REL-0808 User Guide

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1. Operational Instructions

Ahatos REL-0808 module should be operated in an environment, not beyond the limit values (see Specifications).

Manufacturer prohibits usage of module in applications that can endanger human life by their action or inaction.

Ahatos REL-0808 Module's manufacturer is not liable for consequences of exploitation of the equipment connected to module.

User must make sure there are no short circuits caused by wires connected to device.

It is strictly prohibited to plug or unplug wires those are under high voltage! It is strictly prohibited to disassemble module and touch electrical parts and/or violate the integrity of external electrical connections!

2. Purpose

Relay module Ahatos REL-0808 is designed for load control, and consists of eight independent channels.

3. Specifications

Parameter	Value
Control channels	4/8
Maximum channels voltage	250 VAC 30 VDC
Maximum current per channel	8 A
Control interface type	RS-485
- Maximum RS-485 network segment length	1200 meters
- Type of devices identification inside network segment	Addressing
- Logical level protocol	MODBUS RTU
- Bus settings	19200 or 9600 bit/s, 8 data bits, even or none parity, 1 stop bit
Power supply	+12 VDC
Maximum consumption current	500 mA
Working temperature	+10..50 ℃
Allowed humidity	5..80 %
Protection class, IEC-952	IP20
Weight	350 g
Dimensions	107 x 90 x 58 mm
Inputs / outputs	
- Low voltage wires (inputs)	Max. 16AWG (1.5 mm^2)
- High voltage wires (outputs)	Max. 12AWG (2.5 mm^2)

4. Resetting Module

Multifunction RESET button is used to reset module and to reset module's configuration to factory values.

If RESET button is pressed and being held less than 4 seconds, then module will be rebooted after button is released.

If RESET button is being held more than 4 seconds, then module will reset configuration to factory values and perform boot when button is released. Also, please note that BUSY LED will light up when after 4 seconds when module had reset configuration.

5. Module Control Types

User can control channels in two ways:

1. **Low-current push buttons**. Principle of operation of low-voltage push-buttons: manual input channel is a TTL level (with +5 V and a current of several milliamperes), which expects a circuit to a common signal GND. Channel input is considered activated in a moment when button is pressed. At the same time, channel input is deactivated when button is released. So it is required to use pushbuttons without fixation and with normally open contacts
2. **By MODBUS protocol via RS485 bus**. For supported features see *"Functional characteristics point protocol MODBUS RTU"* section of this user guide.

6. Module Operational Modes

The module supports two modes of operation (see "*Module Configuration*" section for details):

1. **Asynchronous** - all channels are controlled independently. Two sub-modes are available:
   - Channel state is being switched to opposite by pressing corresponding button;
   - Channel is active while corresponding button is being held pressed

2. **Pairwise** - all channels are combined into a pairs of mutually exclusive relays (for control of blinds and rolling shutters). Channels are combined as following: 1-2, 3-4, 5-6, 7-8. Only one channel of the pair can be enabled at one time. Also, it will automatically turn off after a set period of time. This time period is set as a request parameter. Time can be set between 0..3600 seconds. (see "*Functional Specifications Protocol MODBUS RTU*", recording parameters in registers).

   In order to turn off channel from particular pair, second channel should be activated. E.g., if channel #1 was activated, it can be deactivated by timeout or by activating the channel #2 (push corresponding push-button). In order to switch from channel #1 to channel #2, you must double-press button that corresponds to channel #2 (in case MODBUS protocol is used to control channels, then it is possible to switch channels directly from channel #1 to channel #2 without an intermediate step). Also, configuration bit 7 is responsible for controlling user's ability to change direction without necessity to double-press opposite channel's button.

   While operating using buttons it has no matter how long button is being pushed and held, the channel will be enabled for a certain period of time only. Also, the channel will not be deactivated when pressing the same button once again. If the button is held, but a request from the master is received to change the state of the channel, then this request will be processed despite the fact that the button pressed and is being held pressed by the user.

If there is no communication with the master via RS485 interface, channels continue to operate using control inputs (push-buttons). When module loses power, all channels will be switched OFF. Also, channels states may be restored to previous states when power supply is attached and/or power is restored. See "*Module configuration*" (switches 2 and 3).

7. Module Status Indication

Module input power LED indicates whether appropriate power source is attached to module:

- **OFF** – appropriate power source is not attached
- **ON** – module has appropriate power source attached

Channels' green LEDs are indicating whether particular channel is active:

- **OFF** – particular channel is not active
- **ON** – particular channel is active (relay is closed)

STATUS green LED can be in the following states:

- **OFF** – there is no power, or failure;
- **Flashes three times per second** - module works, there is no communication via RS-485 or illegitimate query received from master (error CRC16, malformed packet size).
  If this LED flashed along with BUSY LED on module startup, then it indicates module is in error mode because of address is incorrectly configured.
- **ON** – module is OK, communication with master established via RS-485.

BUSY red LED indicates whether module is busy with some task:

- **OFF** – there is no power, or has power and module is idle
- **Flashes three times per second** - module is in busy state, performs the function.
  If this LED flashed along with STATUS LED on module startup, then it indicates module is in error mode because of address is incorrectly configured.
- **ON** – module has reset it's configuration to factory defaults

If "activate/deactivate channel" request comes from master or inputs – the BUSY indicator flashes three times. If such requests will come in sequence (from inputs or master), then indicator will keep flashing until last request will be processed by module.

In pairwise mode, BUSY LED blinks all the time channel is active (time interval).

8. Module Configuration

In order to determine module configuration, switch block should be used. It is located under enclosure's top plate which needs to be removed (this will open access to configuration jumper-switches).

Switch #	Destination	Status	Comments
1	Channels mode	ON	Pairwise operational mode (4 channels)
		OFF	Asynchronous mode (8 channels)
2[I]	Setting channels state after power outage	ON	All channels will be turned ON (if switch 3 is ON, all channels will restore previous states)
		OFF	All channels will be turned OFF
3[I]	Restore	ON	If switch 2 is ON, then all channels will restore their previous states
			If switch 2 is OFF, then all channels will remain OFF in accordance to switch 2 description
		OFF	All channels will remain in state defined in switch 2 description
4[II]	RS-485 communication presence	ON	If communication is not present for longer than 10 seconds, all channels will be turned OFF
		OFF	Does not affect channels' states
5[III]	Channels operation mode	ON	When the input is activated, the channel state is reversed
		OFF	Channel will be activated while input is active
6[IV]	User priority	ON	User has top priority. It means that if user holds button, then master requests will not be processed and error response will be sent

Switch #	Destination	Status	Comments
		OFF	Master/module has priority over user. It means that if user holds button, then master requests will be processed ignoring user presence
7[V]	Autoswitch/Change direction in paired channel	ON	If one of paired channels is turned on and user will press opposite pair member button, then direction will be changed to opposite after specified timeout (can be configured in module register)
		OFF	Does not influence on channels operation
8	Option A	ON	Inputs will be detached from outputs
		OFF	Inputs are directly connected to outputs

[I] – only for asynchronous mode;
[II] – if channel is being currently controlled by button (input), then channel's state will not change;
[III] – does not affect the control via RS-485. Used only for asynchronous mode.
[IV] – affects both master and user. It means that if module would like to turn OFF particular channel (e.g. connection to master was lost) but user is holding button, then channel will NOT be turned OFF
[V] – only for pairwise mode. Does not affect the control via RS-485.

After changing the configuration, module needs to be restarted using RESET button.

9. Module Address Selection

In order to be able selecting/setting module address, enclosure's top plate needs to be removed (this will open access to address jumper-switches).

Jumper #	State/Value	Description
1	2^7	If jumper is "**OFF**" – corresponding bit is "0", If jumper is "**ON**" – corresponding bit is"1"
2	2^6	
3	2^5	
4	2^4	
5	2^3	
6	2^2	
7	2^1	
8	2^0	

If address was changed, then you must reboot module using the RESET button.

Allowed addresses range is from 1 to 247. If address was set to not allowed value, then module will not startup. Busy and Status LEDs will blink constantly indicating module is in error mode because of address value is incorrect. User will need to set correct address value and reset module by turning power OFF and then ON (reset button will not work in this case).

Addresses Examples:

Address (decimal)	Address (binary)	Address (dec)	Address (bin)
16	00010000	24	00011000
17	00010001	25	00011001
18	00010010	26	00011010
19	00010011	27	00011011
20	00010100	28	00011100
21	00010101	29	00011101
22	00010110	30	00011110
23	00010111	31	00011111

10. Module Startup Procedure

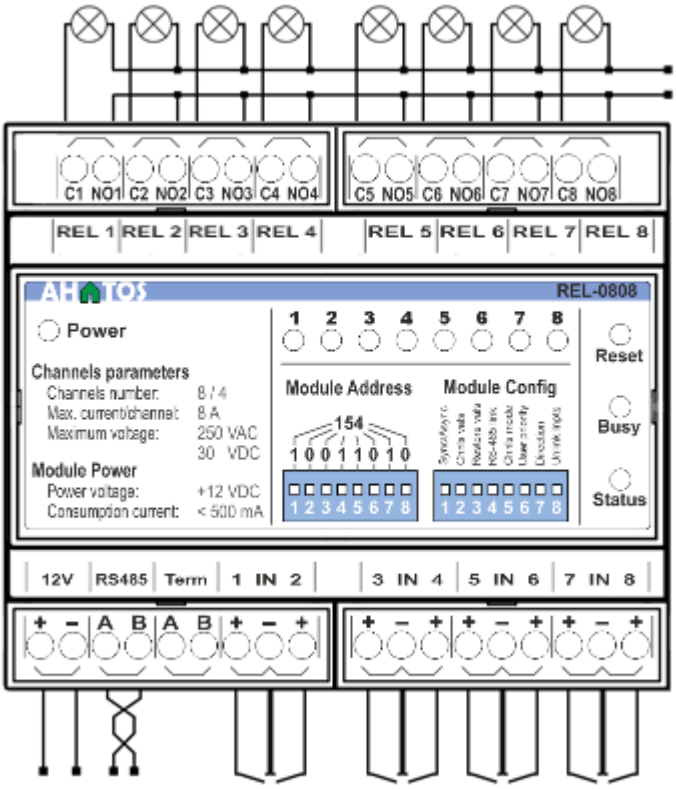
Module should be installed by qualified personnel only. Startup procedure includes:

- Module deployment/installation;
- Address and operational parameters configuration;
- Connecting external electrical circuits.

External electrical circuits/wires should be connected in the following order:

- Turn off high-voltage part;
- Check if there is a short circuit in the load circuit of the high-voltage module according to the scheme drawn up in advance;
- Connect low-voltage switches/buttons;
- Connect RS-485 interface and terminating resistor (if device is the last one on the bus) wires;
- Connect de-energized DC power supply (+12V, 500 mA or more);
- Turn ON power supply;
- Make sure corresponding LEDs are indicating correct module operational status;
- Turn ON high-voltage part.

11. Typical Connection Schema



If relay module is connected to the end of RS-485 bus, then you need to connect terminal resistor 120ohm to TERM_A and TERM_B.

12. ModBus RTU Protocol Functional Characteristics

REL-0808 module implements MODBUS RTU protocol in order to communicate with master device. Please make sure RS-485 bus is configured according to REL-0808 requirements (see "*Specifications*" section for details).

Module supports the following ModBus RTU functions:

Function #	Description	Applies to channels operating mode(s)	Allowed via broadcast
0x01	Read channels state	ALL	No
0x02	Read input status	ALL	No
0x03	Read holding registers	ALL	No
0x05	Turn ON/OFF single channel	ALL	Yes
0x06	Write holding registers	ALL	Yes
0x0F	Turn ON/OFF multiple channels simultaneously	Asynchronous mode	Yes
0x11	Report Slave ID	ALL	No
0x64	Read module serial number	ALL	No

General ModBus request and response format is as following:

Section	Header		Data	Footer
Field	Device Address	ModBus Function Number	Function specific data	CRC16 ModBus
Possible values	0x00..0xF7	See following sections	Depends on function	Calculated
Size	1 byte	1 byte		2 bytes

Please note that if ***Device Address*** is 0 then it means request is broadcast. If request's ModBus function will support broadcast, then module will perform required actions and will NOT send response to master.

12.1. Read channels state (0x01 – Read Coils)

12.1.1. Request

Section	Header	Data				Footer
Field		Start Channel # to read		Channels numbers to read		
		High byte	Low byte	High byte	Low byte	
Possible values		0x00	0x00..0x07	0x00	0x01..0x08	
Size		1 byte	1 byte	1 byte	1 byte	

Note: "*Channels number to read*" value should be calculated as 8 minus "*Start Channel # to read*"

Example: 0x01 0x01 **0x00 0x00 0x00 0x08** 0x3D 0xCC;

12.1.2. Response

Section	Header	Data		Footer
Field		Number of bytes in response	Channels status	
Possible values		0x01	0x00..0xFF	
Size		1 byte	1 byte	

Channels status is placed in corresponding bits of channels status byte. If all eight channels' status was requested, then all eight bits will be filled with corresponding data like in the following table.

Bit #	Description
0	0 = channel #1 turned OFF
	1 = channel #1 turned ON
1	0 = channel #2 turned OFF
	1 = channel #2 turned ON
2	0 = channel #3 turned OFF
	1 = channel #3 turned ON
3	0 = channel #4 turned OFF
	1 = channel #4 turned ON
4	0 = channel #5 turned OFF
	1 = channel #5 turned ON
5	0 = channel #6 turned OFF
	1 = channel #6 turned ON
6	0 = channel #7 turned OFF
	1 = channel #7 turned ON
7	0 = channel #8 turned OFF
	1 = channel #8 turned ON

Example: 0x01 0x01 0x01 **0x81** 0x91 0xE8
(0x81 = 1000 0001. Channels №0 and №7 turned ON)

12.2. Turn single channel ON/OFF (0x05 – Write Single Coil)

12.2.1. Request

Section	Header	Data			Footer
Field		Start Channel # to write		Channel status to be set	
		High byte	Low byte		
Possible values		0x00	0x00..0x07	0x0000 – turn OFF 0xFF00 – turn ON	
Size		1 byte	1 byte	2 bytes	

Example: 0x01 0x05 **0x00 0x00 0xFF 0x00** 0x8C 0x3A (Turn ON channel #1)

12.2.2. Response

If request was successfully processed – then response will be echo of request.

Example: 0x01 0x05 **0x00 0x00 0xFF 0x00** 0x8C 0x3A (Channel #1 turned ON)

12.3. Turn multiple channels ON/OFF (0x0F – Write Multiple Coils)

12.3.1. Request

Section	Header	Data						Footer
Field		Start Channel # to write		Channels numbers to write		Number of data bytes	Channels' values	Reserved
		High byte	Low byte	High byte	Low byte			
Possible values		0x00	0x00..0x07	0x00	0x01..0x08	0x01	0x00..0xFF	0x00
Size		1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte

Note: "*Channels number to write*" value should be calculated as 8 minus "*Start Channel # to read*"

Please refer to "*Read channels state (0x01 – Read Coils)*" function's response description in order to create correct Channels' value byte (bits from 0 to 7).

Example: 0x01 0x0F **0x00 0x00** **0x00 0x08** 0x01 **0xAA** 0x00 0x6A 0x20
(0xAA = 1010 1010. Turn on channels #2, 4, 6, 8 and turn off channels #1, 3, 5, 7)

12.3.2. Response

Section	Header	Data			Footer
Field		Start Channel # written		Number of channels written	
		High byte	Low byte		
Possible values		0x00	0x00..0x07	0x0000 .. 0x0008	
Size		1 byte	1 byte	2 bytes	

Example: 0x01 0x0F **0x00 0x00** **0x00 0x08** 0x54 0x0D (8 channels' values were written)

12.4. Reading holding registers (0x03 – Read Holding Registers)

Registers map (one register is 16 bits)	
Address	**Description**
0x0000	Module configuration, operational modes
0x0001	Pairwise mode timeout, in seconds
0x0002	Up time timer, high part
0x0003	Up time timer, low part
0x0004	Pairwise mode autoswitch timeout, value * 25 milliseconds
0x0005	Firmware version, major and minor
0x0006	Firmware version, service-pack and build
0x0007...0x0010	Serial number (10 * 2 bytes)
0x0011	RS-485 "parity" parameter (is set as "none" parity by default)
0x0012	RS-485 "baud-rate" parameter (is set to 9600 by default)

12.4.1. Request

Section	Header	Data			Footer
Field		Start register address to read		Number of registers to read	
		High byte	Low byte		
Possible values		0x00	0x00..0x10	0x0001..0x0011	
Size		1 byte	1 byte	2 bytes	

Note: "*Number of registers to read*" value should be calculated as 4 minus "*Start register address to read*"

Example: 0x01 0x03 **0x00 0x00** **0x00 0x04** 0x44 0x09 (Read 4 registers starting from first one)

12.4.2. Response

Section	Header	Data		Footer
Field		Number of bytes in response	Registers' values	
Possible values		X = 0x01..2*registers count	0x0000..0xFFFF * X	
Size		1 byte	X * 2 bytes	

Example: 0x01 0x03 **0x08** **0x00 0x09** **0x00 0x3C** **0x00 0x00 0x0A 0x51** 0x9B 0x8E
- device configuration: **0x0009**
- Pairwise mode timeout: **0x003C** (60 seconds)
- Up-timer: **0x00000A51** (2641 seconds)

12.5. Writing single holding register (0x06 – Write Single Registers)

12.5.1. Request

Section	Header	Data			Footer
Field		Start register address to write		Possible values	
		High byte	Low byte		
Possible values		0x00	0x01	0x0000..0x8CA0	
			0x04	0x000A.. 0x0050	
			0x11	0x0001 (even parity) 0x0003 (none parity)	
			0x12	0x0000 (9600 bps) 0x0001 (19200 bps)	
Size		1 byte	1 byte	2 bytes	

Example: 0x01 0x06 **0x00 0x01 0x0E 0x10** 0xDD 0xA6

12.5.2. Response

If request was successfully processed – then response will be echo of request.

Example: 0x01 0x06 0x00 0x01 **0x0E 0x10** 0xDD 0xA6
(pairwise mode timeout is set to 0x0E10 = 3600 seconds)

12.6. Read digital inputs state (0x02 – Read Input Status)

12.6.1. Request

Section	Header	Data				Footer
Field		Start Input # to read		Inputs numbers to read		
		High byte	Low byte	High byte	Low byte	
Possible values		0x00	0x00..0x07	0x00	0x01..0x08	
Size		1 byte	1 byte	1 byte	1 byte	

Note: "*Inputs number to read*" value should be calculated as 8 minus "*Start Input # to read*"

Example: 0x01 0x02 **0x00 0x00 0x00 0x08** 0x79 0xCC;

12.6.2. Response

Section	Header	Data		Footer
Field		Number of bytes in response	Inputs status	
Possible values		0x01	0x00..0xFF	
Size		1 byte	1 byte	

Inputs status is always returned as full status of all inputs (ignoring request's parameters). Inputs status is placed in corresponding bits of inputs status byte. All eight bits will be filled with corresponding data like in the following table.

Bit #	Description
0	0 = input #1 turned OFF
	1 = input #1 turned ON
1	0 = input #2 turned OFF
	1 = input #2 turned ON
2	0 = input #3 turned OFF
	1 = input #3 turned ON
3	0 = input #4 turned OFF
	1 = input #4 turned ON
4	0 = input #5 turned OFF
	1 = input #5 turned ON
5	0 = input #6 turned OFF
	1 = input #6 turned ON
6	0 = input #7 turned OFF
	1 = input #7 turned ON
7	0 = input #8 turned OFF
	1 = input #8 turned ON

Example: 0x01 0x02 0x01 **0x81** 0x61 0xE8
(0x81 = 1000 0001. Inputs №0 and №7 are turned ON)

12.7. Report Slave ID (0x11 – Module Serial Number)

This function behaves the same way as 0x64 (Read module serial number).

12.8. Read module serial number (0x64 – Module Serial Number)

12.8.1. Request

Section	Header	Data	Footer
Field		Any 4 bytes	
Possible values		0x00000000..0xFFFFFFFF	
Size		4 bytes	

Example: 0x01 0x64 **0x12 0x34 0x56 0x78** 0x0B 0x36

12.8.2. Response

Section	Header	Data	Footer
Field		Unique module ID	
Possible values		0x00..0xFF * 20	
Size		4 bytes	

Example: 0x01 0x64 **0x10 0xE8 0x0B 0x00** 0xF3 0xC6
(There is a module with address 0x01 and it has the following unique ID: 0x10E80B00)

12.9. Possible error codes

Error response syntax: device address – function code + 0x80 – error code.

Error code	Description
0x01	Function is not supported
0x02	Incorrect address
0x03	Incorrect data
0x04	It is impossible to process request (collisions, incorrect parameter value)

13. Collisions Between Manual Control And Master

Pairwise mode – if user is holding one of channels from particular pair and master will send request to set both second channel from the same pair to ON, then module will return error code 0x04. Outputs' state will not be changed.