User guide

Advanced IO

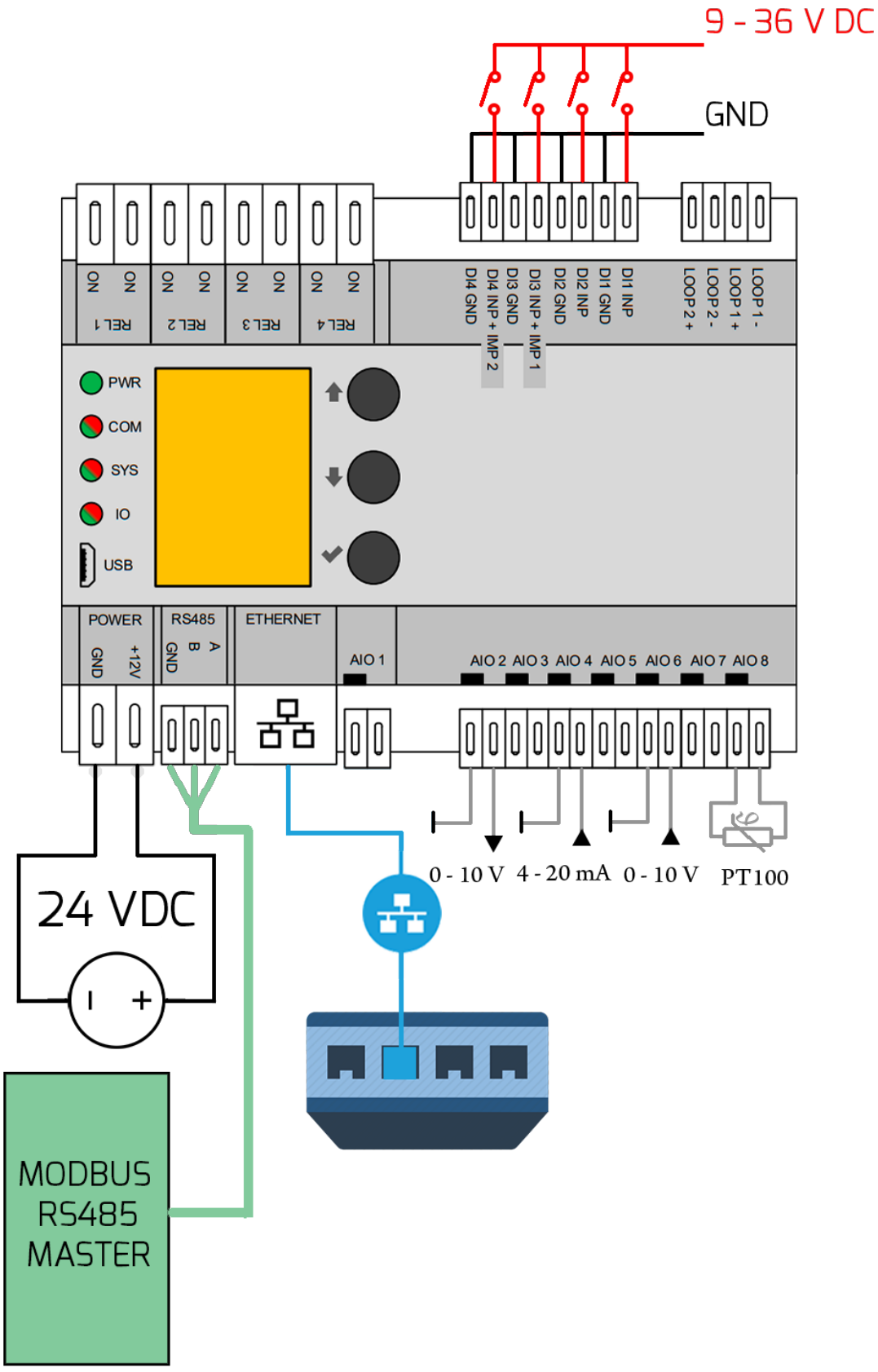
Analog + Rel

v.1.1

INDUSTRY

Contents:

1. System schematic



2. Basic parameters

2.1. System description

AdvancedIO Analog + Rel is a compact device intended for automatization, measurement and regulation.AdvancedIO Analog + Rel includes eight analog inputs/outputs that can be used for temperature measurement (Nix, PTx), voltage (0-10V) and current (0-30mA) measurement. The output voltage setting (0-10V) allows the management of external modules. Advanced IO Analog + Rel includes 2 current outputs (current loops) (0 - 20 mA). The device also includes four digital inputs that can be used for connecting sensors with digital output. Two of the digital inputs include an impulse counting function and can be used to connect measuring devices with impulse output.
AdvancedIO Analog + Rel includes four relays with a maximum switching current 5 A and voltage 250 VAC. They can be used for switching electronic devices.
The whole device can be a part of the Industry 4.0 platform and is controlled through a serial interface RS485 using the industrial communication protocol Modbus/RTU, or through ethernet interface using the industrial communication protocol Modbus/TCP. The integrated display with buttons allows for control of the individual outputs manually, as well as monitoring the state of the inputs/outputs in real-time.
In case a wireless solution is needed, the communication can be executed through Wifi, or one of many radio modules in our selection (434 MHz, 868 MHz, NB-IoT, 3G/GSM, LoRaWAN).
The device can be easily mounted on a DIN rail.

2.2. System parameters

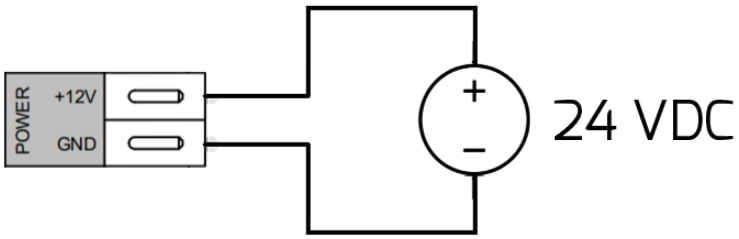
Communication interface	1 x Ethernet 1 x WiFi 1 x RS485
IO interface	8x analog input 0-10 V / 0-30 mA / PT100 / PT1000, or analog output 0-10 V 2x digital input 9-48 VDC / 5 mA 2x digital input 9-48 VDC / 5mA with an option to be configured as impulse type S0 (or similar) 4x relay output 250 VAC / 5 A 2x current output 0-20 mA
Communication protocols	Modbus TCP slave MODBUS RTU slave HTTP API (optional)
Optional radio modules	868/434 MHz, LoRaWAN, NB-IoT, 3G/GSM
Temperature range	-20 to +50 °C
Power supply voltage	24 VDC
Power consumption	max. 2 W (without radio module)
Dimensions	108 x 90 x 63 mm
Mount	DIN rail

Relay output	
Maximum load	5 A / 250 VAC
Digital inputs	
HIGH Level input Voltage	9 - 48 VDC
Current consumption	max. 5 mA
Impulse counter	
Minimum pulse duration	1 ms
Pulse output type	S0 (or similar)
Analog input/output	Voltage input Current input PT100 / PT1000 input Voltage output NTC 10k input
Voltage input (mode 1)	
Input voltage range	0 - 10 VDC
Input impedance	approx. 25 kΩ
Current input (mode 2)	
Input current range	0 - 30 mA
Input impedance	75 Ω
PT100 / PT1000 input (mode 3)	
Excitation current	approx. 4 mA
Voltage output (mode 4)	
Output voltage range	0 - 10 VDC
Minimum output voltage	8 mV flowing current 0 mA
	70 mV flowing current 1 mA
Maximum output current	5 mA
NTC 10k input (mode 5)	
Excitation current	approx. 50 µA
B coefficient	3435
Range	It depends on the sensor used
Current output	
Current range	0 - 20 mA
Exciting voltage	Supply voltage

3. Detailed connection schematics

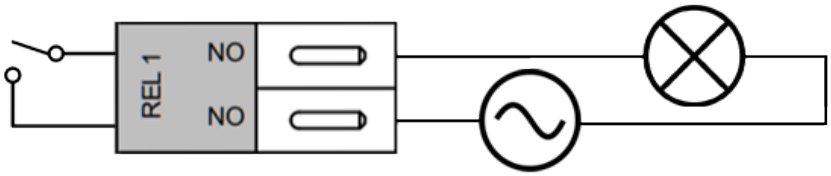
3.1. Power supply

The device requires an external DC power supply, able to provide at least 5 W of power at 24 V.



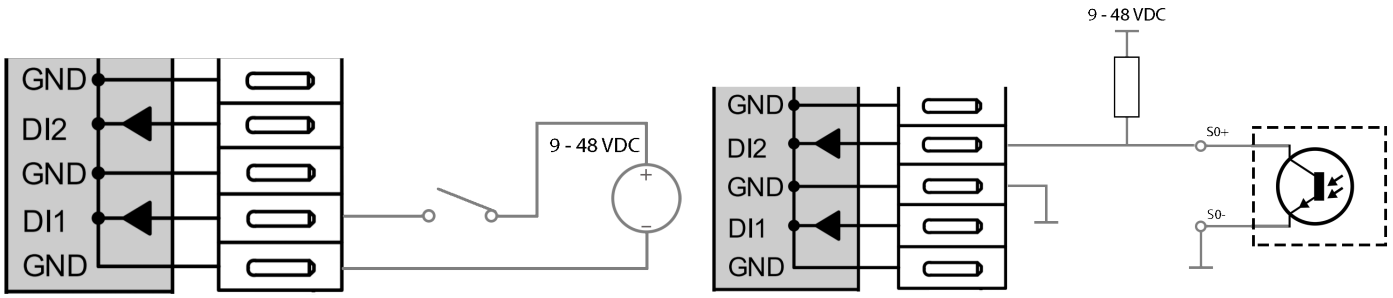
3.2. Relay outputs

Connect the electromagnetic contacts according to the following schematic.
The maximum load for alternating current is 5 A/230 VAC



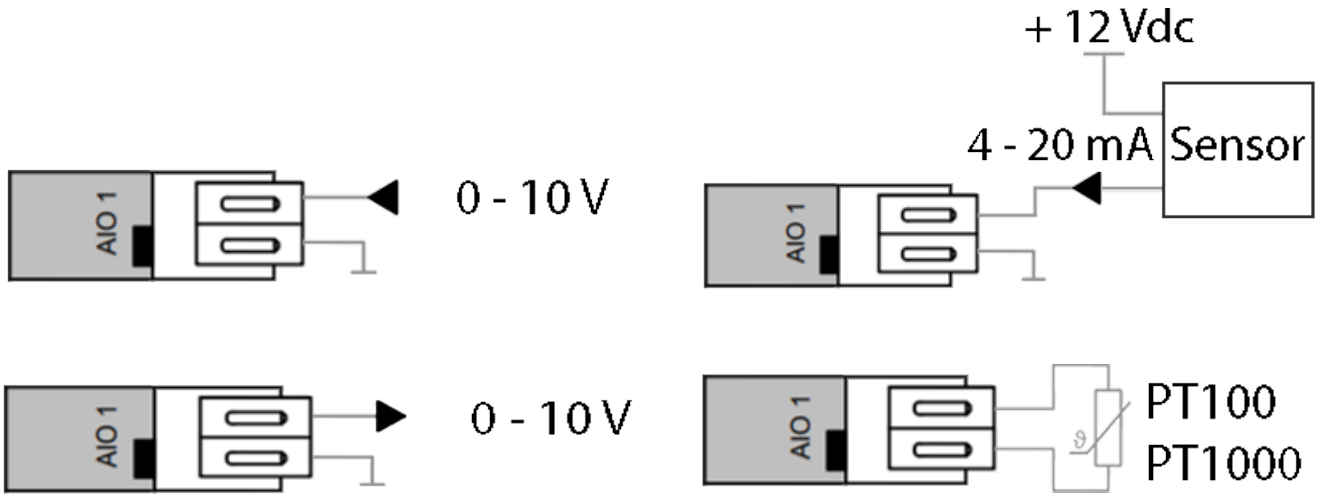
3.3. Digital inputs

The voltage range for digital inputs is 9 to 48 VDC. Lower voltage can lead to inaccurate detection of the signal, higher voltage can damage the device. The polarity of the input must adhere.
Digital inputs can be used to connect sensors with active digital output (flood sensor, position, etc.).
Digital inputs DI3 and DI4 implement an impulse detection feature and can be connected to devices with impulse output (S0 or similar)



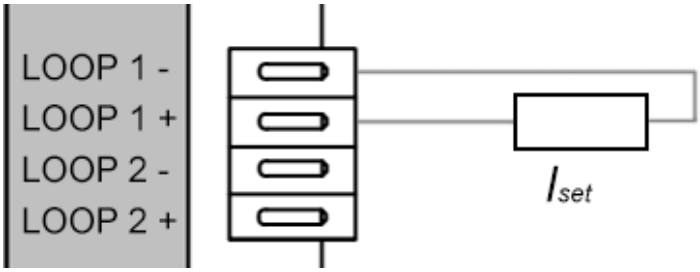
3.4. Analog inputs/outputs

Each of the eight analog inputs/outputs can be configured with one of four functions:
- Voltage input. It can be used to measure voltage for sensors with voltage output.
- Current input. It is primarily used to read the values of sensors with active current output.
- Voltage output: It can set analog voltage value and control systems with analog voltage input.
- PT100 / PT1000: Used to connect the temperature sensor PTx, Nix.



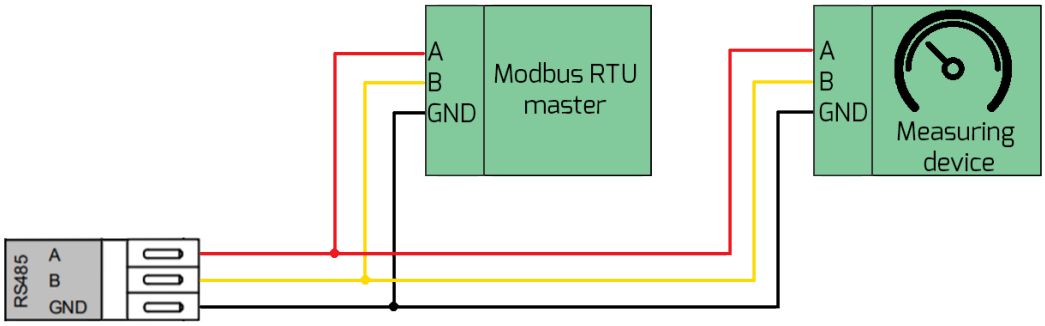
3.5. Current output

The current output can be set in the range of 0 - 20 mA and can be used to control devices with current input.



3.6. RS485

RS485 serves communication purposes through the Modbus RTU protocol with the master control unit (chapter 6).



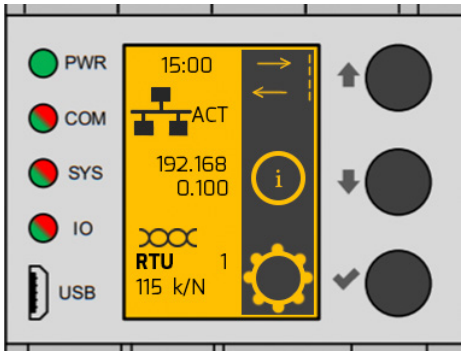
4. USB interface

The interface is intended for maintenance purposes. It is not required in an ordinary workload. After connecting the device to PC it will appear as a virtual COM port. It uses the same commands as TCP server.
USB can be used to update the device firmware (requires special software).

USB interface	
Communication speed	115200 baud
Format	8 bit
Parity	none
Stop bit	1

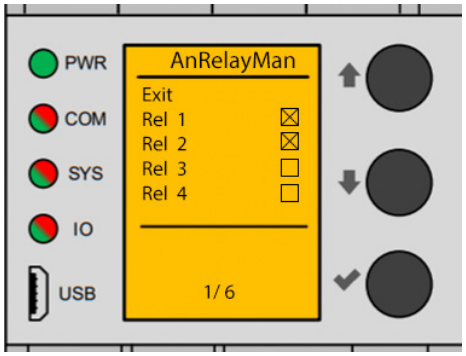
5. Manual user interface

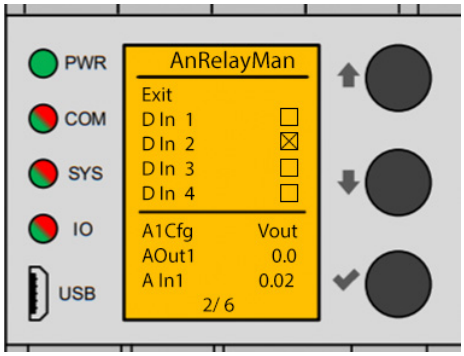
The device can be controlled manually, using a user interface (operator), or fully automated using Modbus TCP/RTU. All necessary service settings and manual interface options are described in the following sections.



5.1. IO interface parameters

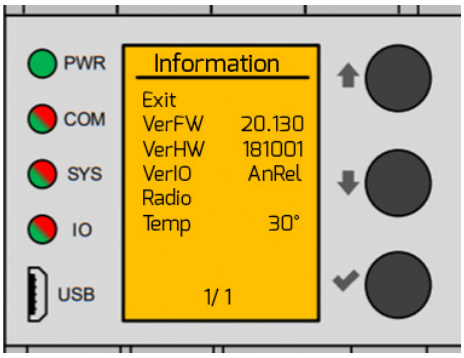
After pressing the "⇑" button, a menu opens in which the IO interface can be controlled. The IO interface means: switching on and off devices using relay contacts, reading the states of digital inputs, setting the working mode of digital inputs/outputs and reading or setting their values.





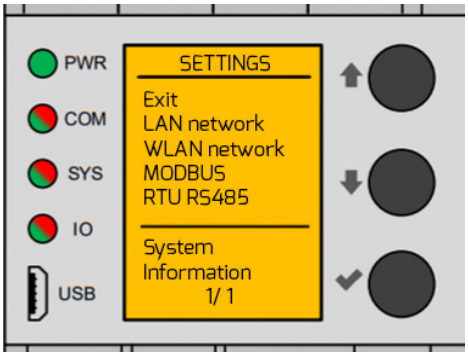
5.2. Device information

Using the "⇩" button, the user gets to the menu in which information about the system is available, such as: firmware version, device version, selected radio module, or device temperature. The hardware version is important for the user to know if the new firmware is compatible with his hardware.



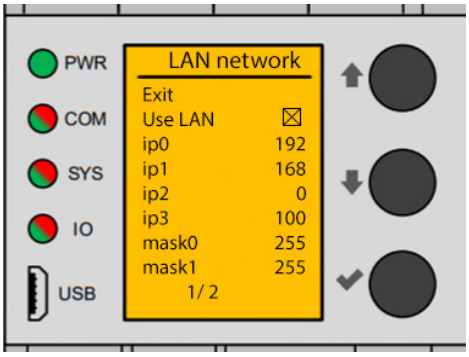
5.3. Settings

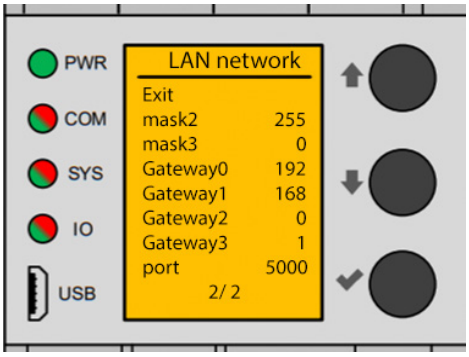
Using the "✔" button the user gets to the menu in which he can set the basic parameters of the device, such as LAN connection, WLAN connection, Modbus communication, RTU communication and system settings. All settings will be described in separate sections.



5.3.1. LAN connection

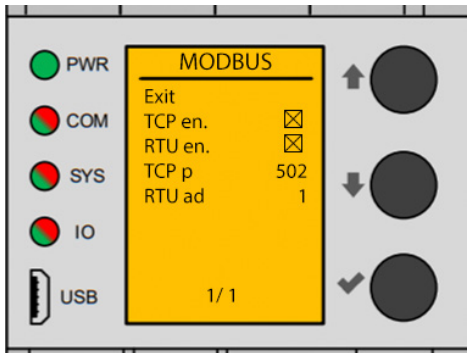
The LAN connection is set in Settings -> LAN network.
When using a LAN connection, it is important to check the "Use LAN" box. Subsequently, the device needs to be restarted (secion 5.3.4. System settings), because the change
The user can set the IP address, mask and gateway as needed.
The factory settings are: IP: 192.168.0.100, mask: 255.255.255.0, gateway: 192.168.0.1.





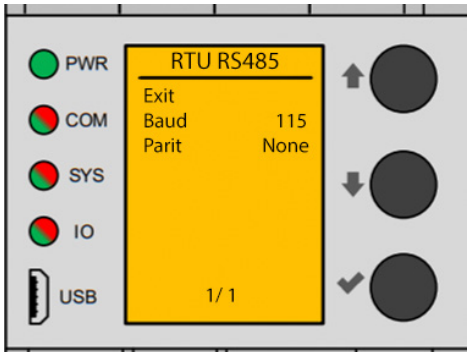
5.3.2. Modbus

Modbus communication is set in Settings -> MODBUS. In the Modbus section, the user can choose the communication method. by checking the TCP en. option, it will be possible to communicate via the Ethernet interface using the Modbus/TCP protocol. The communication port is set in TCP port. By checking the option RTU en., it will be possible to communicate witch the Modbus/RTU protocol via the RS485 interface. Setting the address of the device is realize by writing the address to the RTU ad..



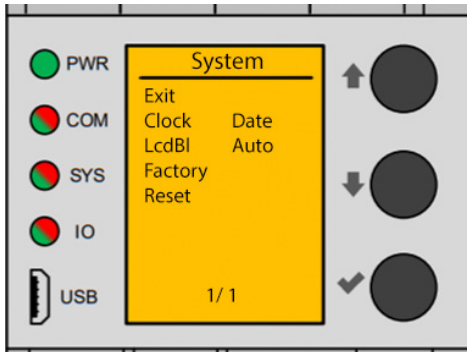
5.3.3. RTU RS485

The RS485 interface is set in Setting -> RTU RS485.
RS485 interface supports Baud rate 9600, 19200, 38400, 57600, 115200. Parity can be set to None, Odd, Even.



5.3.4. System settings

System settings are implemented in Settings -> System.
The system settings include, for example, the time and date, if the time is not displayed correctly after turning the device off and on, it is necessary to insert or replace the battery in the unit (type CR1220).
LcdBl sets the backlight. The user can choose from three backlight options. Always on, always off or automatic (the backlight turns on when you interact with the unit and turns off automatically, after a certain period of inactivity).



6. Modbus communication

6.1. Factory settings

The entire system can be controlled via Modbus/TCP or Modbus/RTU protocol.
To use Modbus/TCP, it is necessary to connect an Ethernet cable to the AdvancedIO Analog + Rel module (or connect via WiFi). The device in Modbus communication is in the role of Modbus slave. When using several devices in the network, it is necessary to assign a different IP address to each one. Setting a different IP address can be done manually on the device (section 5.3.1.).

Modbus TCP factory settings	
IP address	192.168.0.100
Subnet mask	255.255.255.0
Gateway	192.168.0.1
Modbus port	502

AdvancedIO Analog + Rel can be controlled using Modbus RTU, where it is necessary to connect the differentiol pairs of Bus RS485 and GND. When using multiple devices, it is nesessary to change the RTU address. This action is possible by connecting to the device using modbus TCP and writing the required address in the holding register 20 or setting the address manually on the device (section 5.3.2.).

Modbus RTU factory settings	
RTU address	1
Factory communication settings	
Communication speed	19200 Bits/s
Format	8 Bits
Parity	none
Stop bit	1

6.2. Modbus registers

6.2.1. Input registers

		Data type	Order of registers	RAW unit	RAW range from	RAW range to	OpenDAF address	OpenDAF object type	OpenDAF data type
0	FW version year	uint16			0	65535	$a/3:1	measurement	integer
1	FW version month	uint16			1	12	$a/3:2	measurement	integer
2	FW version day	uint16			0	31	$a/3:3	measurement	integer
3	Temperature	int16		°C	-40	85	$a/sl1@3:4	measurement	integer
4	Time since last boot (hours)	uint16			0	65535	$a/3:5	measurement	integer
5	Time since last boot (minutes)	uint16			0	59	$a/3:6	measurement	integer
6	Time since last boot (seconds)	uint16			0	59	$a/3:7	measurement	integer
50 - 51	Value at analog input 1 (Voltage mode)	float32	little endian	V	0,0	14,2	$a/fl2@3:51	measurement	float
	Value at analog input 1 (Current mode)			mA	0,0	33,3			
	Value at analog input 1 (Temperature mode)			°C	-100	850			
52 - 53	Value at analog input 2 (Voltage mode)	float32	little endian	V	0,0	14,2	$a/fl2@3:53	measurement	float
	Value at analog input 2 (Current mode)			mA	0,0	33,3			
	Value at analog input 2 (Temperature mode)			°C	-100	850			
54 - 55	Value at analog input 3 (Voltage mode)	float32	little endian	V	0,0	14,2	$a/fl2@3:55	measurement	float
	Value at analog input 3 (Current mode)			mA	0,0	33,3			
	Value at analog input 3 (Temperature mode)			°C	-100	850			
56 - 57	Value at analog input 4 (Voltage mode)	float32	little endian	V	0,0	14,2	$a/fl2@3:57	measurement	float
	Value at analog input 4 (Current mode)			mA	0,0	33,3			
	Value at analog input 4 (Temperature mode)			°C	-100	850			
58 -59	Value at analog input 5 (Voltage mode)	float32	little endian	V	0,0	14,2	$a/fl2@3:59	measurement	float
	Value at analog input 5 (Current mode)			mA	0,0	33,3			
	Value at analog input 5 (Temperature mode)			°C	-100	850			
60 - 61	Value at analog input 6 (Voltage mode)	float32	little endian	V	0,0	14,2	$a/fl2@3:61	measurement	float
	Value at analog input 6 (Current mode)			mA	0,0	33,3			
	Value at analog input 6 (Temperature mode)			°C	-100	850			

($a - unit address)

		Data type	Order of registers	RAW unit	RAW range from	RAW range to	OpenDAF address	OpenDAF object type	OpenDAF data type
62 - 63	Value at analog input 7 (Voltage mode)	float32	little endian	V	0,0	14,2	$a/fl2@3:63	measurement	float
	Value at analog input 7 (Current mode)			mA	0,0	33,3			
	Value at analog input 7 (Temperature mode)			°C	-100	850			
64 - 65	Value at analog input 8 (Voltage mode)	float32	little endian	V	0,0	14,2	$a/fl2@3:65	measurement	float
	Value at analog input 8 (Current mode)			mA	0,0	33,3			
	Value at analog input 8 (Temperature mode)			°C	-100	850			
66 - 69	Impulse counter on DI3	uint64	little endian		0	4294967295	$a/ul4@3:67	measurement	long
70 - 73	Impulse counter on DI4	uint64	little endian		0	4294967295	$a/ul4@3:71	measurement	long

6.2.2. Holding registers

		Data type	RAW range from	RAW range to	OpenDAF address	OpenDAF object type	OpenDAF data type
0	IP address of device, first octet (standard: 192)	uint16	0	255	$a/4:1	measurement / command	integer
1	IP address of device, second octet (standard: 168)	uint16	0	255	$a/4:2	measurement / command	integer
2	IP address of device, third octet (standard: 0)	uint16	0	255	$a/4:3	measurement / command	integer
3	IP address of device, fourth octet (standard: 100)	uint16	0	255	$a/4:4	measurement / command	integer
4	IP subnet mask, first octet (standard: 255)	uint16	0	255	$a/4:5	measurement / command	integer
5	IP subnet mask, second octet (standard: 255)	uint16	0	255	$a/4:6	measurement / command	integer
6	IP subnet mask, third octet (standard: 255)	uint16	0	255	$a/4:7	measurement / command	integer
7	IP subnet mask, fourth octet (standard: 0)	uint16	0	255	$a/4:8	measurement / command	integer
8	IP gateway, first octet (standard: 192)	uint16	0	255	$a/4:9	measurement / command	integer
9	IP gateway, second octet (standard: 168)	uint16	0	255	$a/4:10	measurement / command	integer
10	IP gateway, third octet (standard: 0)	uint16	0	255	$a/4:11	measurement / command	integer
11	IP gateway, fourth octet (standard: 1)	uint16	0	255	$a/4:12	measurement / command	integer
12	TCP port of modbus communication (standard: 502)	uint16	1	65535	$a/4:13	measurement / command	integer
13	MAC address, first octet	uint16	0	255	$a/4:14	measurement / command	integer
14	MAC address, second octet	uint16	0	255	$a/4:15	measurement / command	integer
15	MAC address, third octet	uint16	0	255	$a/4:16	measurement / command	integer
16	MAC address, fourth octet	uint16	0	255	$a/4:17	measurement / command	integer
17	MAC address, fifth octet	uint16	0	255	$a/4:18	measurement / command	integer
18	MAC address, sixth octet	uint16	0	255	$a/4:19	measurement / command	integer
19	TCP port of text protocol communication (standard 5000)	uint16	1	65535	$a/4:20	measurement / command	integer

($a - unit address)

		Data type	RAW range from	RAW range to	OpenDAF address	OpenDAF object type	OpenDAF data type
20	Modbus RTU RS485 address	uint16	1	254	$a/4:21	measurement / command	integer
21	Modbus RTU RS485 communication speed (change applied after reset) 0-9600 1-19200 2-38400 3-57600 4-115200	uint16	0	4	$a/4:22	measurement / command	integer
22	Modbus RTU RS485 parity (change applied after restart) 0-None 1-Even 2-Odd	uint16	0	2	$a/4:23	measurement / command	integer
50	Analog input/output mode 1 - input: voltage (0), current (1), PT100 / PT1000 (5) - output: voltage (3)	uint16	0	5	$a/4:51	measurement / command	integer
51	Analog input/output mode 2 - input: voltage (0), current (1), PT100 / PT1000 (5) - output: voltage (3)	uint16	0	5	$a/4:52	measurement / command	integer
52	Analog input/output mode 3 - input: voltage (0), current (1), PT100 / PT1000 (5) - output: voltage (3)	uint16	0	5	$a/4:53	measurement / command	integer
53	Analog input/output mode 4 - input: voltage (0), current (1), PT100 / PT1000 (5) - output: voltage (3)	uint16	0	5	$a/4:54	measurement / command	integer
54	Analog input/output mode 5 - input: voltage (0), current (1), PT100 / PT1000 (5) - output: voltage (3)	uint16	0	5	$a/4:55	measurement / command	integer
55	Analog input/output mode 6 - input: voltage (0), current (1), PT100 / PT1000 (5) - output: voltage (3)	uint16	0	5	$a/4:56	measurement / command	integer
56	Analog input/output mode 7 - input: voltage (0), current (1), PT100 / PT1000 (5) - output: voltage (3)	uint16	0	5	$a/4:57	measurement / command	integer
57	Analog input/output mode 8 - input: voltage (0), current (1), PT100 / PT1000 (5) - output: voltage (3)	uint16	0	5	$a/4:58	measurement / command	integer

($a - unit address)

		Data type	Order of registers	RAW unit	RAW range from	RAW range to	OpenDAF address	OpenDAF object type	OpenDAF data type
58 - 59	Analog output setpoint 1	float32	little endian	V	0,0	10,0	$a/fl2@4:59	command	float
60 - 61	Analog output setpoint 2	float32	little endian	V	0,0	10,0	$a/fl2@4:61	command	float
62 - 63	Analog output setpoint 3	float32	little endian	V	0,0	10,0	$a/fl2@4:63	command	float
64 - 65	Analog output setpoint 4	float32	little endian	V	0,0	10,0	$a/fl2@4:65	command	float
66 - 67	Analog output setpoint 5	float32	little endian	V	0,0	10,0	$a/fl2@4:67	command	float
68 - 69	Analog output setpoint 6	float32	little endian	V	0,0	10,0	$a/fl2@4:69	command	float
70 - 71	Analog output setpoint 7	float32	little endian	V	0,0	10,0	$a/fl2@4:71	command	float
72 - 73	Analog output setpoint 8	float32	little endian	V	0,0	10,0	$a/fl2@4:73	command	float
74 - 75	Analog output setpoint 1	float32	little endian	mA	0,0	20,0	$a/fl2@4:75	command	float
76 - 77	Analog output setpoint 2	float32	little endian	mA	0,0	20,0	$a/fl2@4:77	command	float
78 - 81	Setting the value of pulse counter DI13	uint64	little endian		0	4294967295	$a/ul4@4:79	command	long
82 - 85	Setting the value of pulse counter DI14	uint64	little endian		0	4294967295	$a/ul4@4:83	command	long

($a - unit address)

6.2.3. Coils registers

		Data type	RAW range from	RAW range to	OpenDAF address	OpenDAF object type	OpenDAF data type
3	Discovery of the device (LEDs on the outputs will flash for 20 seconds)	bool	0	1	$a/0:4	measurement / command	binary
50	Relay output 1	bool	0	1	$a/0:51	measurement / command	binary
51	Relay output 2	bool	0	1	$a/0:52	measurement / command	binary
52	Relay output 3	bool	0	1	$a/0:53	measurement / command	binary
53	Relay output 4	bool	0	1	$a/0:54	measurement / command	binary
54	Writing the set value of impulse counter DI13	bool	0	1	$a/0:55	command	binary
55	Writing the set value of impulse counter DI14	bool	0	1	$a/0:56	command	binary

($a - unit address)

6.2.4. Input discrete registers

		Data type	RAW range from	RAW range to	OpenDAF address	OpenDAF object type	OpenDAF data type
50	Digital input 1	bool	0	1	$a/1:51	measurement	binary
51	Digital input 2	bool	0	1	$a/1:52	measurement	binary
52	Digital input 3	bool	0	1	$a/1:53	measurement	binary
53	Digital input 4	bool	0	1	$a/1:54	measurement	binary

($a - unit address)

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