Modbus RTU (EIA-485) Interface for Samsung air conditioners

Compatible with NASA commercial air conditioners commercialized by Samsung

USER MANUAL

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Modbus RTU (EIA-485) Interface for Samsung air conditioners

Compatible with NASA commercial air conditioners commercialized by Samsung

ORDER CODE	LEGACY ORDER CODE
INMBSSAM001R100	SM-RC2-MBS-1

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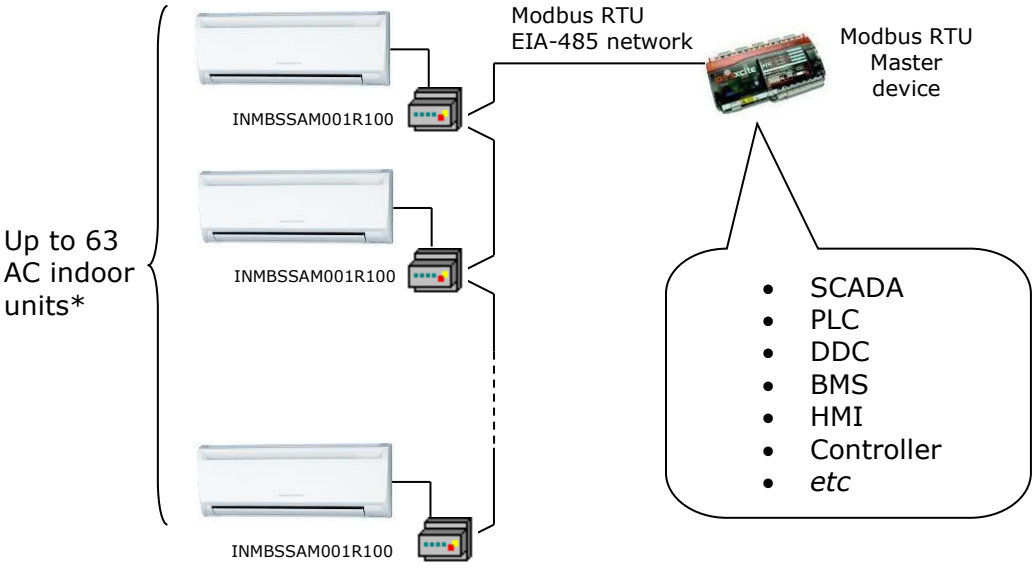
1. Presentation

The INMBSSAM001R100 interfaces allow a complete and natural integration of ***Samsung NASA*** air conditioners into Modbus RTU (EIA-485) networks.

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 INMBSSAM001R100 devices can be connected in the same network.
  INMBSSAM001R100 is a Modbus slave device.
- Direct connection to the AC unit.
- 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.

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2. Connection

The interface comes with 1 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 INMBSSAM001R100 connects directly to the Samsung Remote Controller Bus (F3F4 Connector). Depending on which controllers are available, the recommended connection methods are the following ones (details in Figure 2. 1):

- **Wired remote control available**. Connect the gateway in parallel with the wired Remote Controller (wired remote controller acts as Main).
- **No remote control available** Connect the gateway directly to the F3F4 bus of the indoor unit. There's no Samsung remote controller.

Maximum F3F4 bus length is 100 m (328.08 ft). The communication F3F4 bus has polarity sensitivity.

Important: Communication may shut down if an AC manufacturer's wired remote controller is connected to the same bus. Wired remote controllers have a Main/Sub setting to define their roles and must be set up accordingly when two wired remote controllers are installed. For more information, check the wired remote controller's installation manual.

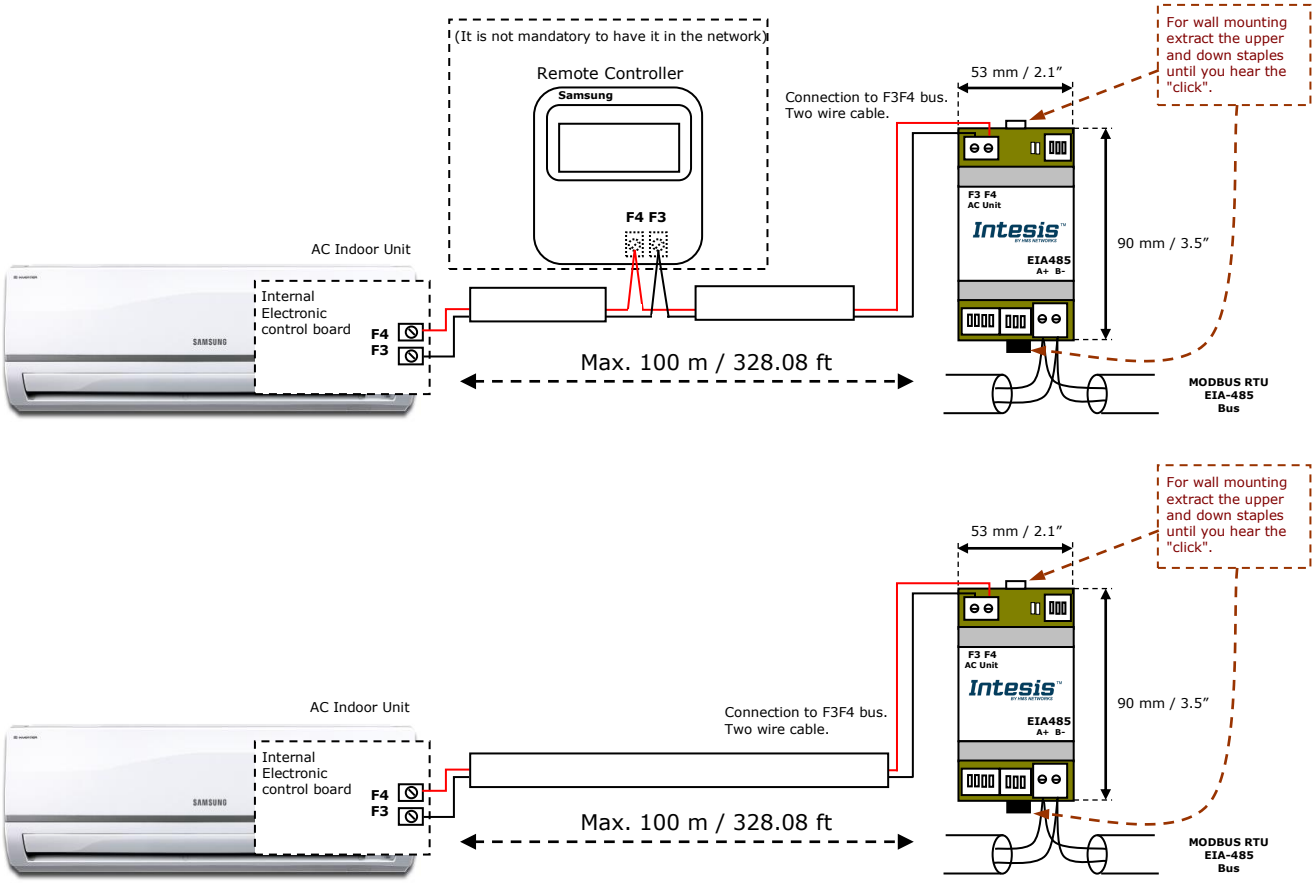

Figure 2. 1 INMBSSAM001R100 connection diagram

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2.2 Connection to the EIA-485 bus

Connect the EIA-485 bus wires to the plug-in terminal block (the one labeled as EIA485) of INMBSSAM001R100 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 F3F4 bus between the interface and the AC indoor unit following the instructions of the diagram. Screw each bare cable end in the corresponding F3F4 terminals.
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 (see section 4.3).

   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.

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4. Modbus Interface Specification

4.1 Modbus physical layer

INMBSSAM001R100 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 (protocol address)	Register Address (PLC address)	R/W	Description
0	1	R/W	AC unit On/Off ▪ 0: Off ▪ 1: On
1	2	R/W	AC unit Mode [1] ▪ 0: Auto ▪ 1: Heat ▪ 2: Dry ▪ 3: Fan ▪ 4: Cool
2	3	R/W	AC unit Fan Speed [1] ▪ 0: Auto ▪ 1: Low ▪ 2: Mid ▪ 3: High ▪ 4: Turbo
3	4	R/W	AC unit Vane UD Position [1] ▪ 0: Swing Off (Auto) ▪ 10: Swing On
4	5	R/W	AC unit Temperature setpoint [1,2,3] ▪ -32768 (Initialization value) ▪ Cool: 18..30ºC (ºC/x10ºC) / 65..86ºF ▪ Heat: 16..30ºC (ºC/x10ºC) / 63..86ºF
5	6	R	AC unit Temperature reference [1,2,3] ▪ -32768 (Initialization value) ▪ -41..38ºC (ºC/x10ºC) ▪ -106..212ºF

[1] 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.
[2] Magnitude for this register can be adjusted to Celsius x 1ºC, Celsius x 10ºC (default) or Fahrenheit. See section 4.2.3 for more information.
[3] It is not possible turn to x10 the value shown in Fahrenheit.

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Register Address (protocol address)	Register Address (PLC address)	R/W	Description
6	7	R/W	Window Contact ▪ 0: Closed (Default) ▪ 1: Open
7	8	R/W	INMBSSAM001R100 Disablement [4] ▪ 0: INMBSSAM001R100 enabled (Default) ▪ 1: INMBSSAM001R100 disabled
8	9	R/W	AC Remote Control Disablement [4] ▪ 0: Remote Controller enabled (Default) ▪ 1: Remote Controller disabled
9	10	R/W	AC unit Operation Time [4] ▪ 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 [5] ▪ 0: No error present ▪ 65535(-1 if it is read as signed value): Error in the communication of INMBSSAM001R100 with the AC indoor unit. ▪ Any other error present, see the table at the end of this document.
22	23	R/W	Indoor unit´s ambient temperature from external sensor (at Modbus side) [1,2,3,6] ▪ -32768: (Initialization value). No temperature is being provided from an external sensor. ▪ Any other: (ºC/x10ºC/ºF)
23	24	R	AC Real temperature setpoint [1,2,3,6] ▪ 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. ▪ 16..31ºC (ºC/x10ºC) ▪ 60..92ºF
26	27	R/W	AC unit Left/Right Vane Position ▪ 0: Swing Off (Auto) ▪ 10: Swing On

[4] This value is stored in non-volatile memory.
[5] See section 7 for possible error codes and their explanation.
[6] See section 4.2.3 for more information.

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Register Address (protocol address)	Register Address (PLC address)	R/W	Description
40	41	R	Window contact ON/OFF Disablement ▪ 0: Window contact is not disabling option On/Off at this moment (Default value) ▪ 1: Window contact is disabling option On/Off at this moment
44	45	R	Filter status ▪ 0: OK ▪ 1: Filter cleaning
66	67	R	Return path Temperature [1,2,3] ▪ -32768 (Initialization value) ▪ Ranges determined by the Manufacturer of the AC indoor unit: (ºC/x10ºC/ºF)
97	98	R/W	Block Periodic Sendings [4,7,8] ▪ 0: Non-blocked (Default value) ▪ 1: Blocked

4.2.2 Configuration Registers

Register Address (protocol address)	Register Address (PLC address)	R/W	Description
13	14	R/W	"Open Window" switch-off timeout [9] ▪ 0..30 (minutes) ▪ Factory setting: 30 (minutes)
14	15	R	Modbus RTU baud-rate ▪ 2400bps ▪ 4800bps ▪ 9600bps (Default) ▪ 19200bps ▪ 38400bps ▪ 57600bps ▪ 76800bps ▪ 115200bps
15	16	R	Modbus Slave Address ▪ 1..63
43	44	W	Filter reset ▪ 1: Filter reset
49	50	R	Device ID: 0x2E00
50	51	R	Software version
67	68	R	Number of IUs connected ▪ Indicates the number of indoor units connected to the same RC bus.

[7] 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 (values sent on change).
[8] This register applies to firmware version 0.1 onwards.
[9] Once window contact is open, a count-down to switch off the AC Unit will start from this configured value.

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68	69	R/W	Internal IU address ▪ All indoor units connected in the RC bus are listed in an Internal array in address ascending order. This register indicates the position in the array of the current indoor unit status reported.
69	70	R	IU Address status reported ▪ Address of the indoor unit that reports the status in case there is more than one indoor unit connected in the RC bus.
99	100	W	Reset/Reboot device ▪ 1: Reset

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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 Samsung 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 Samsung indoor unit as the reference of its own control loop. Depending on the configuration of the indoor unit, this value can be: the temperature reported by the sensor of the return path of the Samsung indoor unit, the temperature provided by the sensor of its remote controller or the temperature provided by Modbus (external temperature). It is a read-only register (Modbus functions 3 or 4).

- **AC unit external temperature reference (Modbus) (R/W)**
  (register 22 – in Protocol address / register 23 – in PLC address):
  This register allows us to provide an external temperature's sensor from the Modbus side. If a valid value is written in this register, this will be sent to the Samsung Remote Controller bus (RC). Notice that in order to apply this setting, the system shall be set so that the Indoor Unit is configured to use the ambient temperature from the Remote Controller as the reference of its own control loop.

  Please, check Samsung's User Manual or Samsung's Installation Manual to see how the reference temperature source can be changed from the own return path to the reference temperature.

  After the startup, the value for "external temperature's reference" (register 22/23) has a value -32768 (0x8000). This value means that no external temperature reference is being provided through INMBSSAM001R100. In this scenario, the AC indoor unit will use its own return path temperature sensor as reference for its control loop or the remote controller's one (if connected and configured to do so).

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

- **AC temperature Real setpoint (R)**
  (register 23 – In Protocol address / register 24 – in PLC address)**:**
  As it has been detailed on the previous point, the real temperature setpoint in the indoor unit and the temperature setpoint requested from INMBSSAM001R100 might differ (when a value in register 22/23 – "external temperature reference" is entered). This register always informs about the current temperature setpoint which is being used by the indoor unit – it is also includes the temperature setpoint that will be shown by an additional remote controller from Samsung connected to the indoor unit, if it is present on the system.

  This register can be read (Modbus function 3 or 4)

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- **Return path Temperature (R)**
  (register 66 – in Protocol address / register 67 – in PLC address):
  This register shows the temperature value reported by the sensor of the own return path of the Samsung indoor unit. It is a read-only register (Modbus functions 3 or 4).

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 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).

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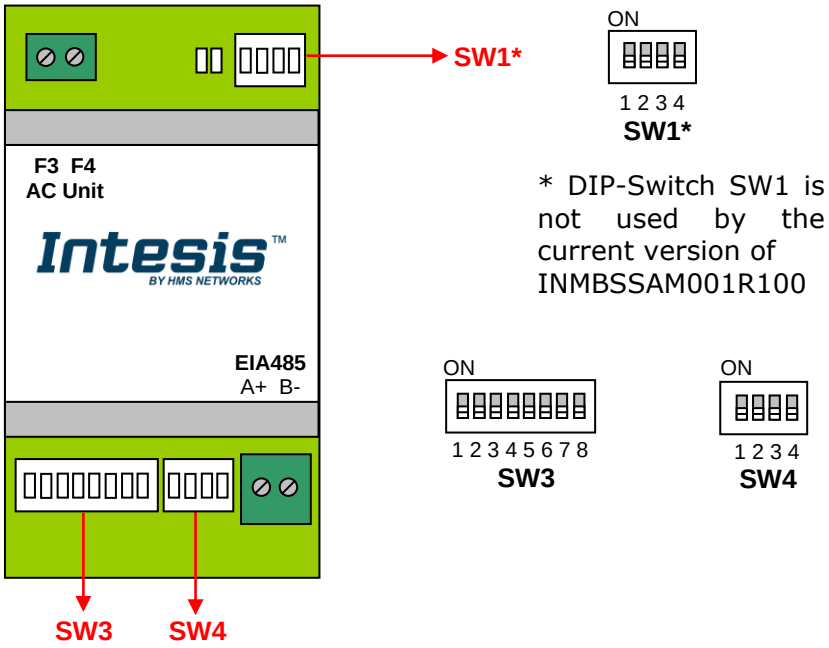
4.3 DIP-switch Configuration Interface

All the configuration values on INMBSSAM001R100 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:

SW3/SW4 – Baud rate configuration

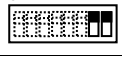
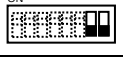
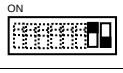
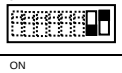
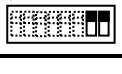
SW3-P7..8	SW4-P3	Description
		2400bps
		4800bps
		9600bps (Default value)
		19200bps
		38400bps
		57600bps
		76800bps
		115200bps

Table 4.1 SW3-SW4: Modbus baud rate

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SW4 – Degrees/Decidegrees (x10), temperature magnitude (ºC/ºF) 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 4.2 SW4: Temperature and termination resistor configuration

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SW3 – Modbus Slave address

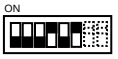
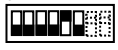
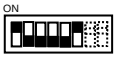
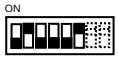
Add	SW3-P1..6	Add	SW3-P1..6	Add	SW3-P1..6	Add	SW3-P1..6	Add	SW3-P1..6
0		13		26		39		52	
1		14		27		40		53	
2		15		28		41		54	
3		16		29		42		55	
4		17		30		43		56	
5		18		31		44		57	
6		19		32		45		58	
7		20		33		46		59	
8		21		34		47		60	
9		22		35		48		61	
10		23		36		49		62	
11		24		37		50		63	
12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

Table 4.3 SW3: Modbus slave address

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4.4 Implemented Functions

INMBSSAM001R100 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).

The maximum of registers that can be read in a single request is 100.

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	Flash checksum not OK

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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.

To prevent fail status detected by the receivers, which are *"listening" the bus,* when all the transmitters' outputs are in three-state (high impedance), a fail-safe biasing mechanism is also required. 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 INMBSSAM001R100 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).

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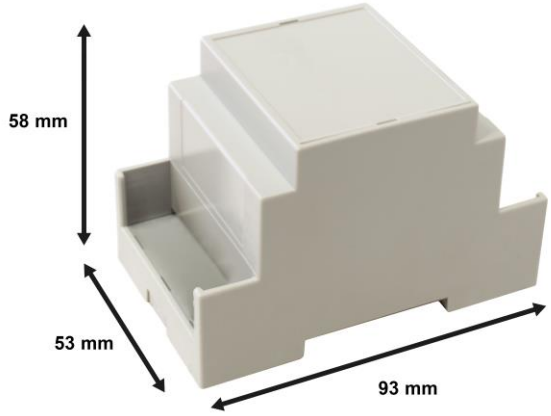
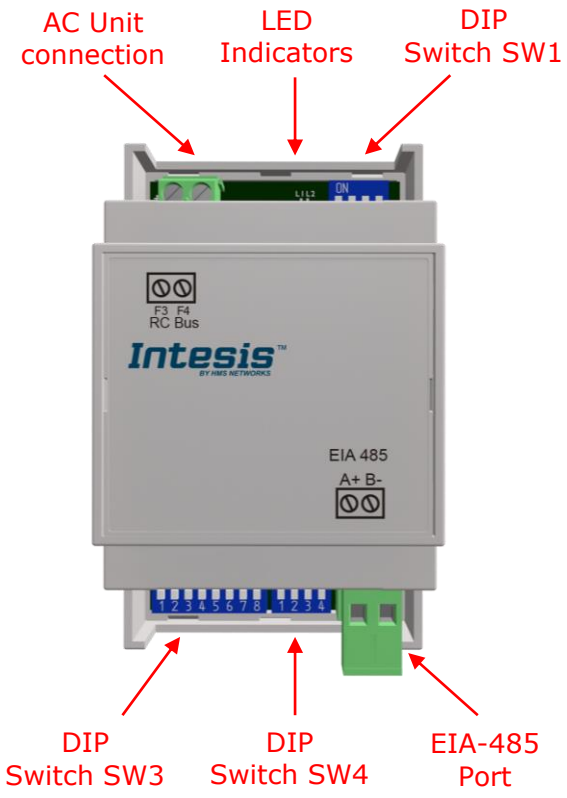
5. Electrical and Mechanical features

Enclosure	Plastic, type PC (UL 94 V-0) Net dimensions (dxwxh): 93 x 53 x 58 mm / 3.7" x 2.1" x 2.3" Color: Light Grey. RAL 7035	Operation Temperature	0ºC to +60ºC
Weight	85 g.	Stock Temperature	-20ºC to +85ºC
Mounting	Wall DIN rail EN60715 TH35.	Operational Humidity	<95% RH, non-condensing
Terminal Wiring (for low-voltage signals)	For 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	Stock Humidity	<95% RH, non-condensing
Modbus RTU port	1 x Serial EIA485 Plug-in screw terminal block (2 poles): A, B Compatible with Modbus RTU EIA-485 networks	Isolation voltage	1500 VDC
AC unit port	1 x F3F4 bus Plug-in screw terminal block (2 poles): F3, F4	Isolation resistance	1000 MΩ
Switch 1 (SW1)	1 x DIP-Switch	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		





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6. List of supported AC Unit Types.

A list of Samsung indoor unit model's references compatible with INMBSSAM001R100 and its available features can be found on this link:

https://www.intesis.com/docs/compatibilities/inxxxsam001r100_compatibility

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7. Error Codes

Error Code Modbus	Error in Remote Controller	Error category	Error Description
0	N/A	INMBSSAM001R100	No active error
101	101	Communication error	Indoor unit communication error
102	102	Communication error	Indoor unit/outdoor unit communication time-out error; errors in more than 6 packets.
121	121	Indoor sensor error	Indoor temperature sensor (open/short).
122	122	Indoor sensor error	Indoor unit evaporator-in sensor (open/short)
128	128	Indoor sensor error	Indoor unit evaporator-in disconnection. (sensor displacement)
129	129	Indoor sensor error	Indoor unit evaporator-out separation.
153	153	Drain diagnostic error	Indoor floating switch secondary detection
201	201	Configuration error	Unit Miss Match indoor/outdoor
202	202	Communication error	Indoor/outdoor communication error (1 min)
203	203	Communication error	Comm. error between indoor/outdoor INV<>MAIN MICOM (1 min)
221	221	Outdoor sensor error	Outdoor temperature sensor error
231	231	Outdoor sensor error	Condenser temperature sensor error
237	237	Outdoor sensor error	Condenser temperature error
251	251	Outdoor sensor error	Inverter Emission temperature sensor error
320	320	Outdoor sensor error	OPL sensor error
402	402	Outdoor sensor error	Detection of outdoor freezing when compressor stop
404	404	Outdoor unit error	Overload Protection of Outdoor when compressor stop
419	419	Control error	EEV Open error (Electronic Evaporation Valve)
422	422	Control error	EEV Close error
425	425	Installation error	Power Cable Miss connection
440	440	Self-diagnostic error	Heating operation blocked
441	441	Self-diagnostic error	Cooling operation blocked
461	461	ODU protection error	Inverter Compressor startup error
462	462	ODU protection error	Inverter total current error / PFC over current error
463	463	ODU protection error	OLP Heat Sink error
464	464	ODU protection error	Inverter IPM over current error
465	465	ODU protection error	Compressor V limit error
466	466	ODU protection error	DC LINK over/low voltage error
467	467	ODU protection error	Inverter compressor rotation error
468	468	ODU protection error	Inverter current sensor error
469	469	ODU protection error	Inverter DC LINK voltage sensor error
471	471	ODU protection error	Inverter OTP error / Inverter EEPROM read/write error
472	472	ODU protection error	AC Zero crossing signal out error
473	473	ODU protection error	Compressor Lock error
474	474	ODU protection error	Heat Sink sensor error
475	475	Self-diagnostic error	Outdoor Fan 2 error
484	484	ODU protection error	PFC Overload error
485	485	ODU protection error	Input current sensor error
500	500	ODU protection error	Heat Sink Overheat error
554	554	Self-diagnostic error	Gas leak detector
556	556	Configuration error	Outdoor unit Capacity Setup option error
557	557	Configuration error	Option Code Miss match indoor units

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601	601	Communication error	Communication error between wired remote and indoor unit. (When communication has stopped for 3 minutes after detecting indoor unit and wired remote control)
602	602	Communication error	Communication error between the Main and Sub wired remote controller. (Only one Main and one Sub can exist).
604	604	Communication error	Tracking 10 or more errors between wired remote control and indoor unit.
606	606	Installation error	-COM1, COM2 crossing connection error. -When wired remote is connected to indoor unit COM1 (F1, F2) terminals.
607	607	Configuration error	-Multiple Main error. (When using Main wired remote control). -Error occurs when two wired remotes are both set as Main in one COM line.
609	609	Configuration error	Indoor unit is not installed. (When the indoor unit is not detected after outside gearing option setting and tracking are finished). In case of using outside gear control.
618	618	Configuration error	-Exceeded maximum no. of installation for indoor units. -A reset is required after checking the number of indoor units.
619	619	Configuration error	-Mixed installations for °C/F° indoor unit. (Only detected on Main wired remote control). -Error occurs when mixed indoor units of °C and °F settings are installed.
620	620	Configuration error	-Wired remote control °C/°F setting error. -This error occurs if the indoor unit is set in °C while the wired remote is set in °F or vice versa.
621	621	Configuration error	This error occurs when the option settings of the Main and Sub wired remote controllers are different from each other.
627	627	Configuration error	Sub wired remote controller installation error (when two Sub wired remote controls are installed).
EA	EA	Configuration error	Wired remote controller COM2 option setting error.
65535 (-1)	N/A	INMBSSAM001R100	Error in the communication of INMBSSAM001R100 with the AC unit.

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

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