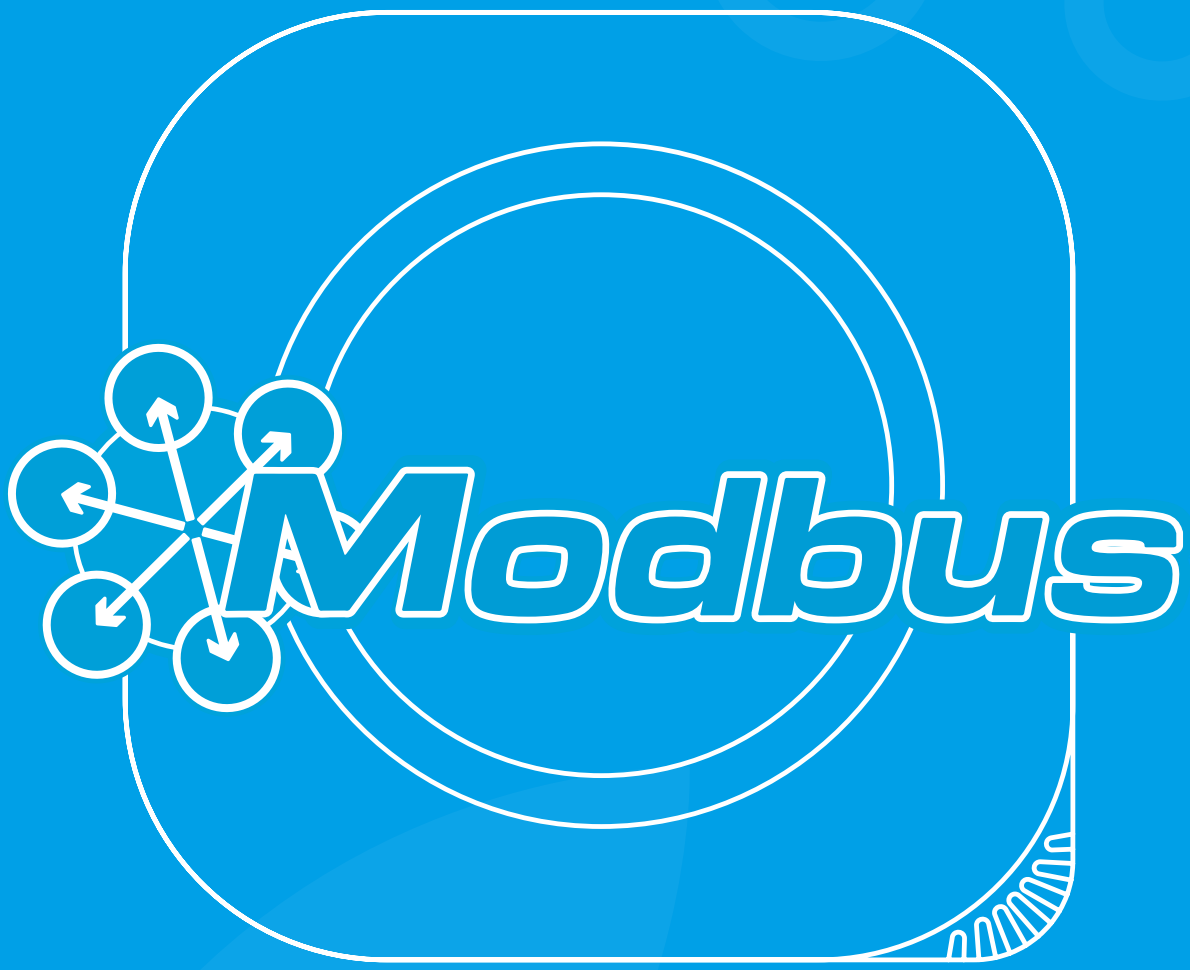
Modbus Guide



V3.2 - 07/25

inBiot

Contents Table

REGISTERS

IAQ Parameters

REGISTER ADDRESS	MODBUS COMMAND	READ / WRITE	DESCRIPTION	DATA TYPE	UNIT	RANGE
100	*03h (Read Holding Registers)*	R	Temperature (MSB)[1]	32b float comma (IEEE 754)[2]	ºC	-40 - 145º
101	*03h (Read Holding Registers)*	R	Temperature (LSB)[3]	32b float comma (IEEE 754)	ºC	-40 - 145º
102	*03h (Read Holding Registers)*	R	Humidity (MSB)	32b float comma (IEEE 754)	%	0 - 100% RH
103	*03h (Read Holding Registers)*	R	Humidity (LSB)	32b float comma (IEEE 754)	%	0 - 100% RH
104	*03h (Read Holding Registers)*	R	CO_2	16b unsigned integer	ppm	0 - 5000 ppm
105	*03h (Read Holding Registers)*	R	TVOC	16b unsigned integer	ppb	0 - 2383 ppb
106	*03h (Read Holding Registers)*	R	PM2.5	16b unsigned integer	µg/m³	0 - 1000 µg/m³
107	*03h (Read Holding Registers)*	R	PM10	16b unsigned integer	µg/m³	0 - 1000 µg/m³
108	*03h (Read Holding Registers)*	R	PM1.0	16b unsigned integer	µg/m³	0 - 1000 µg/m³
109	*03h (Read Holding Registers)*	R	PM4.0	16b unsigned integer	µg/m³	0 - 1000 µg/m³
110	*03h (Read Holding Registers)*	R	Formaldehyde	16b unsigned integer	µg/m³	0 - 1228 µg/m³
111	*03h (Read Holding Registers)*	R	O_3	16b unsigned integer	ppb	0 - 10000 ppb
112	*03h (Read Holding Registers)*	R	NO_2	16b unsigned integer	ppb	0 - 5000 ppb
113	*03h (Read Holding Registers)*	R	CO (MSB)	32b float comma (IEEE 754)	ppm	0 - 1000 ppm
114	*03h (Read Holding Registers)*	R	CO (LSB)	32b float comma (IEEE 754)	ppm	0 - 1000 ppm

Indicators

REGISTER ADDRESS	MODBUS COMMAND	READ / WRITE	DESCRIPTION	DATA TYPE	UNIT	RANGE
126	*03h (Read Holding Registers)*	R	Ventilation Efficiency	16b unsigned integer	index	0 - 100
127	*03h (Read Holding Registers)*	R	Thermohygrometric Comfort	16b unsigned integer	index	0 - 100
128	*03h (Read Holding Registers)*	R	Resistance to Virus Spread	16b unsigned integer	index	0 - 100
129	*03h (Read Holding Registers)*	R	Indoor Air Quality	16b unsigned integer	index	0 - 100
130	*03h (Read Holding Registers)*	R	Resistance to Mold Growth	16b unsigned integer	index	0 - 100

Note: In case of an error or if a sensor is not present, the corresponding register value will be 0. For more information about the sensor status and to understand the cause, refer to the Sensor Status table.

[1] MSB: Most Significant Bit (s).

[2] 32b float comma (IEEE 754), stored as 2x16b unsigned integers. More information.

[3] LSB: Least Significant Bit (s).

For more details check out the Examples section.

Sensor Status

REGISTER ADDRESS	MODBUS COMMAND	READ / WRITE	DESCRIPTION	DATA TYPE	VALUES
136	*03h (Read Holding Registers)*	R	Sensor States (corresponding bits for each sensor): (0 - 2) = Temperature (3 - 5) = Humidity (6 - 8) = CO_2 (9 - 11) = TVOC (12 -14) = PM2.5	16b unsigned integer	000 -> Sensor OK 001 -> Sensor error 010 -> Preheating 011 -> Sensor unavailable
137	*03h (Read Holding Registers)*	R	Sensor States (corresponding bits for each sensor): (0 - 2) = PM10 (3 - 5) = PM1.0 (6 - 8) = PM4.0 (9 - 11) = Formaldehyde (12 -14) = Ozone (15) = Reserved	16b unsigned integer	000 -> Sensor OK 001 -> Sensor error 010 -> Preheating 011 -> Sensor unavailable
138	*03h (Read Holding Registers)*	R	Sensor States (corresponding bits for each sensor): (0 - 2) = NO_2 (3 - 5) = CO (6 - 15) = Reserved	16b unsigned integer	000 -> Sensor OK 001 -> Sensor error 010 -> Preheating 011 -> Sensor unavailable

Modbus registry indexation

Device information

REGISTER ADDRESS	MODBUS COMMAND	READ / WRITE	DESCRIPTION	DATA TYPE	OBSERVATIONS
146	*03h (Read Holding Registers)*	R	Application ID	16b unsigned integer	2018
147	*03h (Read Holding Registers)*	R	Device type	16b unsigned integer	0: MINI, 1: MICA, 2: PLUS, 3: WELL
148	*03h (Read Holding Registers)*	R	MAC Address (MSB)[1]	16b unsigned integer	
149	*03h (Read Holding Registers)*	R	MAC Address	16b unsigned integer	
150	*03h (Read Holding Registers)*	R	MAC Address (LSB)[2]	16b unsigned integer	
151	*03h (Read Holding Registers)*	R	Firmware version	16b unsigned integer	0-7 : minor version, 8-15: major version
152	*03h (Read Holding Registers)* *06h (Write Single Register)*	R / W	Indicator light	16b unsigned integer	0 = ON 1 = OFF
153	*03h (Read Holding Registers)* *06h (Write Single Register)*	R / W	CO_2 calibration cycle	16b unsigned integer	1= 48h, 2 = 24, 3 = 7d, 4 = 15d, 5 = OFF.
154	*03h (Read Holding Registers)* *06h (Write Single Register)*	R / W	Touch button status	16b unsigned integer	0 = Enabled 1 = Disabled
155	*03h (Read Holding Registers)* *06h (Write Single Register)*	R / W	Light ring parameter/ indicator	16b unsigned integer	Ventilation indicator = 0, Comfort indicator = 1, Temperature = 2, Humidity = 3, CO_2 = 4, TVOC = 5, PM2.5 = 6, PM10 = 7, Virus indicator = 8, IAQ indicator = 9, PM1 = 10, PM4 = 11, Formaldehyde = 12, O_3 = 13, NO_2 = 14

[1] MSB: Most Significant Bit (s).
[2] LSB: Least Significant Bit (s).
For more details check out the Examples section.

Other Parameters

REGISTER ADDRESS	MODBUS COMMAND	READ / WRITE	DESCRIPTION	DATA TYPE	RANGE
186	*03h (Read Holding Registers)*	R	Temperature ºF (MSB)[1]	32b float comma (IEEE 754)[2]	-40 - 293 ºF
187	*03h (Read Holding Registers)*	R	Temperature ºF (LSB)[3]	32b float comma (IEEE 754)	-40 - 293 ºF
188	*03h (Read Holding Registers)*	R	Temperature K (MSB)	32b float comma (IEEE 754)	233.15K - 418.15K
189	*03h (Read Holding Registers)*	R	Temperature K (LSB)	32b float comma (IEEE 754)	233.15K - 418.15K
190	*03h (Read Holding Registers)*	R	TVOC Index	16b unsigned integer	0 - 500 index
191	*03h (Read Holding Registers)*	R	TVOC WELL	16b unsigned integer	23 - 6221 ug/m3
192	*03h (Read Holding Registers)*	R	TVOC Reset	16b unsigned integer	20 - 5482 ug/m3
193	*03h (Read Holding Registers)*	R	Formaldehyde ppb	16b unsigned integer	0 - 983 ppb
194	*03h (Read Holding Registers)*	R	O_3 ug/m3	16b unsigned integer	0 - 19600 ug/m3
195	*03h (Read Holding Registers)*	R	NO_2 ug/m3	16b unsigned integer	0 - 9400 ug/m3
196	*03h (Read Holding Registers)*	R	CO ug/m3 (MSB)	32b float comma (IEEE 754)	0 - 1150 mg
197	*03h (Read Holding Registers)*	R	CO ug/m3 (LSB)	32b float comma (IEEE 754)	0 - 1150 mg

[1] MSB: Most Significant Bit (s).

[2] 32b float comma (IEEE 754), stored as 2x16b unsigned integers. More information.

[3] LSB: Least Significant Bit (s).

For more details check out the Examples section.

MODBUSRTU

CONFIGURATION

Application Settings

Parameters such as the device's Modbus address, Modbus speed (baud rate), as well as parity and stop bit settings can be set via the inBiot setup app.

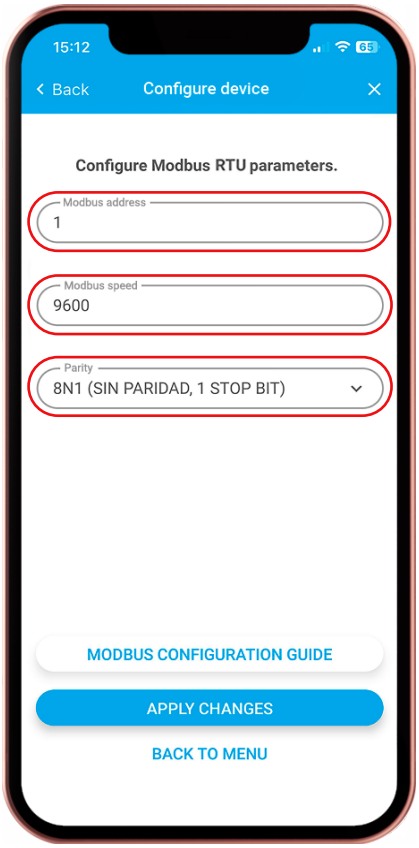
You can download this application through the links to the stores or by scanning the following QR code.

Download on the App Store

GET IT ON Google Play

Parameters (they come by default in the application):

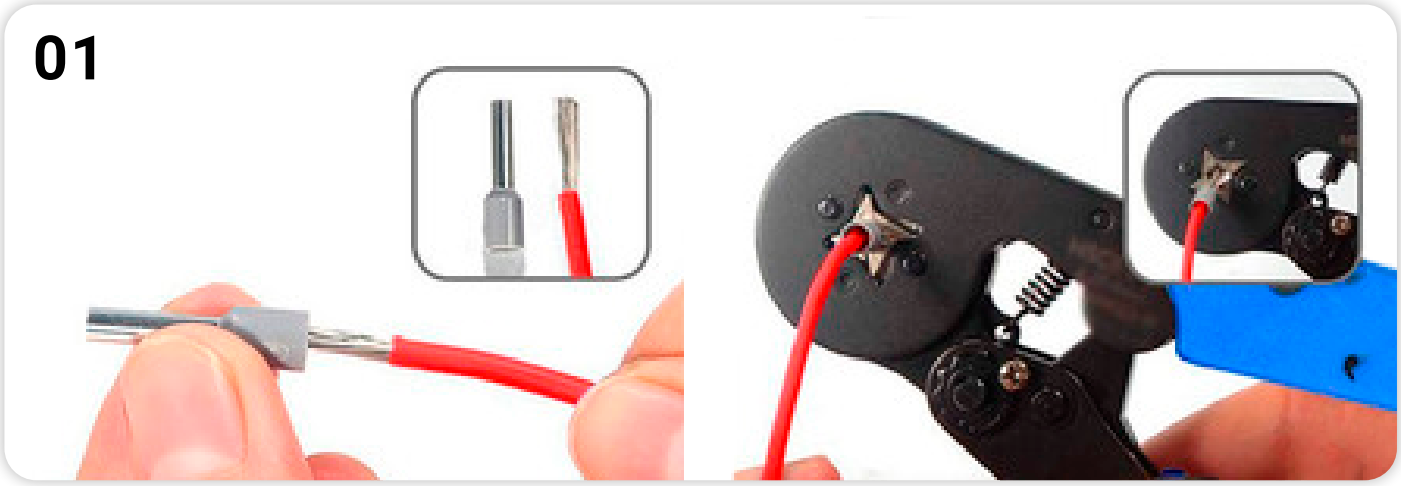
- Modbus address : 1
- Modbus speed: 9600 bauds
- Parity / Stop bits : 8N1 (NO PARITY, 1 STOP BIT)

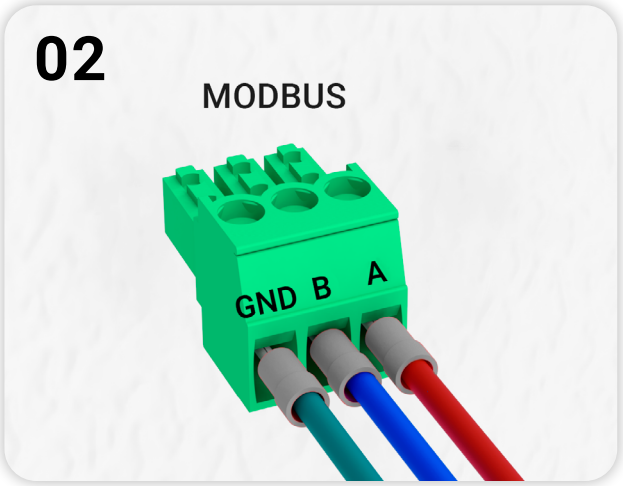


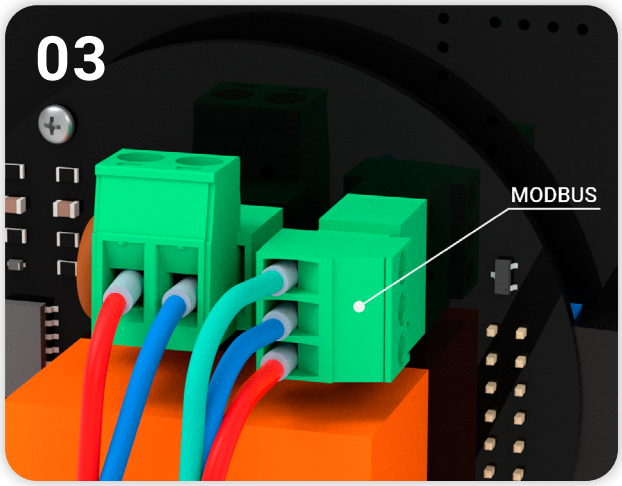
For more information about the setup process, vist the Configuration Manual.

PCB Connection

Modbus RTU PCB connection diagram for MICA devices.







1. **Add a ferrule** to each wire of the Modbus cable.
2. Connect the wires to the male Modbus terminal (3 pin).

    - **A** and **B** connectors: Bus Modbus (twisted pair).

    - **GND** connector: This GND pin must be connected to the reference voltage of the installation:

        - **If the installation has a shielded bus:** The bus shielding must be connected to the GND pin. Shielding is typically used to reduce electromagnetic interferenc.
        - **If there is no shielding in the installation:**

            - The GND terminal of the power supply (i.e., the ground or reference potential of the power source) must be connected to the GND pin.

            - In this case, the Modbus bus must be connected to the GND terminal.

3. Connect the male Modbus terminal to its respective female terminal on the PCB

For more information about the installation process, vist the Installation Manual.

MODBUS TCP/IP

CONFIGURATION

Application Settings

The Modbus Address of the device can be set through the inBiot mobile configuration application.

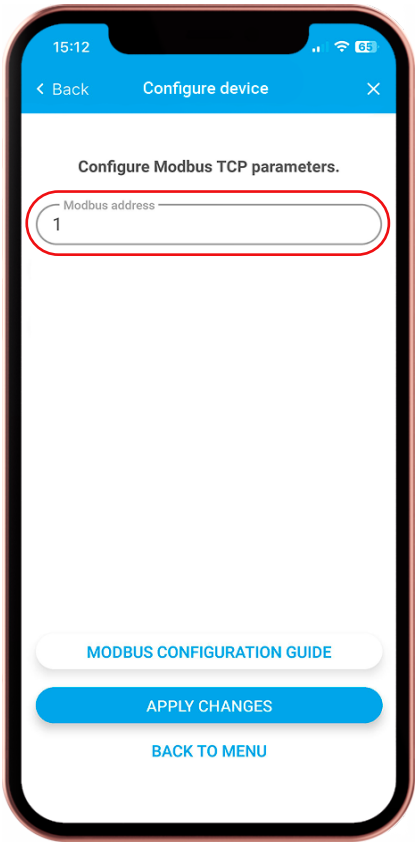
You can download this application through the links to the stores or by scanning the following QR code.

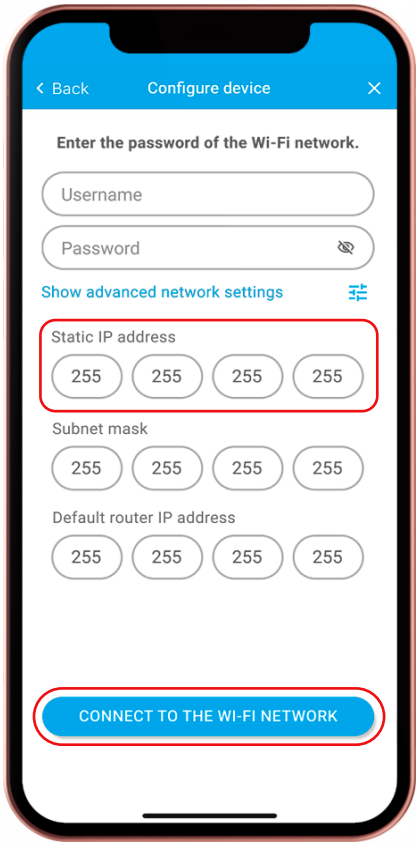
Download on the App Store

GET IT ON Google Play

Parameters (they come by default in the application):

- Modbus address: 1





Note: In the advanced settings of the Wi-Fi network, you can set the static IP address of the device, which will be the one that Modbus clients connect to.

For more information about the setup process, vist the Configuration Manual.

EXAMPLES

Reading 32-bit Parameter

32-bit parameters are stored in a **32-bit floating-point format (IEEE 754)**. To obtain these values, we need to combine two 16-bit Modbus registers: the **most significant bit (MSB)** register and the **least significant bit (LSB)** register.

In the case of temperature, registers **100** and **101** store the **MSB** and **LSB** values, respectively. These values must be combined to obtain the complete reading in degrees Celsius.

Example: Suppose a temperature reading of 22.3ºC has been obtained.

- **Register 100 (MSB):** 0100 0001 1011 0010 (16818 in decimal)
- **Register 101 (LSB):** 0110 0110 0110 0110 (26214 in decimal)

Combination: By combining both registers, the result in binary would be:

- **0100 0001 1011 0010 0110 0110 0110 0110**

This binary value represents **22.3°C** in the 32-bit floating-point format (IEEE 754).

Temperature (32 bits)				
Register address	100 (MSB)		101 (LSB)	
Value (decimal)	16818		26214	
Byte number	Byte 3	Byte 2	Byte 1	Byte 0
Byte (binary)	0100 0001	1011 0010	0110 0110	0110 0110
Byte (decimal)	65	178	102	102

Reading 16-bit Parameter

To read a **16-bit value**, such as the CO_2 concentration, the specific register that stores this value is used. In this case, register 104 stores the CO_2 concentration in parts per million (ppm).

Example: Suppose a CO_2 concentration of 750 ppm has been read.

- **Register 104:** 0000 0010 1111 1110 (750 in decimal)

Calculation of CO_2 Concentration: The CO_2 value read directly from register 104 is an unsigned 16-bit integer.

- CO_2 (ppm) = Register 104 = **750**

In this case, no additional calculation is necessary, as the value of 750 directly represents the CO_2 concentration in ppm.

CO_2 (16 bits)		
Register address	104	
Value (decimal)	750	
Byte number	Byte 1	Byte 0
Byte (binary)	0000010	11111110
Byte (decimal)	2	254

Reading Sensor Status

Register 136 contains information about various sensors in a 16-bit format, where each group of 3 bits (from least to most significant) represents the state of a specific sensor:

- Bits **0-2: Temperature** (000).
- Bits **3-5: Humidity** (000).
- Bits **6-8: CO_2** (001).
- Bits **9-11: TVOC** (010).
- Bits **12-14: PM2.5** (011).
- Bit **15:** Reserved for future use

Example: Suppose the following value has been read from register 136:

- **Register 136:** 0011 0100 0100 0000 (13376 in decimal)

Interpretation of Sensor States:

We break down the binary value into 3-bit groups (from right to left):

- **Bits 0-2 (Temperature):** 000 - Sensor OK
- **Bits 3-5 (Humidity):** 000 - Sensor OK
- **Bits 6-8 (CO_2):** 001 - Sensor Error
- **Bits 9-11 (TVOC):** 010 - Preheating
- **Bits 12-14 (PM2.5):** 011 - Sensor unavailable
- **Bit 15:** 0 - Reserved (currently unused)

Process Explanation

To interpret the state of each sensor, the 16-bit value is taken and broken down into 3-bit blocks, starting from the least significant bit (on the right).

Each 3-bit combination corresponds to a predefined state according to the defined value table. This allows for quickly determining the state of multiple sensors from a single register.

Sensor Status (16 bits)					
Register address	136				
Value (decimal)	13376				
Value (binary)	0 011 0100 0100 0000				
Bit number	Bits 14-12	Bits 11-9	Bits 8 - 6	Bits 5 - 3	Bits 2 - 0
Bits (binary)	011	010	001	000	000
Sensor Status	PM2.5: Sensor not available	TVOC: Preheating	CO_2: Sensor Error	Humidity: Sensor OK	Temperature: Sensor OK

Reading MAC Adress

Registers 148-150 store the MAC address in three parts:

- **Register 148 (MAC MSB):** 0xB8D6 (in hexadecimal)
- **Register 149 (MAC middle):** 0x1A24 (in hexadecimal)
- **Register 150 (MAC LSB):** 0xE084 (in hexadecimal)

To construct the full MAC address, the values from these registers are concatenated in order from most significant to least significant.

Result: The MAC address of the device is **B8:D6:1A:24:E0:84.**

This 48-bit MAC address is commonly used in network communication to uniquely identify devices.

MAC Adress (48 bits)						
Register address	148 (MAC MSB)		149 (MAC)		150 (MAC LSB)	
Value (hexadecimal)	0xB8D6		0x1A24		0xE084	
Byte number	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
Byte (hexadecimal)	B8	D6	1A	24	E0	84

Reading firmware version

Register 151 (Firmware Version):

Suppose the following value has been read from register 151:

- **Register 151:** 0000 0010 0000 0011 (515 in decimal)

Firmware Version Interpretation:

- **Bits 0-7 (minor version):** 0000 0011- 3 (minor version
- **Bits 8-15 (major version):** 0000 0010 - 2 (major version)

Firmware Version		
Register address	151	
Value (decimal)	515	
Byte number	Byte 1	Byte 0
Byte (binary)	0000010	0000011
Byte (decimal)	2	3

Result: The firmware version is 2.3.

Reading and Writing Configuration Registers

These registers allow reading the current state of the device as well as modifying it through Modbus commands.

Register 153: Indicator Light

Description: Controls the status of the device's indicator light.

Available Modbus Commands:

- **03h (Read Holding Registers):** Read the current status of the light.
- **06h (Write Single Register):** Write a new state for the light (on or off).

Example of Reading:

Read command (03h):

- The value read is **0**.
- **Interpretation:** The indicator light is off.

Example of Writing:

Write command (06h):

- Value sent: 1.
- **Interpretation:** The device's indicator light is turned on.

Register 154: CO_2 Sensor Calibration Cycle

Description: Configures the automatic calibration cycle for the CO_2 sensor.

Available Modbus Commands:

- 03h (Read Holding Registers): Read the current calibration cycle.
- 06h (Write Single Register): Set a new calibration cycle.

Example of Reading:

Read command (03h):

- The value read is 3.
- Interpretation: The CO_2 sensor calibration cycle is set to 7 days.

Example of Writing:

Write command (06h):

- Value sent: 5.
- Interpretation: The CO_2 sensor automatic calibration is set to OFF (disabled).

Register 155: Touch Button Lock/Unlock

Description: Controls the lock status of the device's touch button.

Available Modbus Commands:

- 03h (Read Holding Registers): Read the current status of the touch button.
- 06h (Write Single Register): Modify the lock/unlock status of the touch button.

Example of Reading:

Read command (03h):

- The value read is 0.
- Interpretation: The touch button is locked.

Example of Writing:

Write command (06h):

- Value sent: 1.
- Interpretation: The touch button is enabled (unlocked).