

iSMA-B-W0202

User Manual

Wireless Modbus RTU/ASCII

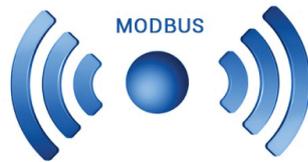
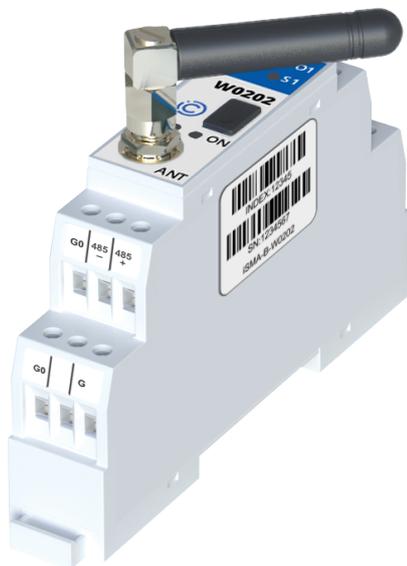


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1.1 Revision History

Rev.	Date	Description
1.0	28 Apr 2015	First edition
1.1	29 Dec 2016	<ul style="list-style-type: none"> • New HVAC functions Heating and Cooling based on output thermostatic control with a setpoint and differential value setting; • Added new input mode Time Relay NC [ms], Time Relay NO and NC in seconds, Input Forwarding; • Added new input mode: Ordinary IO, Monostable Relay, Bistable Relay, Time Relay NO and NC [ms], Time Relay NO and NC in seconds, Input Forwarding, Heating, Cooling with corresponding Modbus registers; • Added reset output to default after input mode change; • Added power Led flashing after I/O watchdog triggered; • Changed I/O watchdog reset after read/write registers through USB; • Added immediately detecting sensors short circuit and disconnection regardless of filter settings on universal inputs.
1.2	17 Dec 2018	Added watchdog functionality for the Radio, if the radio does not receive the correct packet for 180 seconds, the radio module will restart.
1.3	25 May 2022	Rebranded

Table 1. Revision history

2 Safety Rules

- Improper wiring of the product can damage it and lead to other hazards. Make sure that the product has been correctly wired before turning the power on.
- Before wiring or removing/mounting the product, make sure to turn the power off. Failure to do so might cause an electric shock.
- Do not touch electrically charged parts such as power terminals. Doing so might cause an electric shock.
- Do not disassemble the product. Doing so might cause an electric shock or faulty operation.
- Use the product only within the operating ranges recommended in the specification (temperature, humidity, voltage, shock, mounting direction, atmosphere, etc.). Failure to do so might cause a fire or faulty operation.
- Firmly tighten the wires to the terminal. Failure to do so might cause a fire.
- Avoid installing the product in close proximity to high-power electrical devices and cables, inductive loads, and switching devices. Proximity of such objects may cause an uncontrolled interference, resulting in an instable operation of the product.
- Proper arrangement of the power and signal cabling affects the operation of the entire control system. Avoid laying the power and signal wiring in parallel cable trays. It can cause interferences in monitored and control signals.
- It is recommended to power controllers/modules with AC/DC power suppliers. They provide better and more stable insulation for devices compared to AC/AC transformer systems, which transmit disturbances and transient phenomena like surges and bursts to devices. They also isolate products from inductive phenomena from other transformers and loads.
- Power supply systems for the product should be protected by external devices limiting overvoltage and effects of lightning discharges.
- Avoid powering the product and its controlled/monitored devices, especially high power and inductive loads, from a single power source. Powering devices from a single power source causes a risk of introducing disturbances from the loads to the control devices.
- If an AC/AC transformer is used to supply control devices, it is strongly recommended to use a maximum 100 VA Class 2 transformer to avoid unwanted inductive effects, which are dangerous for devices.
- Long monitoring and control lines may cause loops in connection with the shared power supply, causing disturbances in the operation of devices, including external communication. It is recommended to use galvanic separators.
- To protect signal and communication lines against external electromagnetic interferences, use properly grounded shielded cables and ferrite beads.
- Switching the digital output relays of large (exceeding specification) inductive loads can cause interference pulses to the electronics installed inside the product. Therefore, it is recommended to use external relays/contactors, etc. to switch such loads. The use of controllers with triac outputs also limits similar overvoltage phenomena.
- Many cases of disturbances and overvoltage in control systems are generated by switched, inductive loads supplied by alternating mains voltage (AC 120/230 V). If they do not have appropriate built-in noise reduction circuits, it is recommended to use external circuits such as snubbers, varistors, or protection diodes to limit these effects.

3 Technical Specification

Power Supply	Voltage	24 V AC/DC \pm 20%
	Power consumption	2 W at 24 V DC; 4.5 VA at 24 V AC
Special Inputs	Number of inputs	2
	Temperature input	Measurement with attached RTDS Accuracy \pm 0.1°C at 25°C
	Voltage input	Voltage measurement from 0 to 10 V Input impedance 100 k Ω Measurement accuracy \pm 50 mV
	Resistive input	Measurement of resistance from 0 to 1000 k Ω
	Resistance measurement method	Voltage divider
	Dry contact input	Output current \sim 1 mA
	Measurement resolution	12-bits
	Fast counters	50 Hz/100 Hz
	Digital Outputs (Relays)	Number of outputs
Resistive load		3 A at 230 V AC or 3 A at 30 V DC
Inductive load		75 VA at 230 V AC or 30 W at 30 V DC
Interface	Mini USB	For power up and configuration
	RS485	Up to 128 devices
	Communication protocol	Modbus RTU, Modbus ASCII
	Baud rate	From 1200 to 115200 bits/s
	Address	0 to 127
Radio	Frequency	868 MHz
	Max output power	+20 dBm (100 mW)
	Sensitivity	-120 dBm
	Radio channels	1÷8
	Encryption	AES-128
	Baud rate	From 1200 to 200000 bits/s

	External antenna	SMA socket
Ingress Protection	IP	IP40
Temperature	Storage	-40°C to +85°C
	Operating	-10°C to +50°C
Humidity	Relative	5 to 95%
Connectors	Type	Rising clamp
	Maximum cable size	2.5 mm ²
Dimension	Width	17 mm
	Length	56 mm
	Height	90 mm

Table 2. Technical specification

4 Hardware Specification

4.1 Dimensions



Figure 2. iSMA-B-W0202 dimensions

4.2 Power Supply

4.2.1 DC Voltage

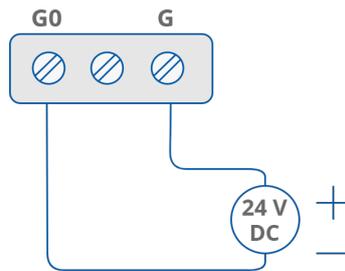


Figure 3. DC voltage

4.2.2 AC Voltage

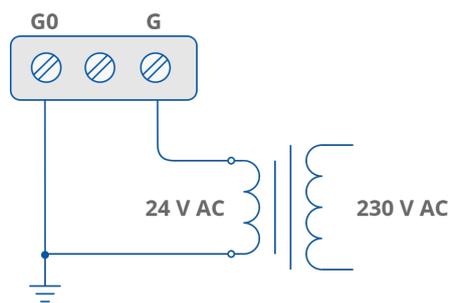


Figure 4. AC voltage

4.3 Front Panel

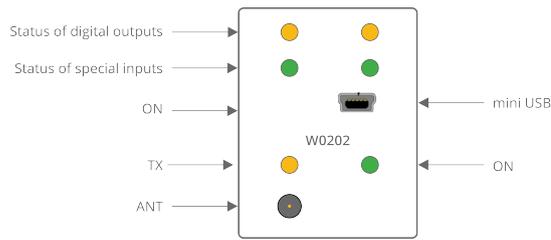


Figure 5. Front panel

- The power LED (ON) is on (green) if the module is running properly;
- The communication LED (TX) is on (orange) for 20 ms after sending each message. If the module receives/sends a lot of messages, the LED can be lit continuously;
- LEDs indicating the status of special inputs (S1-S2) are lit (green) if resistance connected to the input is less than 1 kΩ (dry contact input is active);

WARNING!

The LED also lights up if voltage connected to the input has a very low potential.

- LEDs indicating the status of digital outputs (O1-O2) are lit (orange) if the output is enabled.

4.4 RS485 Communication

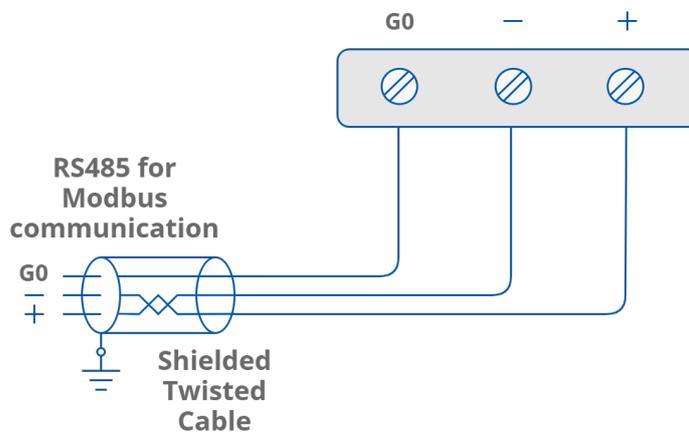


Figure 6. RS485 connection

4.4.1 Grounding and Shielding

In most cases controllers are installed in enclosures along with other devices, which generate electromagnetic radiation (for example, relays, contactors, transformers, motor invertors, etc.). Such electromagnetic radiation can induce electrical noise into both power and signal lines, as well as direct radiation into the controller, causing negative effects on the system. For this reason, an appropriate grounding, shielding, and other protective steps should be taken at the installation stage to prevent negative electromagnetic radiation effects, for example:

- control cabinet grounding;
- cable shield grounding;
- using protective elements for electromagnetic switching devices;

- proper wiring;
- consideration of cable types and their cross sections;
- and other.

4.4.2 Network Termination

Transmission line effects often present problems for data communication networks. These problems include reflections and signal attenuation.

To eliminate the presence of reflections of signal from the end of the cable, the cable must be terminated at both ends with a resistor across the line adequate to its characteristic impedance. Both ends must be terminated since the propagation is bidirectional. In case of an RS485 twisted pair cable this termination is typically 120 Ω .

5 Inputs and Outputs

The iSMA-B-W0202 module is equipped with:

- 2 special inputs;
- 2 digital outputs.

5.1 Special Inputs

5.1.1 Voltage Measurement (0-10 V)

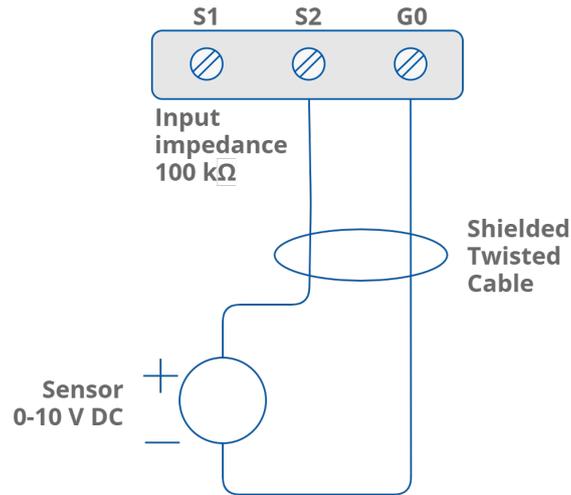


Figure 7. A special input voltage connection

5.1.2 Temperature Measurement

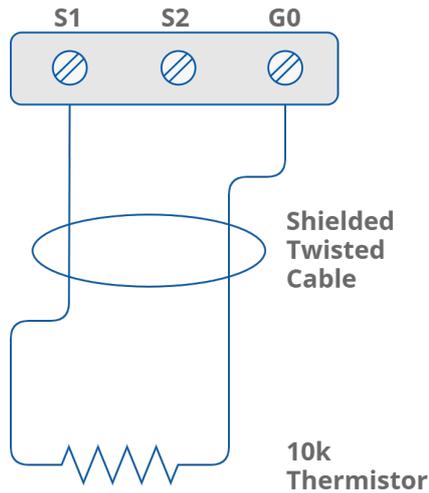


Figure 8. A special input temperature connection

5.1.3 Dry Contact

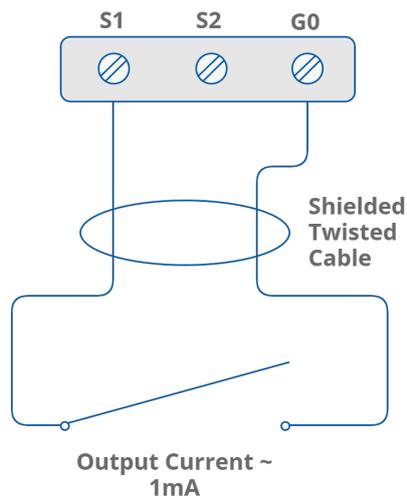


Figure 9. A special input dry contact connection

5.2 Digital Outputs

5.2.1 Solenoid Valve

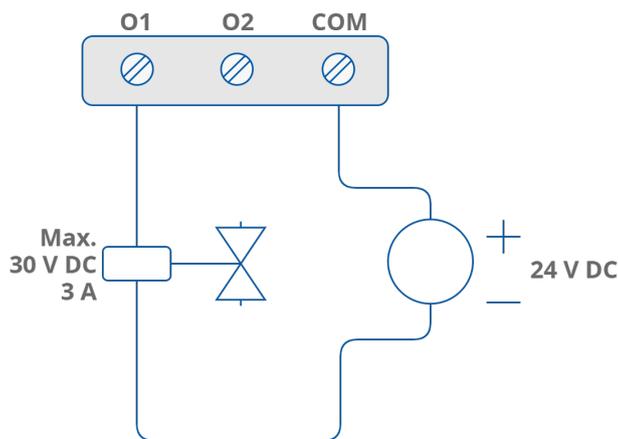


Figure 10. A solenoid valve connection

5.2.2 Resistive Load

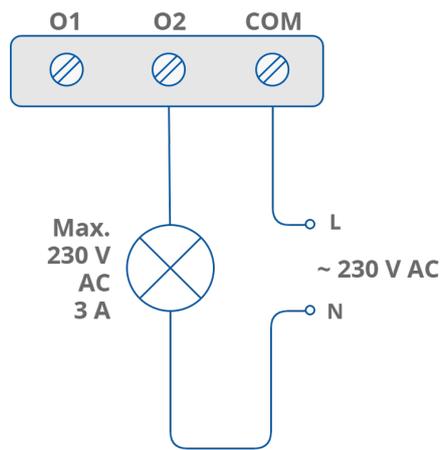


Figure 11. A resistive load connection

6 Configuration

The iSMA-B-W0202 can be configured using Modbus registers or directly by USB connection and iSMA Configurator software. The iSMA Configurator can be downloaded from ismacontrolli.com. If the module is connected, it appears in the hierarchy tree window (left part of the screen). The next step is to read module configuration using the Read Module button or to read configuration from a file using the Load From File button.

To save changes in the module, use the Write Module button. This command writes all parameters to the module.

WARNING!

Radio settings only take effect after the module restarting.

6.1 Communication

The screen below shows configuration options for RS485 bus.

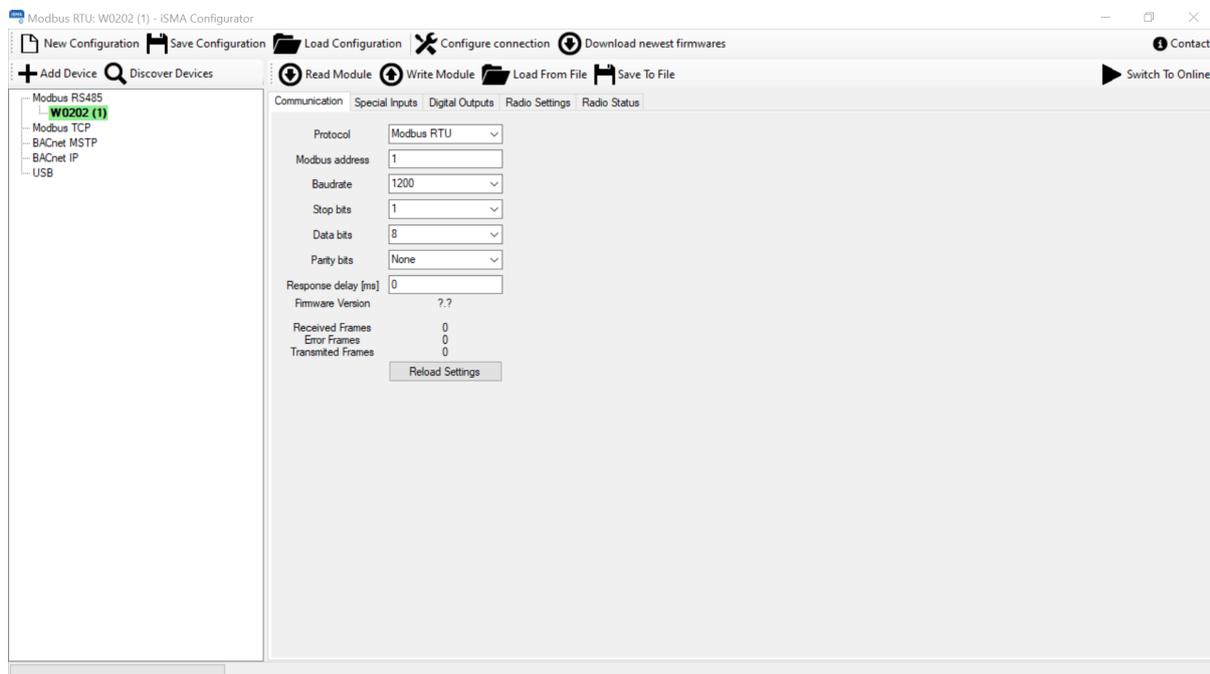


Figure 12. Communication options

6.2 Special Inputs

The screen below shows configuration options for special inputs.

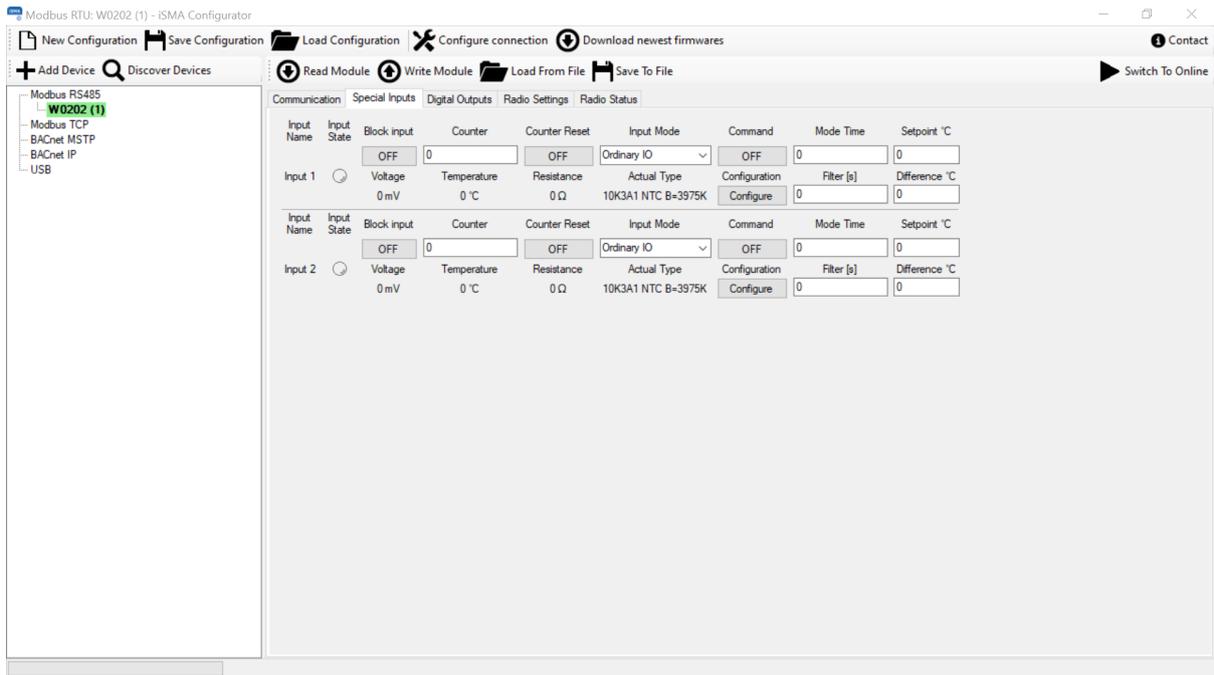


Figure 13. Special inputs configuration

6.3 Digital Outputs

The screen below shows configuration options for digital outputs.

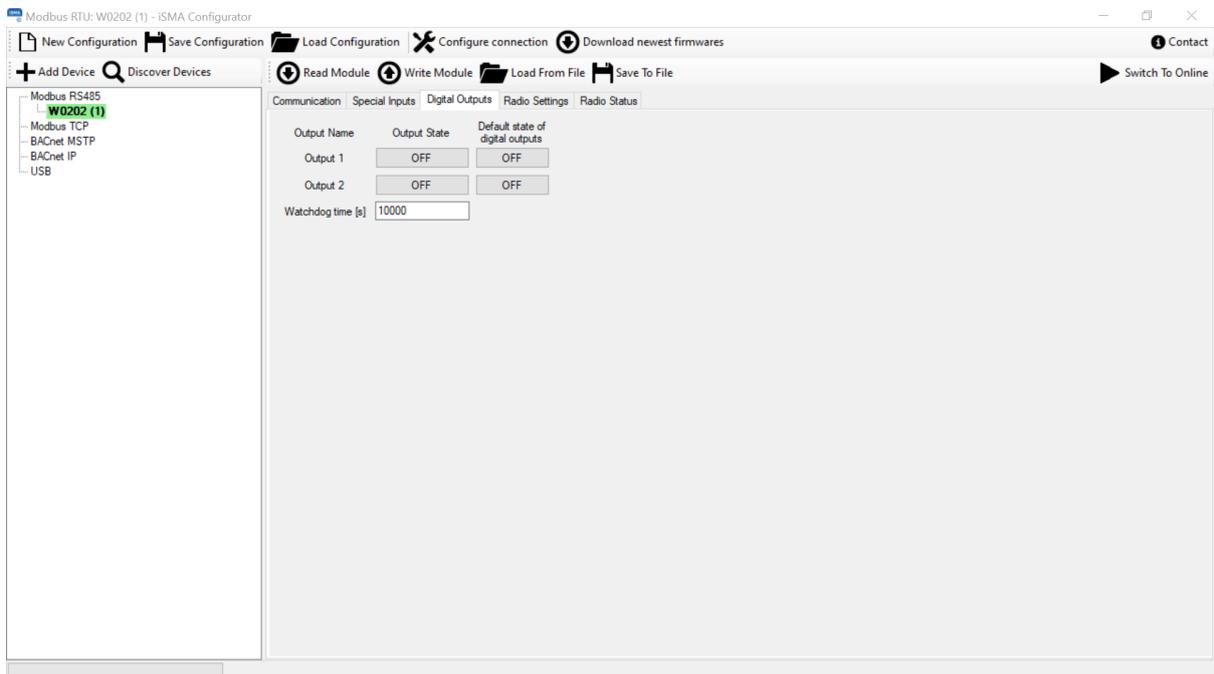


Figure 14. Digital outputs configuration

6.4 Radio Settings

The screen below shows configuration options for radio.

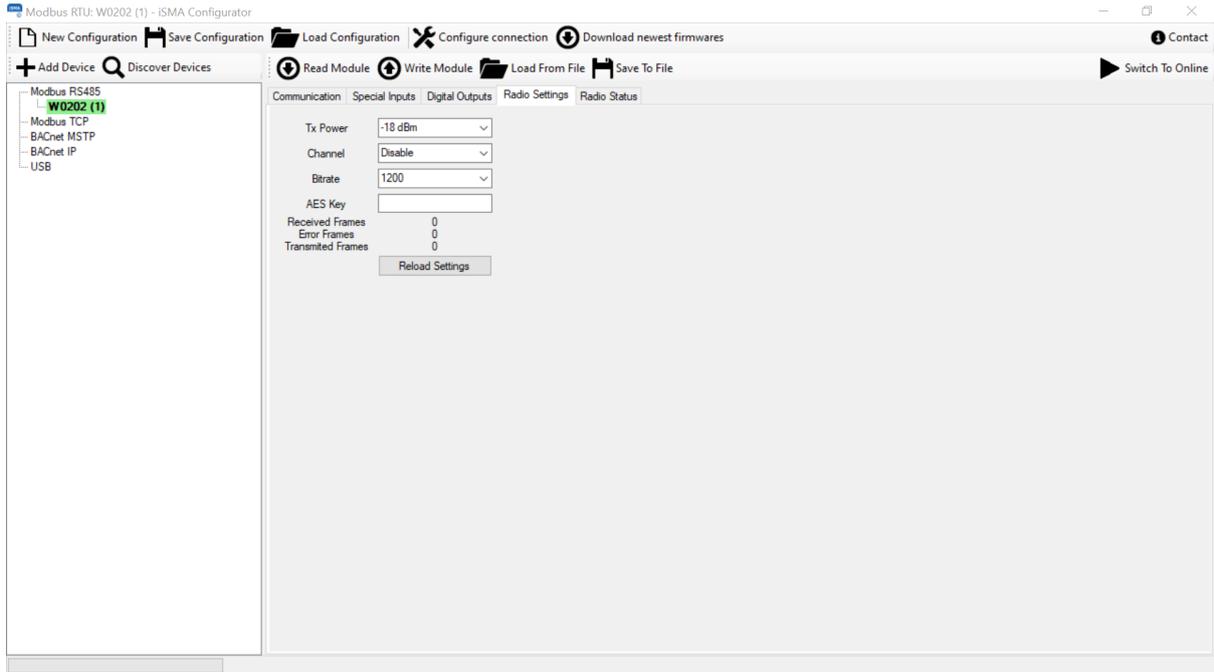


Figure 15. Radio settings

6.5 Radio Status

The screen below shows radio status for all devices working in the same group.

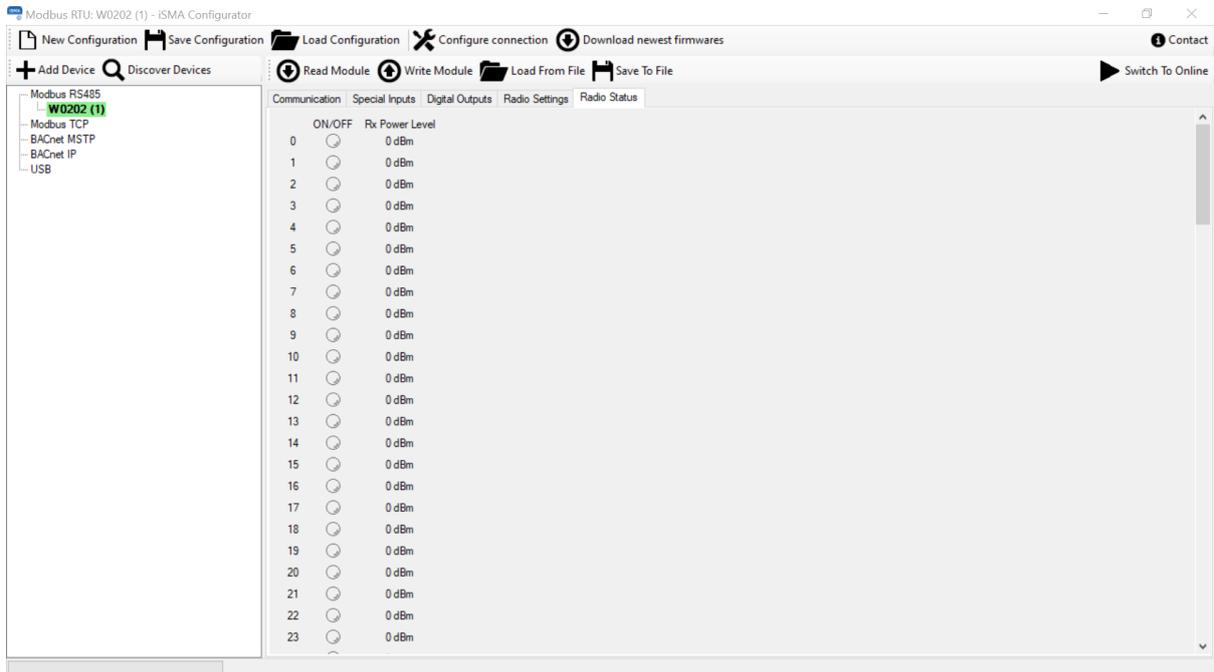


Figure 16. Radio status

7 Modbus Registers

This section outlines all Modbus registers available in the iSMA-B-W0202 wireless module.

7.1 Configuration Registers

WARNING!

Changing parameters concerning the transmission configuration will only take effect after restarting the module or reload settings-register (40001).

7.1.1 Firmware Version and Module Type (30001)

The register contains type and firmware version of module.

Low byte contains information about the type of module in accordance with the table below:

Value	Type
8010 (0x5016)	iSMA-B-W0202

Table 3. Firmware version and module type

High byte contains the module firmware version multiplied by 10.

For example:

In the 30001 register the number is 2049010 = 0x500A16. It means that it is a module iSMA-B-W0202 (0x50) with firmware in version 1.0 (0x0A16 = 1010).

7.1.2 Counter of Received Messages (30004)

The 32-bit register with the number of valid Modbus messages received by the module from the last power up. The value is reset after a power cycle or after changing transmission parameters (baud rate, stop bits, parity, etc.).

7.1.3 Counter of Error Messages (30006)

The 32-bit register with the number of error Modbus messages received by the module from last power up. The value is reset after a power cycle or after changing transmission parameters (baud rate, stop bits, parity, etc.).

7.1.4 Counter of Sent Messages (30008)

The 32-bit register with the number of Modbus messages sent by the module from last power up. The value is reset after a power cycle or after changing transmission parameters (baud rate, stop bits, parity, etc.).

7.1.5 Up Time (30012)

The 32-bits register contains module working time in seconds from last power up or module reset.

7.1.6 Device Actions (40001)

Setting the 40001 register according to the table below enables 1 of 3 available actions: reset module, reload settings, and set to default.

Value	Type of Action
0x01FF	Reset of device
0x02FF	Reload settings (RS485, Radio)
0x03FF	Set device to default

Table 4. Device actions

7.1.7 Modbus Protocol Type (40134)

The register contains parameters, which define the Modbus protocol type (RTU or ASCII).

Value	Protocol Type
0 (default)	Modbus RTU
1	Modbus ASCII

Table 5. The Modbus Protocol Type register

7.1.8 Modbus Address (40135)

The register contains information about the Modbus address of the module. The default address is 1.

7.1.9 Baud Rate (40136)

The register contains information about the baud rate.

Particular register value determines the baud rate in accordance with the table below.

Value	Baud Rate
0	1200
1	2400
2	4800
3	9600
4	19200
5	38400
6	57600

Value	Baud Rate
7	115200 (default)

Table 6. Baud rate

7.1.10 Stop Bits (40137)

The value of the register determines the number of stop bits in accordance with the following table:

Value	No. of Stop Bits
1 (default)	1
2	2

Table 7. Stop bits

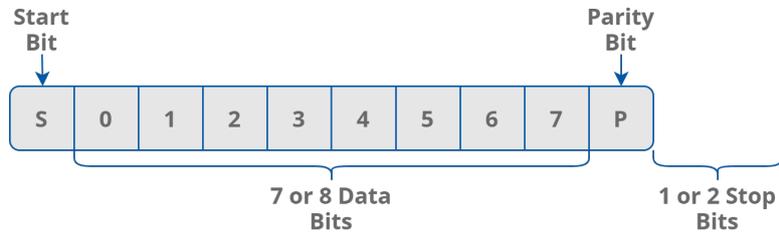


Figure 17. Modbus frame

7.1.11 Data Bits (40138)

The value of the register determines the number of data bits transmitted in a single byte according to the following table:

Value	No. of Data Bits
7	7
8 (default)	8

Table 8. Data bits

7.1.12 Parity Bit (40139)

Each byte of data being transferred may be additionally protected with a parity bit added before stop bit (bits).

The method of calculating parity bit is determined according to the following table:

Register Value	Type of Parity Bit
0 (default)	None
1	Odd (number of all ones in a byte is odd)

Register Value	Type of Parity Bit
2	Even (number of all ones in a byte is even)
3	Always 1
4	Always 0

Table 9. Parity bit

7.1.13 Response Delay Time (40140)

The register contains the value determining the number of milliseconds to wait before the unit answers the question. This time is used to extend the interval between question and answer. The default value of 0 means no delay (the answer is sent once during the 3,5 character required by the protocol Modbus RTU).

7.1.14 Watchdog Time (40141)

The register specifies the time in seconds to watchdog reset. If the module does not receive any valid message within this time, digital outputs are set to default state, which is determined by the value in the 40142 register.

This feature is useful if, for some reason, there is an interruption in data transmission and for security reasons the output must be set to an appropriate state in case of danger to the safety of persons or property.

Setting 0 s disables the watchdog. The default value is 15 seconds.

Watchdog for Radio

If the radio does not receive the correct data packet for 180 seconds, the radio module is restarted. The time of 180 seconds is a constant value.

7.2 Radio Configuration Registers

WARNING!

Changing the parameters concerning the transmission configuration will only take effect after restarting the module or reload settings-register (40001).

7.2.1 Radio TX Power (40242)

The register contains radio transmission signal power. The signal strength depends on the distance between devices and the environment conditions.

Value	Radio TX Power [dBm]	Radio TX Power [mW]
0	-18	0,0158
1	0	1

Value	Radio TX Power [dBm]	Radio TX Power [mW]
2	7	5
3	10	10
4	14	25
5	17	50
6	20	100

Table 10. Radio TX Power register

7.2.2 Radio Channel (40243)

The register contains information about a radio channel. All modules, which work in the same group, require the same channel number. More than one wireless network can be used but each of them has to operate on a different channel. Each channel cannot have any influence on each other (see the Radio Baud Rate section).

Value	Channel	Frequency
0	DISABLE	-
1	Channel 1	869,415 MHz
2	Channel 2	869,445 MHz
3	Channel 3	869,475 MHz
4	Channel 4	869,505 MHz
5	Channel 5	869,535 MHz
6	Channel 6	869,565 MHz
7	Channel 7	869,595 MHz
8	Channel 8	869,625 MHz

Table 11. Radio Channel register

7.2.3 Radio Baud Rate (40244)

The register contains the baud rate used in radio protocol. All devices, which work in the same group (the same channel), require the same baud rate value. Different baud rate values can be used for the RS485 bus and for radio protocol.

Value	Baud Rate
0	1200

Value	Baud Rate
1	2400
2	4800
3	9600
4	19200
5	38400
6	57600
7	115200
8	200000

Table 12. Radio baud rate selection

Higher baud rate value requires more bandwidth, which can occur on adjacent channels. The table below shows the dependencies between these parameters.

Baud Rate	No. of Channels	Channels
1200	1	1-8
2400	1	1-8
4800	1	1-8
9600	1	1-8
19200	1	1-8
38400	2	2-7
57600	3	3-6
115200	4	4
200000	4	4

Table 13. Relation between a baud rate and number of channels

7.2.4 Radio AESKEY (40249-40256)

The registers contain encryption keys for radio protocol.

Each package transmitted by the radio protocol is encrypted by the AES-128 algorithm. It protects the network against unauthorized access. The encryption uses 128-bits key stored in 8 registers (8x16 bits). Each device, which works in the same group, requires the same encryption key.

Register	Device
40249	Radio AESKEY D1-D0
40250	Radio AESKEY D3-D2
40251	Radio AESKEY D5-D4
40252	Radio AESKEY D7-D6
40253	Radio AESKEY D9-D8
40254	Radio AESKEY D11-D10
40255	Radio AESKEY D13-D12
40256	Radio AESKEY D15-D14

Table 14. Radio AESKEY registers

7.2.5 Radio Received Frames Counter (40257)

The 32-bit register contains the number of valid messages received by the module via radio protocol from last power up. The register value is reset after a power cycle or after changing transmission parameters (baud rate, stop bits, parity, etc.).

7.2.6 Radio ERROR Frames Counter (40259)

The 32-bit register contains the number of error messages received by the module via radio from last power up. The value is reset after a power cycle or after changing transmission parameters (baud rate, stop bits, parity, etc.).

7.2.7 Radio Transmitted Frames Counter (40261)

The 32-bit register contains the number of transmitted messages by the module via radio from last power up. The value is reset after power cycle or after changing transmission parameters (baud rate, stop bits, parity, etc.).

7.2.8 Wireless Device Status (40263-40390)

The register contains information about the signal strength of the other W0202 modules operating on the same channel. Each device has its own register for status indication.

The device number equals the Modbus address of this device.

Register	Device
40263	WIRELESS DEVICE STATUS 1
40264	WIRELESS DEVICE STATUS 2
40265	WIRELESS DEVICE STATUS 3

Register	Device
40266	WIRELESS DEVICE STATUS 4
....
40389	WIRELESS DEVICE STATUS 127
40390	WIRELESS DEVICE STATUS 128

Table 15. Wireless Device Status registers

The particular register contains information about the signal strength in dBm and remote device status.

No. of Bit in Register	Function
0 ÷ 7	RX POWER [dBm]
8	0-> DOWN; 1-> OK

Table 16. Wireless Device Status register structure

7.3 Special Inputs Registers

7.3.1 Status of Special Inputs Working as Digital Inputs (30017)

The register contains information about the status of special inputs (dry contact). The input's shortcut to the ground sets the corresponding bit of the register in accordance with the following table:

No. of Input	No. of Register Bit
1	0
2	1

Table 17. Status of special inputs working as digital inputs

7.3.2 Special Input Voltage Measurement 1-2 (30071, 30073)

The registers contain results of measuring voltage for each special input. The result is expressed in millivolts.

Special Input	Register Number
S1	30071
S2	30073

Table 18. Special inputs voltage measurement

7.3.3 Special Input Temperature Measurement 1-2 (30072, 30074)

The registers contain results of measuring temperature for each special input. The result is expressed in Celsius degrees multiplied by 10.

Special Input	Register Number
S1	30072
S2	30074

Table 19. Special inputs temperature measurement

7.3.4 Special Input Resistance Measurement 1-2 (30103-30104, 30105-30106)

The 32-bit registers contain results of measuring temperature for each special input. The result is expressed in Ω (Ohms). The register with lower number contains lower part of the result.

Special Input	Register Number
S1	LO - 30103, HI - 30104
S2	LO - 30105, HI - 30106

Table 20. Special inputs resistance measurement

7.3.5 Fast Counter (40023-40024, 40025-40026)

The module has two 32-bit counters for special inputs. The counter's value is stored in non-volatile memory (EEPROM).

Special Input	Register Number
S1	LO - 40023, HI - 40024
S2	LO - 40025, HI - 40026

Table 21. Fast counter registers for special inputs

To change the value of the register, write any value (called preset) for pulse counting registers. In the particular case, the counter can be reset by entering 0. The counter's reset is also possible by switching on relevant bits in the 40022 register.

WARNING!

By default, fast counters work with 50 Hz frequency. To change the frequency to 100 Hz, please refer to registers (40151-40152).

7.3.6 Resetting Counters Values (40022)

Setting true value for particular bit resets the corresponding counter according to the following table:

No. of Register Bit	Special Input Counter
0	S1
1	S2

Table 22. Resetting counters values

True value of the bit causes continuous resetting of the counter.
Setting the bit to 0 restores normal operation.

7.3.7 Special Input Configuration 1-2 (40151-40152)

These registers are dedicated for the special inputs configuration in accordance with the following table:

Register Value	Description
0	Off resistance measurement (only measuring the voltage, dry contact off)
1 (default)	The temperature sensor 10K3A1 NTC B=3975K
2	The temperature sensor 10K4A1 NTC B=3695K
3	The temperature sensor 10K NTC B=3435K Carel
4	The temperature sensor 20K6A1 NTC B=4262K
5	The temperature sensor 2,2K3A1 NTC B=3975K
6	The temperature sensor 3K3A1 NTC B=3975K
7	The temperature sensor 30K6A1 NTC B=4262K
8	The temperature sensor SIE1
9	The temperature sensor TAC1
10	The temperature sensor SAT1
+128 (set 7 bit of register)	Off voltage measurement and fast counters working on 100 Hz

Table 23. Special inputs configuration register

7.3.8 Filter Time of Special Input 1-2 (40159-40160)

The registers contain a time constant of low pass filter value. The value is expressed in seconds. Valid values are between 1 and 60 seconds.

The default filter value is 2 seconds. Setting 0 disables the filter.

7.4 Digital Outputs Registers

7.4.1 State of Digital Outputs (40018)

The register contains the state of digital outputs. Setting true value of particular bit activates assigned output according to the following table:

No. of Bit in Register	No. of Digital Output
0	1
1	2

Table 24. State of Digital Outputs register values

7.4.2 Default State of Digital Outputs (40143)

The register contain the default states of digital outputs after power up or watchdog reset. Particular bits with assigned digital outputs are shown in the table:

No. of Bit in Register	No. of Digital Output
0	1
1	2

Table 25. Default state of digital outputs register

7.5 Special Application Modes

In the iSMA-B-W0202 module, simple applications are built-in, which can be used to control building devices. The applications provide logic between a signal from the special inputs and control digital output's state. Relation between inputs and outputs is shown in the table below and it cannot be changed.

Special Input	Digital Output
S1	O1
S2	O2

Table 26. Built-in application determines relations between inputs and outputs

Special inputs can be set to work in different modes. There are dedicated registers for operation mode (40176, 40180), time parameters (40177, 40181), setpoints for heating/cooling modes (40178, 40182), and for a differential value in heating/cooling modes (40179, 40183).

Register	Description
40176	Input S1 OPERATION MODE
40177	Input S1 TIME VALUE

Register	Description
40178	Input S1 SETPOINT
40179	Input S1 DIFFERENTIAL
40180	Input S2 OPERATION MODE
40181	Input S2 TIME VALUE
40182	Input S2 SETPOINT
40183	Input S2 DIFFERENTIAL

Table 27. List of registers dedicated for special application modes

7.5.1 Operation Mode Registers (40176,40180)

The register contains information about module working mode. Available modes and register values are shown in the table below:

Value	Operation Mode Register
0	Ordinary IO (def)
1	Monostable Relay
2	Bistable Relay
3	Time Relay NO [ms]
4	Time Relay NC [ms]
5	Time Relay NO [s]
6	Time Relay NC [s]
7	Input Forwarding
8	Heating
9	Cooling

Table 28. Operation mode register

Operating mode can be changed by writing right value in the Operation Mode register.

Special modes are initialized after 3 seconds from power up or restart of the module (the time value needed to stabilize the analog transmitter working).

Each input mode change sets assigned output to default state and resets the timer (used in time-based modes). If the new selected operating mode is running, the output is controlled according to the new mode functioning.

Ordinary IO

In this mode, the module works as a standard IO module, inputs and outputs are not related with each other.

Monostable Relay

In this mode, both rising and falling edge on the special input change the output state. The action of monostable relay can be executed remotely by changing the state of bit from false to true in the Command register (40020). Outputs can be also overwritten by the Digital Output register (40018), which allows remote control from BMS.

Bistable Relay

In this mode, only the rising edge on the special input changes the output state. The action of bistable relay can be executed remotely by changing the state of bit from false to true in the Command register (40020). Outputs can be also overwritten by the Digital Output register (40018), which allows remote control from BMS.

Time Relay NO [ms]

In this mode, if the output value is false, the rising edge on the special input sets the output to true. Every falling edge on the special input starts the counter from the beginning, which means that the output will stay true for a time defined in the Time Value register (expressed in milliseconds), counting from the last falling edge of the special input. The time relay action can be executed remotely by changing the state from false to true in the relevant Command register (40020). Outputs can be also overwritten by the Digital Output register (40018), which allows remote control from BMS.

Time Relay NC [ms]

In this mode, if the output value is false, the falling edge on the special input sets the output to true. Every rising edge on the special input starts the counter from the beginning, which means that the output will stay true for a time defined in the Time Value register (expressed in milliseconds), counting from the last rising edge of the special input. The time relay action can be executed remotely by changing the state from false to true in the relevant Command register (40020). Outputs can be also overwritten by the Digital Output register (40018), which allows remote control from BMS.

Time Relay NO [s]

In this mode, if the output value is false, the rising edge on the special input sets the output to true. Every falling edge on the special input starts the counter from the beginning, which means that the output will stay true for a time defined in the Time Value register (expressed in seconds), counting from the last falling edge of the special input. The time relay action can be executed remotely by changing the state from false to true in the relevant Command register (40020). Outputs can be also overwritten by the Digital Output register (40018), which allows remote control from BMS.

Time Relay NC [s]

In this mode, if the output value is false, the falling edge on the special input sets the output to true. Every rising edge on the special input starts the counter from the beginning, which means that the output will stay true for a time defined in the Time Value register (expressed in seconds), counting from the last rising edge of the special input. The time relay action can be executed remotely by changing the state from false to true in the relevant Command register (40020). Outputs can be also overwritten by the Digital Output register (40018), which allows remote control from BMS.

Input Forwarding

In this mode, any signal from the input is transferred directly to the assigned output without any modifications. The input forwarding mode can be stopped by the Block Input function (see Blocking register).

Heating Mode

In this mode, the output is controlled as a typical thermostat, based on the Setpoint register and control value (input value) with differential parameter defined in the Differential register. The output signal works in 2 states, low and high.

If the control value is lower than or equal to the difference of the Setpoint register and Differential register, the output is in low state.

If the control value is higher than or equal to the sum of the Setpoint register and Differential register, the output is in high state.

Output in low state:

Control value \geq Setpoint + Differential

Output in high state:

Control value \leq Setpoint - Differential

The heating mode algorithm is shown in chart below.

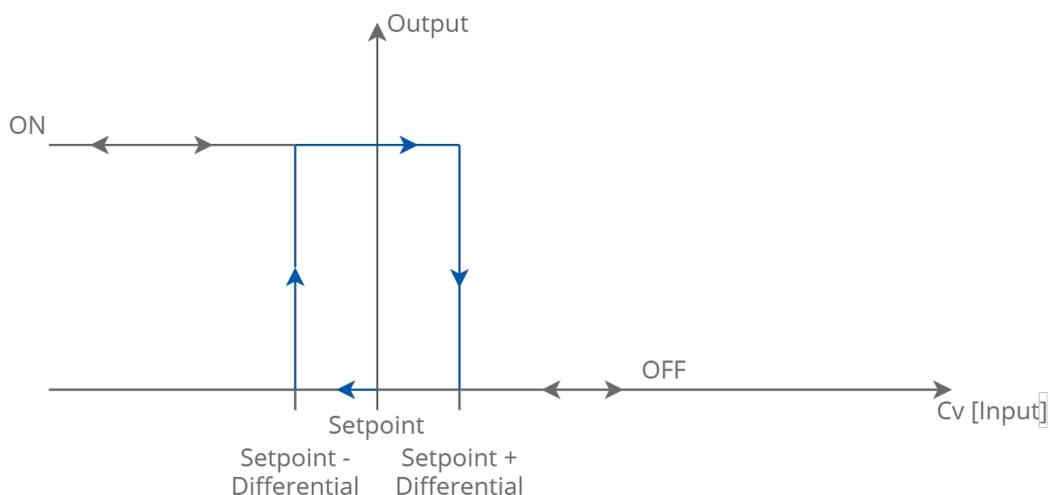


Figure 18. Heating mode algorithm

WARNING!

In the case if the temperature sensor has failed (got disconnected or shortcut), then the heating mode does not work, and the output stays in the false state.

Cooling Mode

In this mode, the output is controlled as a typical thermostat, based on the Setpoint register and control value (input value) with differential parameter defined in the Differential register.

The output signal works in 2 states, low and high.

If the control value is lower than or equal to the difference of the Setpoint register and Differential register, the output is in low state.

If the control value is higher than or equal to the sum of the Setpoint register and Differential register, the output is in high state.

Output in low state:

Control value \leq Setpoint - Differential

Output in high state:

Control value \geq Setpoint + Differential

The cooling mode algorithm is shown in chart below.

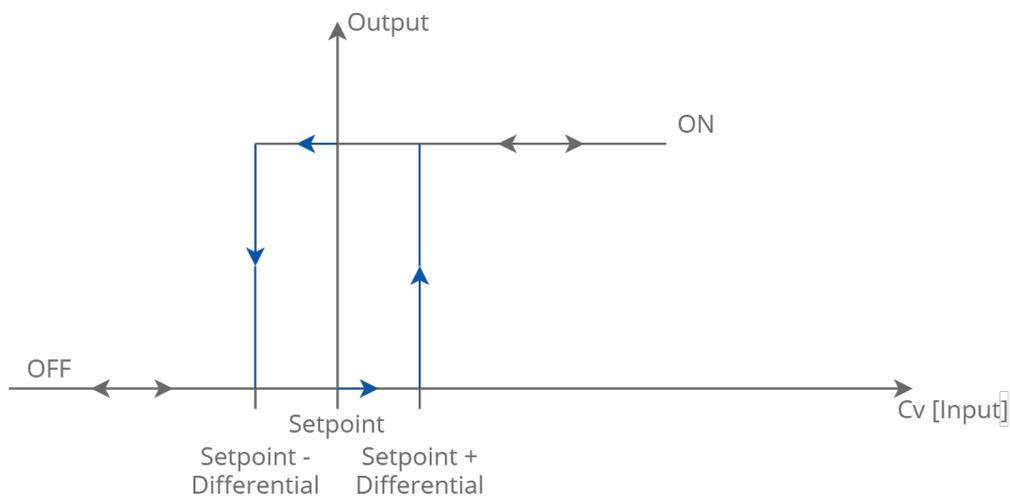


Figure 19. Cooling mode algorithm

WARNING!

In the case if the temperature sensor has failed (got disconnected or shortcut), then the heating mode does not work, and the output stays in the false state.

7.5.2 Command Register (40020)

The module has a special Command register (40020). The Command register is used to remotely execute an action (simulate light switch/PIR). The action is executed by changing

the state of relevant bit (changing from false to true). All special application modes can be executed, except Input Forwarding, Heating and Cooling modes.

No. of Bit in Register	Command Input Number
0	1
1	2
2	3
3	4

Table 29. The Comman register values

7.5.3 Block Inputs Register (40021)

The Block Inputs register is used to block physical inputs signals to take action in logic. By setting true value on the relevant bit, the module blocks the input and no action will be executed. Setting false value restores normal operation. The Block Input function does not work when the heating/cooling input mode is set.

No. of Bit in Register	Block Input Number
0	1
1	2
2	3
3	4

Table 30. The Block Inputs register values

7.5.4 Setpoint Registers (40178, 40182)

The Setpoint registers contain values, which are used in heating/cooling modes as the setpoints for heating/cooling control algorithm.

The default setpoint value is 21.

The register stores the setpoint multiplied by 10.

7.5.5 Differential Registers (40179, 40183)

The Differential registers contain values, which are used in heating/cooling modes as the differential for heating/cooling control algorithm. Setpoint registers and Differential registers create deadband of the control values, which has no influence on output.

Deadband = (Setpoint – Differential, Setpoint + Differential)

The default differential value is 1 (read more in Heating mode and Cooling mode sections).

The register stores the differential multiplied by 10.

8 List of Modbus Registers

Modbus Address	Decimal Address	Hex Address	Register Name	Access	Description								
30001	0	0x00	VERSION AND MODULE TYPE	Read-only	Firmware version and module type (30001)								
30004	3	0x03	RS485 COUNTER OF RECEIVED FRAMES (32 bits)	Read-only	Counter of received messages (30004) Default state is 0 Reset at the unit start and change of transmission parameters								
30006	5	0x05	RS485 COUNTER OF FRAMES WITH ERROR (32 bits)	Read-only	Counter of error messages (30006) Default state is 0 Reset at the unit start and change of transmission parameters.								
30008	7	0x07	RS485 COUNTER OF SENT FRAMES (32 bits)	Read-only	Counter of sent messages (30008) Default state is 0 Reset at the unit start and change of transmission parameters.								
30017	15	0x0F	STATUS OF SPECIAL INPUTS WORKING AS DIGITAL INPUT	Read-only	Status of special inputs working as digital inputs are represented by bits 0 and 1 in register (30017)								
40001	0	0x00	VERSION AND MODULE TYPE PLUS ENABLE OF ACTIONS	Read&Write	Firmware version and module type plus enable of actions <table border="1"> <thead> <tr> <th>Value</th> <th>Type of Action</th> </tr> </thead> <tbody> <tr> <td>0x01FF</td> <td>Reset of device</td> </tr> <tr> <td>0x02FF</td> <td>Reload settings (RS485, Radio)</td> </tr> <tr> <td>0x03FF</td> <td>Set device to default</td> </tr> </tbody> </table>	Value	Type of Action	0x01FF	Reset of device	0x02FF	Reload settings (RS485, Radio)	0x03FF	Set device to default
Value	Type of Action												
0x01FF	Reset of device												
0x02FF	Reload settings (RS485, Radio)												
0x03FF	Set device to default												
40018	17	0x11	STATE OF DIGITAL OUTPUTS	Read&Write	State of digital outputs (40018)								

Modbus Address	Decimal Address	Hex Address	Register Name	Access	Description
40020	19	0x12	SPECIAL INPUTS COMMAND REGISTER	Read&Write	Special inputs command register (40020)
40021	20	0x14	SPECIAL INPUTS BLOCKING	Read&Write	Special inputs blocking (40021) By default set to 0
40022	21	0x15	COUNTER RESET	Read&Write	Resetting counters value (40022) Set bit in register to reset corresponding counter
40023	22	0x16	COUNTER 1 LSB	Read&Write Memory	32-bit counters for each special input counting pulses.
40024	23	0x17	COUNTER 1 MSB		
40025	24	0x18	COUNTER 2 LSB	Read&Write Memory	
40026	25	0x19	COUNTER 2 MSB		
30071	70	0x46	SPECIAL INPUT 1 VOLTAGE	Read-only	Special input measure voltage 1-2 (30071, 30073) and Special Input measure temperature 1-2 (30072, 30074) Voltage measurement value is expressed in mV. For current measurements, the formula for the current: where: U – register value, 500 – value of attached resistance Temperature is expressed in Celsius degrees * 10 For a result, divide the registry value by 10: Selection of the type sensor is done using registers from 40151 to 40152 for each input separately
30072	71	0x47	SPECIAL INPUT 1 TEMPERATURE	Read-only	

Modbus Address	Decimal Address	Hex Address	Register Name	Access	Description
30073	72	0x48	SPECIAL INPUT 2 VOLTAGE	Read-only	
30074	73	0x49	SPECIAL INPUT 2 TEMPERATURE	Read-only	
30087	86	0x56	SPECIAL INPUT 1 VOLTAGE	Read-only	
30088	87	0x57	SPECIAL INPUT 2 VOLTAGE	Read-only	
30095	94	0x5E	SPECIAL INPUT TEMPERATURE 1	Read-only	
30096	95	0x5F	SPECIAL INPUT TEMPERATURE 2	Read-only	
30103	102	0x66	RESISTIVE INPUT 1 LSB	Read-only	Special input resistance measurement 1-2 (30103-30104, 30105-30106) Resistance measurement result is expressed in Ω .
30104	103	0x67	RESISTIVE INPUT 1 MSB	Read-only	
30105	104	0x68	RESISTIVE INPUT 2 LSB	Read-only	
30106	105	0x69	RESISTIVE INPUT 2 MSB	Read-only	
40134	133	0x85	MODBUS PROTOCOL TYPE	Read&Write Memory	RS485 Modbus protocol type 0 - RTU, 1 - ASCII
40136	135	0x87	RS485 BAUD RATE	Read&Write Memory	RS485 baud rate (40136)
40137	136	0x88	RS485 STOP BITS	Read&Write Memory	Stop bits (40137) Supported values are 1 and 2 The default value is 1
40138	137	0x89	RS485 DATA BITS	Read&Write Memory	Data bits (40138) Supported values are 7 and 8 The default value is 7

Modbus Address	Decimal Address	Hex Address	Register Name	Access	Description												
40139	138	0x8A	RS485 PARITY BIT	Read&Write Memory	<p>Parity bit (40139) The default value is 0 (no parity) Allowed values:</p> <table border="1"> <thead> <tr> <th>Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0 (default)</td> <td>None</td> </tr> <tr> <td>1</td> <td>Odd</td> </tr> <tr> <td>2</td> <td>Even</td> </tr> <tr> <td>3</td> <td>Always 1</td> </tr> <tr> <td>4</td> <td>Always 0</td> </tr> </tbody> </table>	Value	Description	0 (default)	None	1	Odd	2	Even	3	Always 1	4	Always 0
Value	Description																
0 (default)	None																
1	Odd																
2	Even																
3	Always 1																
4	Always 0																
40140	139	0x8B	RESPONSE DELAY	Read&Write Memory	<p>Response delay time (40140) Delay in ms before sending response The default value is 0</p>												
40141	140	0x8C	WATCHDOG TIME	Read&Write Memory	<p>Watchdog time (40141) Time in seconds before watchdog reset in case of no transmission Setting value of 0 disables the watchdog The default value is 15 s</p>												
40143	142	0x8E	DEFAULT STATE OF DIGITAL OUTPUTS	Read&Write Memory	<p>Default state of digital outputs (40143) State of digital outputs assigned at the start of the module and watchdog reset The default value is 0</p>												
40151	150	0x96	SPECIAL INPUT 1 CONFIGURATION	Read&Write Memory	<p>Configuration of special input and type of temperature sensor The default value is 1</p>												

Modbus Address	Decimal Address	Hex Address	Register Name	Access	Description	
					Value	Description / Sensor
					0	Resistance measurement off
					1	10K3A1 NTC
					2	10K4A1 NTC
					3	10K NTC Carel
					4	20K6A1 NTC
					5	2,2K3A1 NTC B=3975K
					6	3K3A1 NTC
					7	30K6A1 NTC
					8	SIE1
					9	TAC1
					10	SAT1
					+128	Voltage measurement off and fast counters working on 100Hz
40152	151	0x97	SPECIAL INPUT 2 CONFIGURATION	Read&Write Memory		
40159	158	0x9E	FILTER TIME CONSTANT OF THE SPECIAL INPUT 1	Read&Write Memory		Filter time of the special input 1-2 (40159-40160) Filter time constant, expressed in seconds in the range from 0 to 60 seconds The default value is 2 s, setting to 0 s disables the filter
40160	159	0x9F	FILTER TIME CONSTANT OF THE SPECIAL INPUT 2	Read&Write Memory		

Modbus Address	Decimal Address	Hex Address	Register Name	Access	Description																
40176	175	0xAF	SPECIAL INPUT 1 CONFIGURATIO MODE	Read&Write Memory	<table border="1"> <thead> <tr> <th>Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Ordinary IO</td> </tr> <tr> <td>1</td> <td>Monostabile Relay</td> </tr> <tr> <td>2</td> <td>Bistabile Relay</td> </tr> <tr> <td>3</td> <td>Time Relay</td> </tr> </tbody> </table> <p>TIME VALUE [ms]</p>	Value	Description	0	Ordinary IO	1	Monostabile Relay	2	Bistabile Relay	3	Time Relay						
Value	Description																				
0	Ordinary IO																				
1	Monostabile Relay																				
2	Bistabile Relay																				
3	Time Relay																				
40177	176	0xB0	SPECIAL INPUT 1 TIME VALUE	Read&Write Memory																	
40180	179	0xB3	SPECIAL INPUT 2 CONFIGURATIO MODE	Read&Write Memory																	
40181	180	0xB4	SPECIAL INPUT 2 TIME VALUE	Read&Write Memory																	
40242	241	0xF1	RADIO TX POWER	Read&Write Memory	<table border="1"> <thead> <tr> <th>Value</th> <th>Radio TX Power</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>-18 dBm</td> </tr> <tr> <td>1</td> <td>0 dBm</td> </tr> <tr> <td>2</td> <td>7 dBm</td> </tr> <tr> <td>3</td> <td>10 dBm</td> </tr> <tr> <td>4</td> <td>14 dBm</td> </tr> <tr> <td>5</td> <td>17 dBm</td> </tr> <tr> <td>6</td> <td>20 dBm</td> </tr> </tbody> </table>	Value	Radio TX Power	0	-18 dBm	1	0 dBm	2	7 dBm	3	10 dBm	4	14 dBm	5	17 dBm	6	20 dBm
Value	Radio TX Power																				
0	-18 dBm																				
1	0 dBm																				
2	7 dBm																				
3	10 dBm																				
4	14 dBm																				
5	17 dBm																				
6	20 dBm																				
40243	242	0xF2	RADIO CHANNEL	Read&Write Memory	Radio channel (40243)																
40244	243	0xF3	RADIO BAUD RATE	Read&Write Memory	Radio baud rate (20249)																

Modbus Address	Decimal Address	Hex Address	Register Name	Access	Description
40249	248	0xF8	RADIO AESKEY D1-D0	Read&Write Memory	Radio transmission 128 bit encryption key (40249-40256) Default values: 1111 2222 3333 4444 5555 6666 7777 8888
40250	249	0xF9	RADIO AESKEY D3-D2	Read&Write Memory	
40251	250	0xFA	RADIO AESKEY D5-D4	Read&Write Memory	
40252	251	0xFB	RADIO AESKEY D7-D6	Read&Write Memory	
40253	252	0xFC	RADIO AESKEY D9-D8	Read&Write Memory	
40254	253	0xFD	RADIO AESKEY D11-D10	Read&Write Memory	
40255	254	0xFE	RADIO AESKEY D13-D12	Read&Write Memory	
40256	255	0xFF	RADIO AESKEY D15-D14	Read&Write Memory	
40257	256	0x0100	RADIO COUNTER OF RECEIVED FRAMES (32 – bits)	Read&Write Memory	Counter of received messages (30004) Default state is 0 Reset at the unit start and change of transmission parameters
40259	258	0x0102	RADIO COUNTER OF ERROT FRAMES (32 – bits)	Read&Write Memory	Counter of error messages (30006) Default state is 0 Reset at the unit start and change of transmission parameters
40261	260	0x0104	RADIO COUNTER OF TRANSMITTED FRAMES (32 – bits)	Read&Write Memory	Counter of sent messages (30008) Default state is 0 Reset at the unit start and change of transmission parameters

Modbus Address	Decimal Address	Hex Address	Register Name	Access	Description
40263 - 40390	262 - 389	0x0106 - 0x0185	WIRELESS DEVICE STATUS 1 ÷ 128	Read-only	Bit 7: 0 - Int8 RX POWER [dBm] Bit 8: 0 - Down; 1 - Ok

Table 31. List of Modbus registers