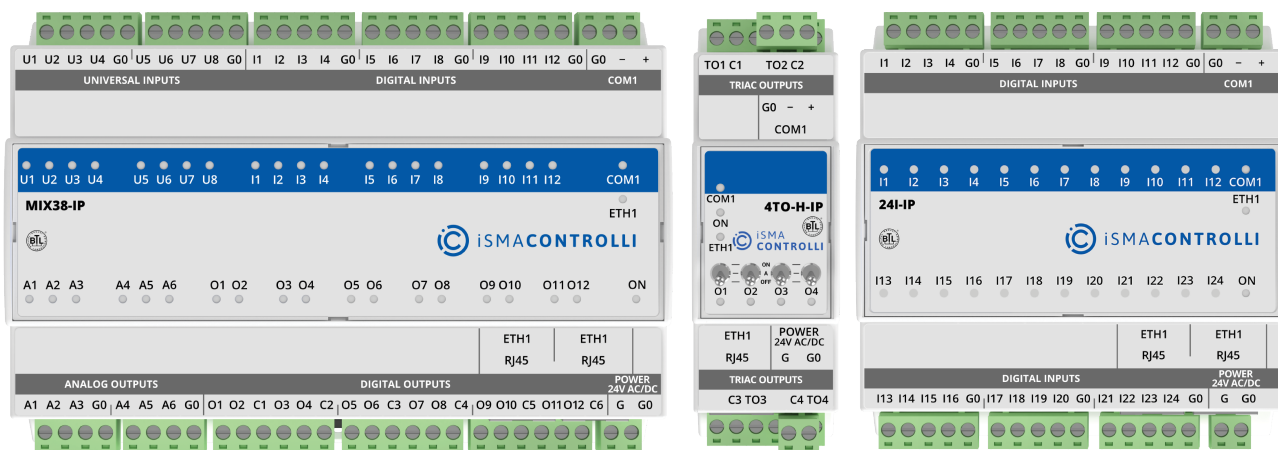


# Multiprotocol I/O Modules

User Manual

## BACnet



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# 1 Introduction

The MINI, MIX, and MAX series of multiprotocol I/O modules with RS485 and IP have been designed for building distributed control systems using MAC36, AAC20, or another controller. Each module is equipped with the most commonly used types of I/Os in building automation. Depending on the version, the modules are equipped with a mix of different types of I/O in one unit:

- MINI series: 4 or 8 inputs and outputs;
- MIX series: 18 or 38 inputs and outputs;
- MAX series: 24 or 12 inputs or outputs.

All I/O modules have BTL, and MINI/MIX series UL, certificates. The modules with RS485 and IP are factory-equipped with the two most popular open communication protocols: Modbus (RTU, ASCII, TCP/IP) and BACnet (MS/TP, IP), which are selected using DIP switches. Rotary switches are used to set the module address, which facilitates and accelerates the process of commissioning the system. Built-in mini USB allows for the initial configuration of the unit without external power supply.

Built-in Modbus TCP/IP to Modbus ASCII/RTU gateway enables to connect additional modules/devices that communicate via Modbus RS485.

Thanks to supporting open communication standards, I/O modules can be installed in both new and completed installations, as part of existing BMS. These versatile devices will fit any BMS perfectly.

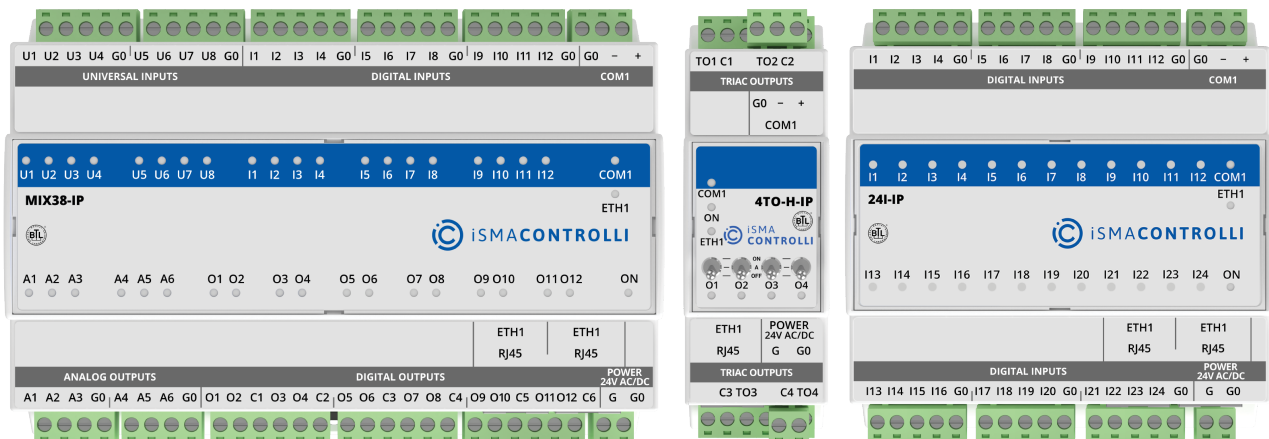


Figure 1. The MIX38-IP (MIX series), 4TO-H-IP (MINI series), and 24I-IP (MAX series) modules

This user manual outlines all information specific to using I/O modules in the BACnet protocol.

## 1.1 Revision History

Rev.	Date	Description
1.9	15 Feb 2023	<ul style="list-style-type: none"> <li>• New title of the user manual for all series of modules (MINI/MIX/MAX) - Multiprotocol I/O Modules User Manual;</li> <li>• MAX series of I/O modules added</li> <li>• DHCP functionality added</li> </ul>
1.8	25 May 2022	Rebranded

Rev.	Date	Description
1.7	13 Oct 2020	<ul style="list-style-type: none"> <li>Improved functionality of the BBMD: new default IP address, registering to the BBMD server is disabled if the BBMD IP address is left default;</li> <li>Introduced an option to disable web server access by changing the HTTP port to 0;</li> <li>Corrected summary table for all modules;</li> <li>Updated information about biasing resistors in MIX modules;</li> <li>General improvements and bugfixes.</li> </ul>
1.6	19 Feb 2020	<ul style="list-style-type: none"> <li>New temperature sensors implemented in Celsius and Fahrenheit degrees</li> <li>Improved filtering on UI</li> <li>Device Name (Object Name) in BACnet is saved in EEPROM memory</li> <li>Fixed one record in sensor 30k6A1 table –resistance 60713 to 80713 (5°C)</li> <li>“Send I Am” message is not sent if BACnet is turned off</li> </ul>
1.5	5 Oct 2018	<ul style="list-style-type: none"> <li>Corrections of typing errors in the text</li> <li>Added imperial unit of measure</li> <li>MINI and MIX modules earned UL recognized component mark</li> </ul>
1.4	7 Dec 2017	<ul style="list-style-type: none"> <li>Firmware Version 6.0 released with BACnet certification</li> <li>fixed out of service flags in AO, BO and TO</li> <li>fixed overridden flags in AO, BO and TO</li> <li>fixed bug with number of counters for Binary input object (now variable is 32 bit)</li> <li>changed AO-1, BO-1, TO-1 HAND_STATUS Access to read-only</li> <li>changed resistance table for 2.2K3A1 sensor</li> </ul>
1.3	16 May 2017	<ul style="list-style-type: none"> <li>Hardware Version info added on the main tab on the web page and in the Modbus register</li> <li>new action in the Modbus register no 0 – enter the bootloader</li> <li>RS485 biasing control added for MINI IP modules with hardware version <math>\geq 2.0</math></li> <li>new Device Object properties added: Version type, Baud rate, User Baud rate, IP address, Subnet mask, Default Gateway, HTTP port, and UDP port</li> <li>www page: RS485 Biasing Resistors activating option (appears only in MINI modules with hardware <math>\geq 2.0</math>)</li> <li>www page fixed: COV increment always in a format with one decimal place</li> <li>module names on the web page the corrected (added -H for all modules with hand operation switches)</li> </ul>
1.2	4 Jan 2017	<ul style="list-style-type: none"> <li>New HVAC functions Heating and Cooling in 4U40 based on output thermostatic control with a setpoint and differential value setting;</li> <li>New input mode added for 4I40: Time Relay NC [ms], Time Relay NO and NC in seconds, Input Forwarding;</li> <li>New input mode added for 4U40: Ordinary IO, Monostable Relay, Bistable Relay, Time Relay NO and NC [ms], Time Relay NO and NC in seconds, Input Forwarding, Heating,</li> </ul>

Rev.	Date	Description
		<p>Cooling with corresponding BACnet objects and Modbus registers;</p> <ul style="list-style-type: none"> <li>• Output for resetting to default after input mode change in 4U4O and 4I4O;</li> <li>• Improved BACnet COV Increment now can have values with the resolution of 0.1;</li> <li>• BACnet COV Increment access (read/write) through USB added;</li> <li>• Power Led added, flashing when the I/O watchdog is triggered;</li> <li>• I/O watchdog reset after read/write registers through USB modified;</li> <li>• Sensors added for the immediate detection of short circuit and disconnection, regardless of filter settings on universal inputs;</li> <li>• Fixed bug with Stop bits, it was always 1.</li> </ul>
1.1	1 Feb 2016	<ul style="list-style-type: none"> <li>• Information about the capacitive load relay added to the technical specifications.</li> <li>• Information about load triac outputs added to the technical specifications.</li> <li>• Information about COV added.</li> <li>• New BACnet objects UP_TIME and WATCHDOG.</li> <li>• Universal Inputs: COV support and new feature of flag OUT_OF_SERVICE added.</li> <li>• Universal Inputs: new objects added: UI_CONFIGURATION, UI_RESOLUTION, UI_FILTER and UI_DRY CONTACT.</li> <li>• Digital Inputs: COV support and new feature of flag OUT_OF_SERVICE added.</li> <li>• Digital Inputs: new objects added: BIA_COUNTER, and BI_COUNTER.</li> <li>• Analog Outputs: COV support and new feature of flags OUT_OF_SERVICE and STATUS_FLAG added.</li> <li>• Analog Outputs: new objects added: AO_CONFIGURATION, AO_HAND_STATUS, and AO_HAND_VALUE.</li> <li>• Digital Outputs: COV support and new feature of flag OUT_OF_SERVICE and STATUS_FLAG added.</li> <li>• Digital Outputs: new object added: HAND_STATUS.</li> <li>• Description of the new MINI module 4x Triac Outputs added: 4TO-H and 4TO-H-IP.</li> <li>• MINI - 4I4O-H and 4I4O-H-IP module built-in application: Change of logic in the Time relay mode. Now the timer counts from the falling edge (is used to do it from the rising edge).</li> <li>• MINI - 4I4O-H and 4I4O-H-IP Module built-in application: new objects added MODE_TIME, COMMAND, and BLOCKING.</li> <li>• Shortlist of BACnet objects added.</li> <li>• Tables with PT1000 and NI1000 updated with more accurate data, due to new FW measuring the temperature at these sensors with 0.1°C accuracy.</li> </ul>
1.0	28 Aug 2015	First edition

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.

## 2.1 Wiring

In most cases, I/O modules will be installed in an enclosure along with the other devices, which generate electromagnetic radiation. Relays, contactors, transformers, motor invertors, etc., are examples of such devices. Radiation can induce electrical noise into both power and signal lines, as well as direct radiation into the module. Whether or not the iSMA modules are immune to such effects, the interferences must be suppressed at their source if possible to ensure the proper functioning of the entire system. Appropriate grounding, shielding and other protective steps should be taken at the installation stage to prevent these effects. It is recommended to at least follow the rules below:

- Line power cables must be routed with spatial separation from signal and data transmission cables.
- Analog and digital signal cables should also be separated.
- It is recommended to use shielded cables for analog signals, cable shields should not be interrupted by intermediate terminals.
- The shielding should be earthed directly after the cable enters the cabinet.

It is recommended to install interference suppressors when switching inductive loads (e.g., coils of contactors, relays, solenoid valves). RC snubbers or varistors are suitable for AC voltage and freewheeling diodes for DC voltage loads. The suppressing elements must be connected as close to the coil as possible.

## 2.2 EN 60730-1 Power Supply Considerations

- Electrical safety in the building automation and control systems is essentially based on the use of extra-low voltage which is strictly separated from the mains voltage. This low voltage is either SELV or PELV according to EN 60730-1.
- Protection against electric shock is ensured by the following measures:
  - Limitation of voltage (low voltage AC/DC 24V supply, either SELV or PELV)
  - Protective-separation of the SELV-system from all circuits other than SELV and PELV
  - Simple-separation of the SELV-system from other SELV-systems, from PELV-systems and earth
- Field devices such as sensors, status contacts, and actuators connected to the low-voltage inputs and outputs of I/O modules must comply with the requirements for SELV or PELV. The interfaces of field devices and other systems must also satisfy SELV or PELV requirements.
- If the supply of SELV or PELV circuits is obtained from supply mains of higher voltages, it shall be provided by safety transformer or a converter designed for continuous operation to supply SELV or PELV circuits.

## 2.3 FCC Compliance Note

**Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a

particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- reorient or relocate the receiving antenna;
- increase the separation between the equipment and receiver;
- connect the equipment into an outlet on a circuit different from that to which the receiver is connected;
- consult the dealer or an experienced radio/TV technician for help.

### 3 Technical Specification

Power supply	Voltage	24 V AC/DC $\pm$ 20%	
	Power consumption		
	Module type	At 24 V DC	At 24 V AC
	8I	0.4 W	0.6 VA
	8I-IP	1.4 W	2.1 VA
	8U	0.5 W	0.8 VA
	8U-IP	1.5 W	2.3 VA
	4I4O-H	1.2 W	1.8 VA
	4I4O-H-IP	2.2 W	3.3 VA
	4U4O-H	1.2 W	1.8 VA
	4U4O-H-IP	2.2 W	3.3 VA
	4U4A-H	2.2 W	3.3 VA
	4U4A-H-IP	3.2 W	4.8 VA
	4O-H	1.6 W	2.4 VA
	4O-H-IP	2.6 W	3.9 VA
	4TO-H	1.0 W	1.5 VA
	4TO-H-IP	2.0 W	3.0 VA
	MIX18	3.0 W	4.5 VA
	MIX18-IP	4.4 W	6.6 VA
	MIX38	5.0 W	7.5 VA
MIX38-IP	7.4 W	11.1 VA	
12O-H	3.4 W	9 VA	
12O-H-IP	4.5 W	11.7 VA	
24I	1 W	3.2 VA	
24I-IP	2.1 W	6.2 VA	
Universal Inputs	Temperature input	Measurement with RTDS attached Accuracy $\pm$ 0.1°C For PT1000 and NI1000 sensors use 16-bit resolution	



	Voltage input	Voltage measurement in 0-10 V DC range Input impedance 100 kΩ Measurement accuracy ±0.1% Measurement resolution 3 mV at 12-bit and 1 mV at 16-bit	
	Current input	Current measurement in 0 - 20 mA range Required external resistor 200 Ω Measurement accuracy ±1.1% Measurement resolution 15 μA at 12-bit and 5 μA at 16-bit	
	Resistive input	Measurement of resistance in 0 to 1000 kΩ range Measurement resolution for 20 kΩ load 20 Ω at 12-bit and 1 Ω at 16-bit Measurement resolution for PT1000 and NI1000 0.1 Ω at 16-bit	
	Resistance measurement method	Voltage divider	
	Dry contact input	Output current ~1 mA	
	Measurement resolution	12-bit (default) or 16-bits	
	Processing time	10 ms/channel at 12-bits 140 ms/channel at 16-bits	
Digital Inputs	Type	Dry contact	
	Max. input frequency	100 Hz saved in EEPROM memory	
Analog Outputs	Voltage range	0-10 V DC	
	Max. load current	20 mA, total 60 mA load current for all outputs for MIX18, MIX18-IP, MIX38, MIX38-IP modules	
	Resolution	12-bit	
	Accuracy	± 0.5%	
Digital Outputs (relays)	Contact material	AgSnO <sub>2</sub>	
		UL compliant ratings	Maximum ratings
	Resistive load AC1	3 A at 24 V AC 3 A at 30 V DC	3 A at 230 V AC 3 A at 30 V DC
	Inductive load AC3	8 VA at 24 V AC 30 W at 30 V DC	75 VA at 230 V AC 30 W at 30 V DC

	Capacitive load		50 W at LED + PS 230 VAC 100 W at fluorescent lamps with electronic ballast 75 W at CFL Compact fluorescent lamp
Digital Outputs (relays) 40-H and 40-H-IP	Contact material	AgSnO2	
		UL compliant ratings	Maximum ratings
	Resistive load AC1	8 A at 230 V AC 8 A at 30 V DC	8 A at 230 V AC 8 A at 30 V DC
	Inductive load AC3	37 VA at 230 V AC 90 W at 30 V DC	360 VA at 230 V AC 90 W at 30 V DC
	Capacitive load		180 W at CFL Compact fluorescent lamp 120 W at LED + PS 230 V AC 240 W at fluorescent lamps with electronic ballast
Digital Outputs (relays) 120-H and 120-H-IP	Contact material	AgSnO2	
	Resistive load AC1	3 A at 230 V AC 3 A at 30 V DC	
	Inductive load AC3	75 VA at 230 V AC 30 W at 30 V DC	
	Capacitive load	50 W at LED + PS 230 VAC 100 W at fluorescent lamps with electronic ballast 75 W at CFL Compact fluorescent lamp	
Triac Outputs	Continuous load per channel	0.5 A at 20 V AC up to max. 250 V AC	
	Peak load per channel	1.5 A at 20 V AC up to max. 250 V AC (30 s)	
	Gate Control	Zero crossing turn ON	
	Frequency Range	47 to 63 Hz	
	Snubber	Snubberless triac	
RS485 Interface	RS485	Up to 128 devices	
	Communication protocols	Modbus RTU, Modbus ASCII, or BACnet set by switch	
	Baud rate	From 2400 to 115200 set by switch	
	Address	0 to 99 set by switch	

<b>Ethernet</b>	MIX18-IP, MIX38-IP, 12O-H-IP, 24I-IP			
	Fast Ethernet	Switch mode (2 RJ45 ports)		
	Baud rate	10/100 Mb/s		
	8I-IP, 8U-IP, 4I4O-H-IP, 4U4O-H-IP, 4U4A-H-IP, 4O-H-IP, TO-H-IP			
	Fast Ethernet	IP interface		
	Baud rate	10/100 Mb/s		
	<b>USB</b>	USB	Mini USB 2.0	
<b>Ingress protection</b>	IP	IP20		
<b>Temperature</b>	Storage	-40°C to +85°C (-40°F to 185°F)		
	Operating	-10°C to +50°C (14°F to 122°F)		
<b>Humidity</b>	Relative	5% to 95%		
<b>Connectors</b>	Type	Removable		
	Maximum cable size	2.5 mm <sup>2</sup> (18-12 AWG)		
	Maximum tightening torque	0.35 Nm		
<b>Dimensions</b>	MAX Series			
	Width	106.30 mm/4.19 in		
	Length	110.00 mm/4.33 in		
	Height	Without hand switches	With hand switches	
		62.00 mm/2.44 in	70.00 mm/2.76 in	
	MIX18, MIX18-IP			
	Width	87.80 mm/3.46 in		
	Length	110.00 mm/4.33 in		
	Height	62.00 mm/2.44 in		
	MIX38, MIX38-IP			
	Width	160.20 mm/6.31 in		
	Length	110.00 mm/4.33 in		

	Height	62.00 mm/2.44 in	
	MINI Series		
	Width	36.30 mm/1.43 in	
	Length	110.00 mm/4.30 in	
	Height	Without hand switches	With hand switches
	62.00 mm/2.44 in	68.70 mm/2.70 in	

Table 2. Technical specification

### 3.1 Summary Table for All Modules

Module Type	UI	DI	AO	DO	TO	Modbus RTU/ASCII	Modbus TCP/IP	BACnet MS/TP	BACnet IP
4I4O-H		4		4		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
4I4O-H-IP		4		4			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
4O-H				4 (NC/ NO- 8A)		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
4O-H-IP				4 (NC/ NO- 8A)			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
4U4A-H	4		4			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
4U4A-H-IP	4		4				<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
4U4O-H	4			4		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
4U4O-H-IP	4			4			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
8I		8				<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
8I-IP		8					<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
8U	8					<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
8U-IP	8						<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
4TO-H					4	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	

4TO-H-IP					4		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
MIX18	5	5	4	4		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
MIX18-IP	5	5	4	4			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
MIX38	8	12	6	12		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
MIX38-IP	8	12	6	12			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
12O-H				12		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
12O-H-IP				12			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
24I		24				<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
24I-IP		24					<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
						RS485 slave	Modbus gateway IP/ RS485 (works only as a master on RS485 network)	RS485 master slave	Modbus gateway IP/ RS485 (works only as a master on RS485 network)

Table 3. Summary table for all modules

## 4 Hardware Specification

### 4.1 Dimensions

MINI Series (Without Hand Switches)

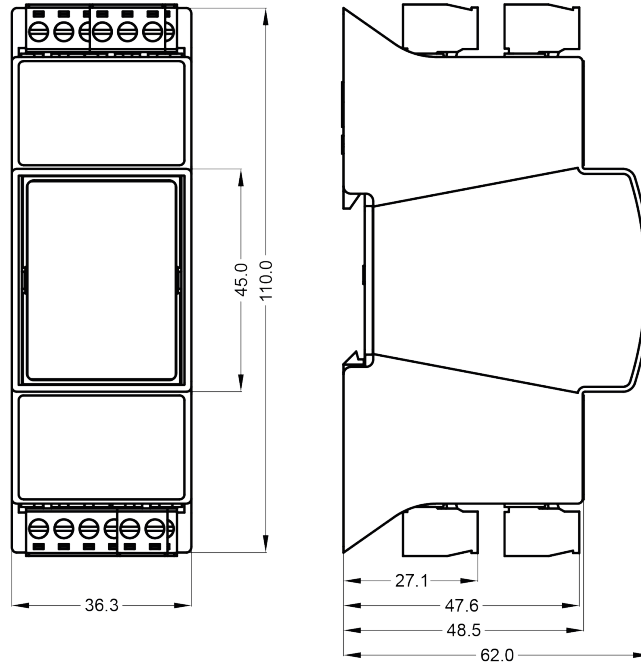


Figure 2. The MINI series dimensions (without hand switches)

MINI Series (With Hand Switches)

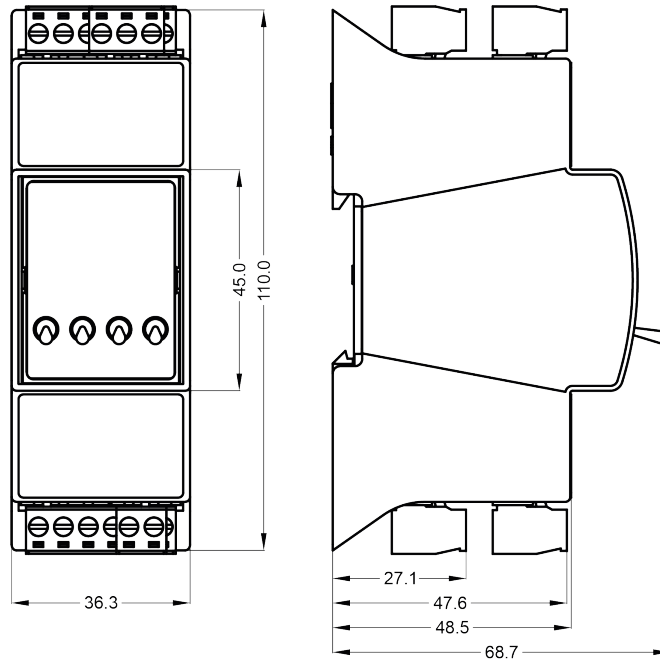


Figure 3. The MINI series dimensions (with hand switches)

### MIX18 Series

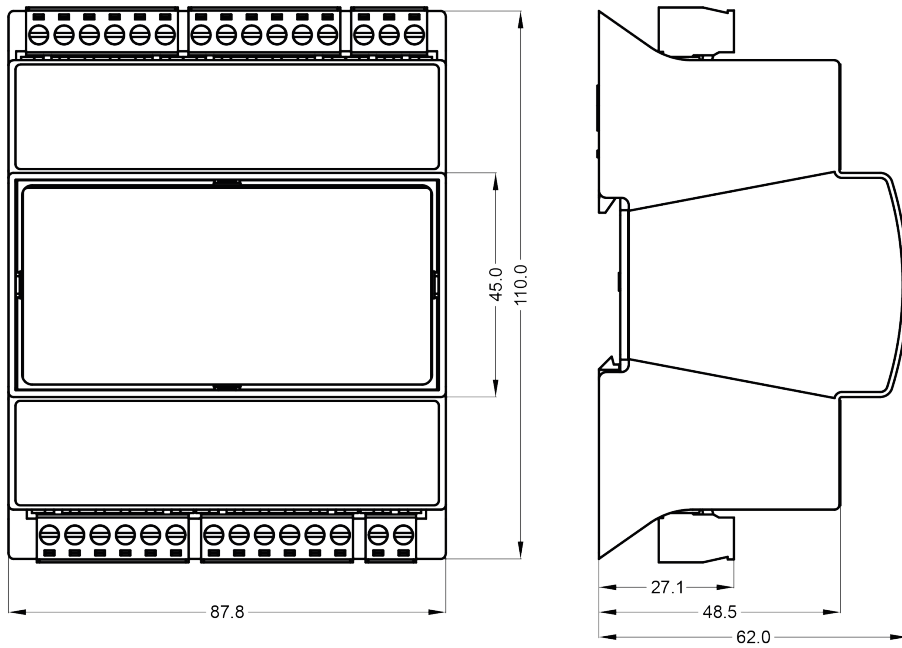


Figure 4. The MIX18 series dimensions

### MIX38 Series

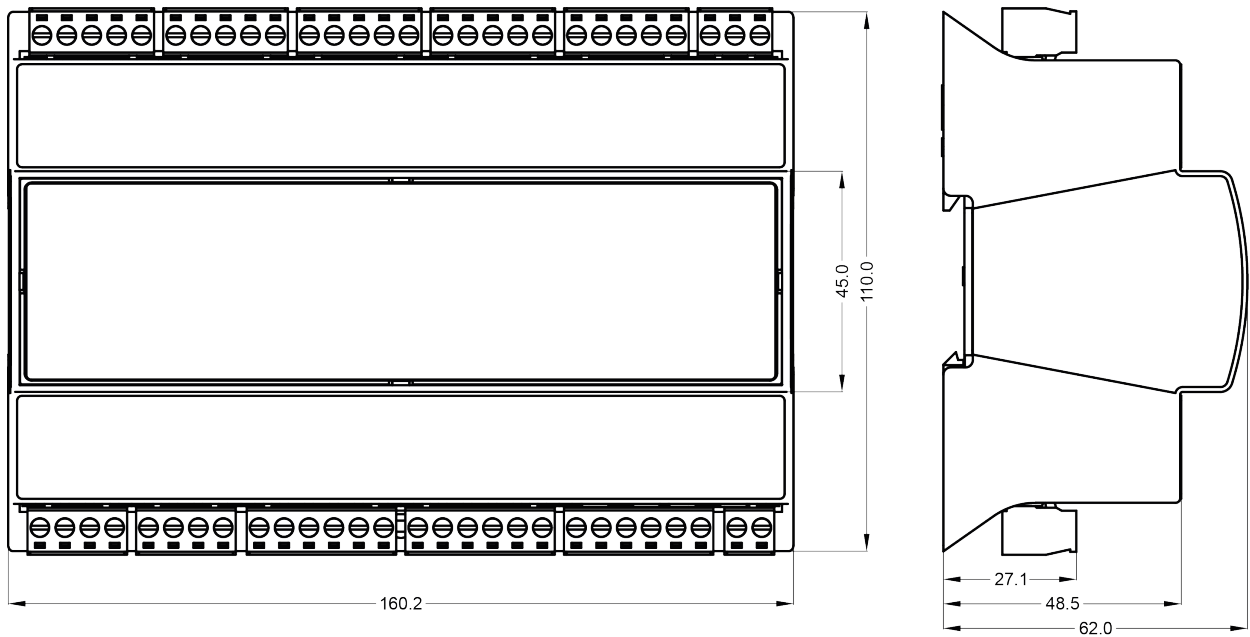


Figure 5. The MIX38 series dimensions

### MAX Series (Without Hand Switches)

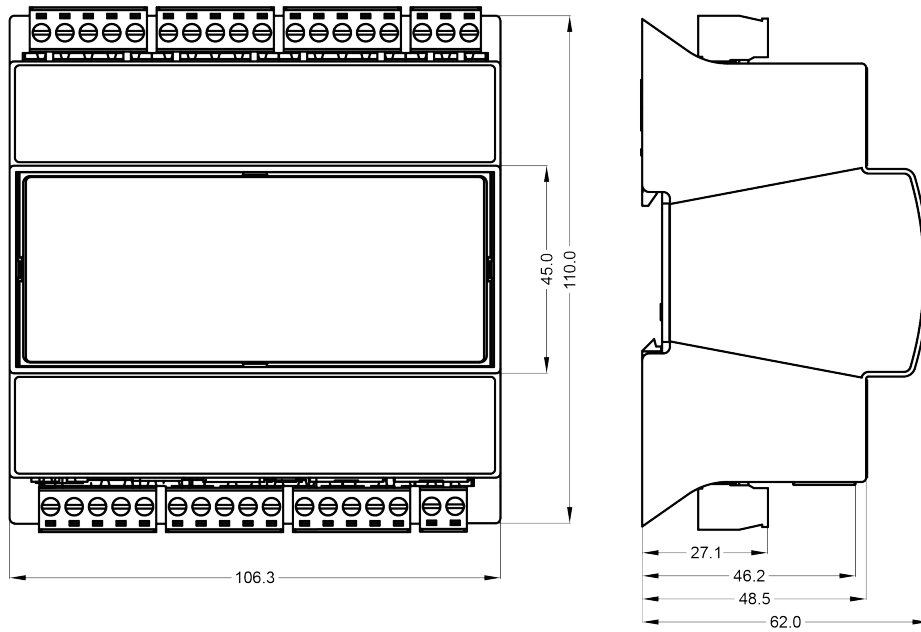


Figure 6. The MAX series dimensions (without hand switches)

### MAX Series (With Hand Switches)

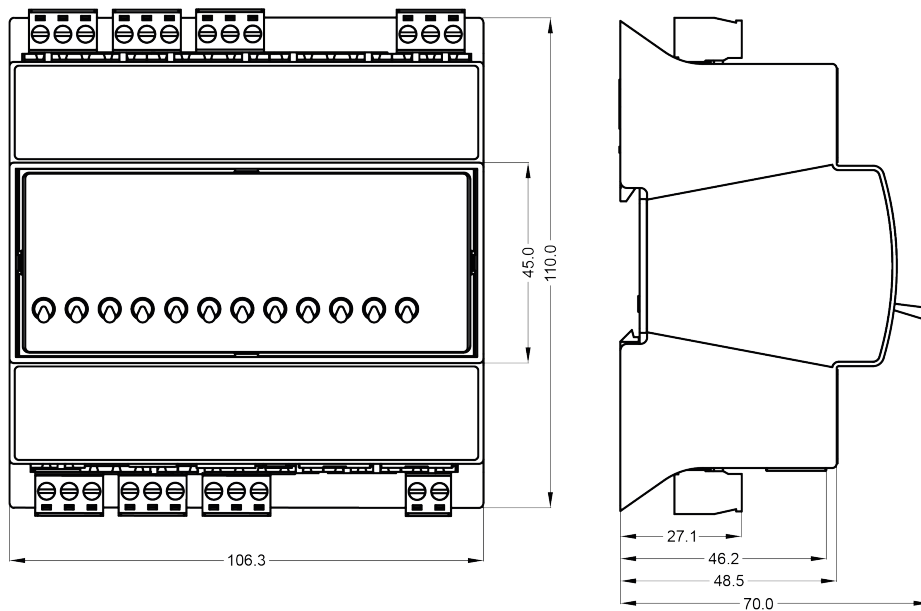


Figure 7. The MAX series dimensions (with hand switches)

## 4.2 Power Supply Connection

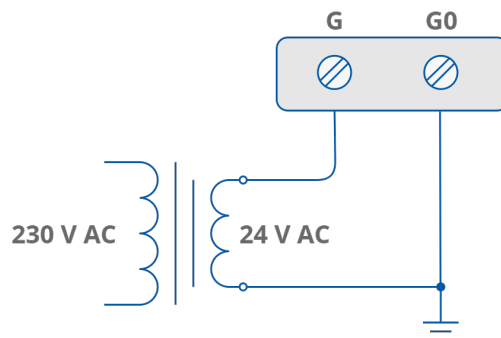


Figure 8. AC power supply connection



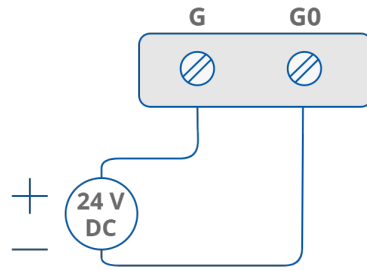


Figure 9. DC power supply connection

### 4.3 LED Indicators

#### 4.3.1 MIX Series Front Panels

##### MIX18

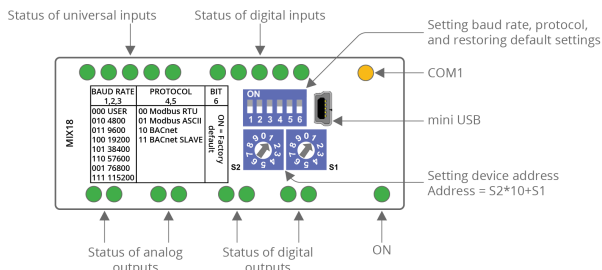


Figure 10. The MIX18 top panel

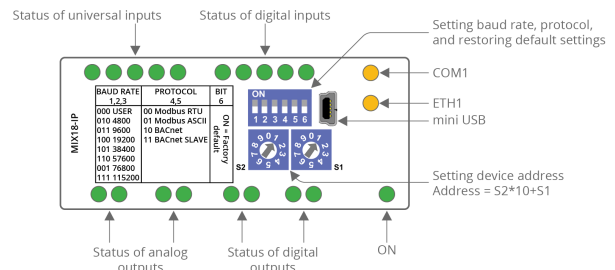


Figure 11. The MIX18-IP top panel

##### MIX38

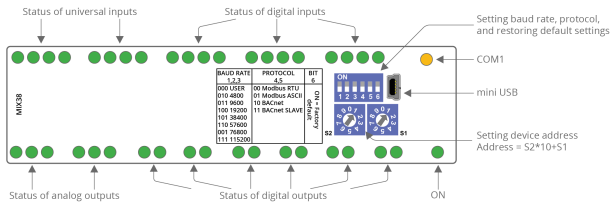


Figure 12. The MIX38 top panel

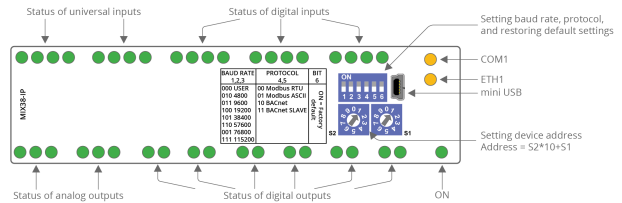


Figure 13. The MIX38-IP top panel

#### 4.3.2 MINI Series Front Panels

##### MINI 8I and 8I-IP

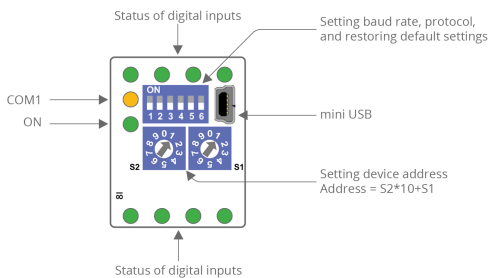


Figure 14. The 8I top panel

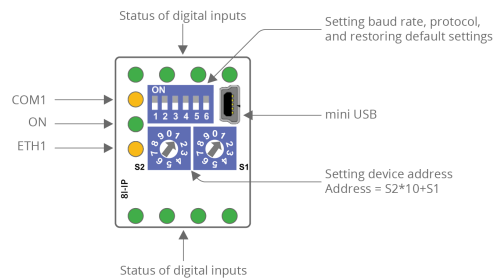


Figure 15. The 8I-IP top panel

## MINI 8U and 8U-IP

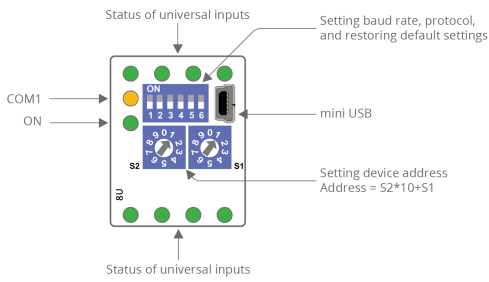


Figure 16. The 8U top panel

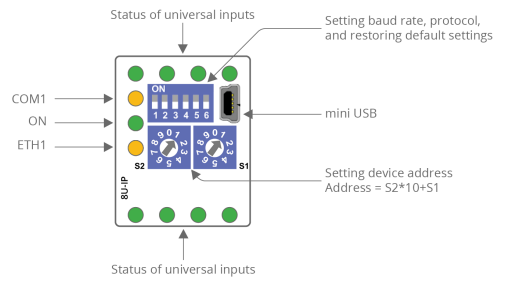


Figure 17. The 8U-IP top panel

## MINI 4I4O-H and 4I4O-H-IP

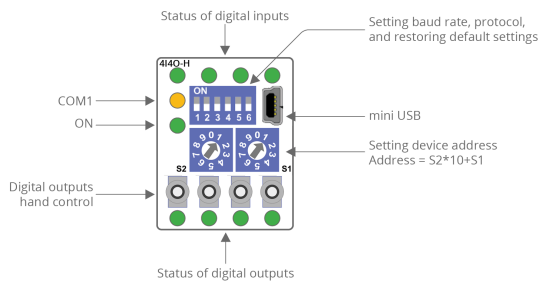


Figure 18. The 4I4O-H top panel

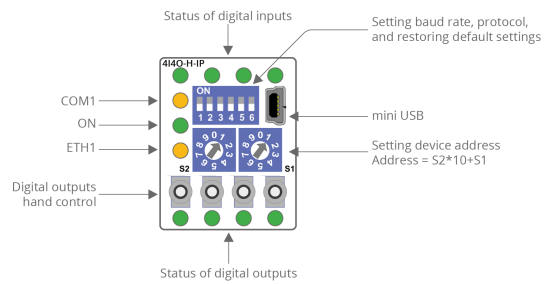


Figure 19. The 4I4O-H-IP top panel

## MINI 4U4O-H and 4U4O-H-IP

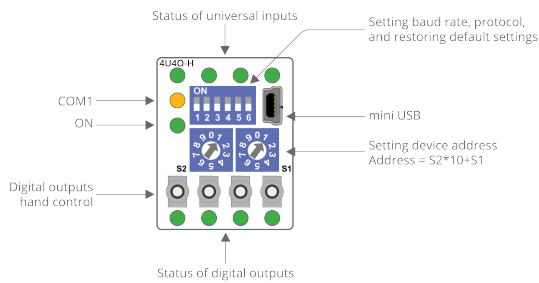


Figure 20. The 4U4O-H top panel

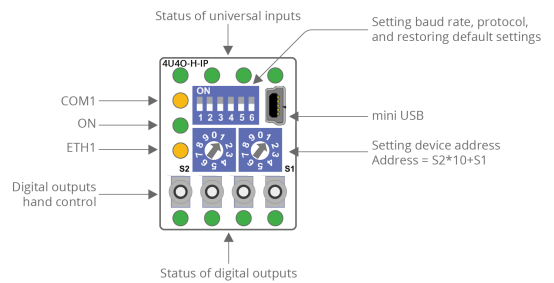


Figure 21. The 4U4O-H-IP top panel

## MINI 4U4A-H and 4U4A-H-IP

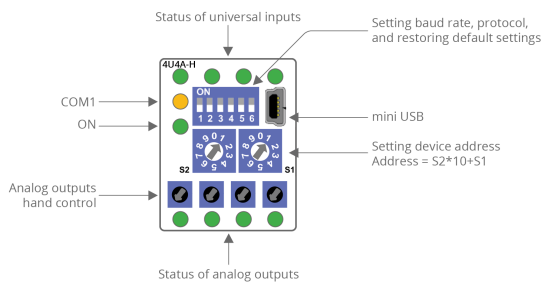


Figure 22. The 4U4A-H top panel

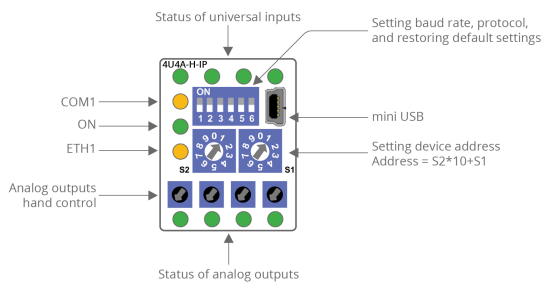


Figure 23. The 4U4A-H-IP top panel

## MINI 4O-H and 4O-H-IP

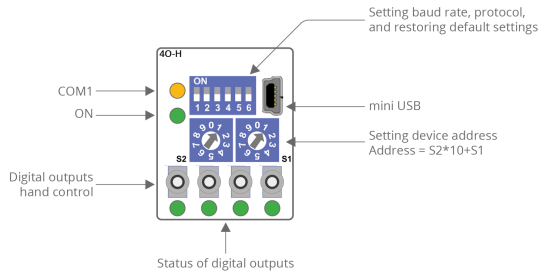


Figure 24. The 4O-H top panel

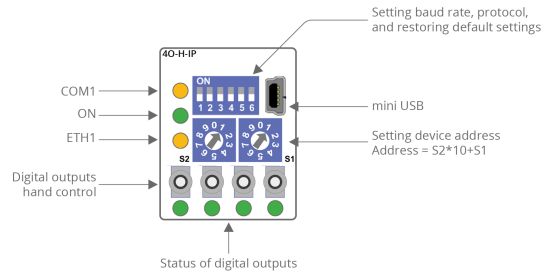


Figure 25. The 4O-H-IP top panel

## MINI 4TO-H and 4TO-H-IP

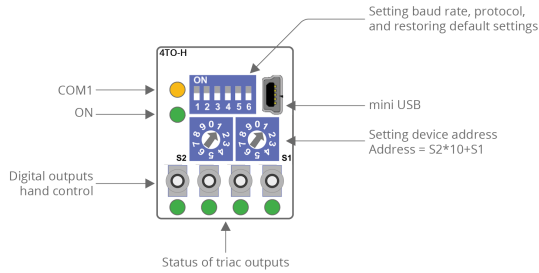


Figure 26. The 4TO-H top panel

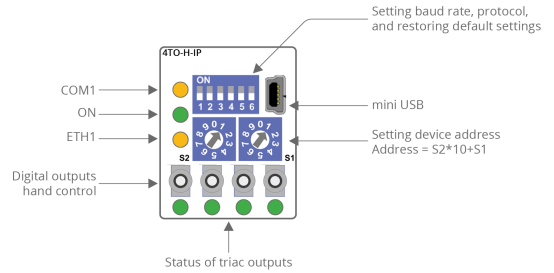


Figure 27. The 4TO-H-IP top panel

## 4.3.3 MAX Series Front Panels

### MAX 12O-H and 12O-H-IP

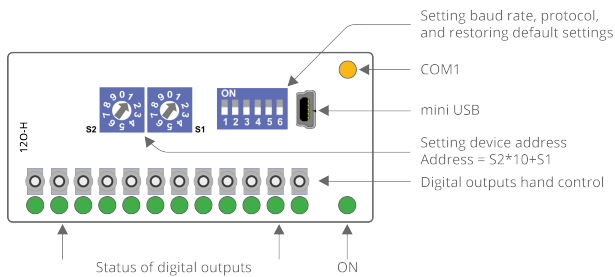


Figure 28. The 12O-H top panel

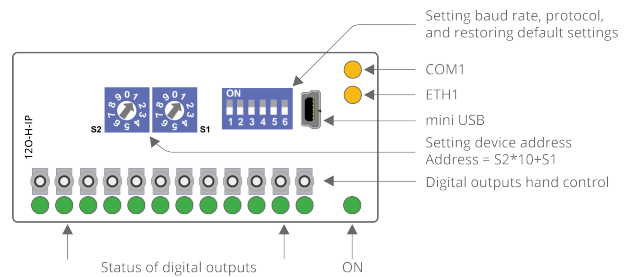


Figure 29. The 12O-H-IP top panel

### MAX 24I and 24I-IP

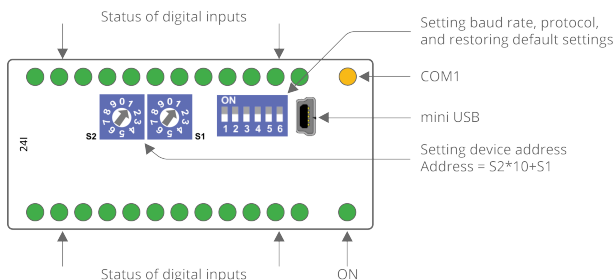


Figure 30. The 24I top panel

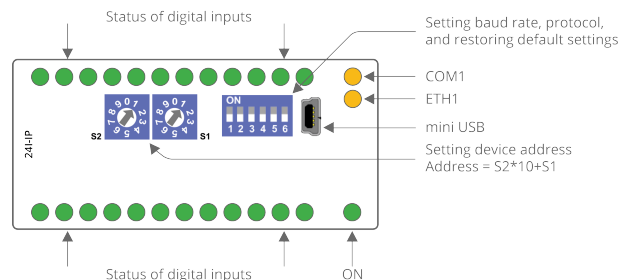


Figure 31. The 24I-IP top panel

- The power LED (ON) is on (green) if the module runs properly.
- The communication LED (COM1) 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.

- The communication LED (ETH1) lights up (orange) in the transmit or receive state when sending/receiving each package through the Ethernet port. As long as the device sends/receives packages, the communication LED blinks continuously.
- LEDs indicating the status of the universal inputs (U1-Un) are lit when the resistance connected to the input is less than 5 kΩ (dry contact input is active).

**WARNING!**

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

- LEDs indicating the status of the digital inputs (I1-In) are lit when the input is active.
- LEDs indicating the status of the analog outputs (A1-An) are lit when the output voltage or PWM duty cycle is greater than 0.
- LEDs indicating the status of the digital outputs (O1-On) are lit when the output is enabled.
- LEDs indicating the status of the triac outputs (TO1-TO<sub>n</sub>) are lit when the output is enabled or PWM duty cycle is greater than 0.

## 4.4 RS485 Port

### 4.4.1 RS485 Communication Bus Connection

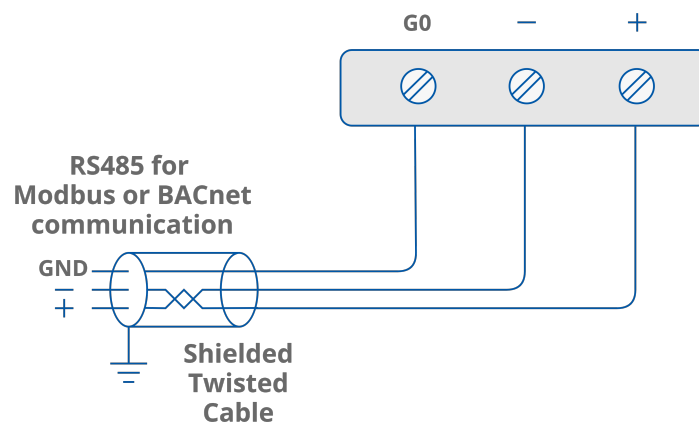


Figure 32. RS485 connection

### 4.4.2 RS485 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.

## 4.5 Setting Module Address

### 4.5.1 Setting MAC Address in BACnet Protocol

The module is equipped with two rotary switches S1 and S2, located on the top panel of the device, for determining the MAC address of the device.

It is possible to set the MAC address within the range from 0 to 99 in BACnet protocol mode or from 128 to 227 in BACnet slave protocol mode (128 + switch value). The formula for setting the MAC address is as follows:

$$\text{MAC} = \text{S2} \cdot 10 + \text{S1}$$

where S1 and S2 are the values of the switches.

The example of the BACnet master protocol mode:

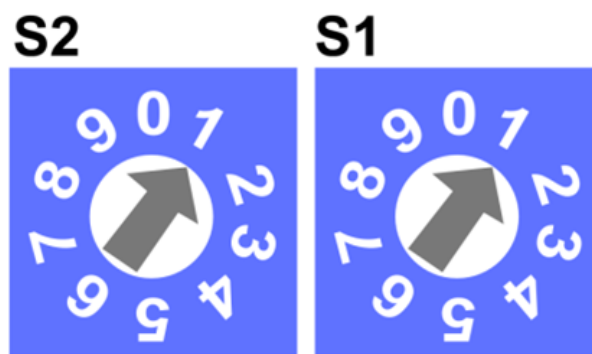


Figure 33. Setting the MAC address in a master mode

Switches set as in the figure above will set the MAC module to 11.

The example of the BACnet slave protocol mode (only RS485 modules; IP modules do not support BACnet slave):

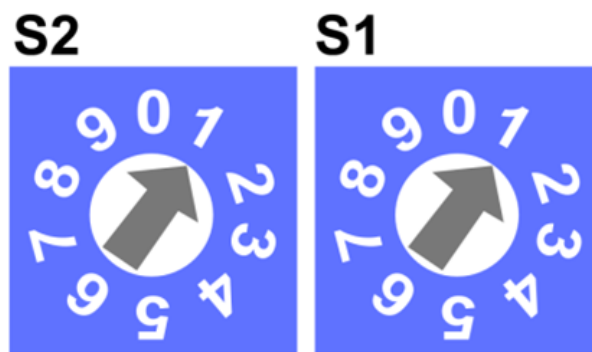


Figure 34. Setting the MAC address in a slave mode

Switches, set as in the picture above, will set the MAC module to 139 (128+11).

### 4.5.2 Setting Device ID in BACnet Protocol

Formula for the Device ID:

$$\text{Device ID} = \text{Vendor ID} * 1000 + \text{MAC} + 128 \text{ (only in BACnet slave)}$$

where iSMA CONTROLLI Poland Vendor ID = 826.

For example, if the MAC address is set to 41, and the protocol is set to BACnet master, then the Device ID = 826041, or if the protocol is set to BACnet slave, then the Device ID = 826169.

If the user changes the Device ID (by setting a new value of the Device ID property in the Device object), then changing the MAC address with rotary switches will not change the Device ID. In order for the Device ID to be modified again by changing the MAC address, the device needs to be restored to the default settings.

### 4.6 Baud Rate

The transmission baud rate is set with the S3 switch (sections 1, 2, and 3) in accordance with the following table:

1	2	3	Baud Rate
Off (0)	Off (0)	Off (0)	Defined by the user in the register
Off (0)	Off (0)	On (1)	76800
Off (0)	On (1)	Off (0)	4800
Off (0)	On (1)	On (1)	9600
On (1)	Off (0)	Off (0)	19200
On (1)	Off (0)	On (1)	38400
On (1)	On (1)	Off (0)	57600
On (1)	On (1)	On (1)	115200

Table 4. Baud rate selection

### 4.7 Protocol

The protocol is selected with sections 4 and 5 of the S3 switch according to the table:

4	5	Protocol
Off (0)	Off (0)	Modbus RTU
Off (0)	On (1)	Modbus ASCII
On (1)	Off (0)	BACnet master
On (1)	On (1)	BACnet slave

Table 5. Protocol selection

**WARNING!**

The BACnet slave mode does not support the discover function.

## 4.8 DHCP

### Warning!

The DHCP functionality is implemented from the 7.0 firmware, which is currently available only for the MAX series modules.

The DHCP functionality allows to turn on/off an automatic IP address setting from the available DHCP server. The DHCP functionality may be turned on/off in the web configurator for modules, iSMA Configurator, and using the 3106 BACnet object.

### 4.8.1 DHCP Algorithm

The DHCP functionality works according to the following algorithm:

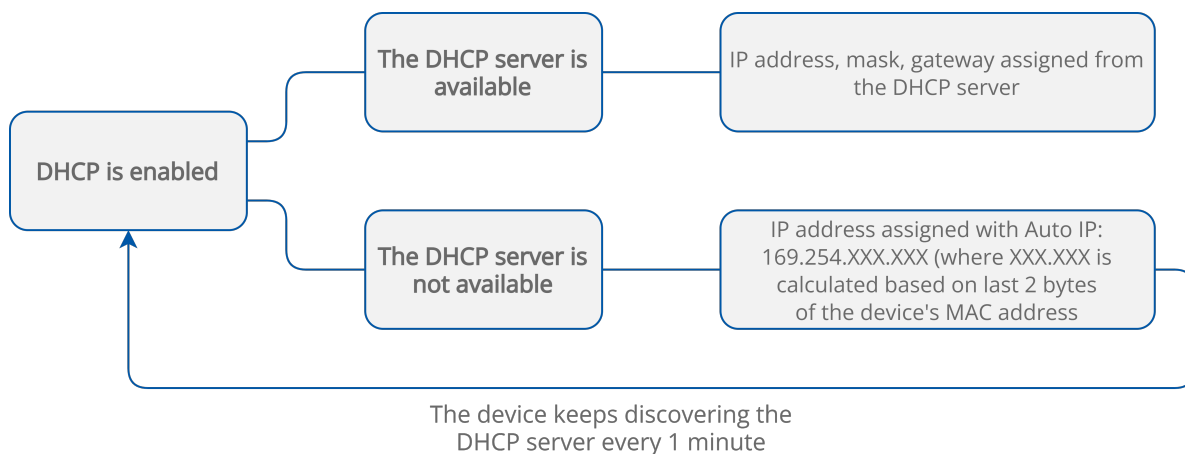


Figure 35. The DHCP algorithm

- If the DHCP functionality is enabled and the DHCP server is available, all network configuration is provided by the DHCP server, and there is no possibility to edit the IP address/mask/default gateway.
- If the DHCP functionality is enabled and the DHCP server is not available, the IP address is provided by Auto IP, and its structure is the following:
  - 169.254.XXX.XXX, where XXX.XXX is calculated based on 2 last bytes of the module's MAC address.
- If the DHCP functionality is disabled, the user sets the IP address, mask, and gateway manually.

## 4.9 Default Settings

In its out-of-the-box state, as well as after restoring the default values, the device has the following default register values:

Register Name	Default Value
COUNTER 1-12	0
COUNTER 12-24 (24I and 24I-IP)	0
USER BAUD RATE	7680 (76800 bps)
STOP BITS	1
DATA BITS	8
PARITY BITS	0
RESPONSE DELAY	0
WATCHDOG TIME	0 (disabled)
DEFAULT STATE OF DIGITAL OUTPUTS (1-12)	0
DEFAULT STATE OF THE ANALOG OUTPUTS (DIGITAL 1-6)	0
DEFAULT STATE OF THE ANALOG OUTPUTS (1-6)	0
UNIVERSAL INPUT CONFIGURATION (1-8)	1 (10K3A1 NTC (°C))
INPUT FILTER TIME CONSTANT (1-8)	2
UNIVERSAL INPUT RESOLUTION (1-8)	0 (12-bit)
ANALOG OUTPUT CONFIGURATION (1-6)	0 (voltage)
COV INCREMENT (BACnet only)	1
<b>Only for IP Modules</b>	
USERNAME	admin
PASSWORD	1000
IP ADDRESS	192.168.1.123
MASK	255.255.255.0
GATEWAY	192.168.1.1
DHCP	Disabled
HTTP PORT	80
MODBUS TCP PORT	502
MODBUS TCP TIMEOUT	60 s



RS485 TIMEOUT	500 ms
RS485 BIASING RESISTORS (MINI only)	DISABLED
SEND MODBUS ERRORS	ENABLED
BACNET ID	826001
BACNET UDP PORT	47808 (0xBAC0)

*Table 6. Default values*

### 4.9.1 Restoring Default Settings

To restore the default configuration of all registers, follow the steps below:

- turn off the power supply;
- set section 6 of the S3 switch to on;
- turn on the power supply, the power LED will start blinking;
- switch section 6 of the S3 switch to off to restore the default settings. To cancel the reset, turn off the power, and switch section 6 of the S3 switch to the off position.

## 5 Inputs and Outputs

### 5.1 Local I/O

The multiprotocol I/O modules are equipped with local inputs and outputs (universal inputs, digital inputs, analog outputs, digital outputs, and triac outputs), and their quantities differ between the modules types, according to the table:

Module Type	UI	DI	AO	DO	TO
4I4O-H		4		4	
4I4O-H-IP		4		4	
4O-H				4 (NC/NO-8A)	
4O-H-IP				4 (NC/NO-8A)	
4U4A-H	4		4		
4U4A-H-IP	4		4		
4U4O-H	4			4	
4U4O-H-IP	4			4	
8I		8			
8I-IP		8			
8U	8				
8U-IP	8				
4TO-H					4
4TO-H-IP					4
MIX18	5	5	4	4	
MIX18-IP	5	5	4	4	
MIX38	8	12	6	12	
MIX38-IP	8	12	6	12	
12O-H				12	
12O-H-IP				12	
24I		24			
24I-IP		24			

Table 7. Inputs and outputs in multiprotocol I/O modules

## 5.2 Universal Inputs

Universal inputs support four types of input signals:

- voltage (0-10 V DC, input impedance 100 kΩ);
- current (0-20 mA);
- resistance and temperature measurement (10k thermistor, a full list of supported temperature sensors is available here: [List of Supported Temperature Sensors](#));
- dry contact (output current 1 mA).

Current measurement is realized by voltage measurement and 200 Ω resistance. According to Ohm's law, the current is directly proportional to the voltage, and the resistance is the constant of proportionality. ( $I = U / R$ ). According to the Ohm's law equation, for 20 mA current with 200 Ω resistance the output voltage is 4 V. It means that the 4 V voltage measured on the universal input corresponds to 20 mA current. The result is expressed in millivolts.

### 5.2.1 Universal Input Voltage Connection

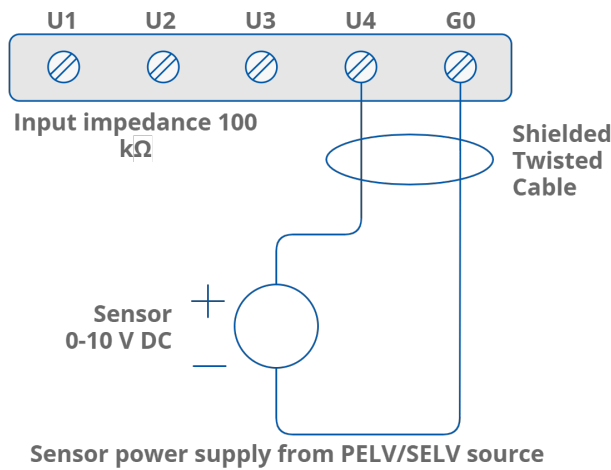


Figure 36. A universal input voltage connection

### 5.2.2 Universal Input Current Connection

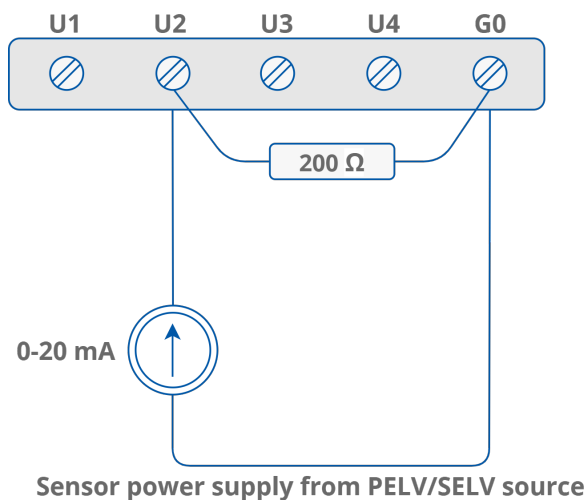


Figure 37. A universal input current connection

### 5.2.3 Universal Input Resistance Connection

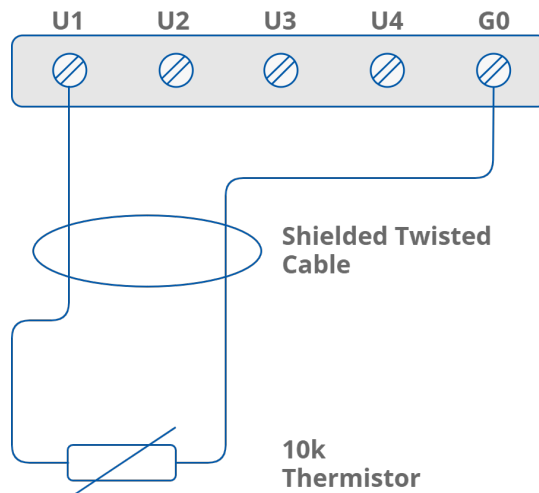


Figure 38. A universal input resistance connection

### 5.2.4 Universal Input Dry Contact Connection

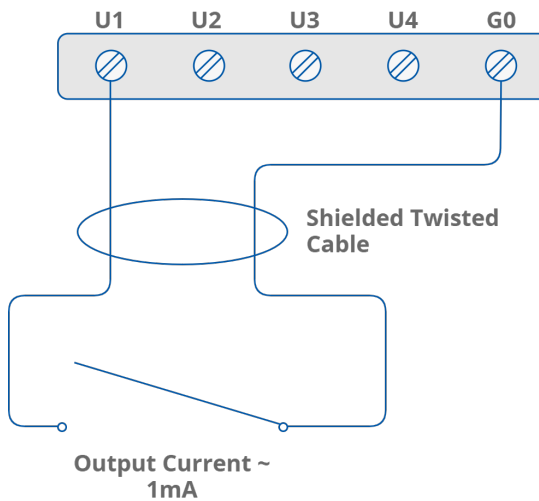


Figure 39. A universal input dry contact connection

## 5.3 Digital Inputs

Digital inputs operate as standard dry contact inputs and, additionally, as high speed pulse counters up to 100 Hz.

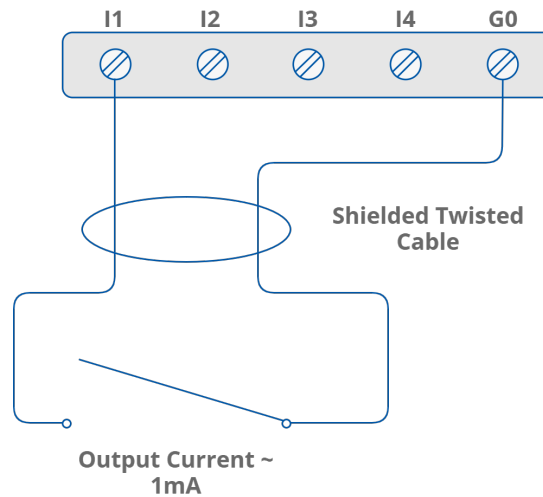


Figure 40. A digital input connection

### 5.3.1 Digital Input Counter

A digital input can work as a counter of dry contact pulses up to 100 Hz. The connection is identical as in case of the dry contact input.

## 5.4 Analog Outputs

Analog outputs provide a 0-10 V DC output with maximum load up to 20 mA. They support three types of output signals:

- voltage (0-10 V DC) with maximum load up to 20 mA;
- digital;
- Pulse Width Modulation (PWM) 0,01 Hz, 0,1 Hz, 1 Hz, 10 Hz, 100 Hz.

### 5.4.1 Analog Output Voltage Connection

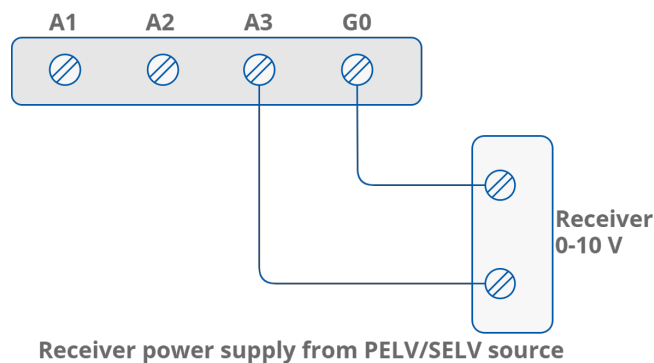


Figure 41. An analog output voltage connection

### 5.4.2 Analog Output Relay Connection

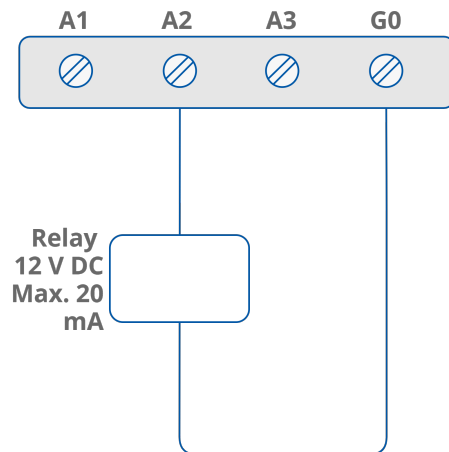
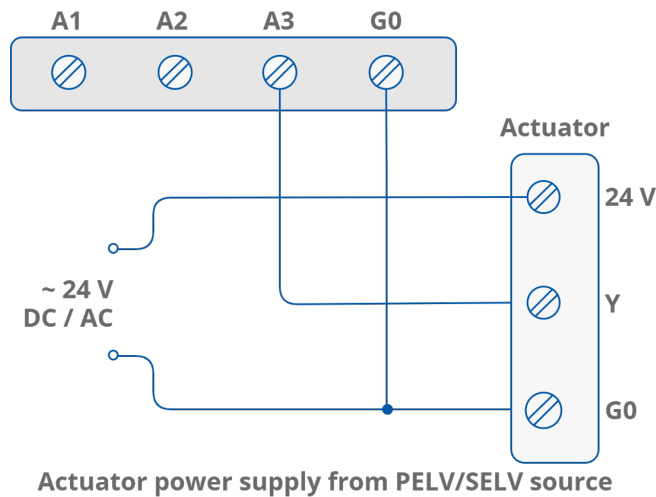


Figure 42. An analog output relay connection

### 5.4.3 Analog Output Actuator Connection



Actuator power supply from PELV/SELV source

Figure 43. An analog output actuator connection

## 5.5 Digital Outputs

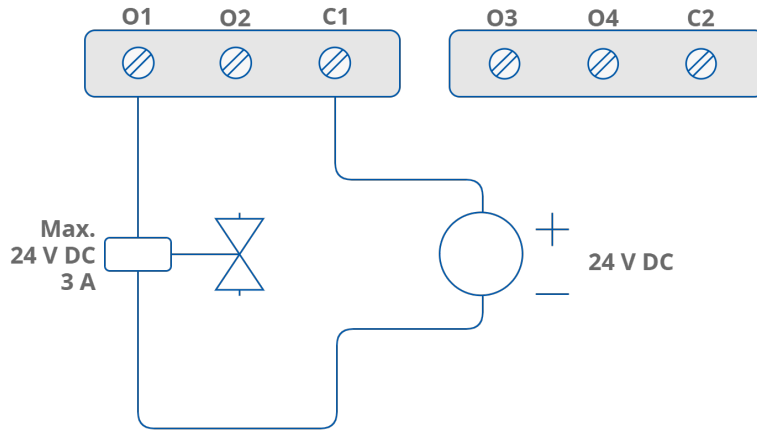
Digital outputs operate as relay outputs with maximum loads of:

		UL compliant ratings	Maximum ratings
Digital outputs (relays)	Resistive load (AC1)	3 A at 24 V AC 3 A at 30 V DC	3 A at 230 V AC 3 A at 30 V DC
	Inductive load (AC3)	8 VA at 24 V AC 30 W at 30 V DC	75 VA at 230 V AC 30 W at 30 V DC
40-H and 40-H-IP	Resistive load (AC1)	8 A at 230 V AC 8 A at 30 V DC	8 A at 230 V AC 8 A at 30 V DC

	Inductive load (AC3)	37 VA at 230 V AC 90 W at 30 V DC	360 VA at 230 V AC 90 W at 30 V DC
--	----------------------	--------------------------------------	---------------------------------------

Table 8. Resistive and inductive loads for digital outputs

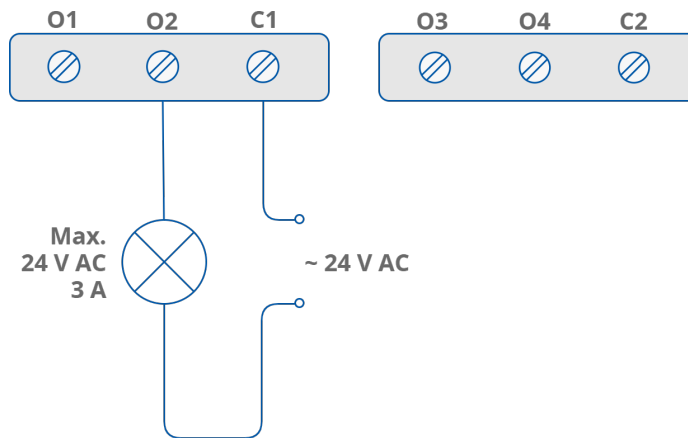
### 5.5.1 Digital Output Solenoid Valve Connection



Every CX terminal can be supplied by different PELV/SELV source

Figure 44. A digital output solenoid valve connection

### 5.5.2 Digital Output Resistive Load Connection



Every CX terminal can be supplied by different PELV/SELV source

Figure 45. A digital output resistive load connection

### 5.5.3 Digital Output Inductive Load Connection

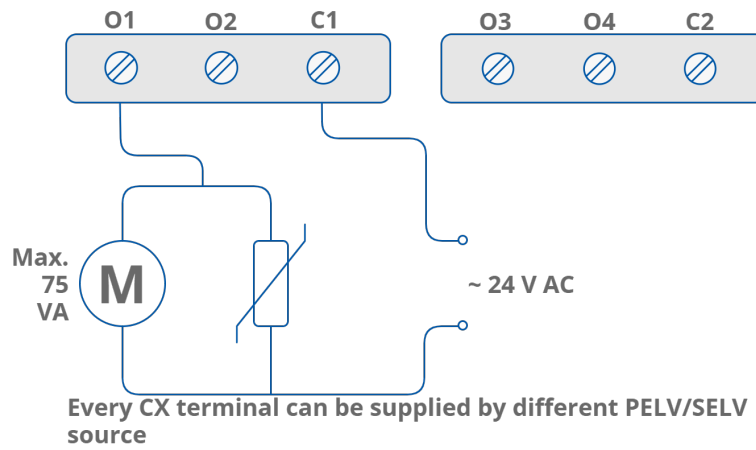


Figure 46. A digital output inductive load connection

### 5.6 Triac Outputs

Triac outputs work as typical binary outputs or in Pulse Width Modulation (PWM) mode: 0,01 Hz, 0,1 Hz, 1 Hz, 10 Hz.

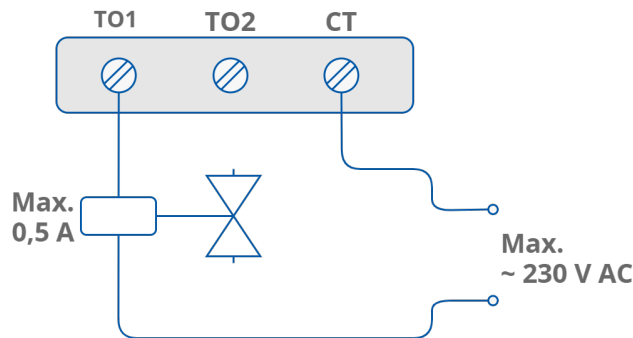


Figure 47. A triac output connection



## 6 Conformance Statement

**WARNING!**

Changing the parameters regarding the configuration of the transmission will only take effect after restarting the unit (except for the registers the value of which is read from the switch).

### 6.1 Conformance Statement Regarding Implementation of BACnet Protocol

Date	2020-09-04
Vendor Name	iSMA CONTROLLI S.p.A
Product Name	iSMA-B-MIX iSMA-B-MINI iSMA-B-MAX
Product Model Number	iSMA-B-MIX18 iSMA-B-MIX38 iSMA-B-8I iSMA-B-8U iSMA-B-4O-H iSMA-B-4I4O-H iSMA-B-4U4O-H iSMA-B-4U4A-H iSMA-B-4TO-H iSMA-B-MIX18-IP iSMA-B-MIX38-IP iSMA-B-8I-IP iSMA-B-8U-IP iSMA-B-4O-H-IP iSMA-B-4I4O-H-IP iSMA-B-4U4O-H-IP iSMA-B-4U4A-H-IP iSMA-B-4TO-H-IP iSMA-B-12O-H iSMA-B-12O-H-IP iSMA-B-24I iSMA-B-24-IP
Firmware Revision	6.5/7.0 (for MAX series)
BACnet Protocol Revision	1.14

Table 9. The conformance statement regarding the implementation of the BACnet protocol

### 6.1.1 BACnet Standardized Device Profile

All I/O modules have been standardized as the BACnet Smart Sensors (B-SS).

### 6.1.2 Supported BACnet Interoperability Building Blocks

Application Service (B-SS)	Designation
Data Sharing - Read Property - B	DS-RP-B
Data Sharing - Write Property - B	DS-WP-B
Data Sharing - COV - B	DS-COV-B
Device Management - Dynamic Device Binding - B	DM-DDB-B
Device Management - Dynamic Object Binding - B	DM-DOB-B
Data Sharing - Read Property Multiple - B	DS-RPM-B
Data Sharing - Write Property Multiple - B	DS-WPM-B

Table 10. Supported building blocks

### 6.1.3 Supported BACnet Standard Object Types

The following is a list of the standard object types as defined by ASHRAE.

Object Name	Object Numbers for a different type of modules										
	8U, 8U-IP	8I, 8I-IP	4I4O-H, 4I4O-H-IP	4U4O-H, 4U4O-H-IP	4U4A-H, 4U4A-H-IP	4O-H, 4O-H-IP	4TO-H, 4TO-H-IP	MIX18, MIX18-IP	MIX38, MIX38-IP	12O-H, 12O-H-IP	24I, 24I-IP
Analog Input	8			4	4			5	8		
Analog Output					4		4	4	6		
Analog Value	9	9	10	6	10	2	2	12	22	2	26
Binary Input		8	4					5	12		24
Binary Output			4	4		4	4	4	12	12	
Binary Value	8		8	4	4			5	8		

Multistate Value	16		8	12	16	4	8	14	22		
Accumulator		8	4					5	12		24
Device	1	1	1	1	1	1	1	1	1	1	1

Table 11. Types of objects supported by modules

### 6.1.4 Data Link Layer Option

- Master-Slave/Token-Passing (MS/TP) master (Clause 9), baud rates: 2400, 4800, 9600, 19200, 38400, 57600, 76800, and 115200;
- MS/TP slave (Clause 9), baud rates: 2400, 4800, 9600, 19200, 38400, 57600, 76800, and 115200;
- BACnet Internet Protocol (IP) (Annex J);
- BACnet IP (Annex J), Foreign Device.

### 6.1.5 Supported Character Sets

ANSI X3.4

### 6.1.6 Supported Application Services

Application Service	Initiates Requests	Executes Requests
I-Am	Yes	
I-Have	Yes	
ReadProperty		Yes
ReadPropertyMultiple		Yes
Who-Has		Yes
Who-Is		Yes
WriteProperty		Yes
WritePropertyMultiple		Yes

Table 12. Supported application services

### 6.1.7 About COV

All MIX, MINI, and MAX I/O modules support COV (change of value) policy. It means that the module can send a value every time it is changed. COV only works with BI, BO, AI, and AO objects. For Binary Input and Binary Output objects, the values are sent with every change. Analog Input and Analog Output objects have special COV Increment property, which defines additional sending criteria—object’s value is sent if it is changed by the COV increment value.

## 7 Device Objects

### 7.1 Device BACnet Object Description

Dynamically creatable: no, dynamically deletable: no.

Property Name	Required	Proprietary	Writable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	Yes					
OBJECT_NAME	Yes					
OBJECT_TYPE	Yes					
SYSTEM_STATUS	Yes					
VENDOR_NAME	Yes					
VENDOR_IDENTIFIER	Yes					
MODEL_NAME	Yes					
FIRMWARE_REVISION	Yes					
APPLICATION_SOFTWARE_VERSION	Yes					
PROTOCOL_VERSION	Yes					
PROTOCOL_REVISION	Yes					
PROTOCOL_SERVICES_SUPPORTED	Yes					
PROTOCOL_OBJECT_TYPES_SUPPORTED	Yes					
OBJECT_LIST	Yes					
MAX_APDU_LENGTH_ACCEPTED	Yes					
SEGMENTATION_SUPPORTED	Yes					
APDU_TIMEOUT	Yes					
NUMBER_OF_APDU_RETRIES	Yes					
MAX_MASTER	Yes		Yes			
MAX_INFO_FRAMES	Yes					

Property Name	Required	Proprietary	Writable	Property ID	Data Type	Description
DEVICE_ADDRESS_BINDING	Yes					
DATABASE_REVISION	Yes					
ACTIVE_COV_SUBSCRIPTION	Yes					
HW_VERSION		Yes		3020	Unsigned	
VERSION_TYPE		Yes	Yes	3030	Unsigned	
RS485_BIASING		Yes	Yes	3045	Unsigned	MINI IP modules only with HW_VERSION>=2.0
BAUD_RATE		Yes		3084	Unsigned	
USER_BAUD_RATE		Yes	Yes	3085	Unsigned	
IP_ADDRESS		Yes	Yes	3101	Unsigned	
SUBNET_MASK		Yes	Yes	3102	Unsigned	
DEFAULT_GATEWAY		Yes	Yes	3103	Unsigned	
HTTP_PORT		Yes	Yes	3104	Unsigned	
UDP_PORT		Yes	Yes	3105	Unsigned	
DHCP		Yes	Yes	3106	Unsigned	Applicable to firmware 7.0 and later
WATCHDOG		Yes	Yes	5001	Unsigned	
VALID_FRAMES_FOR_US_CNT		Yes		5101	Unsigned	
VALID_FRAMES_NOT_FOR_US_CNT		Yes		5102	Unsigned	
ERROR_FRAMES_CNT		Yes		5103	Unsigned	
TRANSMITTED_FRAMES_CNT		Yes		5104	Unsigned	

Table 13. Device BACnet objects

## 7.2 VALID\_FRAMES\_FOR\_US\_CNT Property 5101

The property contains the number of valid frames (on the MS/TP layer) addressed to this module.

## 7.3 VALID\_FRAMES\_FOR\_NOT\_US\_CNT Property 5102

The property contains the number of valid frames (on the MS/TP layer), which are not addressed to this module.

## 7.4 ERROR\_FRAMES\_CNT Property 5103

The property contains the number of invalid frames on the MS/TP layer.

## 7.5 TRANSMITTED\_FRAMES\_CNT Property 5104

The property contains the number of transmitted frames.

## 7.6 UP\_TIME Object (Analog Value: 0)

The object shows the time of module operation module (expressed in seconds) from the last power-up or the module reset.

## 7.7 WATCHDOG Object (Analog Value: 1)

The object specifies the time (expressed in seconds) to watchdog reset. If the module does not receive any valid BACnet message within that time, all PRIORITY\_ARRAYs will be set to null, and the PRESENT\_VALUE for outputs will be set to the RELINQUISH\_DEFAULT value.

This feature is useful in case of an interruption in data transmission, and if, for security reasons, output states must be set to the appropriate state in order to avoid endangering the safety of persons or the property.

The default value is 0 seconds, which means the watchdog function is disabled. To maintain the compatibility, this object is also available as the Device object property 5001.

If the watchdog is triggered, the power LED blinks with the specified sequence (3 blinks with 20 Hz frequency and 1-second pause).

## 7.8 FIRMWARE\_VERSION\_AND\_MODULE\_TYPE Property 3030

The property contains the type and firmware version of a module.

The low byte contains information about a type of a module in accordance with the table below:

Value	Type
81 <sub>10</sub> (0x51 <sub>16</sub> )	8I
91 <sub>10</sub> (0x5B <sub>16</sub> )	8I-IP
84 <sub>10</sub> (0x54 <sub>16</sub> )	8U

Value	Type
94 <sub>10</sub> (0x5E <sub>16</sub> )	8U-IP
83 <sub>10</sub> (0x53 <sub>16</sub> )	4I4O-H
93 <sub>10</sub> (0x5D <sub>16</sub> )	4I4O-H-IP
85 <sub>10</sub> (0x55 <sub>16</sub> )	4U4O-H
95 <sub>10</sub> (0x5F <sub>16</sub> )	4U4O-H-IP
86 <sub>10</sub> (0x56 <sub>16</sub> )	4U4A-H
96 <sub>10</sub> (0x60 <sub>16</sub> )	4U4A-H-IP
82 <sub>10</sub> (0x52 <sub>16</sub> )	4O-H
92 <sub>10</sub> (0x5C <sub>16</sub> )	4O-H-IP
87 <sub>10</sub> (0x57 <sub>16</sub> )	4TO-H
97 <sub>10</sub> (0x61 <sub>16</sub> )	4TO-H-IP
50 <sub>10</sub> (0x32 <sub>16</sub> )	MIX18
51 <sub>10</sub> (0x33 <sub>16</sub> )	MIX38
52 <sub>10</sub> (0x34 <sub>16</sub> )	MIX18-IP
53 <sub>10</sub> (0x35 <sub>16</sub> )	MIX38-IP
88 <sub>10</sub> (0x58 <sub>16</sub> )	12O-H
98 <sub>10</sub> (0x62 <sub>16</sub> )	12O-H-IP
89 <sub>10</sub> (0x59 <sub>16</sub> )	24I
99 <sub>10</sub> (0x63 <sub>16</sub> )	24I-IP

Table 14. Module type value assignment

The high byte contains a module firmware version multiplied by 10.

Example:

The property 3030 has a value of 12810<sub>10</sub> = 0x320A<sub>16</sub>. It means that it is a MIX18 module (0x32) with a firmware version 1.0 (0x0A<sub>16</sub> = 10<sub>10</sub>).

Setting the property 3030 according to the table below enables 1 of 4 available actions: reset module, reload settings, set to default, and enter the bootloader.

Value	Action
511	Reset
767	Reload settings
1023	Set to default
1279	Enter the bootloader

Table 15. Device actions

### 7.9 RS485\_BIASING Property 3045

The property allows activating RS485 biasing resistors in order to pull up voltage on the RS485 bus. The function is **only** available in **MINI IP modules** with a hardware version  $\geq$  2.0. **MIX and MAX IP modules** with hardware version 3.0 and up have a hardware switch for RS485 biasing under the bottom cover. For more information see installation instructions available at [ismacontrolli.com](http://ismacontrolli.com).

The biasing resistors are useful in case when iSMA modules are connected to third party devices with the same RS485 bus and communication errors appear on the network.

**WARNING!**

Only one device in the network can have biasing resistors activated!

### 7.10 DHCP Property 3106

The property allows to enable or disable setting an IP address by the DHCP server.

Value	Action
2	DHCP enabled
Other	DHCP disabled

Table 16. The DHCP property



## 8 Local I/O Objects

The following sections describe the BACnet objects dedicated to inputs and outputs of the multiprotocol I/O modules.

### 8.1 Universal Input BACnet Objects

#### 8.1.1 UI - Universal Input Object Description (Analog Input: 0-7)

Each universal input in all types of modules is represented on the BACnet network as the BACnet Analog Input object with the following properties:

Dynamically creatable: no, dynamically deletable: no.

Property Name	Required	Proprietary	Writable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	Yes					From AI:0 to AI-7
OBJECT_NAME	Yes					UI-x
OBJECT_TYPE	Yes					
PRESENT_VALUE	Yes					PRESENT_VALUE and UNITS property
STATUS_FLAGS	Yes					
EVENT_STATE	Yes					
OUT_OF_SERVICE	Yes					OUT OF SERVICE property
UNITS	Yes					PRESENT_VALUE and UNITS property
COV_INCREMENT						COV INCREMENT property
INPUT_TYPE *		Yes	Yes	4001	Enumerated	UI CONFIGURATION object (Multistate Value: 1-8)
RESOLUTION *		Yes	Yes	4002	Enumerated	
FILTER *		Yes	Yes	4003	Unsigned	
VOLTAGE *		Yes		3010	Unsigned	
RESISTANCE *		Yes		3012	Unsigned	
DRY_CONTACT *		Yes		3013	Enumerated	

Table 17. Properties of the Universal Input object

**Note:** Object’s additional properties are saved to keep the backward compatibility with the older firmware version. In the new firmware version, each property has a corresponding BACnet object.

### PRESENT\_VALUE and UNITS Property

The property contains the actual value and unit of the universal input according to the INPUT\_TYPE property value. The units for the Present Value are defined by the UI\_CONFIGURATION object.

### COV INCREMENT Property

In the firmware version above 4.0, MIX and MINI modules support COV (change of value), which means that the module automatically sends the universal input value if it changes more than the COV Increment property value (in IP modules this value can be also changed from the module web page).

### OUT OF SERVICE Property

If the Out Of Service property is false, the Present Value property represents the actual value read from the input. Setting the Out Of Service property to true stops updating the Present Value property, allowing to write a custom value to it. The custom value will then override the value read from the physical input.

**WARNING!**

If the Out Of Service property is false, the Present Value property cannot be overridden, and the module will return an error message: “Write Access Denied”.

## 8.1.2 UI CONFIGURATION Object (Multistate Value: 1-8)

The object is used to set the type of the universal input. Changing the input type and the analog input units property (voltage, resistance, or sensor type) also has an impact on the UI object units.

Object	Description	Unit Property
1	Voltage measurement 0-10 V	mV
2	Resistance input	Ω
3 (default)	The temperature sensor 10K3A1 NTC B=3975K	°C
4	The temperature sensor 10K4A1 NTC B=3695K	°C
5	The temperature sensor 10K NTC B=3435K Carel	°C
6	The temperature sensor 20K6A1 NTC B=4262K	°C
7	The temperature sensor 2,2K3A1 NTC B=3975K	°C
8	The temperature sensor 3K3A1 NTC B=3975K	°C

Object	Description	Unit Property
9	The temperature sensor 30K6A1 NTC B=4262K	°C
10	The temperature sensor SIE1	°C
11	The temperature sensor TAC1	°C
12	The temperature sensor SAT1	°C
13	The temperature sensor Pt1000	°C
14	The temperature sensor Ni1000	°C
15	The temperature sensor NI1000 21C	°C
16	The temperature sensor NI1000 LG	°C
17	The temperature sensor 10K Type2 NTC B=3975K	°F
18	The temperature sensor 10K Type3 NTC B=3695K	°F
19	The temperature sensor 20K NTC B=4262K	°F
20	The temperature sensor 3K NTC B=3975K	°F
21	The temperature sensor PT1000	°F
22	The temperature sensor NI1000 32F	°F
23	The temperature sensor NI1000 70F	°F

Table 18. Properties of the UI CONFIGURATION object

This parameter is also available as the BACnet UI Analog Input object property number 4001. For configuration parameters, please refer to the Modbus manual register numbers 40151-40158.

### 8.1.3 UI RESOLUTION Object (Multistate Value: 9-16)

The object is used to determine the bit resolution for each of the 12- and 16-bit universal inputs.

Setting the value to 1 sets the resolution of the converter to 12-bit. Setting the value to 2 sets the resolution of the converter to 16-bit.

Object Value	Description
1 (default)	12-bit
2	16-bit

Table 19. The UI Resolution object value list

**WARNING!**

Setting the 16-bit resolution increases the measurement time for one channel from 10 ms to 140 ms. The total time necessary to measure all the channels increases from 80 ms to 1120 ms.

The parameter is also available as the BACnet UI Analog Input object property number 4002.

**8.1.4 UI FILTER Object (Analog Value: 14-21)**

The object is used to determine the time constant of the low pass filter. The value is expressed in seconds. Valid values must be in the range from 0 to 60 seconds. The default value is 2 seconds. Setting the value to 0 disables the filter.

The parameter is also available as the BACnet UI Analog Input object property number 4003.

In case of the UI shortcut or open-loop, the filter is reset and UI value filtering is stopped.

**8.1.5 UI DRY\_CONTACT Object (Binary Value: 0-7)**

The object contains information about the status of digital inputs (dry contact). If the input is shorted to the ground, the value is set to 1. The UI\_DRY\_CONTACT object works only if the UI\_CONFIGURATION object is set to resistance or temperature.

This status is also available as the BACnet UI Analog Input object property number 3013.

**8.2 Digital Input BACnet Objects**

**8.2.1 BI - Digital Input Object Description (Binary Input: 0-11, 12-23 for MAX Modules)**

Each of the digital inputs in all types of modules is represented on the BACnet network as the BACnet Binary Input object with the following properties:

Dynamically createable: no, dynamically deletable: no.

Property Name	Required	Proprietary	Writable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	Yes					From BI:0 to BI:11 and BI:12 to BI:23 for 24I and 24I-IP modules
OBJECT_NAME	Yes					BI-x
OBJECT_TYPE	Yes					
PRESENT_VALUE	Yes					PRESENT_VALUE property

Property Name	Required	Proprietary	Writable	Property ID	Data Type	Description
STATUS_FLAGS	Yes					
EVENT_STATE	Yes					
OUT_OF_SERVICE	Yes					OUT OF SERVICE property
POLARITY	Yes					
UNITS	Yes					
COUNTER *		Yes	Yes	3001	Unsigned	

Table 20. Properties of the Binary Input object

**Note:** Object’s additional properties are saved to maintain the backwards compatibility with the older firmware version. In the new firmware version, each of the properties has a corresponding BACnet object.

### PRESENT\_VALUE Property

The property contains the status of the digital inputs. Shorting the input to G0 sets the value to 1.

### Binary Input COV

In the firmware version above 4.0, multiprotocol I/O modules support COV (change of value). It means that the module automatically sends digital input value after every change.

### OUT OF SERVICE Property

If the Out Of Service is false, the Present Value property represents the actual value read from the input. Setting the Out Of Service property to true, stops updating the Present Value property from the physical input, and allows for entering a custom value into the Present Value property.

**WARNING!**

If the Out Of Service property is false, the Present Value property cannot be overridden, and the module will return an error message: “Write Access Denied”.

## 8.2.2 BIA COUNTER Object (Accumulator: 0-11, 12-23 for MAX Modules)

The object contains the number of counted pulses represented by the Accumulator Value BACnet object. This value is also saved in the non-volatile memory, so the information is

stored even after the power cycle finishes. It is possible to reset the counter by entering 0 to the Present Value property of this object.

This value is also available as the BACnet BI Binary Input object property number 3001.

### 8.2.3 BI COUNTER Object (Analog Value: 2-13, 42-53 for MAX Modules)

The object contains the number of counted pulses identical to the Accumulator BACnet object but stored as the Analog Value object. Not every system supports the accumulator type object, therefore additional objects have been created for the counters. The Analog Value has one drawback—odd values above 16777216 are rounded down by 1. For example, 16777216 + 1 is still displayed as 16777216, but 16777216 + 2 is displayed properly as 16777218.

## 8.3 Analog Output BACnet Objects

### 8.3.1 AO - Analog Output Object Description (Analog Output: 0-5)

Each of the analog outputs in all types of modules is represented on the BACnet network as the BACnet Analog Output object with the following properties.

Dynamically creatable: no, dynamically deletable: no.

Property Name	Required	Proprietary	Writable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	Yes					From AO:0 to AO:5
OBJECT_NAME	Yes					AO-x
OBJECT_TYPE	Yes					
PRESENT_VALUE	Yes		Yes			PRESENT_VALUE property
STATUS_FLAGS	Yes					STATUS FLAG property
EVENT_STATE	Yes					
OUT_OF_SERVICE	Yes		Yes			OUT OF SERVICE property
UNITS	Yes					
PRIORITY_ARRAY	Yes		Yes			
RELINQUISH_DEFAULT	Yes		Yes			
COV_INCREMENT	No		No			COV INCREMENT property

Property Name	Required	Proprietary	Writable	Property ID	Data Type	Description
OUTPUT_TYPE *		Yes	Yes	4001	Enumerated	
HAND_STATUS*		Yes		3014	Boolean	
HAND_VALUE*		Yes		3015	Enumerated	

Table 21. Properties of the Analog Output object

**Note:** Additional properties of the object are saved to maintain the backward compatibility with the older firmware version. In the new firmware version, each of the properties has a corresponding BACnet object.

### PRESENT\_VALUE Property

The property contains the voltage value, expressed in mV or percentage, of the analog output PWM duty cycle. The output operation mode and property units are defined by the AO\_CONFIGURATION object.

### COV INCREMENT Property

In the firmware versions above 4.0, MIX and MINI modules support COV (change of value), which means that the module automatically sends the analog output value if it changes more than the COV Increment property value (for IP modules this value can also be changed in the module’s web page).

### OUT OF SERVICE Property

For the analog output, the OUT OF SERVICE object property is set to true if the output is overridden by the USB connection or in the module’s web page (only in IP version). The OUT OF SERVICE is set to false if the Present Value property is set by the BACnet message.

### STATUS FLAG Property

The STATUS FLAG property contains information about the status of the object. This property consists of 4 binary flags. Each flag is described in the table below.

Module Inputs		Results		
AO Potentiometer	Priority Array	Present Value	Analog Output	Status Flag Property
Auto position	NULL	Default	Default	0000
	ANALOG VALUE	ANALOG VALUE	ANALOG VALUE	
Manual position	NULL	Manual Value	Manual Value	0010
	ANALOG VALUE	Manual Value		

Table 22. STATUS FLAG property changes

### 8.3.2 AO CONFIGURATION Object (Multistate Value: 17-22)

The object contains information about the mode of the analog output according to the following table (changing configuration also has an impact on the analog output unit property):

Object Value	Description	Unit Property
1 (default)	Voltage output 0-10 V	mV
2	PWM 1 Hz	%
3	PWM 10 Hz	%
4	PWM 100 Hz	%
5	PWM 0.1 HZ	%
6	PWM 0.01 Hz	%

Table 23. The AO Configuration object value list

This configuration is also available in the AO Analog Output object as the OUTPUT\_TYPE property 4001.

### 8.3.3 AO HAND\_STATUS Object (Multistate Value: 23-26)

The object contains state of the hand status operation according to the table below:

Object Value	Description
1	AUTO
2	HAND_ON

Table 24. The AO Hand Status object value list

This information is also available in the AO Analog Output object as the HAND\_STATUS property 3014.

**WARNING!**

This object is available only in the MINI 4U4A-H and 4U4A-H-IP modules.

### 8.3.4 AO HAND\_VALUE Object (Analog Value: 22-25)

The object contains the percentage value (0-100%) of hand. This information is also available in the AO Analog Output object as the HAND\_VALUE property 3015.

**WARNING!**

This object is available only in the MINI 4U4A-H and 4U4A-H-IP modules.



## 8.4 Digital Output BACnet Objects

### 8.4.1 BO - Digital Output Object Description

Each of the digital outputs in all types of modules is represented on the BACnet network as the BACnet Binary Output object with the following properties.

Dynamically creatable: no, dynamically deletable: no.

Property Name	Required	Proprietary	Writable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	Yes					From BO:0 to BO:12
OBJECT_NAME	Yes					BO-x
OBJECT_TYPE	Yes					
PRESENT_VALUE	Yes		Yes			PRESENT_VALUE property
STATUS_FLAGS	Yes					STATUS FLAG property
EVENT_STATE	Yes					
OUT_OF_SERVICE	Yes		Yes			OUT OF SERVICE property
POLARITY	Yes					
PRIORITY_ARRAY	Yes		Yes			
RELINQUISH_DEFAULT	Yes		Yes			
HAND_STATUS *		Yes		3014	Enumerated	

Table 25. Properties of the Digital Output object

**Note:** Additional properties of the object are saved to maintain the backward compatibility with the older firmware version. In the new firmware version, each property has a corresponding BACnet object.

#### PRESENT\_VALUE Property

The property contains the actual value of the digital output. If the DO is in the hand mode, the actual value of the DO is stored in both PRESENT VALUE property and HAND\_STATUS object.

#### Digital Output COV

In the firmware versions above 4.0, multiprotocol I/O modules support COV (change of value). It means that the module automatically sends the digital output value with every change.

## STATUS FLAG Property

The Status Flag property contains information about the status of the object. This property consists of 4 binary flags. Each flag is described in the table below.

Module Input		Results		
DO Switch	Priority Array	Present Value	Digital Output	Status Flag Property
Auto position	NULL	Default	Default	0000
	BINARY VALUE	BINARY VALUE	BINARY VALUE	
Manual position ON	NULL	TRUE	ON	0010
	BINARY VALUE			
Manual position OFF	NULL	FALSE	OFF	0010
	BINARY VALUE			

Table 26. STATUS FLAG property changes

## OUT OF SERVICE Property

For digital outputs, the OUT OF SERVICE property is set to true if the output is overridden by the USB connection or from a module web page (only in IP version). In such case, the OUT OF SERVICE is set to false if the Present Value property is set by the BACnet message.

### 8.4.2 HAND\_STATUS Object (Multistate Value: 23-26, 27-34 for MAX Modules)

The property stores information about the status of the hand operation switch and the status of the DO in the hand mode, according to the table below:

Value of Hand Status	Status Description
1	AUTO-OUT=OFF
2	AUTO-OUT=ON
3	HAND-OUT=OFF
4	HAND-OUT=ON

Table 27. The Hand Status object value list

## 8.5 Triac Output BACnet Objects

### 8.5.1 TO - Triac Output Object Description (Binary Output: 0-3)

The object is designed to service the triac output working in the digital mode. The BACnet Triac Output object has the following properties:

Dynamically creatable: no, dynamically deletable: no.

Property Name	Required	Proprietary	Writable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	Yes					From BO:0 to BO:3
OBJECT_NAME	Yes					TO-x
OBJECT_TYPE	Yes					
PRESENT_VALUE	Yes		Yes			PRESENT_VALUE property
STATUS_FLAGS	Yes					STATUS FLAG property
EVENT_STATE	Yes					
OUT_OF_SERVICE	Yes		Yes			OUT OF SERVICE property
POLARITY	Yes					
PRIORITY_ARRAY	Yes		Yes			
RELINQUISH_DEFAULT	Yes		Yes			

Table 28. Properties of the Triac Output object

### PRESENT\_VALUE Property

The Present Value property stores information about the actual state of the triac output.

**Note:** If the TO is in the hand mode, the actual value of the TO is stored in the HAND\_STATUS object.

### COV INCREMENT Property

In the firmware versions above 4.0, MINI modules support COV (change of value), which means that the module automatically sends the triac output value if the value changes more than the COV Increment property value.

### OUT OF SERVICE Property

For the Triac Output object, the OUT OF SERVICE property is set to true if the output is overridden by the USB connection or from the module web page (only in IP version). In such case the OUT OF SERVICE is set to false value if the Present Value property is set by the BACnet message.

The OUT OF SERVICE property is also set if the triac output configuration is set to the PWM mode.

## STATUS FLAG Property

The Status Flag property contains information about the status of object status. This property consists of 4 binary flags. Each flag is described in the table below.

Module Input		Results		
TO Switch	Priority Array	Present Value	Digital Output	Status Flag Property
Auto position	NULL	Default	Default	0000
	BINARY VALUE	BINARY VALUE	BINARY VALUE	
Manual position ON	null	TRUE	ON	0010
	ON			
Manual position OFF	null	FALSE	OFF	0010
	OFF			

Table 29. STATUS FLAG property changes

### 8.5.2 TO PWM VALUE - Triac PWM Object Description (Analog Output: 0-3)

This object is designed to serve the triac output in the PWM mode. The BACnet PWM VALUE object has the following properties:

Dynamically creatable: no, dynamically deletable: no.

Property Name	Required	Proprietary	Writable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	Yes					From AO:0 to AO:3
OBJECT_NAME	Yes					TO-x PWM VALUE
OBJECT_TYPE	Yes					
PRESENT_VALUE	Yes		Yes			PRESENT_VALUE Property
STATUS_FLAGS	Yes					STATUS FLAG Property
EVENT_STATE	Yes					
OUT_OF_SERVICE	Yes		Yes			OUT OF SERVICE Property
UNITS	Yes					
PRIORITY_ARRAY	Yes		Yes			

Property Name	Required	Proprietary	Writable	Property ID	Data Type	Description
RELINQUISH_DEFAULT	Yes		Yes			
COV INCREMENT	No		Yes			This property stores percentage value of PWM output duty cycle. Output operation mode is defined by TO_CONFIGURATION object. COV INCREMENT Property
OUTPUT_TYPE *		Yes	Yes	4001	Enumerated	
HAND_STATUS *		Yes		3014	Boolean	
HAND_VALUE *		Yes		3015	Enumerated	

Table 30. Properties of the PWM Value object

\* Additional properties of the object are saved to maintain the backward compatibility with the older firmware version. In the new firmware version, each property has a corresponding BACnet object.

### PRESENT\_VALUE Property

The property stores the percentage value of the PWM output duty cycle. The output operation mode is defined by the TO\_CONFIGURATION object.

### COV INCREMENT Property

In the firmware versions above 4.0, MINI modules support COV (change of value). It means that the module will automatically send the PWM\_VALUE value if it changes more than the COV Increment property value.

### OUT OF SERVICE Property

For the PWM Outputs object, the OUT OF SERVICE property is set to true if the output is overridden by a USB connection or from the module web page (only in IP version). In such case, the OUT OF SERVICE is set to false if the Present Value property is set by the BACnet message. The OUT OF SERVICE property is also set to true if the triac output configuration is set to the digital output mode.

### STATUS FLAG Property

The Status Flag property contains information about the status of the object. This property consists of 4 binary flags. Each flag is described in the table below.

Module Input		Results		
TO Switch	Priority Array	Present Value	Digital Output	Status Flag Property
Auto position	NULL	Default	Default	0000
	DUTY VALUE	DUTY VALUE	ON/OFF	
Manual position ON	NULL	100%	ON	0010
	DUTY VALUE			
Manual position OFF	NULL	0%	OFF	0010
	DUTY VALUE			

Table 31. Status Flag property changes

### 8.5.3 HAND\_STATUS Object (Multistate Value: 23-26)

The Hand Status object stores the status of the hand operation switch and the status of the TO in the hand mode according to the table below:

Value of Hand Status	Status Description
1	AUTO-OUT=OFF
2	AUTO-OUT=ON
3	PWM
4	HAND-OUT=OFF
5	HAND-OUT=ON

Table 32. The HAND STATUS object value list

### 8.5.4 TO CONFIGURATION Object (Multistate Value: 17-22)

This object contains information about the mode of the triac output according to the following table:

Property Value	Description
1 (default)	Digital Output
2	PWM 1 Hz
3	PWM 10 Hz
4	PWM 0.1 HZ
5	PWM 0.01Hz

Table 33. The TO Configuration object value list

This configuration is also available in the PWM VALUE object as the OUTPUT\_TYPE Property 4001.

## 8.6 Special Application Modes

### 8.6.1 Special Application Modes for 4I4O-H, 4I4O-H-IP, 4U4O-H, and 4U4O-H-IP

The 4I4O-H, 4I4O-H-IP, 4U4O-H, 4U4O-H-IP modules have simple built-in applications, which can be used to control building devices. These applications control digital output states according to the signals from the digital input. The relation between inputs and outputs is shown in the table below, and it cannot be changed.

Digital Input	Digital Output
DI1	DO1
DI2	DO2
DI3	DO3
DI4	DO4

Table 34. Built-in application determining the relation between input and output

The digital inputs in 4I4O-H, 4I4O-H-IP, 4U4O-H, 4U4O-H-IP modules can be set to work in different modes. There are dedicated objects for input mode (Multistate Value 27-30), time parameters (Analog Value 26-29), setpoints for heating/cooling modes (Analog Value 30-33-4U4O-H and 4U4O-H-IP only), and for differential value in heating/cooling modes (Analog Value 34-37-4U4O-H and 4U4O-H-IP only).

### 8.6.2 INPUT MODE Object (Multistate Value: 27-30)

This object contains information about the operating mode of the module. Available modes and multistate object values are shown in the table below:

Value	OPERATING MODE
1	Ordinary IO(def)
2	Monostable Relay
3	Bistable Relay
4	Time Relay NO [ms]
5	Time Relay NC [ms]
6	Time Relay NO [s]
7	Time Relay NC [s]
8	Input Forwarding

Value	OPERATING MODE
9	Heating (4U40-H and 4U40-H-IP only)
10	Cooling (4U40-H and 4U40-H-IP only)

Table 35. The Input Mode object value list

The operating mode can be changed by entering the right value into the Input Mode object.

Special modes are initialized after 3 seconds from the power-up or restart of the module (the time value needed to stabilize the operation of the analog transmitter). Each input mode change sets corresponding output to the default state and resets the timer (used in the time-based modes).

### Ordinary IO

Inputs and outputs operate as standard IO; inputs and outputs are not related to each other.

### Monostable Relay

In this mode, the digital output reflects the corresponding state of the digital Input. The action of the monostable relay can be executed remotely by changing the relevant COMMAND object. The outputs can be also overwritten by the DIGITAL OUTPUT object, which allows for allows remote control from the BMS.

### Bistable Relay

In this mode, only the rising edge on the digital input changes the output state. The action of the bistable relay can be executed remotely by changing the relevant COMMAND object. Outputs can be also overwritten by the DIGITAL OUTPUT object, which allows remote control from the BMS.

### Time Relay NO [ms]

In this mode, if the output value is false, the rising edge on the digital input sets the output to true. Every falling edge on the digital input restarts the counter, which means that the output stays true for the time defined in the MODE TIME object (expressed in milliseconds), counting from the last falling edge of the digital input. The action of the time relay can be executed remotely by changing state from false to true in the relevant COMMAND object. The outputs can be also overwritten by the DIGITAL OUTPUT object, which allows remote control from the BMS.

### Time Relay NC [ms]

In this mode, if the output value is false, the falling edge on the digital input sets the output to a true value. Every rising edge on the digital input starts the counter from the beginning, which means that the output stays true for the time defined in the MODE TIME object (expressed in milliseconds), counting from the last rising edge of the digital input. The action of time relay can be executed remotely by changing state from false to true in



the relevant COMMAND object. The outputs can be also overwritten by the DIGITAL OUTPUT object, which allows remote control from the BMS.

### Time Relay NO [s]

In this mode, if the output value is false, the rising edge on the digital input sets the output to true. Every falling edge on the digital input restarts the counter, which means that the output stays true for the time defined in the MODE TIME object (expressed in seconds), counting from the last falling edge of the digital input. The action of the time relay can be executed remotely by changing state from false to true in the relevant COMMAND object. The outputs can be also overwritten by the DIGITAL OUTPUT object, which allows remote control from the BMS.

### Time Relay NC [s]

In this mode, if the output value is false, the falling edge on the digital input sets the output to true. Every rising edge on the digital input restarts the counter, which means that the output stays true for the time defined in the MODE TIME object (expressed in seconds), counting from the last rising edge of the digital input. The action of time relay can be executed remotely by changing state from false to true in relevant COMMAND object. The outputs can be also overwritten by the DIGITAL OUTPUT object module, which allows remote control from the BMS.

### Input Forwarding

In this mode, any signal from the input is transferred directly to the assigned output without any modifications. Operation in the input forwarding mode can be stopped by the Block Input function.

### Heating Mode (4U40-H and 4U40-H-IP Only)

In this mode, the output is controlled like a typical thermostat, basing on the Setpoint object and the Control value (Input value) with differential parameter defined in the Differential object. The output signal works in 2 states: low and high.

If the Control value is less than or equals to the difference between the Setpoint object and Differential object, the output is in the low state.

If the Control value is greater than or equals to the sum of the Setpoint object and Differential object, the output is in the high state.

The output in the low state:

Control value  $\geq$  Setpoint + Differential

The output in the high state:

Control value  $\leq$  Setpoint – Differential

The heating mode algorithm is shown in the chart below:

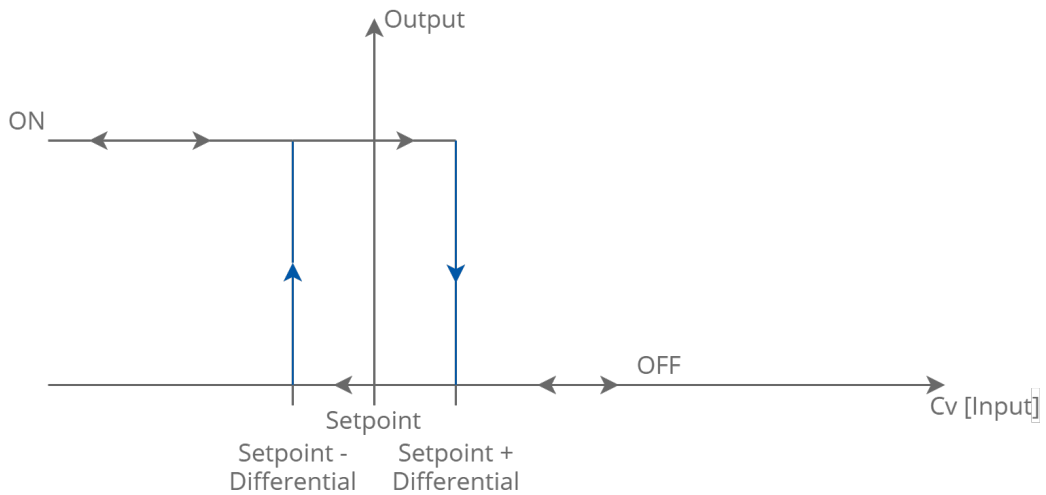


Figure 48. The heating mode algorithm

**WARNING!**

In case if the temperature sensor fails (if it is disconnected or shorted), the heating mode does not work, and the output remains in the false state.

**Cooling Mode (4U40-H and 4U40-H-IP Only)**

In this mode, the output is controlled like a typical thermostat, based on the Setpoint object and Control value (Input signal) with a differential parameter defined in the Differential object.

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

If the Control value is less than or equals to the difference between the Setpoint object and Differential object, the output is in the low state.

If the Control value is greater than or equals to the sum of the Setpoint object and Differential object, the output is in the high state.

The output in the low state:

Control value  $\leq$  Setpoint - Differential

The output in the high state:

Control value  $\geq$  Setpoint + Differential

The cooling mode algorithm is shown in the chart below:

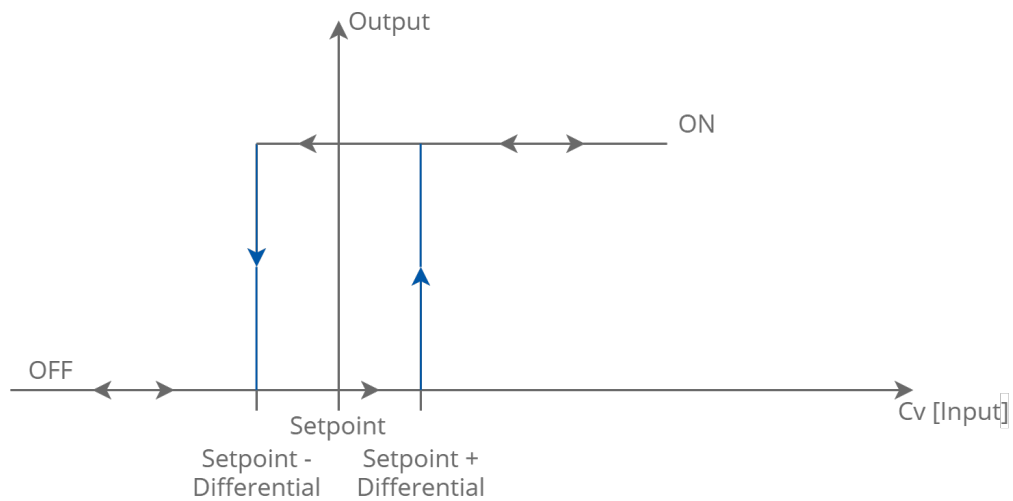


Figure 49. The cooling mode algorithm

**WARNING!**

In case if the temperature sensor fails (if it is disconnected or shorted), the heating mode does not work, and the output remains in the false state.

**8.6.3 MODE TIME Object (Analog Value: 26-29)**

This object contains the time value for TIME RELAY modes. The time unit depends on the selected mode: milliseconds or seconds.

**8.6.4 COMMAND Object (Binary Value: 12-15)**

The module includes special COMMAND objects. The command objects are used to remotely execute the action (simulate light switch/PIR). The action is executed by changing the state of the object from false to true. All special application modes can be executed except for input forwarding, heating and cooling modes.

**8.6.5 BLOCKING Object (Binary Value: 8-11)**

The BLOCKING objects are used to block physical input signals from the control logic (all modes excluding heating/cooling mode). By setting true value on the relevant object, the module blocks the input, and no action will be executed. Setting false value restores normal operation. The block input function does not work if the heating/cooling input mode is set.

**8.6.6 SETPOINT Object (Analog Value: 30-33)**

The SETPOINT objects contain values which are used in heating/cooling modes (4U4O-H and 4U4O-H-IP only) as the setpoints for heating/cooling control algorithm.

The default Setpoint value is 21.

**8.6.7 DIFFERENTIAL Object (Analog Value: 34-37)**

The DIFFERENTIAL objects contain values, which are used in heating/cooling modes (4U4O-H and 4U4O-H-IP only) as the differential for heating/cooling control algorithm.

The Setpoint objects and Differential objects create a deadband of the Control values, which has no influence on the output.

Deadband = (Setpoint – Differential, Setpoint + Differential)

The default Differential value is 1.

## 9 Web Configuration

This section outlines all information specific to configuring IP modules in a web server.

**WARNING!**

Please note that web configuration features are available only for IP versions for the multiprotocol I/O modules.

### 9.1 Web Server Access

All IP version modules are equipped with a built-in web server, which allows for showing the status of the module and for changing the configuration.

To access the web server, open a browser, and enter the IP address of the module; the default address for a new module is 192.168.1.123. Please use the following default credentials:

Username: admin

Password: 1000 (by default)

**Note:** The web server can be disabled by setting the HTTP port to 0. This option is available for firmware versions 6.5 and up.

### 9.2 Device Page

This page contains information about the device and its technical specification. Basic Information section includes information about the type of the module, its firmware version and uptime.



Device Information	
Basic Information	
Module Type	ISMA-B-24I-IP
Firmware Version	7.0.29
Bootloader Version	5.0.12
Hardware Version	1.0
Serial Number	2771180023
Uptime	0 days, 0 hours, 1 minutes, 55 seconds

Figure 50. The 24I-IP device page

### 9.3 Local I/O Status and Configuration

#### 9.3.1 Universal Inputs

This page allows for entering the configuration parameters and showing the actual value of the universal inputs. To open this page, please navigate to the Local I/O tab and choose Universal Inputs from the submenu.



Input	Type	Resolution	UI Flag	Disable Voltage Measure	L.P. Filter Constant	Resistance	Temperature	Voltage	BACnet COV Increment
Universal Input 1	Temperature 10kA1 NTC B=3975K	16 Bit	<input type="checkbox"/>	<input type="checkbox"/>	2	1000000 Ω	-3276.8 °C	0 mV	1.0
Universal Input 2	Temperature 10kA1 NTC B=3975K	16 Bit	<input type="checkbox"/>	<input type="checkbox"/>	2	1000000 Ω	-3276.8 °C	0 mV	1.0
Universal Input 3	Resistance Input	12 Bit	<input type="checkbox"/>	<input type="checkbox"/>	0	1000000 Ω	0.0 °C	0 mV	1.0
Universal Input 4	Resistance Input	12 Bit	<input type="checkbox"/>	<input type="checkbox"/>	0	1000000 Ω	0.0 °C	0 mV	1.0
Universal Input 5	Resistance Input	12 Bit	<input type="checkbox"/>	<input type="checkbox"/>	0	1000000 Ω	0.0 °C	0 mV	1.0
Universal Input 6	Resistance Input	12 Bit	<input type="checkbox"/>	<input type="checkbox"/>	0	1000000 Ω	0.0 °C	0 mV	1.0
Universal Input 7	Resistance Input	12 Bit	<input type="checkbox"/>	<input type="checkbox"/>	0	1000000 Ω	0.0 °C	0 mV	1.0
Universal Input 8	Resistance Input	12 Bit	<input type="checkbox"/>	<input type="checkbox"/>	0	1000000 Ω	0.0 °C	0 mV	1.0

Figure 51. The 8U-IP Universal Inputs page

Input	Type
Universal Input 1	Temperature 10k3A1 NTC B=3975K
Universal Input 2	Disabled Resistance Measurement
Universal Input 3	Temperature 10k4A1 NTC B=3695K
Universal Input 4	Temperature 10k NTC B=3435K Carel
Universal Input 5	Temperature 20k6A1 NTC B=4262K
Universal Input 6	Temperature 2.2k3A1 NTC B=3975K
Universal Input 7	Temperature 3k3A1 NTC B=3975K
Universal Input 8	Temperature 30k6A1 NTC B=4262K
Universal Input 9	Temperature SIE1
Universal Input 10	Temperature TAC1
Universal Input 11	Temperature SAT1
Universal Input 12	Temperature PT1000
Universal Input 13	Temperature NI1000
Universal Input 14	Resistance Input

Figure 52. Types of sensors

The Universal Input table contains the following fields:

- Sensor type (read/write): allows for setting a different type of sensor;
- Resolution (read/write): resolution measurement 12-bit/16-bit (for PT1000 and NI1000 sensors, please use 16-bit resolution);
- UI Flag (read-only): the status of UI configured as dry contact input;
- Disable Voltage Measurement (read/write): disables voltage measuring resistance measurement only;
- L.P. Filter Constant (read/write): the value of the time constant for low pass filter in seconds. Valid values must be between 0 and 60 seconds (default 2s). Setting the 0 value disables the filter;
- Resistance (read-only): in the range from 0 to 1000k [Ω];
- Temperature (read-only): in Celsius with the accuracy of 1 degree [°C];
- Voltage (read-only): in millivolts [mV];
- BACnet COV Increment (read/write): change of state sending threshold value.

**WARNING!**

To save changes, please use the “Submit” button.

## Configuration of Special Application Modes

This page allows for entering the configuration parameters and showing the actual value of Special application modes. To open this page, please navigate to the Local I/O tab and choose Universal Inputs from the submenu.



ISMA-B-4U40-H-IP Universal Inputs									
Input	Type	Resolution	UI Flag	Disable Voltage Measure	L.P. Filter Constant	Resistance	Temperature	Voltage	BACnet COV Increment
Universal Input 1	Temperature 10kΩ/1 NTC B=3975K	12 Bit	<input type="checkbox"/>	<input type="checkbox"/>	0	1000000 Ω	-3276.8 °C	0 mV	1.0
Universal Input 2	Temperature 10kΩ/1 NTC B=3975K	12 Bit	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	0 Ω	0.0 °C	0 mV	1.0
Universal Input 3	Temperature 10kΩ/1 NTC B=3975K	12 Bit	<input type="checkbox"/>	<input type="checkbox"/>	60	1000000 Ω	-3276.8 °C	0 mV	1.0
Universal Input 4	Disabled Resistance Measurement	12 Bit	<input type="checkbox"/>	<input type="checkbox"/>	3	0 Ω	0.0 °C	0 mV	1.0

Special Modes Configuration							
Input	Block Input	Input Mode	Command	Mode Time	Setpoint	Diff	
Universal Input 1	<input type="checkbox"/>	Heating	<input type="checkbox"/>	1000	21.0 °C	0.0 °C	
Universal Input 2	<input type="checkbox"/>	Bistable Relay	<input type="checkbox"/>	10	23.0 °C	0.3 °C	
Universal Input 3	<input type="checkbox"/>	Bistable Relay	<input type="checkbox"/>	3	25.0 °C	3.0 °C	
Universal Input 4	<input type="checkbox"/>	Heating	<input type="checkbox"/>	0	0.0 °C	0.0 °C	

Figure 53. The 4U40-IP special modes configuration

Input	Block Input	Input Mode
Universal Input 1	<input type="checkbox"/>	<div style="border: 1px solid black; padding: 2px;">                     Ordinary IO                      Ordinary IO                      Monostable Relay                      Bistable Relay                      Time Relay NO [ms]                      Time Relay NC [ms]                      Time Relay NO [s]                      Time Relay NC [s]                      Input Forwarding                      Heating                      Cooling                 </div>
Universal Input 2	<input type="checkbox"/>	
Universal Input 3	<input type="checkbox"/>	
Universal Input 4	<input type="checkbox"/>	

Figure 54. Special application modes

The Special Modes Configuration table contains the following fields:

- Block Input (read/write): allows for blocking a particular input (except for heating/cooling modes);
- Input Mode (read/write): allows for selecting the Special Application Mode for a particular input (Ordinary IO in default);
- Command (read/write): execution of the Special Application Modes (except for input forwarding, heating/cooling modes);
- Mode Time (read/write): time base for time relay application modes (the unit depends on the selected mode: [ms] or [s]);
- Setpoint (read/write, 4U40-H-IP only): setpoint value for heating/cooling modes. By default 0;
- Differential (read/write, 4U40-H-IP only): differential value for heating/cooling modes. By default 0.

**WARNING!**

To save changes, please use the “Submit” button.

### 9.3.2 Digital Inputs

This page allows for entering the configuration parameters and showing the actual value of the digital inputs. To open this page, please navigate to the Local I/O tab and choose Digital Inputs from the submenu.



Input	State	Reset Flag	Counter State	Counter State To Set
Digital Input 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 13	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 15	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 16	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 17	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 18	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 19	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 20	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 21	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 22	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 23	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Digital Input 24	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

Figure 55. The 24I-IP Digital Inputs page

The Digital Input table contains the following fields:

- State (read-only): actual input state
- Reset Flag (read/write): reset of pulses value (leaving reset active will reset the value of the pulses);
- Counter State (read-only): the actual value of pulses saved in EEPROM;
- Counter State To Set (read/write): allows for setting the value of the counter.

**WARNING!**

To save changes, please use the "Submit" button.

### 9.3.3 Digital Outputs

This page allows for entering the configuration parameters and showing the actual value of the digital outputs. To open this page, please navigate to the Local I/O tab and choose the Digital Outputs from the submenu.





Output	State	Default State
Digital Output 1	<input type="checkbox"/>	<input type="checkbox"/>
Digital Output 2	<input type="checkbox"/>	<input type="checkbox"/>
Digital Output 3	<input type="checkbox"/>	<input type="checkbox"/>
Digital Output 4	<input type="checkbox"/>	<input type="checkbox"/>
Digital Output 5	<input type="checkbox"/>	<input type="checkbox"/>
Digital Output 6	<input type="checkbox"/>	<input type="checkbox"/>
Digital Output 7	<input type="checkbox"/>	<input type="checkbox"/>
Digital Output 8	<input type="checkbox"/>	<input type="checkbox"/>
Digital Output 9	<input type="checkbox"/>	<input type="checkbox"/>
Digital Output 10	<input type="checkbox"/>	<input type="checkbox"/>
Digital Output 11	<input type="checkbox"/>	<input type="checkbox"/>
Digital Output 12	<input type="checkbox"/>	<input type="checkbox"/>
Watchdog (s)	<input type="text" value="0"/>	

Figure 56. The MIX38-IP Digital Outputs page

The Digital Output table contains the following fields:

- State (read/write): the actual state of the digital output;
- Default State (read/write): the output state after power-up and watchdog operation;
- Hand State Output (read-only, MINI/MAX series only): manually override the status of the switch;
- Watchdog (read/write): device watchdog value in seconds.

**WARNING!**

To save changes, please use the "Submit" button.

### 9.3.4 Analog Outputs

This page allows for entering the configuration parameters and showing the actual value of the analog outputs. To open this page, please navigate to the Local I/O tab and choose the Analog Outputs from the submenu.



Output	Value	Type	Default Value	Digital Output	Default Digital Output	Hand State Output	BACnet COV Increment
Analog Output 1	<input type="text" value="0"/> mV	Voltage 0-10V ▾	<input type="text" value="0"/> mV	<input type="checkbox"/>	<input type="checkbox"/>	Auto	<input type="text" value="1.0"/>
Analog Output 2	<input type="text" value="0"/> mV	Voltage 0-10V ▾	<input type="text" value="0"/> mV	<input type="checkbox"/>	<input type="checkbox"/>	Auto	<input type="text" value="1.0"/>
Analog Output 3	<input type="text" value="0"/> mV	Voltage 0-10V ▾	<input type="text" value="0"/> mV	<input type="checkbox"/>	<input type="checkbox"/>	Auto	<input type="text" value="1.0"/>
Analog Output 4	<input type="text" value="0"/> %	PWM 1 Hz ▾	<input type="text" value="0"/> %	<input type="checkbox"/>	<input type="checkbox"/>	Auto	<input type="text" value="1.0"/>
Watchdog (s)	<input type="text" value="0"/>						

Figure 57. The 4U4A-H-IP Analog Outputs page

The Analog Outputs table contains the following fields:

- Value (read/write): the actual value of the analog output in millivolts [mV];
- Type (read/write): the analog output operating mode voltage/PWM;
- Default Value (read/write): default output value after the power-up and watchdog operation;
- Digital Output (read/write): the output status flag for the DO mode;
- Default Digital Output (read/write): the default output status for the DO mode;
- Watchdog (read/write): the device watchdog value in seconds;
- Hand State Output (read-only, MINI series only): manually overrides the status of the potentiometer;

- BACnet COV Increment (read/write): change of the state sending threshold value.

**WARNING!**

To save changes, please use the “Submit” button.

## 9.4 RS485 Configuration

This page allows to enter the configuration parameters and show the information of the controller’s RS485 port.



iSMA-B-24I-IP RS485 Configuration	
<b>Modbus Settings</b>	
Actual Baud Rate	115200
User Baud Rate	<input type="text" value="76800"/>
Stop Bits	1 Bit
Data Bits	8 Bits
Parity Bits	None
<b>Statistics</b>	
Received Frames	0
Error Frames	0
Transmitted Frames	0
<input type="button" value="Submit"/> <input type="button" value="Refresh"/>	

Figure 58. The RS485 configuration page

This page allows for setting parameters such as:

- Actual Baud Rate (read-only): the RS485 baud rate within the range from 2400 to 115200;
- User Baud Rate (read/write): allows to set the baud rate by the user; the value overwrites the baud rate set on the DIP switch;
- Stop Bits (read/write): number of stop bits (1 or 2);
- Data Bits (read/write): number of data bits transmitted in a single byte (7 or 8);
- Parity Bits (read/write): transmission protection as a parity bit added before the stop bit (bits);
- RS485 Biasing Resistors: activation of the biasing resistors for MINI IP modules only, with a hardware version 2.0 and later; MIX and MAX series IP modules with hardware version 3.0 and up have a hardware switch for RS485 biasing under the bottom cover;
- Received Frames (read-only): number of received frames;
- Transmitted Frames (read-only): number of transmitted frames;
- Error Frames (read-only): number of error frames.

**WARNING!**

To save changes, please use the “Submit” button.

## 9.5 IP Configuration

This page allows for changing parameters of the Ethernet port, Modbus TCP, BACnet IP, and Foreign Device (for BACnet network).



iSMA-B-24I-IP IP Configuration	
<b>Network Configuration</b>	
DHCP	Disabled ▾
Ip Address	192.168.34.209
Mask	255.255.254.0
Gateway	192.168.34.1
Http Port	80
Mac Address	00:34:28:38:33:5E
<b>Modbus Configuration</b>	
Protocol Type	Modbus RTU
Modbus TCP Port	502
Modbus Address	1
Modbus TCP Connection Timeout [s]	60
Free Modbus TCP Sockets	4 / 4
RS485 Timeout [ms]	500
Send Modbus Errors	<input checked="" type="checkbox"/>
<b>BACnet Configuration</b>	
BACnet ID	826001
BACnet UDP Port	47808
BBMD IP	
BBMD UDP Port	47808
BBMD Time To Live [s]	500
BACnet Register us as Foreign Device	<input type="checkbox"/>
<input type="button" value="Submit"/> <input type="button" value="Refresh"/> <input type="button" value="Reboot"/>	

Figure 59. The IP configuration page

This page allows for setting parameters such as:

- DHCP (read/write): enables address setting by the DHCP server; If enabled, the IP, Mask, and Gateway parameters become empty; it is required to insert own static values before clicking the Submit button;

**Warning!**

Currently, the 7.0 firmware with the DHCP functionality is only available for the MAX series modules.

- IP Address (read/write): the IP address of the controller’s Ethernet interface (if the DHCP slot is enabled, this slot shows the current IP address);
- Mask (read/write): the network mask (if the DHCP slot is enabled, this slot shows the current IP mask);
- Gateway (read/write): the network default gateway(if the DHCP slot is enabled, this slot shows the current gateway IP address);
- Http Port (read/write): the http port;
- Mac Address (read-only): the Ethernet interface MAC address;
- Protocol Type (read-only): the DIP switch protocol selection;
- Modbus TCP Port (read/write): the Modbus TCP port number, default 502;
- Modbus Address (read-only): the Modbus device address set by rotary switches;
- Modbus TCP Communication Timeout (read/write): the timeout value for TCP/IP messages;
- Free Modbus TCP Sockets (read-only): the number of available TCP connections;
- RS485 Timeout (read/write): the timeout value for Modbus RTU/ASCII messages,
- Send Modbus Errors (read-only), enable/disable sending Modbus error messages;
- BACnet ID (read/write): BACnet ID set by rotary switches, this value can be overridden by the user; once overridden by the user, changing rotary switches will not affect the BACnet ID;
- BACnet UDP port (read/write): the BACnet IP port;
- BBMD IP (read/write): the IP address of the BACnet Broadcast Management Device (BBMD) server; the default value is blank (0.0.0.0);

**Note:** If the BBMD IP address is left to its default value (0.0.0.0), registering to the BBMD server is disabled. The default value of the BBMD IP address is displayed as an empty field in the IP Configuration web view.

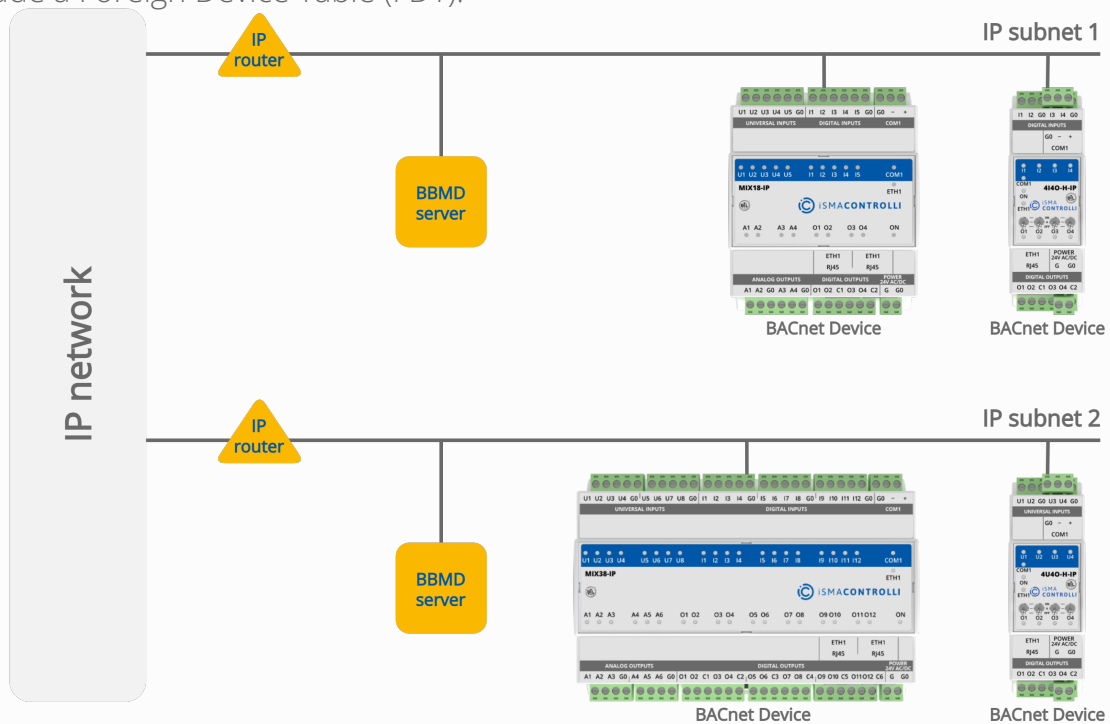
- BBMD UDP Port (read/write): the UDP port of the remote BBMD server; the default UDP port value is 47808;
- BBMD Time To Live [s] (read/write): the number of seconds, within which a foreign device must re-register with a BBMD; the default Time To Live value is 500;
- BACnet Register us as Foreign Device (request): multiprotocol I/O IP modules can register to receive broadcasts from devices on different subnets by sending a “BACnet Register us as Foreign Device request” to the BBMD that supports the foreign device registration.

**WARNING!**

To save changes, please first click the “Submit” button, and then the “Reboot” button.

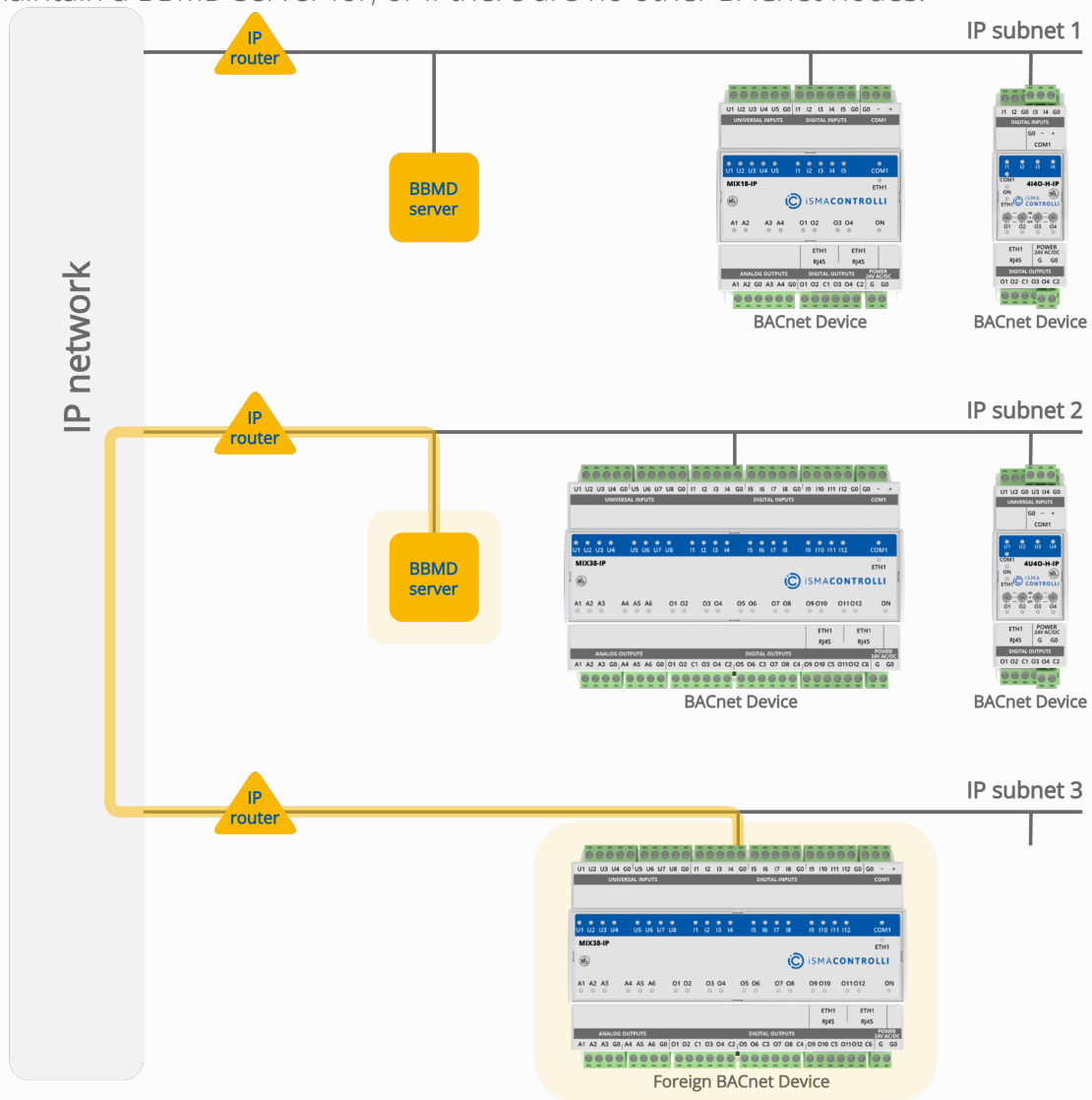
**What is BBMD?**

The BACnet/IP Broadcast Management Device (BBMD) is a device added to the BACnet network, which broadcasts messages discovering devices on the network. The BBMD solution allows to overcome an issue of standard IP routers, which cannot forward BACnet messages for BACnet networks on multiple IP subnets (two or more). In such networks, each IP subnet, which is a part of a BACnet IP network with two or more subnets, needs a BBMD Server in order to communicate. If the BBMD Server has also been designated to register foreign devices like iSMA I/O IP modules, it shall include a Foreign Device Table (FDT).



### iSMA IP Module as Foreign Device

Each iSMA I/O IP module can be a foreign BACnet device. The foreign device is a BACnet device that has a different IP subnet address than those devices comprising the BACnet IP network, which the foreign device wants to join. The foreign device could be a full-time node on the foreign subnet or it could be a part-time participant. The foreign device mechanism is designed to enable communication with a BACnet IP network for BACnet devices, which present no economical sense to install, configure, or maintain a BBMD server for, or if there are no other BACnet nodes.



To register the iSMA module as a foreign device, sending a request is necessary. The BBMD server IP address and UDP port must be filled accordingly to the server configuration. Using the “Send Request” button in the BACnet Register us as Foreign Device field, a device is being registered to the BBMD server.

By registering with the BBMD server, each iSMA I/O IP module becomes a member of the BACnet IP network, and receives broadcast messages forwarded from the BBMD server, when they are available, and may request these messages be broadcast by the BBMD server on its behalf.

Once the message is received, the BBMD server adds the foreign device to its Foreign-Device-Table (FDT), and starts a timer equal to the BBMD Time To Live [s] parameter plus a fixed 30 seconds period. If the foreign device fails to re-register before the timer expires, the BBMD Server may delete the foreign device from its FDT.

## 9.6 Device Management

This page allows for changing the password and rebooting the device remotely.

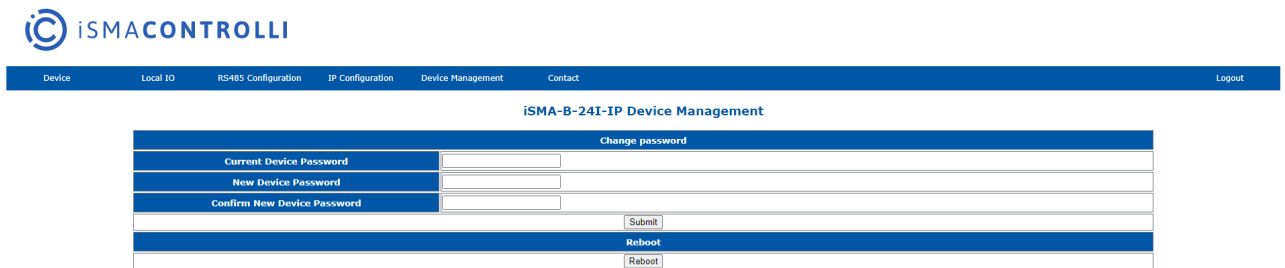


Figure 60. The Device Management page

The procedure of changing the device password:

- enter current device password in the Current Device Password field;
- enter the new device password in the New Device Password field;
- enter the new device password again in the Confirm New Device Password field;
- to confirm the password change, please click the “Submit” button;
- please log out and log in again using the new password.

**WARNING!**  
To reset the password to default, refer to “Restoring default settings”.

## 9.7 Contact

This page displays information about Manufacturer’s web page address and the e-mail address to technical support.



Figure 61. Contact page view

## 10 List of BACnet Objects

BACnet Name	BACnet Type	ID	Access	COV	Description
UI-1	Analog Input	0	Read-only	Yes	Universal input current value
UI-2	Analog Input	1	Read-only	Yes	
UI-3	Analog Input	2	Read-only	Yes	
UI-4	Analog Input	3	Read-only	Yes	
UI-5	Analog Input	4	Read-only	Yes	
UI-6	Analog Input	5	Read-only	Yes	
UI-7	Analog Input	6	Read-only	Yes	
UI-8	Analog Input	7	Read-only	Yes	
AO-1	Analog Output	0	Read/write	Yes	Analog output current value
AO-2	Analog Output	1	Read/write	Yes	
AO-3	Analog Output	2	Read/write	Yes	
AO-4	Analog Output	3	Read/write	Yes	
AO-5	Analog Output	4	Read/write	Yes	
AO-6	Analog Output	5	Read/write	Yes	
BI-1	Binary Input	0	Read-only	Yes	Digital input current value
BI-2	Binary Input	1	Read-only	Yes	
BI-3	Binary Input	2	Read-only	Yes	
BI-4	Binary Input	3	Read-only	Yes	
BI-5	Binary Input	4	Read-only	Yes	
BI-6	Binary Input	5	Read-only	Yes	
BI-7	Binary Input	6	Read-only	Yes	
BI-8	Binary Input	7	Read-only	Yes	
BI-9	Binary Input	8	Read-only	Yes	
BI-10	Binary Input	9	Read-only	Yes	
BI-11	Binary Input	10	Read-only	Yes	

BACnet Name	BACnet Type	I D	Access	COV	Description	
BI-12	Binary Input	11	Read-only	Yes		
For 24I and 24I-IP only						
BI-13	Binary Input	12	Read-only	Yes		
BI-14	Binary Input	13	Read-only	Yes		
BI-15	Binary Input	14	Read-only	Yes		
BI-16	Binary Input	15	Read-only	Yes		
BI-17	Binary Input	16	Read-only	Yes		
BI-18	Binary Input	17	Read-only	Yes		
BI-19	Binary Input	18	Read-only	Yes		
BI-20	Binary Input	19	Read-only	Yes		
BI-21	Binary Input	20	Read-only	Yes		
BI-22	Binary Input	21	Read-only	Yes		
BI-23	Binary Input	22	Read-only	Yes		
BI-24	Binary Input	23	Read-only	Yes		
BO-1	Binary Output	0	Read/write	Yes		Digital output current value
BO-2	Binary Output	1	Read/write	Yes		
BO-3	Binary Output	2	Read/write	Yes		
BO-4	Binary Output	3	Read/write	Yes		
BO-5	Binary Output	4	Read/write	Yes		
BO-6	Binary Output	5	Read/write	Yes		
BO-7	Binary Output	6	Read/write	Yes		
BO-8	Binary Output	7	Read/write	Yes		
BO-9	Binary Output	8	Read/write	Yes		
BO-10	Binary Output	9	Read/write	Yes		
BO-11	Binary Output	10	Read/write	Yes		
BO-12	Binary Output	11	Read/write	Yes		



BACnet Name	BACnet Type	ID	Access	COV	Description	
UI-1_DRY_CONTACT	Binary Value	0	Read-only	No	Universal input dry contact binary value	
UI-2_DRY_CONTACT	Binary Value	1	Read-only	No		
UI-3_DRY_CONTACT	Binary Value	2	Read-only	No		
UI-4_DRY_CONTACT	Binary Value	3	Read-only	No		
UI-5_DRY_CONTACT	Binary Value	4	Read-only	No		
UI-6_DRY_CONTACT	Binary Value	5	Read-only	No		
UI-7_DRY_CONTACT	Binary Value	6	Read-only	No		
UI-8_DRY_CONTACT	Binary Value	7	Read-only	No		
UP_TIME	Analog Value	0	Read-only	No	Module working time [s]	
WATCHDOG	Analog Value	1	Read/write	No	Watchdog time value [s] 0 - disable	
BI-1_COUNTER	Analog Value	2	Read/write	No	Digital input counter value Analog Value BACnet object (The same function is also available using the Accumulator BACnet object.)	
BI-2_COUNTER	Analog Value	3	Read/write	No		
BI-3_COUNTER	Analog Value	4	Read/write	No		
BI-4_COUNTER	Analog Value	5	Read/write	No		
BI-5_COUNTER	Analog Value	6	Read/write	No		
BI-6_COUNTER	Analog Value	7	Read/write	No		
BI-7_COUNTER	Analog Value	8	Read/write	No		
BI-8_COUNTER	Analog Value	9	Read/write	No		
BI-9_COUNTER	Analog Value	10	Read/write	No		
BI-10_COUNTER	Analog Value	11	Read/write	No		
BI-11_COUNTER	Analog Value	12	Read/write	No		
BI-12_COUNTER	Analog Value	13	Read/write	No		
For 24I and 24I-IP only						
BI-13_COUNTER	Analog Value	42	Read/write	No		
BI-14_COUNTER	Analog Value	43	Read/write	No		
BI-15_COUNTER	Analog Value	44	Read/write	No		

BACnet Name	BACnet Type	ID	Access	COV	Description
BI-16_COUNTER	Analog Value	45	Read/write	No	
BI-17_COUNTER	Analog Value	46	Read/write	No	
BI-18_COUNTER	Analog Value	47	Read/write	No	
BI-19_COUNTER	Analog Value	48	Read/write	No	
BI-20_COUNTER	Analog Value	49	Read/write	No	
BI-21_COUNTER	Analog Value	50	Read/write	No	
BI-22_COUNTER	Analog Value	51	Read/write	No	
BI-23_COUNTER	Analog Value	52	Read/write	No	
BI-24_COUNTER	Analog Value	53	Read/write	No	
UI-1_FILTER	Analog Value	14	Read/write	No	
UI-2_FILTER	Analog Value	15	Read/write	No	
UI-3_FILTER	Analog Value	16	Read/write	No	
UI-4_FILTER	Analog Value	17	Read/write	No	
UI-5_FILTER	Analog Value	18	Read/write	No	
UI-6_FILTER	Analog Value	19	Read/write	No	
UI-7_FILTER	Analog Value	20	Read/write	No	
UI-8_FILTER	Analog Value	21	Read/write	No	
AO-1_HAND_VALE	Analog Value	22	Read-only	No	Analog output value in hand mode value
AO-2_HAND_VALE	Analog Value	23	Read-only	No	
AO-3_HAND_VALE	Analog Value	24	Read-only	No	
AO-4_HAND_VALE	Analog Value	25	Read-only	No	
UI-1_CONFIGURATIO N	Multistate Value	1	Read/write	No	Universal input configuration: - voltage - resistance - temperature sensor type
UI-2_CONFIGURATIO N	Multistate Value	2	Read/write	No	
UI-3_CONFIGURATIO N	Multistate Value	3	Read/write	No	

BACnet Name	BACnet Type	ID	Access	COV	Description
UI-4_CONFIGURATIO N	Multistate Value	4	Read/write	No	
UI-5_CONFIGURATIO N	Multistate Value	5	Read/write	No	
UI-6_CONFIGURATIO N	Multistate Value	6	Read/write	No	
UI-7_CONFIGURATIO N	Multistate Value	7	Read/write	No	
UI-8_CONFIGURATIO N	Multistate Value	8	Read/write	No	
UI-1_RESOLUTION	Multistate Value	9	Read/write	No	Universal input resolution: - 12-bit (default) - 16-bit
UI-2_RESOLUTION	Multistate Value	10	Read/write	No	
UI-3_RESOLUTION	Multistate Value	11	Read/write	No	
UI-4_RESOLUTION	Multistate Value	12	Read/write	No	
UI-5_RESOLUTION	Multistate Value	13	Read/write	No	
UI-6_RESOLUTION	Multistate Value	14	Read/write	No	
UI-7_RESOLUTION	Multistate Value	15	Read/write	No	
UI-8_RESOLUTION	Multistate Value	16	Read/write	No	
AO-1_CONFIGURATIO N	Multistate Value	17	Read/write	No	Analog output working mode (default mode 0-10 V)
AO-2_CONFIGURATIO N	Multistate Value	18	Read/write	No	
AO-3_CONFIGURATIO N	Multistate Value	19	Read/write	No	
AO-4_CONFIGURATIO N	Multistate Value	20	Read/write	No	
AO-5_CONFIGURATIO N	Multistate Value	21	Read/write	No	
AO-6_CONFIGURATIO N	Multistate Value	22	Read/write	No	
AO-1_HAND_STATUS	Multistate Value	23	Read-only	No	Analog output value in hand mode status: hand/auto

BACnet Name	BACnet Type	ID	Access	COV	Description
AO-2_HAND_STATUS	Multistate Value	24	Read-only	No	Digital output value in hand mode status: hand/auto
AO-3_HAND_STATUS	Multistate Value	25	Read-only	No	
AO-4_HAND_STATUS	Multistate Value	26	Read-only	No	
BO-1_HAND_STATUS	Multistate Value	23	Read-only	No	
BO-2_HAND_STATUS	Multistate Value	24	Read-only	No	
BO-3_HAND_STATUS	Multistate Value	25	Read-only	No	
BO-4_HAND_STATUS	Multistate Value	26	Read-only	No	
<b>For 120-H and 120-H-IP only</b>					
BO-5_HAND_STATUS	Multistate Value	27	Read-only	No	
BO-6_HAND_STATUS	Multistate Value	28	Read-only	No	
BO-7_HAND_STATUS	Multistate Value	29	Read-only	No	
BO-8_HAND_STATUS	Multistate Value	30	Read-only	No	
BO-9_HAND_STATUS	Multistate Value	31	Read-only	No	
BO-10_HAND_STATU S	Multistate Value	32	Read-only	No	
BO-11_HAND_STATU S	Multistate Value	33	Read-only	No	
BO-12_HAND_STATU S	Multistate Value	34	Read-only	No	
BIA-1_COUNTER	Accumulator	0	Read/write	No	Digital input counter value Accumulator BACnet object (The same function is also available using the Analog Value BACnet object.
BIA-2_COUNTER	Accumulator	1	Read/write	No	
BIA-3_COUNTER	Accumulator	2	Read/write	No	
BIA-4_COUNTER	Accumulator	3	Read/write	No	
BIA-5_COUNTER	Accumulator	4	Read/write	No	
BIA-6_COUNTER	Accumulator	5	Read/write	No	
BIA-7_COUNTER	Accumulator	6	Read/write	No	
BIA-8_COUNTER	Accumulator	7	Read/write	No	
BIA-9_COUNTER	Accumulator	8	Read/write	No	

BACnet Name	BACnet Type	ID	Access	COV	Description	
BIA-10_COUNTER	Accumulator	9	Read/write	No		
BIA-11_COUNTER	Accumulator	10	Read/write	No		
BIA-12_COUNTER	Accumulator	11	Read/write	No		
For 24I and 24I-IP only						
BIA-13_COUNTER	Accumulator	12	Read/write	No		
BIA-14_COUNTER	Accumulator	13	Read/write	No		
BIA-15_COUNTER	Accumulator	14	Read/write	No		
BIA-16_COUNTER	Accumulator	15	Read/write	No		
BIA-17_COUNTER	Accumulator	16	Read/write	No		
BIA-18_COUNTER	Accumulator	17	Read/write	No		
BIA-19_COUNTER	Accumulator	18	Read/write	No		
BIA-20_COUNTER	Accumulator	19	Read/write	No		
BIA-21_COUNTER	Accumulator	20	Read/write	No		
BIA-22_COUNTER	Accumulator	21	Read/write	No		
BIA-23_COUNTER	Accumulator	22	Read/write	No		
BIA-24_COUNTER	Accumulator	23	Read/write	No		
For MINI 4TO-H and 4TO-H-IP only						
TO-1	Binary Output	0	Read/write	Yes		Triac output current value (in digital output operation mode)
TO-2	Binary Output	1	Read/write	Yes		
TO-3	Binary Output	2	Read/write	Yes		
TO-4	Binary Output	3	Read/write	Yes		
TO-1_PWM VALUE	Analog Output	0	Read/write	Yes		Triac output current value (in PWM operation mode)
TO-2_PWM VALUE	Analog Output	1	Read/write	Yes		
TO-3_PWM VALUE	Analog Output	2	Read/write	Yes		
TO-4_PWM VALUE	Analog Output	3	Read/write	Yes		
TO-1_CONFIGURATIO N	Multistate Value	17	Read/write	No	Triac output operation mode configuration, options:	

BACnet Name	BACnet Type	ID	Access	COV	Description
TO-1_CONFIGURATI ON	Multistate Value	18	Read/write	No	- digital output - PWM
TO-1_CONFIGURATI ON	Multistate Value	19	Read/write	No	
TO-1_CONFIGURATI ON	Multistate Value	20	Read/write	No	
TO-1_HAND_STATUS	Multistate Value	23	Read-only	No	Triac output hand mode status
TO-1_HAND_STATUS	Multistate Value	24	Read-only	No	
TO-1_HAND_STATUS	Multistate Value	25	Read-only	No	
TO-1_HAND_STATUS	Multistate Value	26	Read-only	No	
<b>For MINI 4I4O-H and 4I4O-H-IP only</b>					
BI-1_INPUT_MODE	Multistate Value	27	Read/write	No	Ordinary IO (def) Monostable Relay Bistable Relay Time Relay NO [ms] Time Relay NC [ms] Time Relay NO [s] Time Relay NC [s] Input Forwarding (4U4O-H, 4U4O-H-IP only) Heating Cooling
BI-2_INPUT_MODE	Multistate Value	28	Read/write	No	
BI-3_INPUT_MODE	Multistate Value	29	Read/write	No	
BI-4_INPUT_MODE	Multistate Value	30	Read/write	No	
BI-1_MODE_TIME	Analog Value	26	Read/write	No	Time Value object for Time Relay Mode
BI-2_MODE_TIME	Analog Value	27	Read/write	No	
BI-3_MODE_TIME	Analog Value	28	Read/write	No	
BI-4_MODE_TIME	Analog Value	29	Read/write	No	
BI-1_BLOCK_INPUT	Binary Value	12	Read/write	No	Digital input blocking command
BI-2_BLOCK_INPUT	Binary Value	13	Read/write	No	
BI-3_BLOCK_INPUT	Binary Value	14	Read/write	No	
BI-4_BLOCK_INPUT	Binary Value	15	Read/write	No	
BI-1_COMMAND	Binary Value	8	Read/write	No	Digital input remote command
BI-2_COMMAND	Binary Value	9	Read/write	No	

BACnet Name	BACnet Type	ID	Access	COV	Description
BI-3_COMMAND	Binary Value	10	Read/write	No	
BI-4_COMMAND	Binary Value	11	Read/write	No	
For MINI 4U40-H and 4U40-H-IP only					
BI-1_SETPOINT	Analog Value	30	Read/write	No	SETPOINT for heating/cooling modes Default: 0
BI-2_SETPOINT	Analog Value	31	Read/write	No	
BI-3_SETPOINT	Analog Value	32	Read/write	No	
BI-4_SETPOINT	Analog Value	33	Read/write	No	
BI-1_DIFFERENTIAL	Analog Value	34	Read/write	No	DIFFERENTIAL for heating/cooling modes Default: 0
BI-2_DIFFERENTIAL	Analog Value	35	Read/write	No	
BI-3_DIFFERENTIAL	Analog Value	36	Read/write	No	
BI-4_DIFFERENTIAL	Analog Value	37	Read/write	No	

Table 36. List of BACnet objects

## 11 List of Supported Temperature Sensors

- 10K3A1
- 10K4A1
- 10K Carel
- 20K6A1
- 2.2K3A1
- 3K3A1
- 30K6A1
- SIE1
- TAC1
- SAT1
- PT1000
- NI1000
- NI1000 21C (°C)
- NI1000 LG (°C)
- 10K Type II NTC
- 10K Type III NTC
- 20K NTC
- 3K NTC
- NI1000 32F (°F)
- NI1000 70F (°F)
- PT1000 (°F)

No.	1
Sensor	<b>10K3A1</b>
$\beta$ coefficient	3975K
Manufacturers	Aquatrol, Cylon, Honeywell, Johnson, Satchwell, Seachange
°C	$\Omega$
-50	667828
-45	491749
-40	335671
-35	241840
-30	176683
-25	131251
-20	96974
-15	72895
-10	55298



No.	1
-5	42314
0	32650
5	25396
10	19904
15	15714
20	12494
25	10000
30	8056
35	6530
40	5325
45	4367
50	3601
55	2985
60	2487
65	2082
70	1751
75	1480
80	1256
85	1070
90	916
95	787
100	678
105	587
110	510
115	444
120	388

No.	1
125	340
No.	2
Sensor	<b>10K4A1</b>
$\beta$ coefficient	3695K
Manufacturers	Andover, Delta Controls, Siebe, York
$^{\circ}\text{C}$	$\Omega$
-50	441667
-45	330749
-40	239831
-35	181532
-30	135233
-25	105081
-20	78930
-15	61030
-10	47549
-5	37316
0	29490
5	23462
10	18787
15	15136
20	12268
25	10000
30	8197
35	6754
40	5594
45	4656

No.	2
50	3893
55	3271
60	2760
65	2339
70	1990
75	1700
80	1458
85	1255
90	1084
95	939
100	817
105	713
110	624
115	547
120	482
125	426
No.	3
Sensor	<b>10K Carel</b>
$\beta$ coefficient	3435K
$^{\circ}\text{C}$	$\Omega$
-50	329500
-45	247700
-40	188500
-35	144100
-30	111300
-25	86430

No.	3
-20	67770
-15	53410
-10	42470
-5	33900
0	27280
5	22050
10	17960
15	14690
20	12090
25	10000
30	8313
35	6940
40	5827
45	4912
50	4161
55	3536
60	3020
65	2588
70	2228
75	1924
80	1668
85	1451
90	1266
95	1108
100	973
105	857

No.	3
110	758
115	672
120	597
125	531
No.	4
Sensor	<b>20K6A1</b>
$\beta$ coefficient	4262K
$^{\circ}\text{C}$	$\Omega$
-40	806800
-35	574400
-30	413400
-25	300400
-20	220600
-15	163480
-10	122260
-5	92220
0	70140
5	53780
10	41540
15	32340
20	25340
25	20000
30	15886
35	12698
40	10212
45	8260

No.	4
50	6718
55	5494
60	4518
65	3732
70	3098
75	2586
80	2166
85	1823
90	1541
95	1308
100	1114
105	953
110	818
115	704
120	609
125	528
115	444
120	388
125	340
No.	5
Sensor	<b>2.2K3A1</b>
$\beta$ coefficient	3975K
Manufacturers	Ambiflex, Johnson
$^{\circ}\text{C}$	$\Omega$
-50	150395
-45	112994

No.	5
-40	75593
-35	57691
-30	39789
-25	30814
-20	21839
-15	16416
-10	12453
-5	9529
0	7353
5	5719
10	4482
15	3539
20	2814
25	2252
30	1814
35	1471
40	1199
45	983
50	810
55	672
60	560
65	468
70	394
75	333
80	282
85	241

No.	5
90	206
95	177
100	152
105	132
110	114
115	100
120	88
125	77
No.	6
Sensor	<b>3K3A1</b>
$\beta$ coefficient	3975K
Manufacturers	Alerton
$^{\circ}\text{C}$	$\Omega$
-50	200348
-45	150524
-40	100701
-35	76853
-30	53005
-25	41048
-20	29092
-15	21868
-10	16589
-5	12694
0	9795
5	7619
10	5971



No.	6
15	4714
20	3748
25	3000
30	2417
35	1959
40	1598
45	1310
50	1080
55	896
60	746
65	625
70	526
75	444
80	377
85	321
90	275
95	236
100	204
105	176
110	153
115	133
120	117
125	102

No.	7
Sensor	<b>30K6A1</b>
$\beta$ coefficient	4262K
Manufacturers	Drayton
$^{\circ}\text{C}$	$\Omega$
-30	622911
-25	477393
-20	331876
-15	245785
-10	183697
-5	138502
0	105305
5	80713
10	62347
15	48511
20	38019
25	30000
30	23828
35	19046
40	15317
45	12390
50	10079
55	8243
60	6777
65	5600
70	4650
75	3879

No.	7
80	3251
85	2737
90	2313
95	1963
100	1672
105	1430
110	1228
115	1058
120	915
125	793
No.	8
Sensor	<b>SIE1</b>
Manufacturers	Barber Colman, Siebe
°C	Ω
-50	10732
-45	10624
-40	10517
-35	10344
-30	10172
-25	9913
-20	9654
-15	9320
-10	8933
-5	8496
0	8044
5	7489

No.	8
10	6938
15	6370
20	5798
25	5238
30	4696
35	4185
40	3707
45	3271
50	2875
55	2521
60	2206
65	1929
70	1685
75	1472
80	1287
85	1127
90	986
95	866
100	760
105	670
110	590
115	522
120	462
125	410

No.	9
Sensor	<b>TAC1</b>
$\beta$ coefficient	3500K
Manufacturers	TAC
$^{\circ}\text{C}$	$\Omega$
-40	39024
-35	29358
-30	22284
-25	17073
-20	13192
-15	10276
-10	8068
-5	6382
0	5085
5	4078
10	3294
15	2676
20	2188
25	1800
30	1488
35	1237
40	1034
45	869
50	733
55	622
60	529
65	453

No.	9
70	389
75	335
80	290
85	252
90	220
95	192
100	169
105	149
110	131
115	116
120	103
125	92
No.	10
Sensor	<b>SAT1</b>
Manufacturers	Satchwell
°C	Ω
-50	9719
-45	9652
-40	9584
-35	9467
-30	9349
-25	9159
-20	8968
-15	8708
-10	8396
-5	8031

No.	10
0	7614
5	7150
10	6649
15	6121
20	5580
25	5039
30	4513
35	4012
40	3545
45	3117
50	2730
55	2386
60	2082
65	1816
70	1585
75	1385
80	1213
85	1064
90	937
95	828
100	734
105	654
110	585
115	525
120	474
125	429

No.	11
Sensor	<b>PT1000</b>
Manufacturers	Honeywell, Sauter, Serck, Siebe, Cylon
°C	$\Omega$
-50	803.1
-40	842.7
-30	882.2
-20	921.6
-10	960.9
0	1000.0
10	1039.0
20	1077.9
30	1116.7
40	1155.4
50	1194.0
60	1232.4
70	1270.8
80	1309.0
90	1347.1
100	1385.1
110	1422.9
120	1460.7
130	1498.3
140	1535.8
150	1573.3
160	1610.5
170	1647.7



No.	11
180	1684.8
190	1721.7
200	1758.6
210	1795.3
220	1831.9
230	1868.4
240	1904.7
250	1941.0
260	1977.1
270	2013.1
280	2049.0
290	2084.8
300	2120.5
310	2156.1
320	2191.5
330	2226.8
340	2262.1
350	2297.2
360	2332.1
370	2367.0
380	2401.8
390	2436.4
400	2470.9
No.	12
Sensor	<b>NI1000</b>
Manufacturers	Sauter

No.	12
°C	Ω
-50	742.6
-40	791.3
-30	841.5
-20	893.0
-10	945.8
0	1000.0
10	1055.5
20	1112.4
30	1170.6
40	1230.1
50	1291.1
60	1353.4
70	1417.2
80	1482.5
90	1549.4
100	1617.8
110	1687.9
120	1759.8
130	1833.4
140	1909.0
150	1986.6
No.	13
Sensor	<b>NI1000 21C (°C)</b>
Manufacturers	Distech
°C	Ω

No.	13
-40	699,3
-30	745,5
-20	792,8
-10	841,2
0	891,0
10	942,0
20	994,3
30	1047,8
40	1102,6
50	1158,5
60	1215,8
70	1274,3
80	1334,4
90	1407,8
100	1473,1
110	1524,0
No.	14
Sensor	<b>NI1000 LG (°C)</b>
Manufacturers	LG
°C	Ω
-50	790,9
-40	830,8
-30	871,7
-20	913,5
-10	956,2
0	1000,0

No.	14
10	1044,8
20	1090,7
30	1137,6
40	1185,7
50	1235,0
60	1285,4
70	1337,1
80	1390,1
90	1444,4
100	1500,0
110	1557,0
120	1615,4
130	1675,2
140	1736,5
150	1799,3
No.	15
Sensor	<b>10K Type II NTC</b>
$\beta$ coefficient	3975K
Manufacturers	Alerton
$^{\circ}\text{F}$	$\Omega$
-40	336095
-35	279921
-30	233942
-25	196184
-20	165062
-15	139324

No.	15
-10	117968
-5	100192
0	85346
5	72910
10	62464
15	53660
20	46222
25	39919
30	34563
35	30001
40	26104
45	22767
50	19903
55	17439
60	15313
65	13476
70	11884
75	10501
80	9298
85	8249
90	7333
95	6530
100	5826
105	5208
110	4663
115	4182

No.	15
120	3757
125	3381
130	3047
135	2751
140	2487
145	2252
150	2042
155	1855
160	1687
165	1536
170	1401
175	1279
180	1169
185	1070
190	981
195	901
200	827
205	761
210	701
215	646
220	597
225	551
230	510
235	472
240	438
245	406

No.	15
250	377
No.	16
Sensor	<b>10K Type III NTC</b>
$\beta$ coefficient	3695K
Manufacturers	Andover
$^{\circ}\text{F}$	$\Omega$
-40	239831
-35	203801
-30	173631
-25	148378
-20	127139
-15	109226
-10	94078
-5	81235
0	70317
5	61012
10	53063
15	46255
20	40411
25	35382
30	31046
35	27298
40	24051
45	21234
50	18782
55	16646

No.	16
60	14780
65	13148
70	11717
75	10459
80	9353
85	8378
90	7517
95	6755
100	6080
105	5481
110	4948
115	4474
120	4051
125	3673
130	3335
135	3032
140	2761
145	2517
150	2297
155	2100
160	1921
165	1760
170	1615
175	1453
180	1363
185	1255



No.	16
190	1156
195	1066
200	985
205	910
210	842
215	780
220	723
225	671
230	623
235	580
240	540
245	503
250	469
No.	17
Sensor	<b>20K NTC</b>
$\beta$ coefficient	4262K
Manufacturers	Honeywell
$^{\circ}$ F	$\Omega$
-40	817605
-35	674624
-30	558679
-25	464299
-20	387186
-15	323956
-10	271927
-5	228972

No.	17
0	193390
5	163823
10	139177
15	118571
20	101293
25	86764
30	74511
35	64152
40	55369
45	47904
50	41543
55	36109
60	31457
65	27464
70	24029
75	21068
80	18509
85	16294
90	14372
95	12700
100	11244
105	9974
110	8862
115	7888
120	7034
125	6282

No.	17
130	5620
135	5036
140	4519
145	4062
150	3657
155	3297
160	2976
165	2691
170	2436
175	2209
180	2005
185	1823
190	1659
195	1512
200	1379
205	1260
210	1153
215	1055
220	967
225	888
230	816
235	750
240	691
245	637
250	588

No.	18
Sensor	<b>3K NTC</b>
$\beta$ coefficient	3975K
°F	$\Omega$
-40	100618
-35	83827
-30	70079
-25	58783
-20	49468
-15	41763
-10	35367
-5	30042
0	25593
5	21866
10	18735
15	16096
20	13865
25	11975
30	10369
35	9000
40	7831
45	6830
50	5971
55	5232
60	4594
65	4043
70	3565

No.	18
75	3150
80	2789
85	2475
90	2200
95	1959
100	1748
105	1562
110	1399
115	1254
120	1127
125	1014
130	914
135	825
140	746
145	676
150	613
155	556
160	506
165	461
170	420
175	384
180	351
185	321
190	294
195	270
200	248

No.	18
205	228
210	210
215	194
220	179
225	165
230	153
235	142
240	131
245	122
250	113
No.	19
Sensor	<b>NI1000 32F (°F)</b>
Manufacturers	Distech
°F	Ω
-40	791,3
-30	818,9
-20	847,1
-10	875,6
0	904,6
10	933,9
20	963,7
30	993,9
40	1024,5
50	1055,5
60	1086,9
70	1118,7

No.	19
80	1151,0
90	1183,6
100	1216,7
110	1250,2
120	1284,1
130	1318,5
140	1353,4
150	1388,5
160	1424,2
170	1460,3
180	1497,0
190	1534,1
200	1571,7
210	1609,8
220	1648,4
230	1687,9
240	1727,3
250	1767,6
No.	20
Sensor	<b>NI1000 70F (°F)</b>
Manufacturers	Distech
°F	Ω
-40	699,3
-30	724,8
-20	750,7
-10	776,9

No.	20
0	803,4
10	830,3
20	857,7
30	885,4
40	913,5
50	942,0
60	970,9
70	1000,2
80	1029,9
90	1059,9
100	1090,3
110	1121,1
120	1152,2
130	1183,8
140	1215,8
150	1248,1
160	1280,9
170	1314,2
180	1347,9
190	1382,0
200	1417,0
210	1452,0
220	1487,0
230	1524,0
240	1560,0
250	1597,0



No.	21
Sensor	<b>PT1000 (°F)</b>
Manufacturers	Distech
°F	Ω
-40	842,7
-30	864,7
-20	886,6
-10	908,5
0	930,3
10	952,2
20	973,9
30	995,7
40	1017,4
50	1039,0
60	1060,7
70	1082,2
80	1103,8
90	1125,3
100	1146,8
110	1168,3
120	1189,7
130	1211,1
140	1232,4
150	1253,7
160	1275,0
170	1296,2
180	1317,4

No.	21
190	1338,6
200	1359,7
210	1380,8
220	1401,8
230	1422,9
240	1443,8
250	1464,8