INMBSMID001I000 Modbus RTU Gateway

Compatible with Commercial and VRF lines commercialized by Midea

USER MANUAL

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

Compatible with VRF and Commercial lines

ORDER CODE	LEGACY ORDER CODE
INMBSMID001I000	MD-AC-MBS-1

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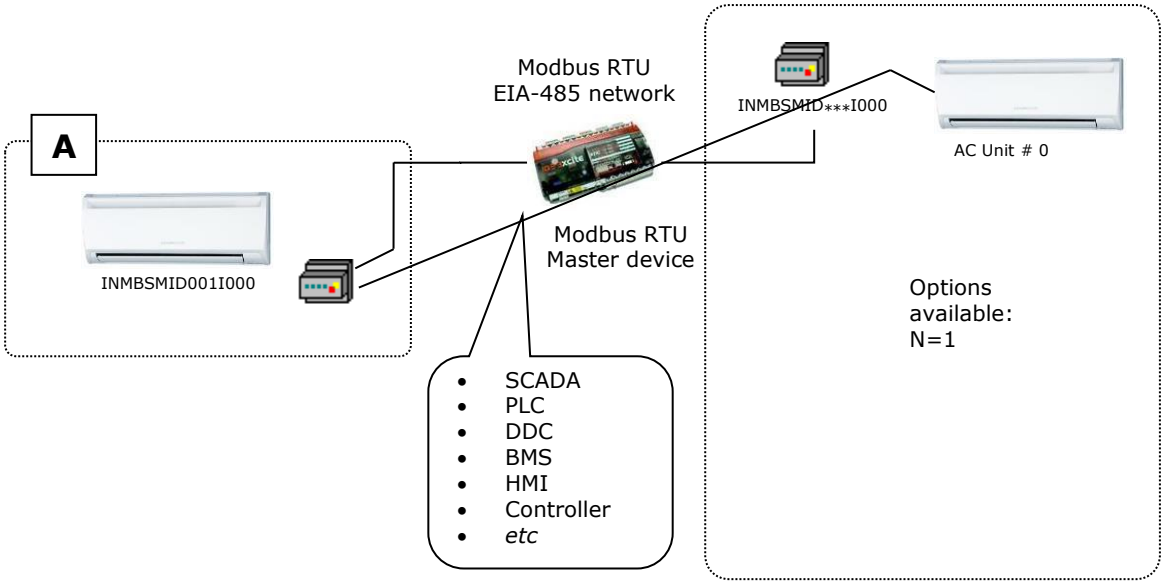
1 Presentation

The INMBSMID001I000 interface allows a complete and natural integration of ***Midea*** air conditioners into Modbus RTU (EIA-485) networks.

Compatible with VRF and Commercial lines.

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 on some models of AC.
- External power required.
- Direct connection to the Midea XYE bus.
- 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.
- Individual control.



A Integration of single AC unit from independent XYE bus using INMBSMID001I000 interface

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2 Connection

The interface comes with 3 plug-in terminal blocks of 2 poles.

The first (XY) is used to establish direct connection with the AC indoor unit. The second one (V1V2) is used to provide power.

The third one (AB) is used to stablish connection with the Modbus RTU EIA-485 network.

2.1 Connect to the AC indoor unit

The INMBSMID001I000 connects directly to the Midea XYE bus. The cable for proper connection is not provided with the interface. Maximum XYE bus length is 1,200 meters (3,937 ft).

Connector E, from the XYE bus, is not used to connect to the indoor unit or indoor units. The XYE bus has specific polarity.

NOTE: The INMBSMID001I000 acts as a central controller. Since the XYE bus supports only one central controller, the only way to use another central controller in addition to the gateway is to add an XYE Extension Kit (not included).

2.2 Connection to the EIA-485 bus

Connect the EIA-485 bus wires to the plug-in terminal block of the INMBSMID001I000 interface and respect the polarity on this connection (A+ and B-).

Make sure that the maximum distance of the bus is 1,200 meters (3,937 ft.) in daisy chain set up. Loop or star topologies are not allowed in the EIA-485 bus. A terminator resistor of 120Ω must be present at each end of the bus to avoid signal reflections. The bus might need a fail-safe biasing mechanism (see section 4.7 for more details).

2.3 Connection to the power supply

The INMBSMID001I000 must be powered from an external power supply.

Use an external 12V DC power supply connected to V1/V2 connector. The V1/V2 connection has specific polarity (V1- y V2+).

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2.4 Connection diagrams

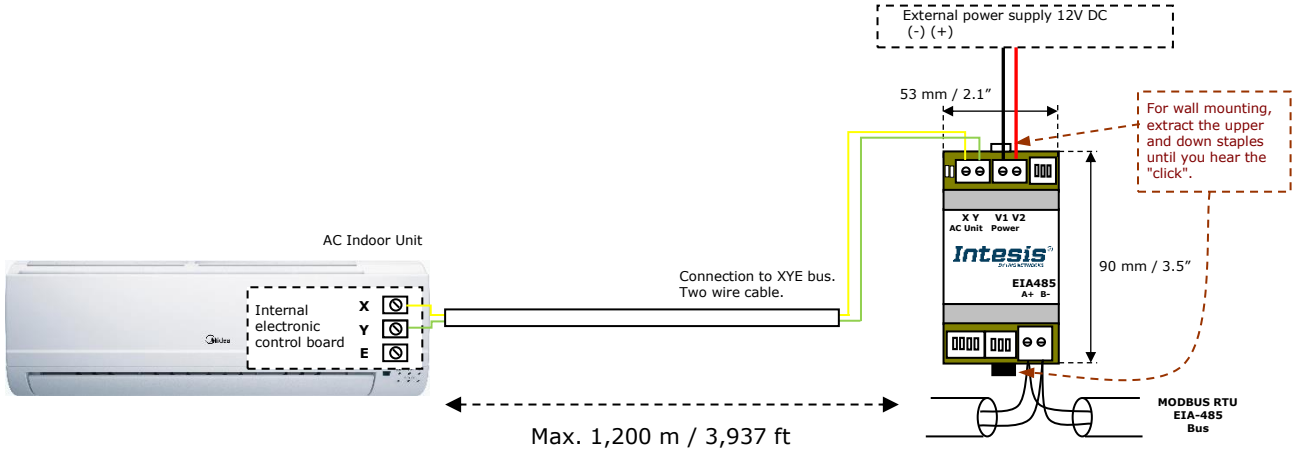

Figure 2.1 INMBSMID001I000 connection diagram

NOTE: The INMBSMID001I000 acts as a central controller. Since the XYE bus supports only one central controller, the only way to use another central controller in addition to the gateway is to add an XYE Extension Kit (not included).

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3 Quick Start Guide

1. Disconnect the air conditioning from the Mains Power.

2. Attach the interface close to the AC indoor unit (wall mounting) following the instructions of the diagram above. Install it inside the AC indoor unit or an electrical enclosure (respect the safety instructions provided by the AC manufacturer).

3. Connect the XYE bus between the interface and the AC indoor unit following the instructions of the installation diagram respecting the polarity.

4. Connect the Modbus RTU (EIA-485) bus to the *EIA485* A/B connector of the interface.

5. Connect the power cable between the interface and the Mains Power following the instructions of the diagram. Screw each bare cable end in the corresponding V1/V2 terminals.

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 SW3 and SW4 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 the communication.

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4 Modbus Interface Specification

4.1 Modbus physical layer

INMBSMID001I000 implements a Modbus RTU (Slave) interface, to be connected to an EIA-485 line. It performs an 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 will automatically detect the communication type (8N1 or 8N2) and set itself accordingly. No user action or manual settings are required.

4.2 Modbus Registers for INMBSMID001I000

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

Important note: match Midea addressing before controlling from Modbus
All indoor units must be addressed within the range of 0 to 63 in the Midea system. The "Indoor Unit Address assignation" R/W configuration register (protocol address 1210 / PLC address 1211) sets the indoor unit address to control with the gateway. Therefore, the assigned address in this register must match the address set for the unit in the Midea system.

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 (Default value) ▪ 1: Heat ▪ 2: Dry ▪ 3: Fan ▪ 4: Cool
2	3	R/W	AC unit Fan Speed[1] ▪ 0: Auto (Default value) ▪ 1: SP1 ▪ 2: SP2 ▪ 3: SP3
3	4	R/W	AC unit Up/Down Vane Position[1] ▪ 0: Off (Default value) ▪ 10: Swing
4	5	R/W	AC unit Temperature setpoint[1,2,3] ▪ -32678 (Initialization value) ▪ 17..30 °C (°C/x10°C) ▪ 63..86 °F

[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 1°C, Celsius x 10°C (default) or Fahrenheit. See section 4.4 for more information.
[3] It is not possible turn the value shown in Fahrenheit to x10.

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Register Address (protocol address)	Register Address (PLC address)	R/W	Description
5	6	R	AC unit Temperature reference[1,2,3] ▪ -32678 (Initialization value) ▪ Ranges determined by the Manufacturer of the AC indoor unit. (°C/x10°C/°F)
6	7	R/W	Window Contact ▪ 0: Closed (Default Value) ▪ 1: Open
7	8	R/W	INMBSMID001I000 Disablement[4] ▪ 0: INMBSMID001I000 enabled (Default) ▪ 1: INMBSMID001I000 disabled
8	9	R/W	Remote Control Disablement[4,5] ▪ 0: Remote enabled (Default Value) ▪ 1: Remote 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[6] ▪ 0: No error active ▪ 65535 (-1 if it is read as signed value): Error in the communication of INMBSMID001I000 with the AC unit ▪ Any other error present, see the table at the end of this document. (Section 7)
22	23	R/W	Indoor unit ambient temperature from external sensor (at Modbus side)[1,2,3,7] ▪ -32768: (Initialization value). No temperature is being provided from an external sensor. ▪ Any other: (°C/x10°C/°F)
23	24	R	AC Real temperature setpoint[1,2,3,7] ▪ -32678 (Initialization value) ▪ 17..30 °C (°C/x10°C) ▪ 63..86 °F
66	67	R	Return path Temperature[1,2,3] ▪ -32768 (Initialization value) ▪ Ranges determined by the Manufacturer of the AC indoor unit. (°C/x10°C/°F)
97	98	R/W	Block Periodic Sendings[4,8,9] ▪ 0: Non-blocked (Default value) ▪ 1: Blocked

[4] This value is stored in non-volatile memory
[5] This register blocks the communication of a remote controller installed on the MD-RC bus, if installed (using an XYE Extension kit)
[6] See section 7 for possible error codes and their explanation
[7] See section 4.3 for more information
[8] 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).
[9] This register applies to firmware version 1.0 onwards

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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[10] ▪ 0..30 (minutes) ▪ Factory setting: 30 (minutes)
14	15	R	Modbus RTU Baud rate ▪ 2400bps ▪ 4800bps ▪ 9600bps (Default Value) ▪ 19200bps ▪ 38400bps ▪ 57600bps ▪ 76800bps ▪ 115200bps
15	16	R	Device's Modbus Slave address ▪ 1..63
21	22	R	Max number of fan speeds
99	100	W	Reset/Reboot device ▪ 1: Reset
1150	1151	R/W	Machine Mode ▪ 0: Normal (Default Value) ▪ 1: Autochangeover ▪ 2: Limited setpoint
1151	1152	R/W	Machine Threshold Cool (°C/°F)[11] ▪ Default value: 26°C/79°F
1152	1153	R/W	Machine Threshold Heat (°C/°F)[11] ▪ Default value: 21°C/70°F
1153	1154	R/W	Machine Min Setpoint Cool (°C/°F)[12] ▪ Default value: 24°C/75°F
1154	1155	R/W	Machine Max Setpoint Cool (°C/°F)[12] ▪ Default value: 28°C/82°F
1155	1156	R/W	Machine Min Setpoint Heat (°C/°F)[12] ▪ Default value: 19°C/66°F
1156	1157	R/W	Machine Max Setpoint Heat (°C/°F)[12] ▪ Default value: 23°C/73°F
1210	1211	R/W	Indoor unit address (0..63)
2031	2032	R	Capacity ▪ 1: INMBSMID001I000 (1 Indoor Unit)

[10] Once window contact is open, a count-down to switch off the AC Unit will start from this configured value.
[11] Only applies when Machine Mode is set to 1 (Autochangeover).
[12] Custom limits. These registers only apply when Machine Mode is set to 2 (Limited setpoint).

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4.3 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 required by the user.

  This register can be read (Modbus function 3 or 4) or written (Modbus functions 6 or 16). If present[13], a remote controller connected to the Midea indoor unit will report the same temperature setpoint value as this register, but this will only happen when no AC unit´s external reference is provided from INMBSMID001I000 (see detail for register 22/23 below).

- **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 Midea 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 on the return path of the Midea indoor unit or the sensor of its remote controller. 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 to provide an external temperature's value from the Modbus side. The Midea indoor unit does not allow to provide an external temperature to be used as a reference of the control loop of the AC indoor unit. In order to overcome this limitation and enable the usage of an external temperature sensor (i.e. from Modbus side), INMBSMID001I000 applies the following mechanism (only if "external temperature's reference" is being used):

  - After a couple of values have been entered in the "AC unit external temperature's reference" (register 22/23) and "AC unit temperature set point" (register 4/5), INMBSMID001I000 is going to estimate the chosen temperature differences (e.g. if a "temperature setpoint (register 4/5)" of **22°C**, and an "external temperature reference (register 22/23)" of **20°C** are entered, INMBSMID001I000 will assume that the user is demanding a **+2°C** increase in temperature).

  - By knowing at any time the ambient temperature currently used by the indoor unit to control its own operation (register 5/6), INMBSMID001I000 can calculate the required temperature setpoint needed to apply the decrease/increase on the real temperature and reach the temperature chosen by the user (following the example above, if INMBSMID001I000 reads an "ambient temperature" (register 5/6) of **24°C** in the indoor unit, it will apply a final setpoint of **24°C + 2°C = 26°C**).

  - At this moment, each time that INMBSMID001I000 detects a change on the ambient temperature reported by the indoor unit (register 5/6), it will also change the required setpoint, in order to keep the temperature required by the user at any time. If we follow the last example, if INMBSMID001I000 receives a new temperature´s value coming from the indoor unit of **25°C**, INMBSMID001I000 will automatically adjust the temperature setpoint required of the AC indoor unit to **25°C + 2°C = 27°C**).

[13] An XYE Extension kit is required to install a remote controller along the gateway.

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- In general, INMBSMID001I000 is constantly applying the "*Virtual Temperature*" formula:

$$S_{AC} = S_u - (T_u - T_{AC})$$

Where:

S_{AC} - setpoint value currently applied to the indoor unit
S_u - setpoint value written at Modbus side (register 4/5)
T_u - external temperature reference written at Modbus side (register 22/23)
T_{AC} - ambient temperature that the indoor unit is using as the reference of its own control loop (register 5/6)

When INMBSMID001I000 detects a change in any of the values of $\{ S_u , T_u , T_{AC} \}$, it will send the new setpoint (S_{AC}) to the indoor unit.

- 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 INMBSMID001I000. In this scenario, the setpoint value shown in register 4/5 will always be the same as the current setpoint value of the indoor unit. AC indoor unit will use its own return path temperature sensor as reference for its control loop.

- When the mechanism of "*Virtual Temperature*" is applied. The temperature setpoint's value shown by the Remote Controller from Midea connected to the indoor unit shall show a different value from the value shown in register 4/5. Instead it shall show the calculated Virtual Setpoint.

- **AC Real temperature setpoint (R)**
  (register 23 – In Protocol address / register 24 – in PLC address)**:**
  As detailed on the previous point, the real temperature setpoint in the indoor unit and the temperature setpoint requested from INMBSMID001I000 might differ (when a value in register 22/23 – "external temperature reference" is entered). This register always informs about the current temperature setpoint, used by the indoor unit – this is the actual setpoint that will be shown by an additional remote controller if present.

Moreover, notice that temperature's values of all these three registers are expressed according to the temperature's format configured through its onboard DIP Switches. The 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).

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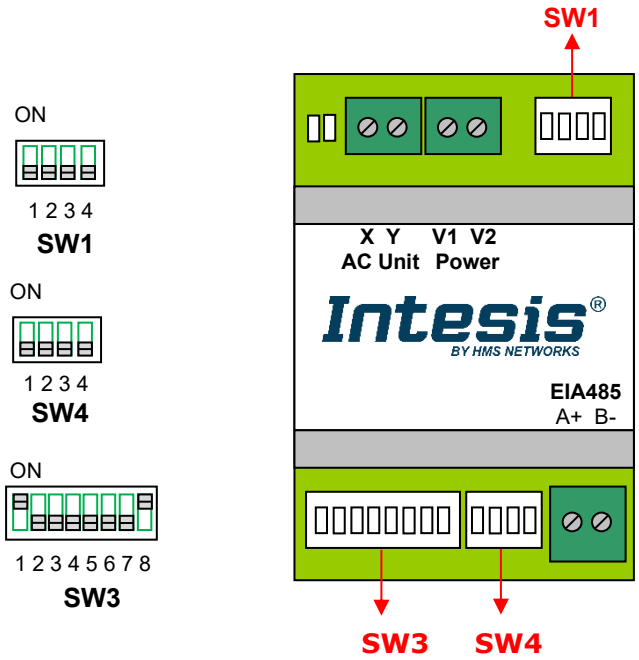
4.4 DIP switch Configuration Interface

All the configuration values on INMBSMID001I000 can be written and read from Modbus interface. Otherwise, some of them can also be set up from their 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
ON	AC Unit does not have AUTO mode (Default value)
ON	AC Unit has AUTO mode
ON	AC Unit does not have DRY mode (Default value)
ON	AC Unit has DRY mode
ON	AC Unit does not have fan AUTO mode (Default value)
ON	AC Unit has fan AUTO mode
ON	AC Unit has 2 fan speeds (Default value)
ON	AC Unit has 3 fan speeds

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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

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SW3 – Modbus Slave address

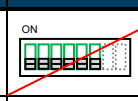
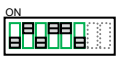
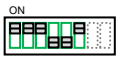
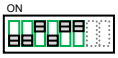
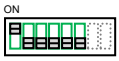
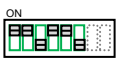
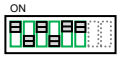
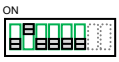
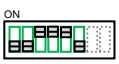
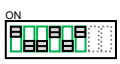
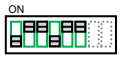
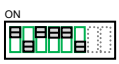
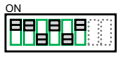
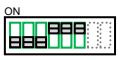
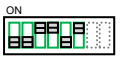
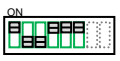
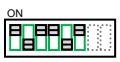
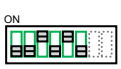
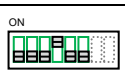
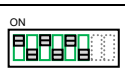
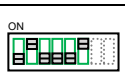
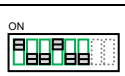
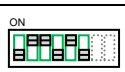
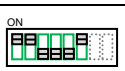
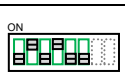
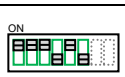
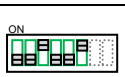
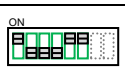
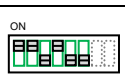
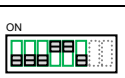
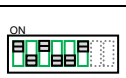
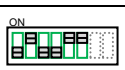
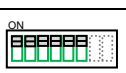
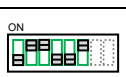
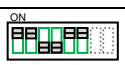
Add	SW3-P1..6	*Add*	SW3-P1..6	*Add*	SW3-P1..6	*Add*	SW3-P1..6	*Add*	SW3-P1..6
0		**13**		**26**		**39**		**52**	
1		**14**		**27**		**40**		**53**	
2		**15**		**28**		**41**		**54**	
3		**16**		**29**		**42**		**55**	
4		**17**		**30**		**43**		**56**	
5		**18**		**31**		**44**		**57**	
6		**19**		**32**		**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 4.4 SW3: Modbus Slave address

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4.5 Implemented Functions

INMBSMID001I000 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 always be 1 when this function is being used for writing)

4.6 Device LED indicator

The device includes LED indicators to show all the possible operational states. In the following table you will find the possible indication combinations and its meaning.

L1 (green LED)

Device status	LED indication	ON / OFF Period	Description
During faulty 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 faulty operation	LED Pulse	3sec ON / --- OFF	Under voltage occurs.

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 faulty operation	LED alternatively blinking	500ms ON / 500ms OFF	Flash checksum not OK

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4.7 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 detections 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 required. This mechanism provides a safe status (a correct voltage level) in the bus when all the transmitters' outputs are in three-state.

The INMBSMID001I000 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. Check the technical documentation of the Master device connected to the EIA-485 network in each case.

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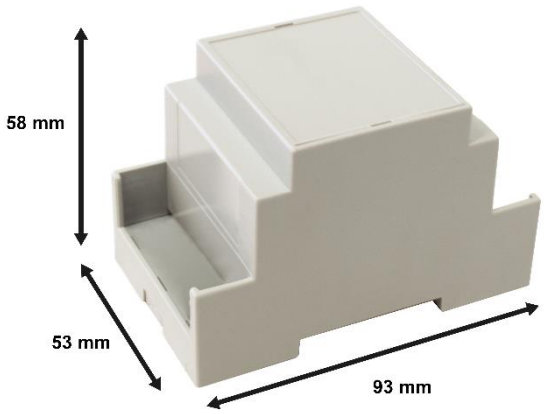
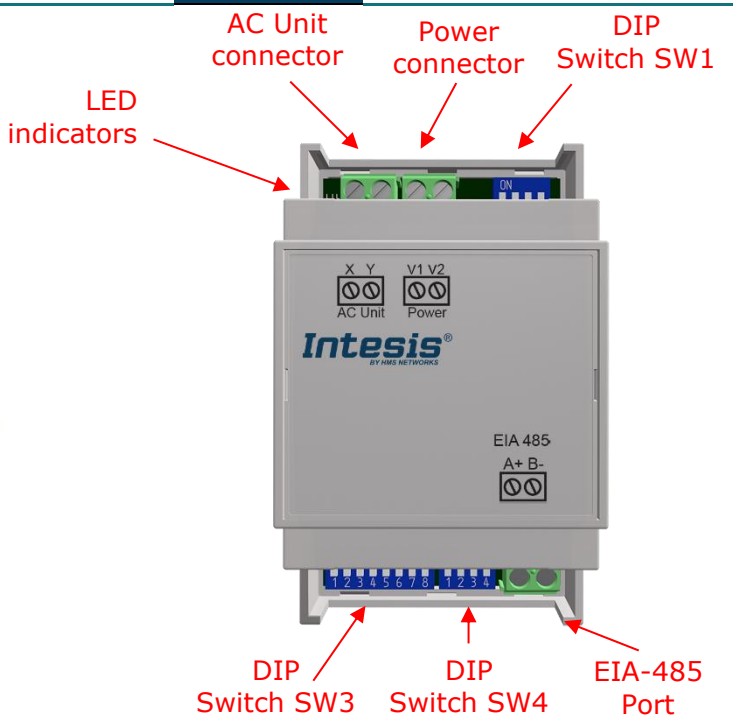
5 Electrical and Mechanical features

Housing	Plastic, type PC (UL 94 V-0) Net dimensions (hxwxd): 93 x 53 x 58 mm / 3.7" x 2.1" x 2.3" Color: Light Grey. RAL 7035	Operation Temperature	0°C to +60°C
Weight	85 g	Stock Temperature	-20°C to +85°C
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) One core: 0.2 mm^2… 2.5 mm^2 Two cores: 0.2 mm^2… 1.5 mm^2 Three 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 XYE bus Plug-in screw terminal block (2 poles): X, Y Compatible with Midea networks	Isolation resistance	1000 MΩ
Power port	1 x V1 V2 Power screw terminal block (2 poles): V1, V2	Protection	IP20 (IEC60529)
Switch 1 (SW1)	1 x DIP Switch for AC features	Power Supply	12 VDC / 100 mA NEC Class 2 or Limited Power Source (PS2) and SELV rated PS. Max. 3 meters between device and external PS
Switch 3 (SW3)	1 x DIP Switch for Modbus RTU settings		
Switch 4 (SW4)	1 x DIP Switch for extra functions	LED indicators	2 x Onboard LED - Operational status





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6 List of supported AC Unit Types

Use the compatibility tool at the following link to see which Daikin unit models are compatible with the INMBSMID001I000 gateway:

https://compatibility.intesis.com/

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7 Error Codes

Error Code	Error in Remote Controller	Error description
0	N/A	No active error
1	E0	Phase error or error in the phase sequence
2	E1	Communication error
3	E2	T1 sensor error
4	E3	T2A sensor error
5	E4	T2B sensor error
6	E5	T3 temperature and T4 temperature Compressor discharge temperature sensors error
7	E6	Zero cross error detection
8	E7	EEPROM memory error
9	E8	Indoor fan speed out of control
10	E9	Communication error between the main panel and the visualization panel
11	EA	Compressor's current overload error (4 times)
12	EB	Inverter module protection
13	EC	Cooling error
14	ED	Outdoor unit fault protection
15	EE	Water level fault detection
16	EF	Other errors
101	P0	Vaporizer temperature protection
102	P1	Thawing or cold air protection
103	P2	Condenser high temperatures protection
104	P3	Compressor temperature protection
105	P4	Evacuation duct temperature protection
106	P5	Discharge high pressure protection
107	P6	Discharge low pressure protection
108	P7	Current overload or under load protection
109	P8	Compressor's current overload protection
110	P9	Reserved
111	PA	Reserved
112	PB	Reserved
113	PC	Reserved
114	PD	Reserved
115	PE	Reserved
116	PF	Other protection measures
65535 (-1)	N/A	Error in the communication of INMBSMID001I000 with the AC unit
-100	N/A	License error / Indoor units not supported by current license
-200	N/A	Overconsumption error in EXY bus

In case you detect an error code not listed, contact your nearest Midea technical support service.

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