E2 | P02 | P02 |                      | Outdoor unit fault, Compressor motor thermal overload, over or under voltage                                                     |
| E3 | P03 | P03 |                      | Outdoor unit fault, Compressor discharge temperature too high (Comp1) over 111 °C. Low on ref gas, exp valve, pipework damage.   |
| E4 | P04 | P04 |                      | Outdoor unit fault, High pressure trip                                                                                           |
| E5 | P05 | P05 |                      | Outdoor unit fault, Open phase on power supply. Check power on each phase, inverter pcb, control pcb                             |
| E7 | P07 | P07 |                      | Indoor unit, hydrokit model, Abnormal internal heater overload                                                                   |
| E9 | P09 | P09 |                      | Indoor unit fault, air-to-air unit: Ceiling panel incorrectly wired, hydrokit model: Abnormal water flow                         |
| EA | P10 | P10 |                      | Indoor unit fault, Condensate float switch opened                                                                                |
| EB | P11 | P11 |                      | Air-to-water indoor unit low temp (frost protection) fault                                                                       |
| EC | P12 | P12 |                      | Indoor unit fault, air-to-air unit: Fan DC motor fault, hydrokit model: Abnormal water pump speed                                |
| EE | P14 | P14 |                      | Input from leak detector (If fitted)                                                                                             |
| EF | P15 | P15 |                      | Refrigerant loss, high discharge temp and EEV wide open and low compressor current draw.                                         |
| F0 | P16 | P16 |                      | Outdoor unit fault, Open phase on compressor power supply                                                                        |
| F1 | P17 | P17 |                      | Outdoor unit fault, Compressor discharge temperature too high (Comp2) over 111 degC. Low on ref gas, exp valve, pipework damage. |
| F2 | P18 | P18 |                      | Outdoor unit fault, By-pass valve failure                                                                                        |
| F3 | P19 | P19 |                      | Outdoor unit fault, 4 way valve failure, i/door temp                                                                             |

|            |     |     |                 |                                                                                                                                                                                                                                                                           |
|------------|-----|-----|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            |     |     |                 | risers in cooling or fills in heating. Check wiring, coil, pcb output, valve operation.                                                                                                                                                                                   |
| F4         | P20 | P20 |                 | Ref gas, high temp/pressure fault, heat exch temp high C2, 55-60 degC, cooling over-load, sensor fault.                                                                                                                                                                   |
| F6         | P22 | P22 |                 | Outdoor unit fan motor fault, fan blade jammed, check connections, does fan turn freely, motor resistance 30-40ohm on each pair, no fan fault, yes pcb fault.                                                                                                             |
| F7         | P23 | P23 |                 | Air-to-water interlock warning, within 30 seconds after the water pump start command, the interlock does not turn ON or the interlock turns OFF during water pump operation (interlock signal by flow switch and/or differential pressure switch, depending on the model) |
| FA         | P26 | P26 |                 | Outdoor unit fault, Compressor overcurrent - check winding resistance, Inverter failure - check internal resistance term HIC + & - to UVW 200-300Kohm or more                                                                                                             |
| FC         | P29 | P29 |                 | Outdoor unit fault, Inverter circuit fault - Motor-current Detection Circuit (MDC) fault, check comp windings, sensors C1 & TS, if ok possible pcb failure.                                                                                                               |
| FD         | P30 | P30 |                 | Indoor unit fault, System controller detected fault on sub indoor unit                                                                                                                                                                                                    |
| FF         | P31 | P31 |                 | Simultaneous operation multi control fault, Group controller fault                                                                                                                                                                                                        |
| 65535 (-1) | N/A | N/A | INMBSPAN001R000 | Error in the communication of INMBSPAN001R000 device with the AC unit                                                                                                                                                                                                     |

In case to detect an error code not listed, contact your closest Panasonic/Sanyo technical support service.