IntesisBox®

PA-RC2-MBS-4 v.1.3

MODBUS RTU (EIA485) Interface for Panasonic and Sanyo air conditioners. Compatible with ECOi and PACi line models.

User Manual

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Order Codes: **PA-RC2-MBS-4**

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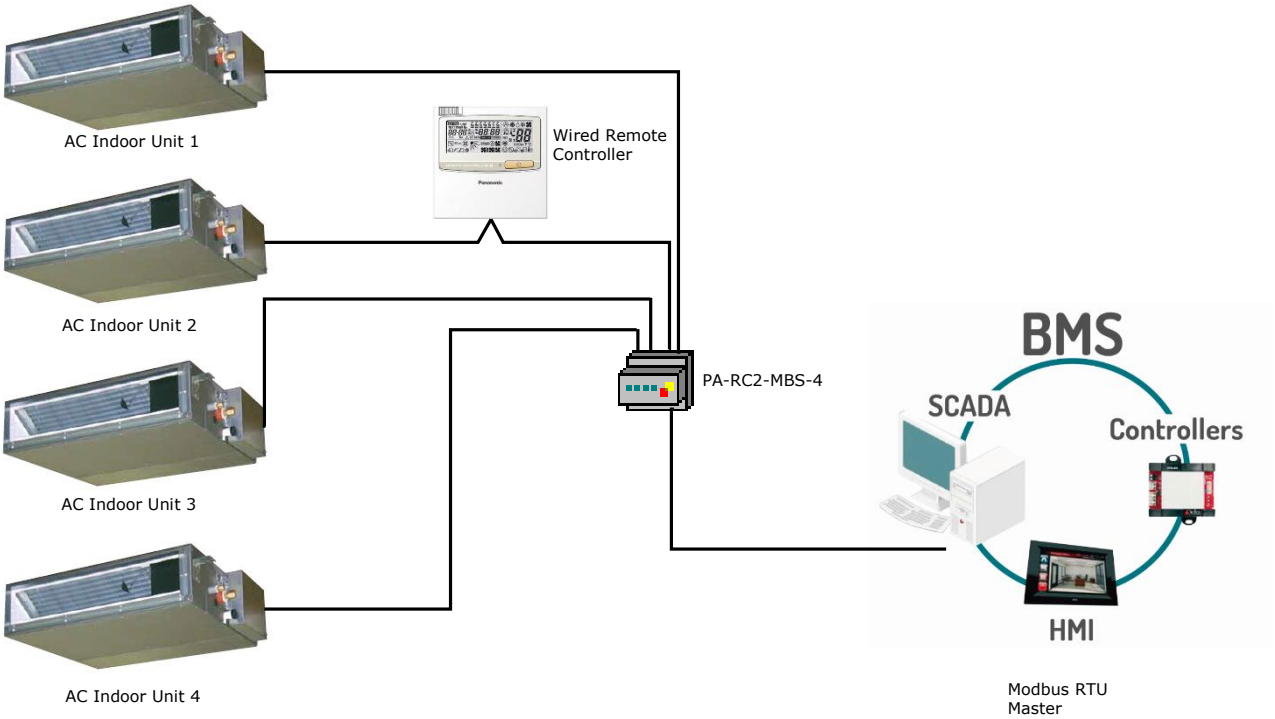
1. Presentation

The PA-RC2-MBS-4 interface allows a complete and natural integration of ***Panasonic*** and ***Sanyo*** air conditioners into Modbus RTU (EIA485) networks.

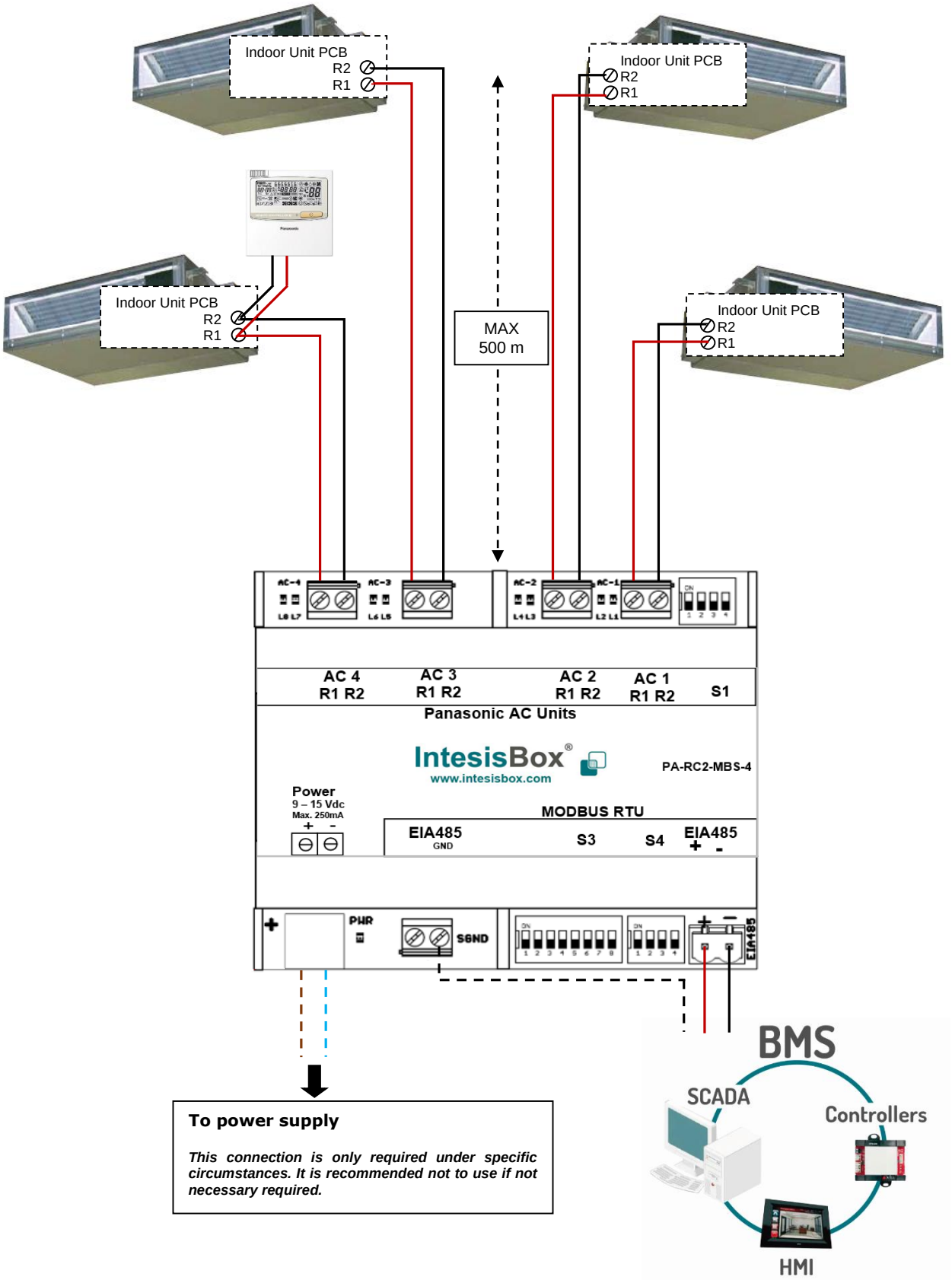
Compatible with all models of ECOi and PACi line (section 4).

- Quick and easy installation.
  Mountable on DIN rail, wall.
- Direct connection to MODBUS RTU (EIA485) networks.
  PA-RC2-MBS-4 acts as 4 Modbus slave devices using a single EIA485 connection.
- Direct connection to the AC indoor unit.
- No external power supply required.
- Configuration from both on-board DIP-switches and MODBUS RTU.
- Total Control and Supervision.
- Real states of the AC unit's internal variables.
- Allows using simultaneously the control panel and MODBUS RTU.



2. Connection

The interface comes with 4 plug-in terminal blocks of 2 poles for connection to Panasonic R1R2 bus and 1 plug-in terminal block of 2 poles for Modbus RTU EIA485 network connection.



2.1 Connect to the AC indoor unit

To connect the PA-RC2-MBS-4 interface to each AC indoor unit follow these steps:

Disconnect mains power from the AC unit and the IntesisBox interface (if connected). Open the front cover of the indoor unit in order to have access to the electronic circuit. In the electronic circuit, locate the socket connector marked as R1R2[1]:

Using a cable, connect the interface to R1R2 bus in any point of the bus. The R1R2 bus is the bus that connects the AC indoor unit and the wired remote controller, is a two-wire bus connecting terminals R1R2 of both and has no specific polarity. Respect the maximum distance of 500 m for the bus length.

Notice that PA-RC2-MBS-4 can be installed along with the manufacturer's Wired Remote Controller, but only 1 Wired Remote Controller can be installed per each AC unit line.

2.2 Connection to the EIA485 bus

Connect the EIA485 bus wires to the plug-in terminal block (the one of two poles) of PA-RC2-MBS-4, respect the polarity on this connection (A+ and B-). Respect the maximum distance of 1200 meters for the bus, no loop or star topologies are allowed for EIA485 bus. A terminator resistor of 120 Ω must be present at each end of the bus to avoid signal reflections and also a fail-safe biasing mechanism (see section 3.6 for more details).

2.3 Connection to power supply

This connection is only required under specific circumstances. It is recommended not to use if not necessary required.

If required, use a DC NEC Class 2 or Limited Power Source (LPS) and SELV rated power supply. Respect polarity applied of terminals (+) and (-). Be sure the voltage applied is within the range admitted (9 Vdc) and 250mA. Remember that the power supply can be connected to earth but only through the negative terminal, never through the positive terminal.

[1] In some models, the R1R2 connector is not present. Find the Control Panel (remote controller) bus and connect the cable coming from the IntesisBox gateway into these cables as if they were the R1R2 connector.

3. Modbus Interface Specification

3.1 Modbus physical layer

PA-RC2-MBS-4 implements a MODBUS RTU (slave) interface, to be connected to an EIA485 line. It performs 8N2 (8N1-compatible) communication (8 data bits, no parity and 2 stop bit) with several available baud rates (2400 bps, 9600 bps -default-, 19200 bps and 57600 bps).

3.2 Modbus Registers

All registers are of type "16-bit signed Holding Register", in standard Modbus' big endian notation.

Each AC unit has its own individual control and status registers map. That means that, for each AC unit, there is a different Modbus slave device with the same Modbus register map.

The Modbus Slave address ca be set using SW3. More information on how to set SW3 can be seen on section 3.3.

3.2.1 Control and status registers

Register Addr (Protocol addr)	Register Addr (PLC addr)	R/W	Description
0	1	R/W	AC unit On/Off ▪ 0: Off ▪ 1: On
1	2	R/W	AC unit Mode ▪ 0: Auto ▪ 1: Heat ▪ 2: Dry ▪ 3: Fan ▪ 4: Cool
2	3	R/W	AC unit Fan Speed ▪ 0: Auto ▪ 1: Low ▪ 2: Mid ▪ 3: High
3	4	R/W	AC unit Vane Position ▪ 0: Vane Off (Stand-by) ▪ 1: POS1 (Horizontal) ▪ 2: POS2 (Horizontal) ▪ 3: POS3 (Med) ▪ 4: POS4 (Vert) ▪ 5: POS5 (Vert) ▪ 10: SWING
4	5	R/W	AC unit Temperature Set point (ºC/ºF) ▪ (ºC/x10ºC/F)[2] ▪ ***See section 0 below.***
5	6	R	AC unit Ambient Temperature (ºC/ºF) ▪ (ºC/x10ºC/F)[2] ▪ ***See section 0 below.***

[2] Magnitude for this register can be adjusted to Celsius x 1ºC, Celsius x 10ºC (default) or Fahrenheit through DIP switches

6	7	R/W	Window Contact ▪ 0: Closed ▪ 1: Open
7	8	R/W	Modbus Command Disablement[3] ▪ 0: Modbus Commands enabled (default) ▪ 1: Modbus Commands disabled (device in monitor-only mode)
8	9	R/W	Remote Command Disablement ▪ 0: Remote Command enabled ▪ 1: Remote Command disabled
9	10	R/W	AC unit Operation Time[3] ▪ 0..65535 (hours). Counts the time the AC unit is in "On" state.
10	11	R	AC unit Alarm Status ▪ 0: No alarm condition ▪ 1: Alarm condition
11	12	R	Error Code
22	23	R/W	Indoor unit ambient temperature from external sensor (at Modbus side) ▪ -32768: Default value. No temperature is being provided from an external sensor. ▪ Any other: (ºC/x10ºC/ºF)[4] ▪ ***See section 0 below.***
23	24	R	Current set point in AC indoor unit ▪ (ºC/x10ºC/F)[2] ▪ This read-only register shows the set point of the indoor unit: when register "indoor unit ambient temperature from external sensor" (23 in PLC addressing) is not used, value for register 24 and register 5 will be the same. ▪ ***See section 0 below.***
82	83		Outdoor Unit Demand Rate ▪ Current Demand Rate
83	84	R	Outdoor Unit Demand Rate Max Value ▪ Upper limit of the settable Demand Rate
84	85	R	Outdoor Unit Demand Rate Min Value ▪ Lower limit of the settable Demand Rate

[3] Value of this register is stored in non-volatile memory (EEPROM)
[4] Magnitude for this register can be adjusted to Celsius x 1ºC, Celsius x 10ºC (default) or Fahrenheit through DIP switches S4

3.2.2 Configuration Registers

Register Addr (protocol address)	Register Addr (PLC address)	R/W	Description
12	13	R/W	Reserved
13	14	R/W	"Open Window" switch-off timeout ▪ 0..30 (minutes) ▪ Factory setting: 30 (minutes)
14	15	R	Modbus RTU baud rate (bps) ▪ 2400 ▪ 4800 ▪ 9600 ▪ 19200
15	16	R	Device's Modbus slave address ▪ 1..63
21	22	R	Max number of fan speeds ▪ It depends on the Indoor Unit specifications
49	50	R	Device Identification PA-RC2-MBS-4: 0x1500 (5376d)
50	51	R	Software version

3.2.3 Considerations on PA-RC2-MBS-4 temperature registers

PA-RC2-MBS-4 implements four registers containing temperature values:

- **AC unit Temperature Set Point (R/W)** (register 5 – in PLC addressing): This is the adjustable temperature set point meant to be required by the user. This register can be read (Modbus function 3 or 4) or written (Modbus functions 5 or 16). A remote controller connected to the R1R2 bus of the Panasonic indoor unit will report the same temperature set point value as this register only when no AC unit external reference is provided from PA-RC2-MBS-4 (see detail for register 23 below).

- **AC unit Ambient Temperature (R)** (register 6 – in PLC addressing): This register reports the temperature that is actually used by the Panasonic indoor unit as reference of its own control loop. Depending on the configuration of the indoor unit, this can be the temperature reported by the sensor in in the return path of the Panasonic indoor unit or the sensor of an additional remote controller in the R1R2 bus. It is a read-only register (Modbus functions 3 or 4).

- **AC unit External Temperature Reference (R/W)** (register 23 – in PLC addressing): This register allows providing an external temperature reference from Modbus side.

  After startup, value for "external temperature reference" (register 23) has value -32768 (0x8000). This value means that no external temperature is being provided through PA-RC2-MBS-4. In this scenario, set point shown or written in register 5 will always have same value as the actual set point of the indoor unit.

- **Current Set Point in AC indoor unit (R)** (register 24 – in PLC addressing)**:** As detailed in previous point, actual set point in the indoor unit and set point requested from PA-RC2-MBS-4 might differ (when a value in register 23 – "external temperature reference" is put). This register always informs of the actual set point being used by the indoor unit – this is also the set point that will show an additional remote controller from Panasonic in the R1R2 bus.

Additionally, note that temperature values in all these three registers are expressed according to the temperature format configured through its onboard DIP-Switches (See "3.3 - DIP-switch Configuration Interface"). Following formats are possible:

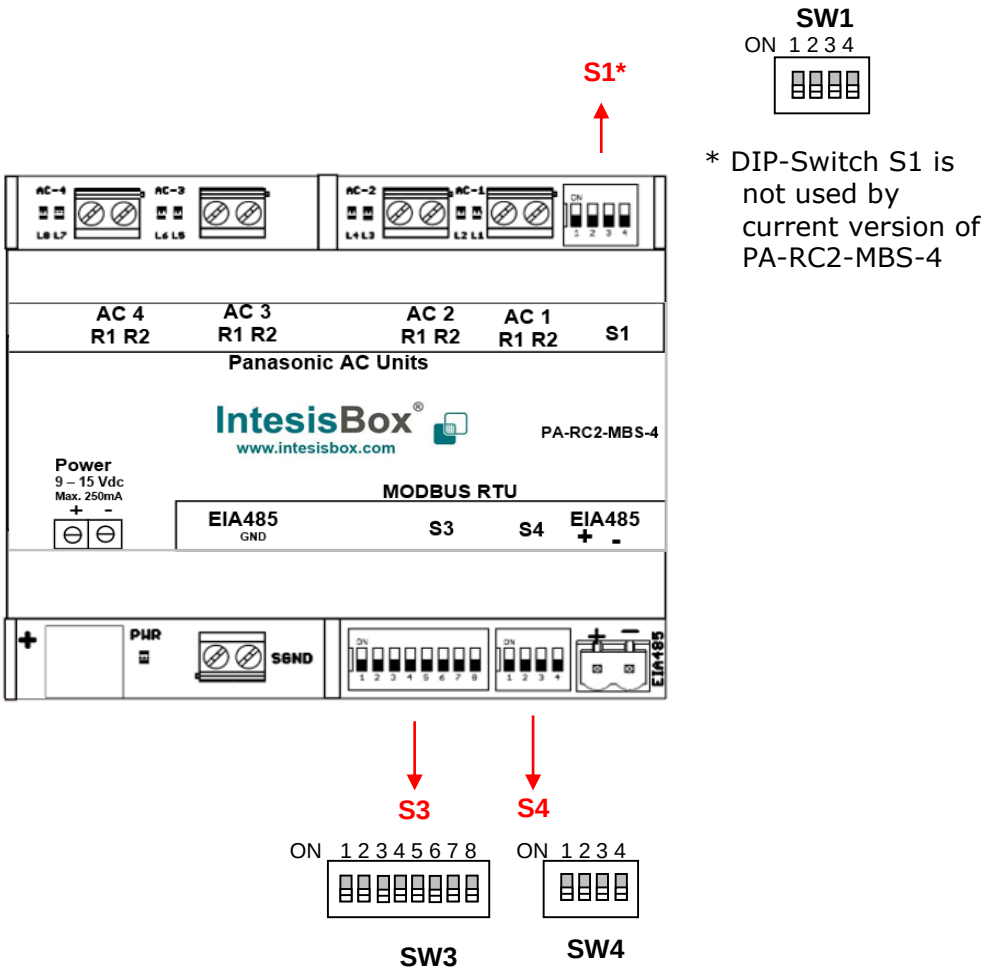
- Celsius value: Value in Modbus register is the temperature value in Celsius (i.e. a value "22" in the Modbus register must be interpreted as 22ºC)
- Decicelsius value: Value in Modbus register is the temperature value in decicelsius (i.e. a value "220" in the Modbus register must be interpreted as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

NOTE: All temperature registers do have 0.5ºC resolution.

3.3 DIP-switch Configuration Interface

All configuration values on PA-RC2-MBS-4 can be written and read from Modbus interface. Though, some of them can also be setup from its on-board DIP-switch interface.

They are DIP-switches S1*, S3* and S4 on the device, in the following location:



The following table applies for configuration of the interface through these DIP-switches:

SW3 – Modbus protocol: Slave address and baud rate

Slave address

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

Table 3.1 Modbus Slave address

Modbus address selected on the DIP Switch will be directly AC-1 address. AC-2, AC-3 and AC-4 can be obtained as follows:

AC	Modbus Slave Address
AC-1	S3 DIP-Switch value
AC-2	S3 DIP-Switch value + 1
AC-3	S3 DIP-Switch value + 2
AC-4	S3 DIP-Switch value + 3

Baud rate

Binary value $b_0...b_8$	Decimal value	Switches 1 2 3 4 5 6 7 8	Description
xxxxxx00	0	x x x x x x ↓ ↓	2400bps
xxxxxx10	1	x x x x x x ↑ ↓	4800bps
xxxxxx01	2	x x x x x x ↓ ↑	9600bps (- default value)
xxxxxx11	3	x x x x x x ↑ ↑	19200bps

Table 3.2 Modbus baud rate

* Default value

S4 – Degrees/Decidegress (x10), temperature magnitude (ºC/ºF) and EIA485 termination resistor

Binary value $b_0...b_4$	Decimal value	Switches 1 2 3 4	Description
0xxx	0	↓ x x x	Temperature values in Modbus register are represented in degrees (x1) (default value)
1xxx	1	↑ x x x	Temperature values in Modbus register are represented in decidegrees (x10)
x0xx	0	x ↓ x x	Temperature values in Modbus register are represented in Celsius degrees (default value)
x1xx	1	x ↑ x x	Temperature values in Modbus register are represented in Fahrenheit degrees
xxx0	0	x x x ↓	EIA485 bus without termination resistor (default value)
xxx1	1	x x x ↑	Internal termination resistor of 120Ω connected to EIA485 bus**

Table 3.3 Temperature and termination configuration

3.4 Implemented Functions

PA-RC2-MBS-4 implements the following standard MODBUS functions:

- 3: Read Holding Registers
- 4: Read Input Registers
- 6: Write Single Register
- 16: Write Multiple Registers (Although this function is allowed, the interface does not allow write operations on more than 1 register with the same request, this means that length field should always be 1 when using this function for writes)

** Only in the interfaces connected at both ends of the bus must be activated the termination resistor. More information in section 3.6

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3.5 Device LED indicator

The device includes two LED indicators for each AC unit connection to signal their different possible operational states. In this section their meaning is explained:

L1, L3, L5, L7 (yellow)			
Operation	**ON**	**OFF**	**Meaning**
Blinking	500 ms	500 ms	Communication error
Flashing	100 ms	1900 ms	Normal operation (configured and working)
L1, L3, L5, L7 (yellow) & L2, L4, L6, L8 (red)			
Operation	**ON**	**OFF**	**Meaning**
Pulse	5 secs	--	Device start-up
Alternate blinking	500 ms	500 ms	EEPROM failure

3.6 EIA485 bus. Termination resistors and Fail Safe Biasing mechanism

EIA485 bus may require a 120Ω terminator resistor at each end of the bus, depending on the cable length and baud rate, to avoid signal reflections.

In order to prevent fail status detections by the receivers *"listening"* the bus when all the transmitters outputs are in three-state (high impedance), it is also required a fail-safe biasing mechanism, provided by the master device present in the bus. This mechanism provides a safe status (a correct voltage level) in the bus when all the transmitters' outputs are in three-state.

The PA-RC2-MBS-4 device includes an on-board terminator resistor of 120Ω that can be connected to the EIA485 bus by using DIP-switch P5 (see below).

4. List of supported AC Unit Types

A list of Panasonic and Sanyo indoor unit model references compatible with PA-RC2-MBS-4 and their available features can be found in:

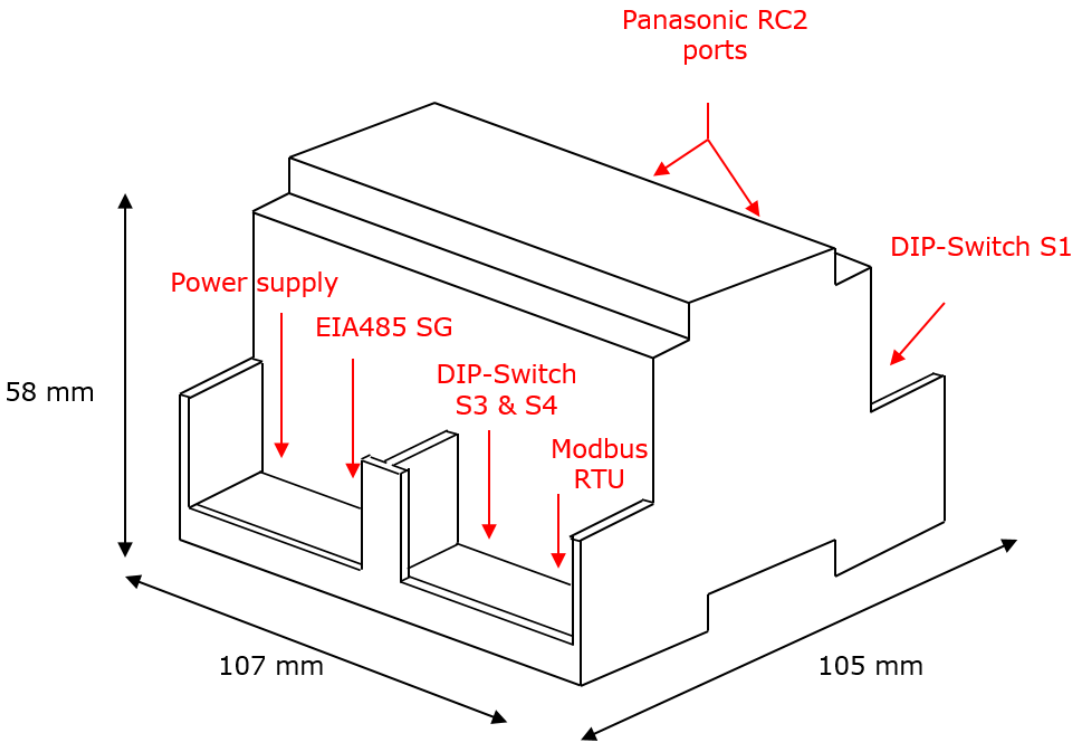
Panasonic:
http://www.intesis.com/pdf/IntesisBox_PA-RC2-xxx-1_Panasonic_Compatibility.pdf

Sanyo:
http://www.intesis.com/pdf/IntesisBox_PA-RC2-xxx-1_Sanyo_Compatibility.pdf

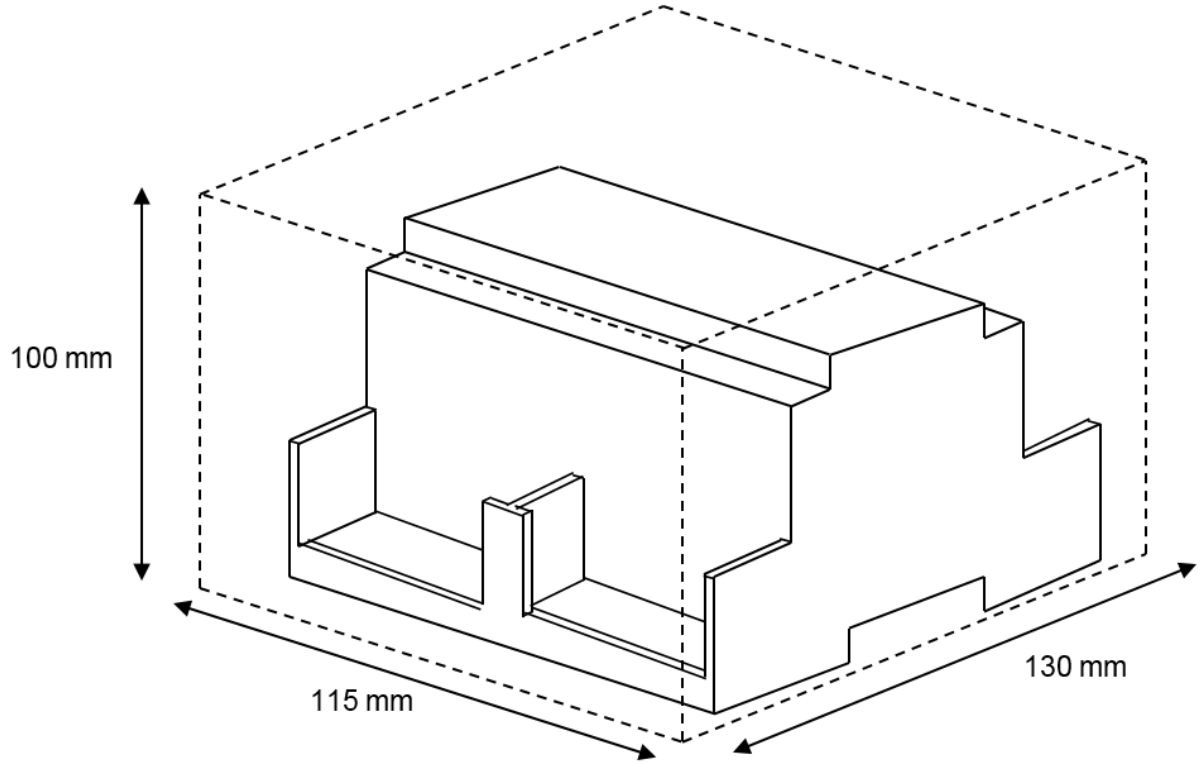
5. Technical characteristics

Enclosure	Plastic, type PC (UL 94 V-0). Dimensions: 107mm x 105mm x 58mm.
Color	Light Grey. RAL 7035.
External Power	8Vdc – 15Vdc, Max.: 250mA. Must use a NEC Class 2 or Limited Power Source (LPS) and SELV rated power supply. Plug-in terminal block for power connection (2 poles).
Terminal wiring (for power supply and low-voltage signals)	Per terminal: solid wires or stranded wires (twisted or with ferrule) 1 core: 0.5mm^2… 2.5mm^2 2 cores: 0.5mm^2… 1.5mm^2 3 cores: not permitted
Mounting	Wall. DIN rail EN60715 TH35.
Modbus RTU ports	1 x Serial EIA485 (Plug-in screw terminal block 2 poles). SELV
Panasonic RC2 ports	4 x Serial EIA485 (Plug-in screw terminal block 2 poles). SELV
LED indicators	1 x Power. 4 x AC communication status (L1, L3, L5 and L7). 4 x Interface status (L2, L4, L6 and L8).
Operational temperature	0°C to +70°C
Operational humidity	5% to 95%, non-condensing
Isolation voltage	1000 Vdc
Protection	IP20 (IEC60529).

6. Dimensions



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



7. Error Codes

Error Code	Error in Control Panel	Error category	Error Description
0	N/A	PA-RC2-MBS-4	No active error
01	A01	GHP Engine Issues	GHP - Engine oil pressure fault
02	A02		GHP - Engine oil level fault
03	A03		GHP - Engine over speed
04	A04		GHP - Engine under speed
05	A05		GHP - Ignition power supply failure
06	A06		GHP - Engine start up failure
07	A07		GHP - Fuel gas valve failure
08	A08		GHP - Engine stalled
09	A09		GHP - Engine overload
0A	A10		GHP - High exhaust gas temp
0B	A11		GHP - Engine oil level failure
0C	A12		GHP - Throttle actuator fault
0D	A13		GHP - Fuel gas valve adjustment failure
0E	A14		GHP - Engine oil pressure sensor fault
0F	A15		GHP - Starter power output short circuit
10	A16		GHP - Starter motor locked
11	A17		GHP - Starter current (CT) coil failed
13	A19		GHP - Wax Valve (3 Way) fault
14	A20		GHP - Cooling water temp high
15	A21		GHP - Cooling water level fault
16	A22		GHP - Cooling water pump fault
17	A23		GHP - Engine crank angle sensor failure
18	A24		GHP - Engine cam angle sensor failure
19	A25		GHP - Clutch fault
1A	A26		GHP - Misfire
1B	A27		GHP - Catalyst temperature fault
1C	A28		GHP - Generator fault
1D	A29		GHP - Converter fault
1E	A30		GHP - Fuel gas pressure low
21	C01	Central Controller Issues	Duplicated setting of control address
22	C02		Central control number of units mis-matched
23	C03		Incorrect wiring of central control
24	C04		Incorrect connection of central control
25	C05		System Controller fault, error in transmitting comms signal, i/door or o/door unit not working, wiring fault
26	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		Batch alarm by local controller
30	C16		Transmission error from adaptor to unit
31	C17		Reception error to adaptor from unit
32	C18		Duplicate central address in adaptor
33	C19		Duplicate adaptor address
34	C20		Mix of PAC & GHP type units on adaptor
35	C21		Memory fault in adaptor
36	C22		Incorrect address setting in adaptor
37	C23		Host terminal software failure
38	C24		Host terminal hardware failure
39	C25		Host terminal processing failure
3A	C26		Host terminal communication failure

3C	C28		Reception error of S-DDC from host terminal
3D	C29		Initialization failure of S-DDC
3F	C31		Configuration change detected by adaptor
41	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		Remote detecting error from indoor unit,
43	E03		Indoor unit detecting error from remote,
44	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		Indoor unit detecting error from outdoor unit, Error in sending comms signal
46	E06		Outdoor unit detecting error from indoor unit, Error in receiving comms signal
47	E07		Outdoor unit detecting error from indoor unit, Error in sending comms signal
48	E08		Incorrect setting indoor/controller, Indoor address duplicated
49	E09		Incorrect setting indoor/controller, Remote address duplicated or IR wireless controller not disabled
4A	E10		Indoor unit detecting error from 'option' plug, Error in sending comms signal
4B	E11		Indoor unit detecting error from 'option' plug, Error in receiving comms signal
4C	E12		Auto addressing failed, Auto address connector CN100 shorted during auto addressing
4D	E13		Indoor unit failed to send signal to remote controller
4E	E14		Setting Failure, Duplication of master indoor units
4F	E15		Auto addressing failed, Number of indoor units connected are less than number set
50	E16		Auto addressing failed, Number of indoor units connected are more than number set
51	E17		Group control wiring error, Main indoor unit not sending signal for sub indoor units
52	E18		Group control wiring error, Main indoor unit not receiving signal for sub indoor units
54	E20		Auto addressing failed, No indoor units connected
58	E24		Auto addressing failed, Error on sub outdoor unit
59	E25		Auto addressing failed, Error on outdoor unit address setting
5A	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		Auto addressing failed, Sub outdoor unit not receiving comms for main outdoor unit
5F	E31		Between units, Comms failure with MDC, does E31 remain after power is re-instated? If so replace PCB. & power PCB
61	F01	Sensor Faults	Indoor Heat Exch inlet temp sensor failure (E1)
62	F02		Indoor Heat Exch freeze temp sensor failure (E2)
63	F03		Indoor Heat Exch outlet temp sensor failure (E3)
64	F04		Outdoor Discharge temp sensor failure (TD) or (DISCH1)
65	F05		Outdoor Discharge temp sensor failure (DISCH2)
66	F06		Outdoor Heat Exch temp sensor failure (C1) or (EXG1)
67	F07		Outdoor Heat Exch temp sensor failure (C2) or (EXL1)
68	F08		Outdoor Air temp sensor failure (TO)
6A	F10		Indoor inlet temp sensor failure
6B	F11		Indoor outlet temp sensor failure
6C	F12		Outdoor Intake sensor failure (TS)
6D	F13		GHP - Cooling water temperature sensor failure

70	F16		Outdoor High pressure sensor failure
71	F17		GHP - Cooling water temperature sensor fault
72	F18		GHP - Exhaust gas temperature sensor fault
74	F20		GHP Clutch coil temperature fault
77	F23		Outdoor Heat Exch temp sensor failure (EXG2)
78	F24		Outdoor Heat Exch temp sensor failure (EXL2)
7D	F29		Indoor EEPROM error
7E	F30		Clock Function (RTC) fault
7F	F31		Outdoor EEPROM error
81	H01	Compressor Issues	Compressor Fault, Over current (Comp1)
82	H02		Compressor Fault, Locked rota current detected (Comp1)
83	H03		Compressor Fault, No current detected (Comp1)
85	H05		Compressor Fault, Discharge temp not detected (Comp1)
86	H06		Compressor Fault, Low Pressure trip
87	H07		Compressor Fault, Low oil level
88	H08		Compressor Fault, Oil sensor Fault (Comp1)
8B	H11		Compressor Fault, Over current (Comp2)
8C	H12		Compressor Fault, Locked rota current detected (Comp2)
8D	H13		Compressor Fault, No current detected (Comp2)
8F	H15		Compressor Fault, Discharge temp not detected (Comp2)
95	H21		Compressor Fault, Over current (Comp3)
96	H22		Compressor Fault, Locked rota current detected (Comp3)
97	H23		Compressor Fault, No current detected (Comp3)
99	H25		Compressor Fault, Discharge temp not detected (Comp3)
9B	H27		Compressor Fault, Oil sensor fault (Comp2)
9C	H28		Compressor Fault. Oil sensor (connection failure)
9F	H31		Compressor Fault. IPM trip (IMP current on temperature)
C1	L01	Incorrect Settings	Setting Error, Indoor unit group setting error
C2	L02		Setting Error, Indoor/outdoor unit type/model miss-matched
C3	L03		Duplication of main indoor unit address in group control
C4	L04		Duplication of outdoor unit system address
C5	L05		2 or more controllers have been set as 'priority' in one system - shown on controllers set as 'priority'
C6	L06		2 or more controllers have been set as 'priority' in one system - shown on controllers not set as 'priority'
C7	L07		Group wiring connected on and individual indoor unit
C8	L08		Indoor unit address/group not set
C9	L09		Indoor unit capacity code not set
CA	L10		Outdoor unit capacity code not set
CB	L11		Group control wiring incorrect
CD	L13		Indoor unit type setting error, capacity
CF	L15		Indoor unit paring fault
D0	L16		Water heat exch unit setting failure
D1	L17		Miss-match of outdoor unit with different refrigerant
D2	L18		4-way valve failure
D3	L19		Water heat exch unit duplicated address
D5	L21		Gas type setup failure
E1	P01	Indoor Unit Problems	Indoor unit fault, Fan motor thermal overload
E2	P02		Outdoor unit fault, Compressor motor thermal overload, over or under voltage
E3	P03		Outdoor unit fault, Compressor discharge temperature too high (Comp1) over 111 ºC. Low on ref gas, exp valve, pipework damage.
E4	P04		Outdoor unit fault, High pressure trip
E5	P05		Outdoor unit fault, Open phase on power supply. Check power on each phase, inverter pcb, control pcb

E9	P09		Indoor unit fault, Ceiling panel incorrectly wired
EA	P10		Indoor unit fault, Condensate float switch opened
EB	P11		GHP - Water Heat exch low temp (frost protection) fault
EC	P12		Indoor unit fault, Fan DC motor fault
EE	P14		Input from leak detector (If fitted)
EF	P15		Refrigerant loss, high discharge temp and EEV wide open and low compressor current draw.
F0	P16		Outdoor unit fault, Open phase on compressor power supply
F1	P17		Outdoor unit fault, Compressor discharge temperature too high (Comp2) over 111 degC. Low on ref gas, exp valve, pipework damage.
F2	P18		Outdoor unit fault, By-pass valve failure
F3	P19		Outdoor unit fault, 4-way valve failure, i/door temp rises in cooling or fills in heating. Check wiring, coil, pcb output, valve operation.
F4	P20		Ref gas, high temp/pressure fault, heat exch temp high C2, 55-60 degC, cooling over-load, sensor fault.
F6	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.
FA	P26		Outdoor unit fault, Compressor overcurrent - check winding resistance, Inverter failure - check internal resistance term HIC + & - to UVW 200-300Kohm or more
FC	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		Indoor unit fault, System controller detected fault on sub indoor unit
FF	P31		Simultaneous operation multi control fault, Group controller fault
65535 (-1)	N/A	PA-RC2-MBS-4	Error in the communication of PA-RC2-MBS-4device with the AC unit

☞ In case you detect an error code not listed, contact your nearest Panasonic or Sanyo technical support service.