FoxIoT 6Ai6Ro Product Manual

Modbus RTU Controller

With 6 Analog/Digital Inputs
and 6 Relay Outputs

Product Manual
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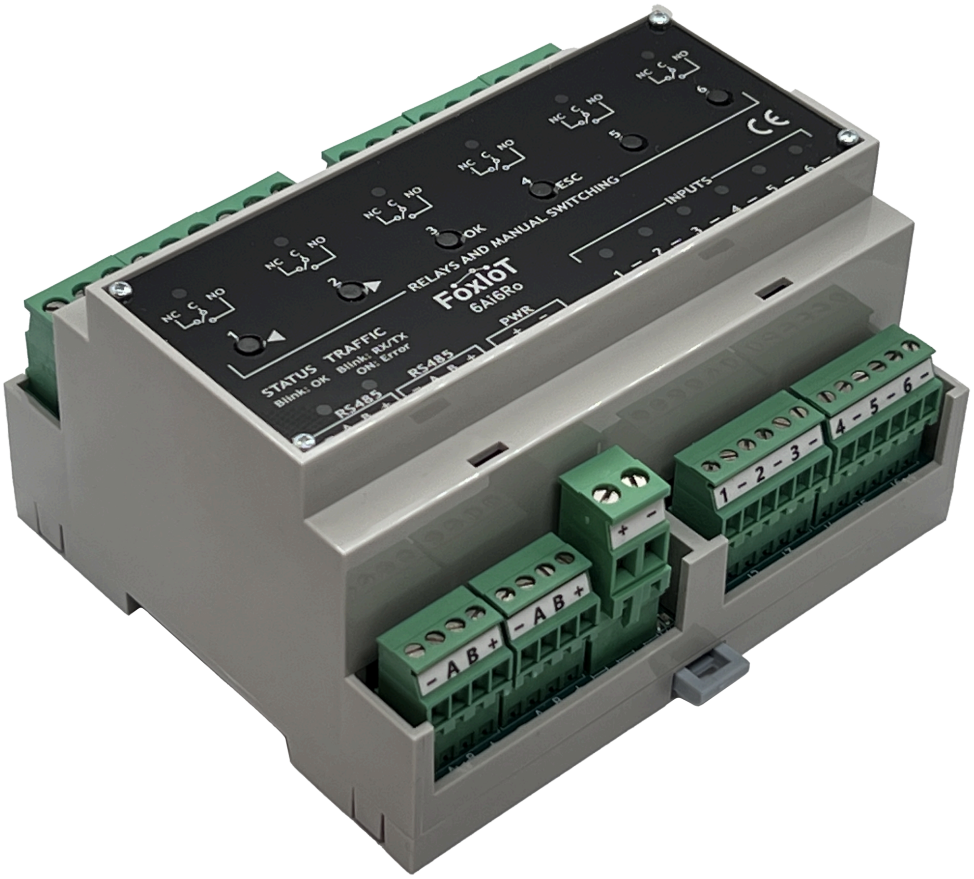

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1. Introduction

1.1 About This Manual

The FoxIoT 6Ai6Ro manual provides key information for the safe and efficient use of the device. It describes the main features such as 6 analog inputs, 6 relay outputs, Modbus RTU communication, and an integrated rule engine for basic automation. The manual includes safety guidelines for electrical installation, handling, and suitable environmental conditions. It outlines the technical specifications, including electrical, input/output, communication, and mechanical parameters, along with certifications. Installation instructions cover unpacking, mounting, wiring, and power connection. Configuration can be performed locally using buttons or remotely via Modbus-compatible software. Communication settings, Modbus register mapping, and usage examples are explained in detail. The internal rule engine supports simple control logic, such as thermostat and switch rules. Firmware updates can be carried out via Modbus or through configuration software. Troubleshooting guidance helps identify issues using LED indicators and provides solutions for common problems. Maintenance recommendations include cleaning, periodic inspections, and firmware management. The manual also explains warranty conditions, support contacts, and the RMA return procedure.

1.2 Overview of FoxIoT 6Ai6Ro

The FoxIoT 6Ai6Ro is a versatile Modbus RTU controller designed for reliable operation across a wide range of applications. It is widely used in building automation, industrial systems, and virtual power plant (VPP) solutions, where robustness, flexibility, and seamless integration are essential.

1.3 Key Features and Benefits

Quick and Easy Installation: The FoxIoT 6Ai6Ro makes installation simple. Removable connectors make wiring easy. Technicians can set the Modbus address on-site using buttons, so there's no need to pre-configure devices. The status LEDs and relay buttons help technicians quickly check communication, test inputs, and control relays to ensure everything works well from the start. This allows technicians to complete the setup without needing to wait for a systems integrator, making the installation process smoother and faster.

Flexible Configuration: On-site, technicians can easily set the Modbus address, baud rate, and serial format using simple button controls. For more advanced settings, the full configuration can be done remotely via Modbus RTU, ensuring the device can be tailored to fit various systems.

Reliable Performance: The FoxIoT 6Ai6Ro is engineered for dependable operation in industrial and automation environments. It uses high-quality Omron relays for consistent switching performance. The controller responds quickly and fully complies with Modbus RTU standards, ensuring smooth and predictable communication. Thanks to carefully selected components and a wide operating temperature range of -40°C to +55°C, the 6Ai6Ro remains stable and reliable even in harsh conditions.

Advanced Control: The FoxIoT 6Ai6Ro supports firmware updates via Modbus, allowing new features and improvements to be added over time. Its built-in rule engine enables flexible internal automation, such as switching relays based on input changes, implementing temperature control, or managing analog outputs like motor speed. These rules operate independently and respond instantly, ensuring that critical functions continue even if the Modbus master or communication link fails. This local fallback capability enhances system reliability and resilience.

Energy-Efficient and Safe: The FoxIoT 6Ai6Ro includes a coil voltage reduction mode that lowers power consumption while relays are active. To improve safety, all input and communication pins are protected

against wiring mistakes and voltage spikes. For example, the RS-485 interface can safely tolerate accidental connections of up to 30 V to the A or B lines, helping prevent damage during installation or maintenance.

1.4 Typical Applications

The FoxIoT 6Ai6Ro is designed for a wide range of industrial and automation scenarios where reliable input monitoring and relay control are essential. Its flexible architecture and support for both Modbus master control and internal logic make it suitable for many use cases. Typical applications include:

- **Industrial Automation**
  The device can monitor analog signals such as temperature, humidity, pressure, or voltage, and control machinery or actuators using relay outputs. It is suitable for process control, equipment monitoring, and data acquisition in manufacturing and industrial systems.
- **Building Automation (HVAC & Lighting)**
  Ideal for managing heating, ventilation, and air conditioning systems. The built-in thermostat rule logic enables temperature-based control without the need for external controllers. The device is also commonly used for lighting control. Lights can be switched on or off based on input conditions - such as motion sensors or wall switches - using internal rules, or controlled directly by a Modbus master. This flexibility supports both autonomous and centralized building automation strategies.
- **Energy Management and VPP Integration**
  The FoxIoT 6Ai6Ro is used in local control tasks within energy management and virtual power plant (VPP) systems. It monitors analog signals (e.g. 0–10 V or 4–20 mA) and sends control signals via relays to local automation equipment. In typical VPP setups, it can return outputs to a default state if Modbus master communication is lost, ensuring predictable behavior during disconnections.
- **Agricultural Automation**
  Ideal for smart farming and greenhouse automation. The controller can monitor environmental parameters like temperature, soil moisture, and light levels, and activate devices such as fans, heaters, or irrigation systems based on sensor input or Modbus commands.
- **Remote Monitoring and Control**
  Suitable for remote or distributed systems where data from field devices must be collected and acted upon locally. Internal rules allow the device to continue operating critical functions even if communication with the Modbus master is lost, improving reliability in disconnected or unreliable network environments.

2. Safety Information

2.1 General Safety Guidelines

Always follow basic safety practices when installing or operating this device. The following guidelines help ensure personal safety and protect the equipment:

- Read and understand this manual before starting any installation or maintenance work.
- Only qualified personnel should handle the device.
- Use appropriate personal protective equipment (PPE) when working with electrical components.
- Do not operate the device if it appears damaged or has been exposed to moisture.
- Ensure all wiring and connections comply with local regulations and standards.
- Keep the working area clean and free of conductive materials.

2.2 Electrical Installation Safety

WARNING: Electrical Hazard
This device may operate with live electrical components. Always disconnect power before performing any installation or maintenance to prevent electric shock, which could result in severe injury or death.

⚡ High Voltage Risk

If relay outputs are connected to mains voltage (e.g., 230 V AC), a lethal electric shock is possible if the terminals are touched during operation.

All wiring and installation involving mains voltage must be performed only by qualified personnel in accordance with local electrical regulations.

Ensure power is disconnected before working on circuits connected to the relays.

Qualified Personnel Only
Installation and maintenance should be performed only by trained and qualified personnel with experience in Modbus, low-voltage systems, and electrical installations.

Installation Precautions

- **DIN Rail Mounting:** Ensure the controller is correctly attached to the DIN rail within an electrical cabinet, with the mounting clip fully engaged to prevent any movement or detachment.
- **Wiring Guidelines:**
    - **Low-Voltage Wiring:** Use appropriate low-voltage wires for power and inputs. Do not route low- and high-voltage wires together. This may be prohibited by local regulations.
    - **Modbus Data Line:** Use twisted-pair cable with controlled impedance (typically 120 ohms) for RS-485 lines to reduce interference and ensure reliable communication.
    - **Relay Wiring:** When connecting the relay outputs to external circuits, use properly rated wiring, especially if the relay controls high-voltage equipment.

Relay Output Guidelines
The FoxIoT 6Ai6Ro controller includes six relay outputs, each rated for up to **250 V AC / 16 A** (resistive load). Relays are suitable for switching lighting circuits, heating elements, motors, and general-purpose loads.
Key Usage Notes:

- **Maximum Ratings:** The 16 A rating applies to purely resistive loads. Do not exceed rated voltage or current.
- **Motors and Inductive Loads:** Suitable for switching motors and inductive loads, but the usable current is lower. For example: 200,000 operations at 8 A, 250 V AC (cosφ = 0.4).
- **Capacitive Loads:** Devices with high inrush current, such as LED drivers or power supplies, may exceed safe switching limits and cause contact welding. Use inrush limiters or an external contactor designed for capacitive loads.

Separation of Power Sources
If using multiple power sources, such as low-voltage control power and a separate relay-controlled power source, ensure they are adequately isolated to prevent cross-connection.

Avoid Moisture and Dust Exposure

Install the device in a dry, dust-free environment. If moisture or dust exposure is unavoidable, use an appropriate enclosure to protect the device.

Follow Label Instructions
Follow any specific instructions or labels on the device, such as terminal markings, polarity indicators, and voltage ratings, to ensure proper connections and operation.

Double-Check Connections
Before powering the device, double-check all connections to ensure they are secure and correctly configured. Loose connections can cause malfunction or damage.

Disclaimer

FoxIoT OÜ is not responsible for any damage, injury, or loss resulting from improper installation, misuse, or unauthorized modifications of this device. This product must be installed and maintained by qualified personnel. All instructions in this manual must be followed to ensure safe and reliable operation. Use of this device in ways not specified by FoxIoT OY may impair its safety features and void warranties.

2.3 Handling and Storage Precautions

Handle the FoxIoT 6Ai6Ro controller with care to avoid mechanical shock or damage during installation or transport. Do not apply excessive force on the top-side buttons, as they are not designed to withstand high pressure.

For storage prior to installation, keep the device in its original packaging and store it in a clean, dry location within the specified temperature range (see Section 3.9 link). Avoid exposure to moisture, dust, or corrosive environments.

During transport, ensure the product is protected from vibration and impact. Use appropriate protective packaging to prevent damage.

2.4 Environmental Conditions

The FoxIoT 6Ai6Ro must be installed in environments that comply with the environmental ratings listed in Section 3.9 link. While it is designed for indoor use, outdoor installation is possible if the device is mounted inside a properly rated weatherproof electrical enclosure (e.g. IP65 or higher) that protects against moisture, dust, and temperature extremes.

Avoid installation in areas with:

- Excessive humidity or condensation
- Direct sunlight or strong radiant heat
- Corrosive gases, dust, or vibration

For use above 2000 m altitude or in non-standard environments, consult the manufacturer for guidance.

3. Technical Specifications

3.1 Electrical Specifications

Parameter	Value
Nominal Voltage	12V or 24V DC
Operating Voltage Range	11V – 30V DC
Idle Power Consumption	0.35W @ 12V / 0.5W @ 24V
Power Consumption (All Relays On, Coil Voltage Reduction Mode Enabled)	1.8W @ 12V / 2.1W @ 24V
Power Consumption (All Relays On, Coil Voltage Reduction Mode Disabled)	3W @ 12V / 3.3W @ 24V
Reverse Voltage Protection	Up to 30V

3.2 Input/Output Specifications

Parameter	Value
Number of Inputs	6
Max Input Voltage	30V DC
Digital Input Voltage Range (Active)	2.5V to 30V
Digital Input Voltage Range (Inactive)	0V to 1.5V
Software Debounce Filter	50 ms
Analog Input Resolution	16-bit
Analog Input Range	0–10V DC
Analog Input Accuracy	±0.1% or ±3mV (whichever is greater) from 0.05 to 10V DC
Analog Sampling Rate	>100 Hz
Analog Input Impedance	>5 MΩ
Software-Controllable Pull-up Resistor	10kΩ @ 10V (software-enabled)
Number of Relays	6
Relay Type	Omron G2RL-1-E (SPDT)

Parameter	Value
Number of Inputs	6
Mechanical Life	20 million operations
Electrical Life	200,000 operations at 8A, 250 VAC (cosφ=0.4) (NO) 30,000 operations at 250 VAC, 16A 10,000 operations at 8A, 30 VDC (L/R = 7 ms) (NO)
Relay Rating	250V AC / 30V DC, max 16A
Coil Voltage Reduction Mode	Software-controlled

3.3 Button Specification

Parameter	Value
Number of Buttons	6
Button Function	Relay control and configuration at startup

3.4 LED Indicators

Parameter	Value
Relay Status LEDs	6 Yellow LEDs, each indicating the status of a specific relay (OFF, ON, BLINKING)
Input Status LEDs	6 Red LEDs, each corresponding to a specific digital input
Status LED	1 Red LED for device operational status
Modbus Traffic LED	1 Green LED for Modbus communication activity

3.5 Communication Parameters

Parameter	Value
Baud Rate Options	300 / 600 / 1200 /2400 / 4800 / 9600 / 19200 / 38400 / 57600 / 115200
Data Format	8N1 / 8N2 / 8E1 / 8O1

Modbus Address Range (via Modbus)	1 to 247
Modbus Address Range (via Buttons)	1 to 62
Bus Pin Protection	±30V
ESD Protection	±16 kV HBM
Fail-safe Receiver	Handles open-circuit, short-circuit, and idle-bus conditions
Network Capacity	Up to 247 devices
Common Mode Range	-20V to +25V

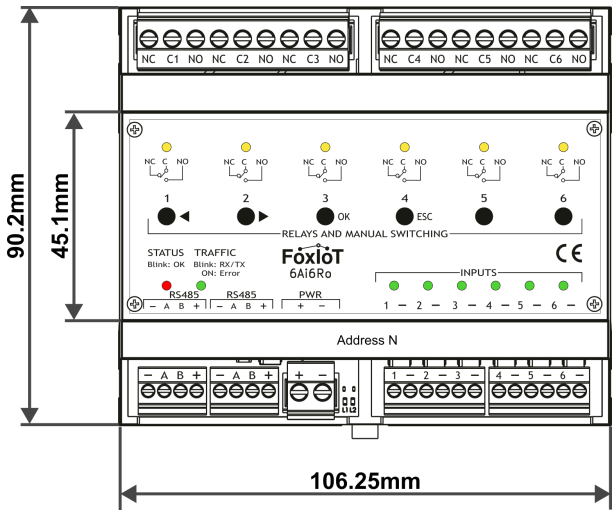
3.6 Processor

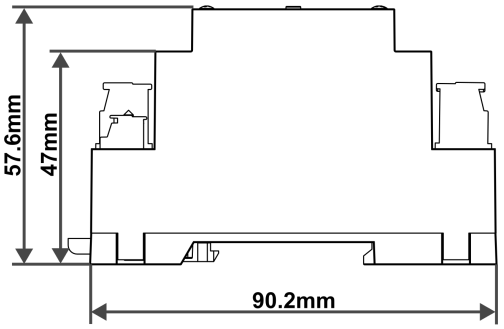
Parameter	Value
Type	32-bit ARM Cortex-M33
Clock Speed	Up to 76.8 MHz

3.7 Mechanical Specifications

Parameter	Value
Mounting Type	DIN-Rail (TH35)
Module Size	6M (6 x 17.5 mm slots)
Dimensions (L x W x H)	106 x 98 x 58 mm
Weight	265 g
Connector Type	Pluggable terminal blocks
Input Connectors	2 x 6-pin, up to 1.5 mm²
RS-485 & Power Connectors	2 x 4-pin, up to 1.5 mm²
External Power Connector	1 x 2-pin, up to 2.5 mm²
Relay Connectors	6 x 3-pin, up to 2.5 mm²

3.8 Mechanical Dimensions





3.9 Environmental Ratings

Parameter	Value
Operating Temperature	-40°C to +55°C
Storage Temperature	-40°C to +60°C
Relative Humidity	Less than 90% non-condensing
Altitude	Up to 2000 meters above sea level

3.10 Certifications

Parameter	Value
Relative Humidity	<90%, non-condensing
Altitude	Up to 2000 m
CE Compliance	2014/30/EU, 2014/35/EU

4. Product Description

4.1 Input Channels

The controller includes 6 universal inputs, each capable of reading digital signal levels, analog voltage 0–10V, and supporting 4–20 mA current loop sensors when using an external resistor. Inputs are designed for flexible use without reconfiguration - a single input can be monitored simultaneously as both a voltage and a digital state.

- **Digital Input Use**
  Each input is suitable for use with dry contacts (also known as potential-free contacts), switches, or open-collector outputs. A software-controlled 10 kΩ pull-up to a precise 10 V source can be enabled per input to ensure reliable detection of switches or contacts that don't supply voltage.
  Software-based debounce filtering ensures stable signal recognition and minimizes false triggering due to contact bounce.
  The maximum input voltage is 30V DC.
- **Analog Input Use**
  Inputs support 0–10 V measurements, suitable for sensors such as temperature transmitters, pressure sensors, position sensors, level indicators, and other analog monitoring devices.

  To connect 4–20 mA current loop sensors, a resistor (typically 250 Ω or 500 Ω) can be placed between the input terminal and ground. This converts the current into a corresponding voltage (1–5 V or 2–10 V), allowing the controller to read the signal within its supported voltage range.
- **NTC Mode**
  Inputs can be configured to a special NTC mode for direct connection of 10k thermistors (β=3435 or β=3977). In this mode, the internal pull-up is managed automatically during measurement to ensure precision. Mode selection is done via Modbus and applies per input.

> Input configuration options are described in the **6Ai6Ro Modbus register table** link.
>
> See **Section 5.0** link for connection examples and sensor wiring.

4.2 Relay Outputs

The controller includes **6 high-current relay outputs**, based on Omron G2RL-1-E SPDT relays. Each relay can be controlled remotely via Modbus or automatically using internal rules.

- **Contact Type and Ratings**
  Each relay provides both **Normally Open (NO)** and **Normally Closed (NC)** contacts.
  Supports up to **16A at 250VAC or 30VDC** for resistive loads. Lower limits apply for inductive loads depending on voltage and switching cycles.

- **Energy-Efficient Coil Control**
  The controller supports a **software-controlled coil voltage reduction** feature. After switching, the coil voltage is automatically lowered to reduce power consumption and heat generation, improving long-term relay durability.

- **Status Feedback**
  Relay states are indicated via **yellow LEDs** on the front panel and can also be monitored through Modbus.

> Relay control and coil voltage reduction settings are described in the **6Ai6Ro Modbus Register Table** link.
> See **Section 5.3** link for wiring examples.

4.3 Communication Interface

The controller communicates via RS-485 using the Modbus RTU protocol, allowing easy integration into industrial networks, PLCs, SCADA systems, BMS platforms, and other automation environments.

- **Modbus Settings**
  Baud rate, parity, stop bits, and Modbus address are all configurable via Modbus registers or locally using the device's onboard buttons. Supported baud rates range from **300 to 115200 bps**.

- **Address Configuration**
  The controller supports two configuration methods:
  - **Via Modbus**: Full address range (1–247)
  - **Via Buttons**: Quick setup for addresses 1–62

- **Bus Capacity and Electrical Robustness**
  A reduced-load RS-485 driver allows up to **247 devices** on a single Modbus bus.
  The interface includes built-in protection features:
  - **±30V fault protection helps** prevent damage if a technician accidentally connects power (e.g., 24V) to the A or B line.
  - **A fail-safe receiver** ensures correct behavior when the bus is idle, disconnected, or shorted.

- **Status Indication**
  - RS-485 activity is indicated by a **green LED** on the front panel, blinking with each Modbus transmission.
  - Communication Error: The status LED remains continuously ON if the controller detects a communication error. This may occur due to incorrect baud rate, parity settings, or improperly connected A/B signal lines.

> Communication parameters are described in the **6Ai6Ro Modbus Register Table** link.
> See **Section 5.3** link for RS-485 wiring examples and bus termination guidance.

4.4 Power Supply

The controller operates on a **12V or 24V DC power supply**, with a supported input voltage range from **11V to 30V DC**. This ensures compatibility with standard industrial power systems.

To reduce energy consumption, the device includes a **coil voltage reduction feature** that lowers relay coil power after activation, helping minimize heat and extend relay life.

The power input is protected against **reverse polarity connections** up to 30V, reducing the risk of damage during installation.

For detailed power consumption values, see the **Technical Specifications** section 3 link. See **Section 5.3 link** for power wiring examples.

4.5 User Interface: LEDs and Buttons

The controller includes six front-panel buttons and a set of status LEDs for local control and diagnostics.

- **Buttons**
  By default, each button toggles its corresponding relay output.
  However, button behavior is configurable via Modbus, with multiple operational modes:

  - **Disabled**
  - **Standard Toggle Mode**
  - **Offline Mode** (buttons only control relays if no Modbus master is active)
  - **Relay Disable Mode** (relay is blocked from Modbus control until re-enabled via button)

  These modes allow the buttons to be adapted for manual override, safety lockout, or local-only operation.
  Buttons are also used during startup to set the Modbus address and communication settings without the need for external tools.

- **LED Indicators**

  - **Relay LEDs (Yellow)**: Indicate ON, OFF, or BLINKING states for each relay.
  - **Input LEDs (Red)**: Show digital input activity for each input.
  - **Modbus Traffic LED (Green)**: Blinks on Modbus activity.
  - **Status LED (Red)**: Blinks continuously to indicate the controller is running.

These interfaces are designed to support fast installation, diagnostics, and manual control where needed.

Button modes are described in the **6Ai6Ro Modbus Register Table link** .
See **Section 5 link** for hardware layout and LED/button locations.
For local configuration procedures, including setting the Modbus address and baud rate, see **Section 6.1 list .**

4.6 Built-in Rule Engine

The controller features a built-in rule engine that enables local automation by linking inputs, outputs, and internal logic without requiring an external PLC or Modbus master. Each rule is configured via Modbus registers, using dedicated rule type codes and parameters. Up to eight rules can be active at the same time.

Supported Rule Types

Toggle Relay Rule
This rule links one input channel directly to its corresponding relay (e.g., Input 1 controls Relay 1). The relay toggles its state whenever the input changes. Both toggle switches and push-buttons are supported. This mode is primarily intended for lighting control, though it can be used for other simple on/off functions.

Flexible Switch Control Rule
Allows flexible control of multiple relays using multiple inputs, configurable via bitmasks. Each input can be set as a toggle switch or a push-button. A countdown timer can be defined to automatically reset relays after activation. If a new input event occurs during the countdown period, the timer is extended accordingly. This rule is especially suitable for room lighting and scenes where grouped control is needed.

Thermostat Control
Activates or deactivates relays based on the measured temperature from a connected 10k NTC sensor. It is intended for simple heating or cooling control.

Configurable parameters include:

- Temperature input selection
- Relay selection (bitmask)
- Setpoint temperature
- Hysteresis band
- Operating mode: Heating (activate below setpoint) or Cooling (activate above)

Analog Threshold Control
Same structure as the thermostat rule, but compares against the measured voltage instead of a temperature reading. Suitable for level detection, pressure thresholds, or other analog signal-driven control.

Rule Execution

- Rules are executed continuously and locally, regardless of Modbus communication status.
- Each rule is independent and may control one or more relays based on real-time input conditions.
- To modify a rule's configuration, it must first be disabled, updated, and then re-enabled. Changes take effect immediately after re-enabling the rule.

> Rule configuration and register layout are described in the **6Ai6Ro Modbus Register Table** link

4.7 Mechanical and Environmental Design

The 6Ai6Ro controller is intended for use in building automation and general-purpose control systems. It is designed for standard DIN-rail mounting and fits into typical electrical enclosures used in residential, commercial, and industrial installations.

All input, output, and communication connections are made using pluggable terminal blocks, allowing easy installation and replacement without disturbing wiring. The controller occupies a standard 6M DIN rail width and includes clearly labeled terminals to simplify wiring.

The device operates within a wide temperature range and is suitable for dry, non-condensing environments as defined in the technical specifications. Its construction and dimensions follow established electrical cabinet standards, ensuring full compatibility with common enclosure types.

> For exact dimensions, connector types, and environmental ratings, see the **Technical Specifications** section 3 link.

5. Installation

5.1 Unpacking and Inspection

The FoxIoT 6Ai6Ro is shipped in a protective cardboard box. Upon opening, inspect the device for any signs of physical damage that may have occurred during transport. If damage is found or the device appears incomplete, do not proceed with installation and contact FoxIoT technical support.

The package includes:

- FoxIoT 6Ai6Ro controller (with pluggable connectors attached)
- Sticker containing a QR code and a link to online documentation

All necessary installation and configuration resources can be accessed digitally using the provided link or QR code.

5.2 Mounting Instructions

The FoxIoT 6Ai6Ro is designed for quick installation on a standard 35 mm DIN rail (EN 60715). Ensure the electrical cabinet or enclosure provides proper mechanical support. Install the device in an upright position to ensure proper operation and clear visibility of status LEDs.

To mount the device:

1. Tilt the top of the controller slightly toward the DIN rail.
2. Hook the upper part of the mounting clip over the rail.
3. Press the bottom inward until the clip locks into place.

To remove the device, use a small flat-head screwdriver to release the DIN clip at the bottom, then tilt and lift the unit off the rail.

5.3 Wiring and Power Connection

For detailed wiring diagrams and power supply connection instructions, refer to the separate **FoxIoT_6Ai6Ro_Wiring_Instructions.pdf** link provided with this manual.

6. Configuration

6.1 Quick Setup via Front-Panel Buttons: Modbus Address and Serial Parameters

You can quickly set up the device on-site using the front-panel buttons — no software needed.

This allows technicians to configure the Modbus address, baud rate, and serial format directly during installation, making the device ready to communicate with the Modbus master right away.

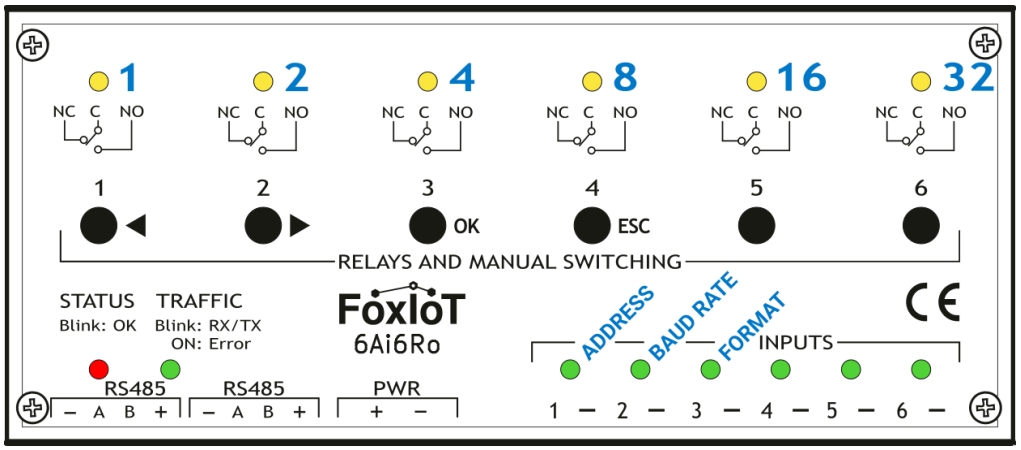
Accessing Configuration Mode

1. **Power Off:** Make sure the device is turned off.
2. **Power On:** Connect power to the device.
3. **Enter Mode:** Within 10 seconds after powering on, press and hold Buttons 1 and 2 simultaneously. If you do not press the buttons within this time, you must restart the process from Step 1.

4. **Confirmation:** Watch for the Status and Modbus Traffic LEDs to blink rapidly while the Input 1 LED blinks more slowly. This indicates that you have successfully entered configuration mode.
5. **Auto-Exit Timer:** Once in configuration mode, a 60-second timer starts. The timer resets with each button press. If no buttons are pressed within 60 seconds, the menu will automatically exit, and any changes made will be saved.

LED/Buttons Panel Overview

Before configuring your device, it's important to understand the functions of the buttons and LEDs on the panel. The following section explains the role of each button and how the LEDs indicate the current status during configuration mode.



Buttons and Their Functions

- **Button 1 (< - Move Left / Decrease):**
  - **In Menu:** Move left to select the previous item.
  - **In Changing Value:** Decrease the current item's value.
- **Button 2 (> - Move Right / Increase):**
  - **In Menu:** Move right to select the next item.
  - **In Changing Value:** Increase the current item's value.
- **Button 3 (OK - Select/Save):**
  - **In Menu:** Select the highlighted item.
  - **In Changing Value:** Save the new value.
- **Button 4 (ESC - Quit/Cancel):**
  - **In Menu:** Exit the menu.
  - **In Changing Value:** Cancel and exit without saving changes.

Status & Traffic LED

- **Blinking Quickly:** Indicates that the configuration menu is currently active.

Input LEDs

- **Functionality:**
  - **Blinking:** Shows the current menu position.
  - **Solid:** Indicates the active item being edited.
- **LED Assignments:**

- **Input LED 1:** Device Modbus address
- **Input LED 2:** Baud rate
- **Input LED 3:** Serial format

How It Works:

- **Only one LED is active at a time.**
  - **Blinking LED:** If LED 2 is blinking, you're navigating the menu. Use the left/right buttons to switch between items (LED 1 for address, LED 3 for format). Press OK to select the item, or press ESC to exit the menu without making changes.
  - **Solid LED:** For example, if LED 2 is solid, the baud rate is selected. Use the left/right buttons to adjust the value. If you're happy with the result, press OK to save or press ESC to cancel.

Output LEDs (1-6)

- **Binary Display:** Each LED represents a binary value:
  - **LED 1:** 1, **LED 2:** 2, **LED 3:** 4, **LED 4:** 8, **LED 5:** 16, **LED 6:** 32

Quick Calculation Guide:
To find the number of the value:

1. **Look at which LEDs are ON.**
2. **Add their values together** using this simple rule:
   - **LED 1 on:** Add 1
   - **LED 2 on:** Add 2
   - **LED 3 on:** Add 4
   - **LED 4 on:** Add 8
   - **LED 5 on:** Add 16
   - **LED 6 on:** Add 32

Example: If LEDs 2 and 4 are on, add their values: 2 + 8 = 10. The displayed value is 10.

Examples:

- **Value 1:** LED 1 on (binary 000001)
- **Value 3:** LEDs 1, 2 on (binary 000011)
- **Value 5:** LEDs 1, 3 on (binary 000101)
- **Value 10:** LEDs 2, 4 on (binary 001010)
- **Value 21:** LEDs 1, 3, 5 on (binary 010101)
- **Value 63:** All LEDs on (binary 111111)

6.1.1 Accessing Configuration Mode

- Power Off: Ensure the device is turned off.
- Power On: Connect power.
- Enter Mode: Within 10 seconds of power-on, press and hold **Buttons 1 and 2** simultaneously.
  Confirmation: The **Status** and **Modbus Traffic LEDs** blink rapidly, and **Input LED 1** blinks slowly — this confirms configuration mode.
  Auto-Exit: If no buttons are pressed for 60 seconds, the mode exits automatically and saves any changes.

6.1.2 Setting Modbus Address

Step 1: Navigate to the address setting using the left/right buttons until **Input LED 1** is blinking.
Step 2: Press **OK** to select the address setting. LED 1 will turn solid to indicate it is active.
Step 3: Use the left/right buttons to adjust the address value (**1 to 62**).
Note: If a higher address is required, it can be set via Modbus.
Step 4: Press **OK** to save the new address, or press **ESC** to cancel and return to the menu.

6.1.3 Setting Baud Rate and Serial Format

Setting the Baud Rate

- **Step 1:** Navigate to the baud rate setting using the left/right buttons until the **Input LED 2** is blinking.
- **Step 2**: Press **OK** to select the baud rate setting. LED 2 will turn solid.
- **Step** 3: Use the left/right buttons to select the desired baud rate:
  1: 300 bps
  2: 600 bps
  3: 1200 bps
  4: 2400 bps
  5: 4800 bps
  6: 9600 bps
  7: 19200 bps
  8: 38400 bps
  9: 57600 bps
  10: 115200 bps

- **Step 4:** Press **OK** to save the baud rate, or **ESC** to cancel.

Setting the Serial Format

- **Step 1**: Navigate to the serial format setting using the left/right buttons until **Input LED 3** is blinking.
- **Step 2**: Press **OK** to select the serial format setting. LED 3 will turn solid.
- **Step 3**: Use the left/right buttons to select the desired format:
  1: 8E1 (8 bits, Even parity, 1 stop bit)
  2: 8N2 (8 bits, No parity, 2 stop bits)
  3: 8N1 (8 bits, No parity, 1 stop bit)
  4: 8O1 (8 bits, Odd parity, 1 stop bit)
- **Step 4**: Press **OK** to save the format, or **ESC** to cancel.

6.1.4 Confirming and Exiting Configuration Mode

- After setting all parameters, press **ESC** repeatedly until all LEDs stop blinking.
- This indicates the device has exited configuration mode, and settings are applied.

6.2 Remote Configuration (via Software/Modbus)

All configuration parameters can be accessed and modified remotely using Modbus RTU communication. This method is suitable for automated setup, system integration, and bulk device management.

Settings such as input modes, relay control, rule definitions, and communication parameters can be configured via Modbus registers.

For a full list of Modbus addresses and register definitions, refer to the separate document: **6Ai6Ro Modbus Register Table** link .

7. Modbus Communication

The FoxIoT 6Ai6Ro communicates over RS-485 using the Modbus RTU protocol, allowing easy integration with PLCs, SCADA systems, and other automation platforms.

All input/output data, configuration settings, and rule parameters are accessible via Modbus registers.

For complete register details, communication examples, and rule configuration via Modbus, refer to: **6Ai6Ro Modbus Register Table** link

8. Firmware Updates

The FoxIoT 6Ai6Ro supports firmware updates via Modbus for secure and convenient in-field upgrades.

8.1 Firmware Update Procedure via Modbus

Firmware updates can be performed remotely through the Modbus interface. This enables the deployment of new features, improvements, or bug fixes without requiring physical access to the device. Firmware is developed and provided by FoxIoT as needed.

For detailed instructions on performing the update, refer to: **6Ai6Ro Modbus Register Table** link .

9. Troubleshooting and Diagnostics

9.1 Status and Traffic LED Indicators

The FoxIoT 6Ai6Ro features two primary diagnostic LEDs on the front panel:

- **STATUS LED** - Indicates the controller's power and operational state.
- **TRAFFIC LED** - Indicates Modbus RTU communication activity and errors..

LED	State	Description
STATUS	Blinking	Normal operation – the controller is powered and running correctly.
	Off	No power or device failed to start.
TRAFFIC	Short blink (50ms)	A valid Modbus RTU packet was received on the bus (regardless of address).
	Long blink (300ms)	The controller sent a response to a Modbus request addressed to it.
	Solid ON	Communication error – check baud rate, parity, and A/B line wiring.
	Off	No communication activity detected.

9.2 Common Problems and Solutions

Problem	Possible Cause	Suggested Action
No Power	Power supply is disconnected, voltage is too low, or polarity is reversed	Verify that the 10–30 V DC power supply is connected with correct polarity and within the required voltage range.
No communication with the controller	Incorrect Modbus address, baud rate, or serial format; wiring issue on A/B lines	- Check that the Modbus master is using the correct slave address, baud rate, parity, and stop bits - Ensure signal lines are connected properly - controller pin A (+) to master A (+) and B (–) to B (–) - If using multiple devices, confirm bus termination is appropriate.
Digital input does not register	Internal pull-up not enabled or Dry contact not closing properly	- Enable the internal 10 kΩ pull-up resistor via Modbus if using a dry (potential-free) contact - Verify that the contact or switch is closing properly and making an electrical connection - Check wiring and ensure input is referenced to the correct ground
Analog input reading is incorrect or unstable	Input mode incorrectly set, pull-up resistor enabled, or sensor wiring issue	- Set the input mode to 1 (pull-up disabled) for analog voltage measurements (e.g., 0–10 V or 4–20 mA). - Check wiring and verify the sensor output is within the expected voltage range - For 4–20 mA sensors, ensure a 250 Ω or 500 Ω resistor is installed between the input and ground - Use shielded cables to minimize electrical noise in sensitive environments
Temperature reading from NTC sensor is incorrect or unstable	Input mode not set correctly for NTC, incorrect thermistor type, or poor wiring issue	- Set the input mode to 10 (for 10 kΩ, β=3435) or 11 (for 10 kΩ, β=3977), depending on your thermistor type - Ensure the thermistor is properly connected to the input and ground - Avoid long, unshielded cables, which may introduce noise or resistance.
Relay does not switch	Incorrect Modbus command or relay damaged	- Verify the Modbus command sent to control the relay is correct (write 1 to turn ON, 0 to turn OFF) - Confirm that the Output LED turns ON when the relay is activated - this indicates the controller is attempting to switch the relay - If the LED is ON but no click or output change is observed, the relay may be damaged - Check wiring and confirm proper voltage is present at the relay terminals
Relay does not respond to button press	Button functionality disabled or incorrect button mode configured	- Check the button mode in the configuration registers; buttons can be disabled or assigned to other functions - Refer to the Modbus register table for valid button modes

10. Maintenance

10.1 Cleaning and Care

⚠️ **Disconnect all power sources before handling the device.**
This includes both the controller's power supply and any connected external circuits.

This device is designed for indoor cabinet installation and requires minimal maintenance. However, to ensure long-term reliability:

- **Exterior Cleaning:** If needed, wipe the enclosure with a dry or slightly damp lint-free cloth. Avoid using solvents or abrasive materials.
- **Connector Maintenance**: Occasionally inspect power and communication terminals. If oxidation or debris is present, clean with contact cleaner or compressed air approved for electronics.
- **Environmental Considerations:** Make sure the controller operates within the specified environmental limits. Excessive dust, moisture, or heat can degrade performance or shorten lifespan.

Do Not Open Enclosure:
The device contains no user-serviceable internal parts. Opening the enclosure voids the warranty.

10.2 Periodic Inspections

- **Visual Inspection (every 12 months):**
  - Check for signs of mechanical damage or wear.
  - Ensure mounting is secure and stable.
  - Verify that no cables or connectors are loose, frayed, or damaged.
  - Tighten any loose terminals or mounting screws.
- **Communication & Power Status:**
  - Verify indicator LEDs for normal operation.
  - Use Modbus diagnostics registers to confirm communication health and system uptime.
- **Firmware Version Check:**
  - Ensure the device is running the recommended firmware version for your system.

10.3 Firmware Maintenance

Version Monitoring:

- Periodically check the manufacturer's website or support channel for firmware updates, especially if new features or bug fixes are released.

Update Procedure:

- Firmware updates are performed via Modbus RTU. Follow the official update guide carefully.
- Do not disconnect power or communication during the update.

Post-Update Validation:

- After updating, verify the firmware version via the Modbus register.
- Check that all previous settings are unchanged and the device operates normally.

11. Warranty and Support

This chapter outlines the terms of the product warranty, its limitations, the procedure for contacting technical support, and the process for returning a device under the Return Material Authorization (RMA) process.

11.1 Warranty Conditions

The manufacturer provides a limited warranty for a period of **24 months** from the date of purchase. This warranty covers defects in materials and workmanship under normal use, in accordance with the product's user manual and environmental specifications.

During the warranty period, the manufacturer will repair or replace defective units at no charge, provided the product has not been modified, misused, or subjected to adverse environmental conditions.

Key conditions:

- Valid only for original products from the manufacturer
- Proof of purchase may be required
- Warranty service is limited to repair or replacement
- The warranty does not cover any associated costs such as removal, reinstallation, or transportation

11.2 Warranty Limitations

The warranty **does not apply** in the following cases:

- Physical damage caused by mishandling, impact, fire, or water exposure
- Damage due to improper installation, incorrect wiring, or operation outside the specified limits
- Modifications or repairs carried out by unauthorized personnel
- Normal wear and tear
- Software issues related to non-standard configurations

The warranty is void if the product has been opened or tampered with in any way not approved by the manufacturer.

11.3 How to Contact Technical Support

If you encounter a problem or have technical questions, please contact our support team through one of the following channels:

- **Email:** support@foxiot.eu
- **Support Hours:** Monday to Friday, 10:00–16:00 CET
- **Languages Supported:** English, Estonian

We recommend having your device's serial number, firmware version, and a detailed description of the problem ready when contacting support.

11.4 RMA Process (Return Material Authorization)

To return a product for repair or replacement, you must obtain a valid **RMA number** from our support team. Devices returned without an RMA will not be accepted or processed.

RMA Procedure:

1. Contact technical support to report the issue.

2. Provide the product's serial number, a clear description of the issue, and proof of purchase.
3. Receive an RMA number and return instructions.
4. Carefully package the product to prevent shipping damage and include the RMA number.
5. Send the unit to the designated return address provided by support.

Once received, the device will be inspected to determine warranty coverage. If the issue is not covered under warranty, a repair estimate will be provided.

Returns via Distributors or Resellers:

If the product is being returned by an end customer through an **authorized reseller or distributor**, the following applies:

- The **reseller/distributor** is responsible for collecting all required documentation from the end customer, including the product serial number, fault description, and proof of purchase.
- The **RMA request must still be submitted by the reseller/distributor** to the manufacturer's support team to obtain a valid RMA number.
- The **reseller/distributor must consolidate communication** with the end customer and manage the logistics of the return, unless agreed otherwise.
- Please ensure that all returns, even if initiated by an end customer, follow the official RMA process through the authorized sales channel to avoid delays in handling.

Direct Returns from End Customers

If an end customer wishes to return a product directly to the manufacturer (without going through a reseller or distributor), the following rules apply:

- The end customer must first contact the technical support team and provide:
    - Product serial number
    - Detailed fault description
    - Proof of purchase showing purchase date and seller

- The manufacturer reserves the right to verify whether the product was purchased through an authorized sales channel and to determine its eligibility for warranty service.
- If eligible, an RMA number and return instructions will be provided.
- If the product is **not covered** under warranty (e.g., unauthorized source, expired warranty, excluded fault), a quotation for repair or replacement will be issued.

Note: While direct returns are accepted, we recommend contacting your reseller or distributor first, as they may be able to offer faster handling and local support.