AcuIOM
Universal I/O Module
User Manual



ACCUENERGY

Legal Notice

Please read this manual carefully before installation, operation, and maintenance of the AcuIOM I/O Module.

The information contained in this document is believed to be accurate at the time of publication. However, Accuenergy assumes no responsibility for any errors which may appear here and reserves the right to make changes without prior notice as part of continuing improvements.

Please ask the local representative for the latest product specifications before ordering.

The following symbols in this manual are used to provide warning of danger or risk during the installation and operation of the module.

ELECTRIC SHOCK SYMBOL: Carries information about procedures which must be followed to reduce the risk of electric shock and danger to personal health.

SAFETY ALERT SYMBOL: Carries information about circumstances which, if not considered, may result in injury or death.

NOTE SYMBOL: Advance notice providing additional information before an action is taken by the user.

Prior to maintenance and repair, the equipment must be de-energized and grounded. All maintenance work must be performed by qualified, competent accredited professionals who have received formal training and possess experience with high voltage and current devices. Accuenergy shall not be responsible or liable for any damage or injury caused by improper module installation and/or operation.

Table of Contents

Chapter 1: Introduction

1.1 Overview

The AcuIOM I/O Module is a flexible, high precision input/output device designed for signal acquisition and control in industrial and building automation systems.

The module enables reliable communication between field devices such as sensors/actuators and control systems, including PLCs (Programmable Logic Controllers), DCS (Distributed Control Systems), and gateway devices. It provides real-time monitoring and control of analog and digital signals for a wide range of applications.

The AcuIOM supports multiple types of input and output signals as described below:

- **Analog Input (AI)**
  Measures continuous signals such as voltage or current from sensors for tracking parameters like temperature, pressure, and flow.
- **Analog Output (AO)**
  Outputs continuous control signals to devices such as pumps, valves, or variable-speed drives.
- **Digital Input (DI)**
  Detects status signals (ON/OFF), supports pulse counting, and records sequence-of-events (SOE).
- **Digital Output (DO)**
  Provides switching (ON/OFF) control for external devices such as alarms, indicators, and control circuits.
- **Relay Output (RO)**
  Enables switching of higher-power loads using isolated relay contacts.

These functions allow the AcuIOM to act as a flexible interface between physical processes and digital control systems.

1.2 Product Models

The AcuIOM series includes multiple models with different I/O configurations. Table 1-1 provides available I/O combinations for all the models of AcuIOM.

Table 1-1 I/O Combinations for Different AcuIOM Models

Model	Configuration
AcuIOM-1	8 Analog Input, 2 Analog Output
AcuIOM-2	16 Analog Input, 4 Analog Output
AcuIOM-3	14 Digital Input, 2 Digital Output, 2 Relay Output
AcuIOM-4	28 Digital Input, 4 Digital Output, 2 Relay Output

Each model is designed to meet specific application requirements while maintaining consistent communication and configuration interfaces.

1.3 Key Features

- High accuracy signal acquisition and control
- Modular I/O configurations for flexible deployment
- Support for Modbus RTU and Modbus TCP/IP
- Dual Ethernet ports for network connectivity
- Built-in data acquisition and event logging (SOE)
- Configuration and monitoring via Acuview 2 software
- DIN rail mounting for quick installation

1.4 Applications

AcuIOM is suitable for a wide range of industrial and building automation applications.

Process Monitoring and Control

- Acquires data from sensors including temperature, pressure, and flow.
- Controls actuators such as valves and pumps.

Factory Automation

- Monitors machine statuses and safety signals.
- Controls motors, conveyors, and robotic systems.

Energy Management

- Monitors electrical parameters and energy consumption.
- Controls loads such as lighting and HVAC systems.

Building Automation

- Integrates with HVAC, lighting, and access control systems.

- Monitors environmental and safety conditions.

Water and Wastewater Systems

- Monitors and controls pH, flow rates, and turbidity.
- Controls pumps and valves for safe and efficient operation.

1.5 Standards and Compliance

The AcuIOM is designed and tested to meet relevant international standards including:

- UL Certification
- CE Certification
- IEC 61131-2 Compliance

Chapter 2: Installation

2.1 Safety Information

SAFETY WARNING

- Installation must be performed by qualified personnel with experience in electrical systems.
- Ensure the device is de-energized before wiring or maintenance.
- Use appropriate Personal Protective Equipment (PPE) such as gloves and safety glasses.
- Do not exceed the rated voltage and current limits specified for the device.
- Avoid contact with terminals during operation, as hazardous voltage may be present.

Failure to follow these instructions may result in equipment damage, injury, or death.

NOTE

Any repair should only be performed by the manufacturer. A switch or circuit breaker should be utilized in the equipment. The switch should be placed close to the equipment, so that it can be easily accessed. The switch is regarded as part of the breaking device.

2.2 Environmental Requirements

Ensure the installation environment meets the conditions shown in Table 2-1.

Table 2-1 Installation Environment Requirements

Parameter	Specification
Operating Temperature	-25°C to 70°C (-13°F to 158°F)
Storage Temperature	-40°C to 85°C (-40°F to 185°F)
Relative Humidity	0% to 95% (Non-Condensing)
Altitude	≤ 2000 m
Pollution Degree	2
Installation Location	Indoor Use Only

Installation Guidelines

- Install the module in a clean, dry, and well-ventilated enclosure
- Avoid exposure to:

- Excessive heat or direct sunlight
- Strong electromagnetic interference (EMI)
- Dust, vibration, or corrosive environments

2.3 Appearance and Dimensions

The front panel provides a power indicator and an operation indicator. The power indicator is located on the left, and the operation status indicator is on the right. Please refer to the silkscreen markings for exact identification.

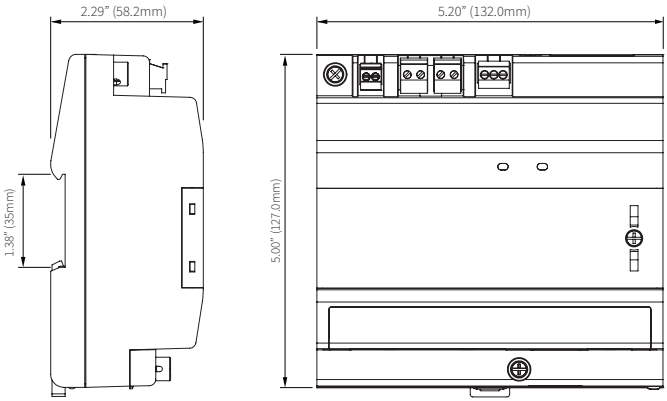

Figure 2-1 Module Appearance and Dimensions

2.4 Methods

The AcuIOM module is designed for mounting on a standard 35mm DIN rail.

Installation Steps

1. Pull down the mounting clip at the bottom of the module.
2. Position the module onto the DIN rail.
3. Press the module firmly until it is seated.
4. Push the mounting clips back into place until they lock.

Ensure the module is securely fastened and does not move on the rail.

Clearance Requirements

Provide sufficient space around the module for:

- Wiring access
- Heat dissipation
- Maintenance and removal

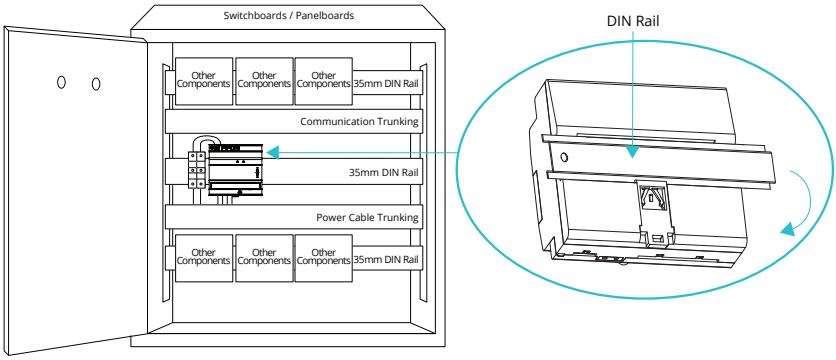

Figure 2-2 I/O Module DIN Rail Installation

2.5 Wiring

2.5.1 Terminals

The I/O module terminals are grouped as shown in Table 2-2. Specified input and output terminals depend on select models.

Table 2-2 Module Terminal Groups

Terminal Group	Description
Power	DC Power Input (+ / -)
AI	Analog Input Channels
AO	Analog Output Channels
DI	Digital Input Channels
DO	Digital Output Channels
RO	Relay Output Channels
Communication	RS485, Ethernet
USB	USB Communication and Power

Refer to product labelling for exact terminal locations. Note, AcuIOM-1 and AcuIOM-2 models do not include the relay output ports as shown in Figure 2-3.

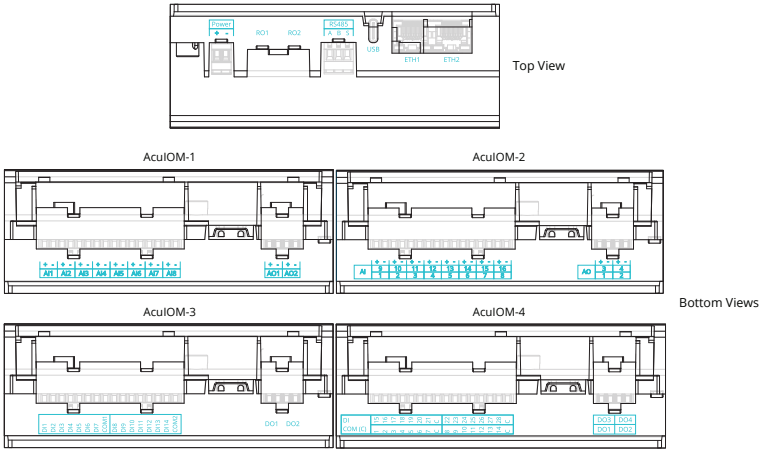

Figure 2-3 Terminals for AcuIOM-1, AcuIOM-2, AcuIOM-3, and AcuIOM-4

2.5.2 Wiring Guidelines

When wiring the AcuIOM use appropriate wire sizes according to Table 2-3.

NOTE When powered via USB, the RS485 terminal cannot be operated.

Table 2-3 I/O Module Terminal Specifications

Terminal Name	Function	Terminal Type	Terminal Aperture	Wire/Cable Type	Screw Torque
Power + -	Power Input Port	AWG Type	1.5 mm²	16 AWG	0.2 N·m
S, B, A	RS485 Communication Port	AWG Type	1.5 mm²	16 AWG	0.2 N·m
USB	Power Input Port for MCU or USB Modbus RTU	Plug-In Type	Dedicated Line	USB-C	-
ETH, ETH2	Ethernet	Plug-In Type	Dedicated Line	CAT5/6	-
AIx	Sensor Input of Voltage or Current Signal	AWG Type	1.5 mm²	16 AWG	0.2 N·m
DIx	Used as Status Input or Pulse Counter	AWG Type	1.5 mm²	16AWG	0.2 N·m
AOx	Protocol-Controlled Output, Converted into Voltage or Current Signal	AWG Type	1.5 mm²	16 AWG	0.2 N·m
DOx	Protocol-Controlled Output	AWG Type	1.5 mm²	16 AWG	0.2 N·m
ROx	Protocol-Controlled Output	AWG Type	2.5 mm²	16 AWG	0.66 N·m

2.5.3 Power Supply

Safety Warning

Ensure power is OFF before wiring to prevent personal injury or damage to the device.

Supply Type	SELV / LPS compliant DC supply
Voltage Range	12-36 VDC
Maximum Power Consumption	6 W

Ensure correct polarity when connecting the power terminals.

2.5.4 Analog and Digital I/O Terminal Wiring

Before wiring the analog and digital I/O terminal:

- Ensure the correct signal type, voltage or current is used for the AI/AO channels.
- Verify polarity before powering the module.
- Use shielded cables for analog signals in noisy environments.

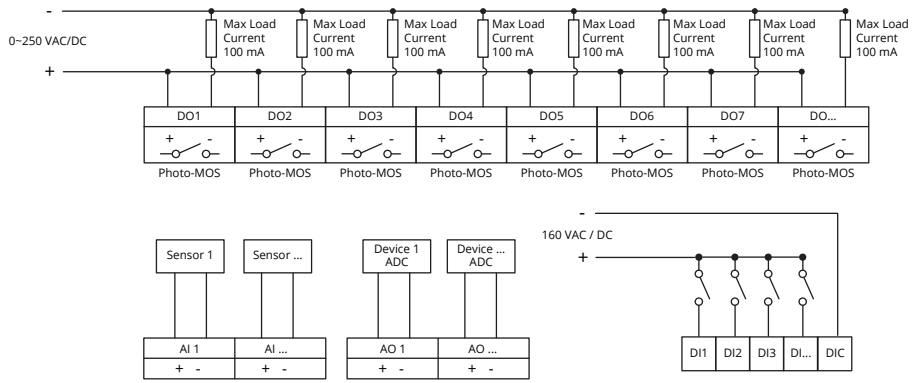

Figure 2-4 Analog and Digital I/O Terminal Wiring

2.5.5 Relay Output Wiring

Ensure to use appropriate cable rating for load and the load current does not exceed relay specifications.

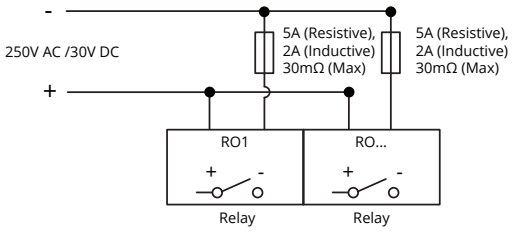

Figure 2-5 RO Wiring

2.6 Communication Connections

2.6.1 Ethernet Modbus TCP/IP

Use a standard CAT5 or higher Ethernet cable and connect it to either Ethernet port, as the ports are not independent.

Default Settings	
IP	192.168.1.254
Subnet	255.255.255.0
Gateway	192.168.1.1
Modbus Port	502
Modbus Slave ID	1

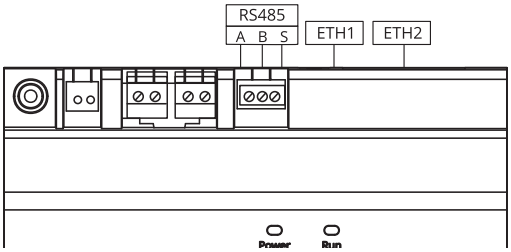

Figure 2-6 Communication Connections

2.6.2 RS485 Modbus RTU

RS485 Modbus RTU uses a shielded twisted-pair cable and supports a maximum bus length of 1200 m.

Installation Guidelines:

- Use daisy-chain topology; avoid star wiring.
- Install 120 Ω resistors at both ends of the bus.
- Max devices per bus: 32; use repeaters if more are required.
- Ground shield at a single point only.

Default Settings	
Modbus Slave ID	1
Baud Rate	19200
Parity	None 1 (No parity, 1 stop bit)

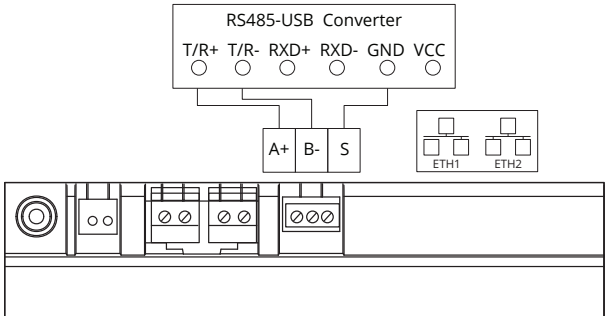

Figure 2-7 RS485 Wiring

2.7 USB Connection

The AcuIOM module includes a USB-C port for configuration and communication.

USB Mode Characteristics
• Can power the module when external power is not connected • Supports Modbus configuration via Acuview 2 software
Limitations
• I/O functions are disabled. • RS485 communication is not available. • The USB mode is for setup only, not for operation.
Default Settings
• Modbus Slave Address: 1 • Baud Rate: 19200 • Parity: None 1 (No parity, 1 stop bit)

Chapter 3: Functions and Software

3.1 Introduction to Acuview 2 Software

The AcuIOM module is configured and monitored using the Acuview 2 software, which provides:

- Device configuration and parameter setup
- Real-time monitoring of I/O signals
- Data logging and export
- Diagnostics and system management tools

The software communicates with the module through:

- Ethernet using Modbus TCP/IP
- RS485 using Modbus RTU
- USB using Modbus RTU for configuration only

The Acuview 2 software can be downloaded for free from the Accuenergy website:
https://www.accuenergy.com/acuview-2

3.2 Connecting to the Module

3.2.1 Connection Methods

The AcuIOM supports the following connection methods:

- Ethernet for Modbus TCP/IP
- RS485 for Modbus RTU
- USB for Modbus RTU to perform configuration only

RS485 connection to a PC requires a USB-to-RS485 converter.

Two wires should be used for connecting the USB-to-RS485 converter to the module:

- T/R+ from the converter to A+ on the I/O module
- T/R- from the converter to B- on the I/O module
- GND from the converter to S on the I/O module

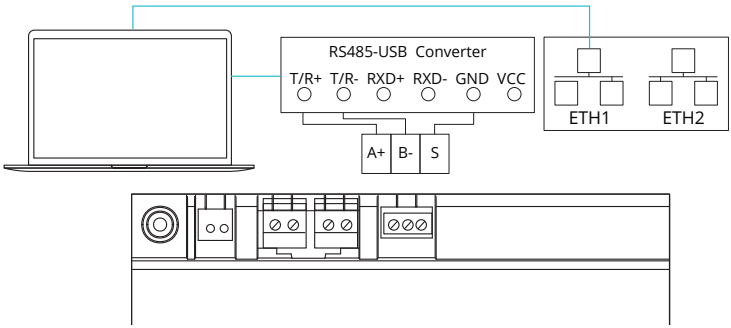

Figure 3-1 I/O Module Communication Port Connection

3.2.2 Connection Procedure

1. Open the Acuview 2 software on the PC.
2. Click **+** as shown in the first image of Figure 3-2.
3. On the new page, click ⊕.
4. Enter a name for the I/O module. For the Model, select **AcuIOM.**
5. There are two connection methods: **Modbus RTU** and **Modbus TCP/IP.** Select the appropriate method based on your connection.
   If **Modbus RTU** is selected, the COM port can be confirmed through the Microsoft Windows Device Manager of the computer.

Modbus TCP/IP Default Settings	
IP Address	192.168.1.254
Subnet	255.255.255.0
Gateway	192.168.1.1
Modbus Port	502
Modbus Slave ID	1

Modbus RTU Default Settings	
Modbus Slave ID	1
Baud Rate	19200
Parity	None1 (No parity, 1 stop bit)

6. Click **Save.**

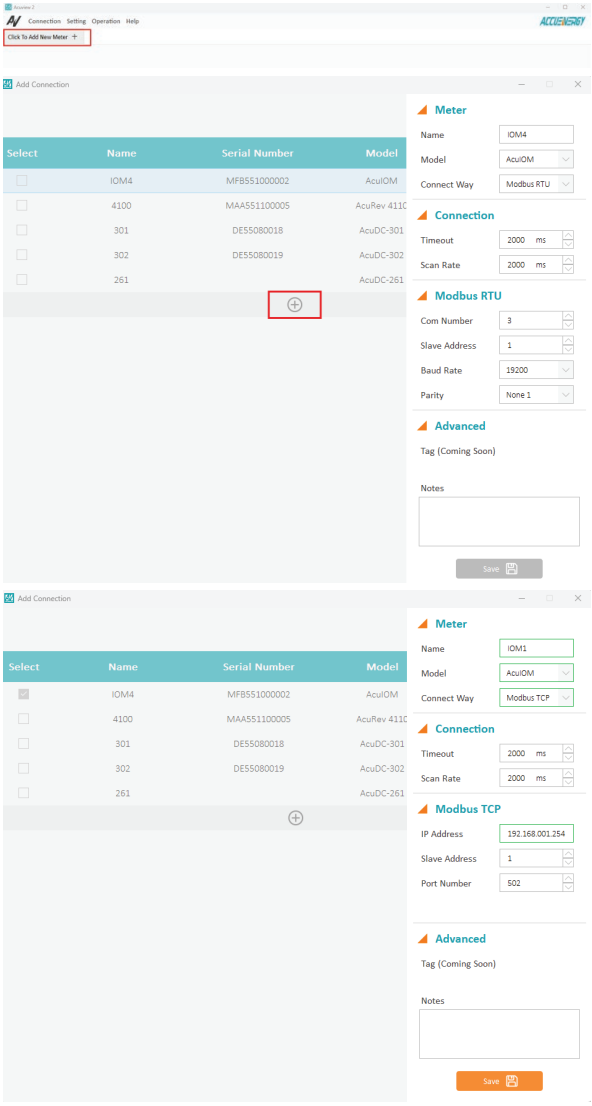

Figure 3-2 Acuview 2 Connection Procedure

7. Select the device and click on **Connect.**

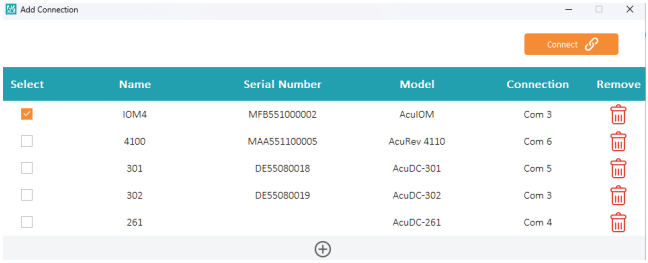

Figure 3-3 Device Selection in Acuview 2

8. After the connection is successful, enter the main interface.

3.2.3 Software Interface Overview

The Acuview 2 software allows users to interact with the device. A range of operations can be performed through Acuview 2. Figure 3-4 presents a view of the software interface and highlights four sections labeled A, B, C and D. Details for the labeled parts are provided below the figure.

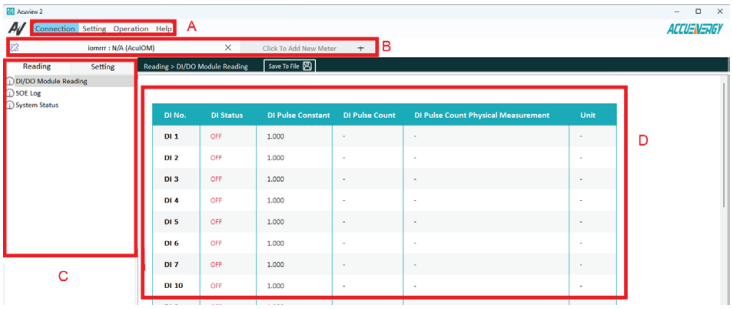

Figure 3-4 Acuview 2 Interface

A. Menu Bar

The section labeled A is the Menu Bar. It contains four parts: Connection, Setting, Operation and Help.

Connection		
	Connect	Connects Device, Enables Data Reading, and Allows Writing Command.
	Disconnect	Disconnects Device, Stops Data Reading, and Disallows Write Command.
	Add Connection	Adds and Connects to a New Device.
	Remove Connection	Disconnects and Removes Current Active Connection.

Setting		
	General Setting	Checks and Sets the General Setting of the Application.
	Data Log Setting	Checks and Sets the Data Log Setting of Each Connected Module.
	Clear Cache	Removes All Connections.

Operation		
	Export Configuration	Saves Current Active Module's Configuration and Exports it as Configuration File.
	Import Configuration	Selects Downloaded Configuration File and Imports Settings to Current Module.
	Firmware Update	Selects Firmware File and Updates Available Module.
	Find Device	Searches for All Available Modules on the Local Network.
	Calculate Pulse Constant	Helps Calculate Pulse Constant Parameters.
	Start Data Logging	Starts Data Logging if the Data Log Setting is Completed.
	Stop Data Logging	Stops Data Logging.

Help		
	User Manual	Opens Acuview 2 User Manual.
	About	Opens a Window that Displays Software Information.
	Check for Software Update	Updates Acuview 2.

B. Window Title

Section B shows the Window Title. It displays name, serial number, and model type for each device. Users can choose the device they want to interact with by clicking the corresponding tab.

C. Explore Panel

Section C represents the Explore Panel. It allows for quick navigation of the module's functions. The basic functions of the device are divided into two parts: Reading and Setting. Data in the Reading part automatically refreshes according to the configured scan rate when the user connects the device.

D. Data Panel

Section D is the Data Panel, which presents real-time readings of the module. It provides users with various operations to interact with and control the module's functionality. The top function bar exhibits the current page name along with additional operation buttons, such as save and reset.

3.3 Settings

Users can configure the settings of the AcuIOM I/O module from the Acuview 2 software. Multiple configuration options are available, including password, communication, and demand method.

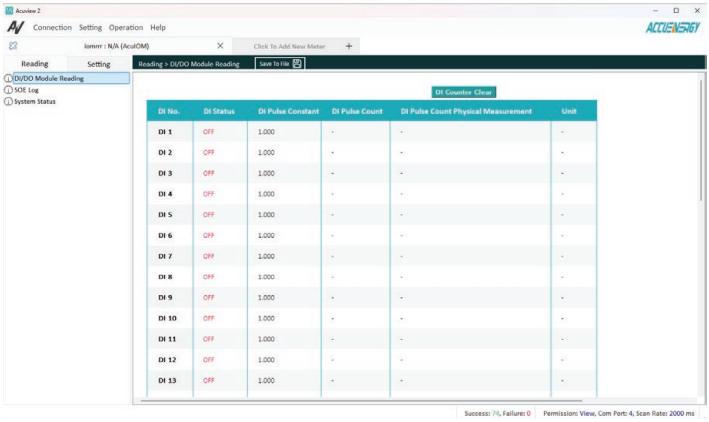

Figure 3-5 AcuIOM Configuration in Acuview 2

3.3.1 General Settings

To access the settings from Acuview 2, click on the **Setting** tab located on the left panel of the software and select General. Users can change the settings for the AcuIOM and use the Update Device button to confirm the settings.

This page is primarily for the system's communication configuration.

Ethernet Default Communication Settings	
IP Address	192.168.001.254
Subnet Mask	255.255.255.000
Gateway	192.168.001.001
Address	Users can configure the Modbus TCP/IP address for the module; the default is 1 and the range is 1-247.

RS485 Default Communication Settings	
Address	Users can configure the Modbus address for the device; this refers to the Modbus address via RS485. The range is from 1-247 while the default slave address is 1.
Baud Rate	Users can configure the baud rate for the RS485 port. The range is 2400-115200 bps while the default is 19200 bps.
Parity	Users can configure the parity check; the default is None 1 (No parity, 1 stop bit).

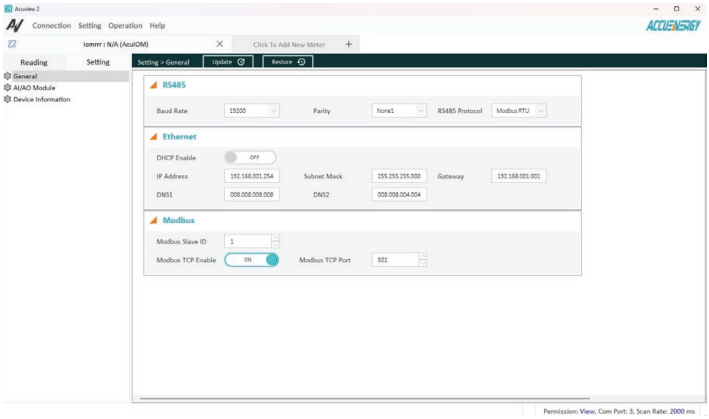

Figure 3-6 AcuIOM Communication Settings in Acuview 2

After modifying parameters, click **Update Device** to apply changes.

To cancel the changes and revert to the previously saved values, click **Restore.**

The same procedure applies across all configuration pages.

3.3.2 AI/AO Module

Users can configure the AI/AO type, curve, and physical unit.

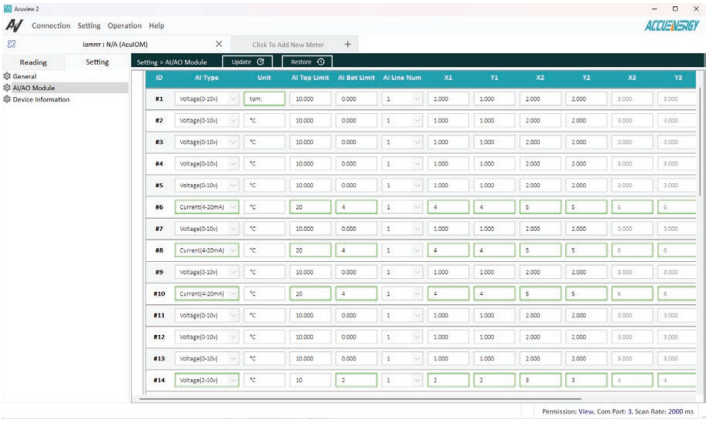

Figure 3-7 AI Settings

AI/AO Type	Four types are available for user selection Voltage: 0 - 10 V, 2 - 10 V; Current: 0 - 20 mA, 4 - 20 mA.
Engineering Unit	User defined for example, °C, Pa, kWh. The maximum input length is 4 characters.
Scaling Limits	Set the maximum and minimum values of the physical quantity for the channel signal.
Signal Conversion Curve	Piecewise linear scaling with custom calibration. Users can set the number of segments for the curve and the corresponding coordinate points. Refer to the calibration plot Figure 3-7 below.
Unit	°C
AI Top limit	100 °C
AI Bottom limit	-10 °C
Number of Linear Segments	3
X1: 0 mA, **Y1:** -10 °C; **X2:** 10 mA, **Y2:** 0 °C; **X3:** 15 mA, **Y3:** 20 °C; **X4:** 20 mA, **Y4:** 100 °C	

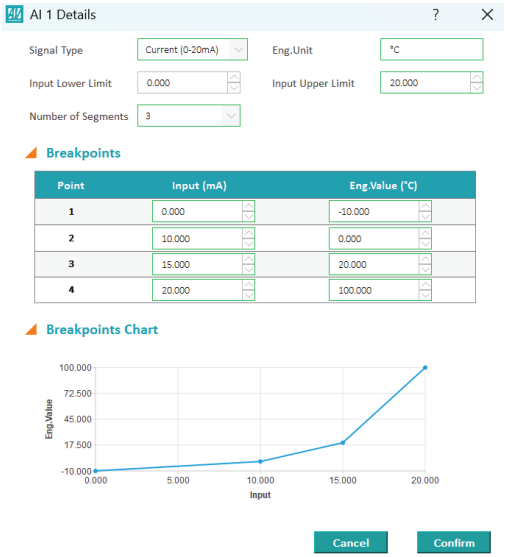

Figure 3-8 Current-Temperature Calibration Plot

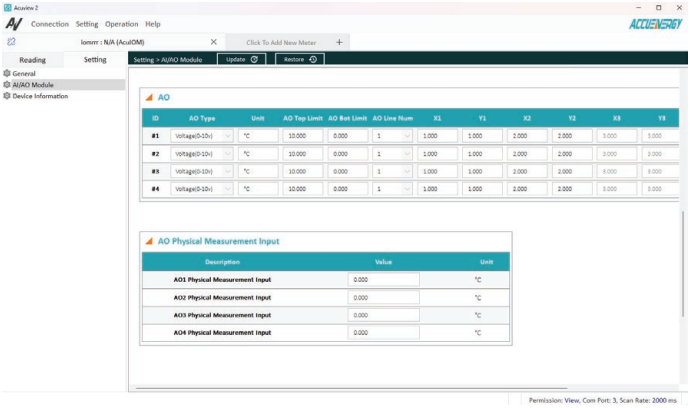

Figure 3-9 Analog Output Settings

Users can set the AO output physical quantity for debugging, which is updated in real-time through the communication protocol during operation.

The AO output signal is typically controlled via communication protocols by PLCs, DCS systems, or third-party devices such as the AcuRev-4100-WEB2.

For example, when a user intends to control the opening of a valve, a corresponding command is sent to AcuIOM. Upon receiving the command, the AcuIOM generates a corresponding current signal, between 4 and 20 mA, to control the valve position. For example, 4 mA and 20 mA represent 0% open and 100% open, respectively.

AI signals are typically sourced from external devices, such as pressure, temperature, humidity, and displacement sensors/transmitters, inverters/controllers with analog outputs, or laboratory/test equipment. The signals may also be user-defined setpoints.

For example, when the user intends to measure the ambient humidity in a working environment, the humidity sensor signal can be connected to the AI input terminal. By applying the sensor characteristics and corresponding scaling curve, the AcuIOM will measure the ambient humidity. A humidity range of 0–100 % RH maps to a voltage range of 0–10 V.

3.3.3 DI/DO/RO Module

The AcuIOM contains digital output ports, digital input ports and relay output ports.

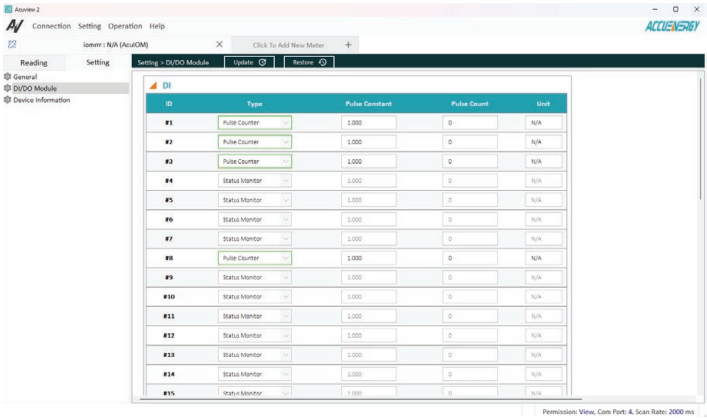

Figure 3-10 Digital Input Settings

Digital Input Channel

The DI channels support two operating modes:

Pulse Counter

Used for pulse metering, displaying the pulse count and the converted physical measurement. At this stage, it is necessary to select a proper pulse constant, which will be used as the reference for physical measurement. The relationship is defined as follows:

$$\text{Physical Measurement} = \text{Pulse Count} \times \text{Pulse Constant}$$

Users can configure the pulse count value and its measurement unit for the channel.

Status Monitor

Monitors the status signals of external inputs and records them. SOE function incorporates status and timestamp.

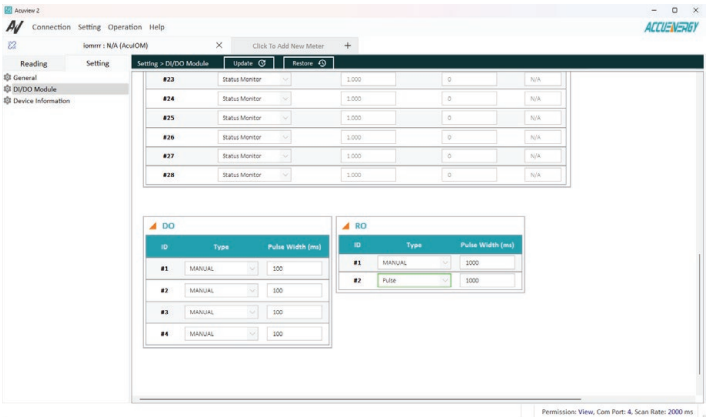

Figure 3-11 Digital Output Settings

Relay Output and Digital Output Channels

The DO and RO channels support two operating modes:

Pulse Mode

Output activated for a defined duration between 20 and 3000ms; the default pulse is 100ms.

Manual Mode

Output state (ON/OFF) is controlled directly by communication protocol.

Both DO (Digital Output) and RO (Relay Output) are binary controls with different characteristics. DO provides active powered output, while RO is a dry contact output with a higher load capacity. Both types of outputs can be controlled via communication protocols by third-party devices and are commonly used for start/stop control, status indication, logic control, switch actuation, external triggering, and similar applications. For example, they can be used to control the start and stop of a motor, enabling automated operations.

3.3.4 Device Information

Users can view the software version information through **Device Information.**

Device Information	
Function Model	AcuIOM 01
Serial Number	N/A
Hardware Version	N/A
Bootloader Version	v1.01p04
Firmware Version	v1.01p04
Release Date	2025/08/05
Mac Address	N/A
Manufacture	ACCUENERGY(CANADA)

Figure 3-12 Device Specifications

3.4 Reading

The Reading section provides real-time visibility of all I/O channels.

3.4.1 Analog Signals

The AI/AO Module Reading page displays:

- Raw signal values in V or mA
- Scaled physical values
- User-defined units
- Data refresh rate:10 ms.

Each page under the **Reading** menu has a **Save To File button,** allowing users to save the file at any time.

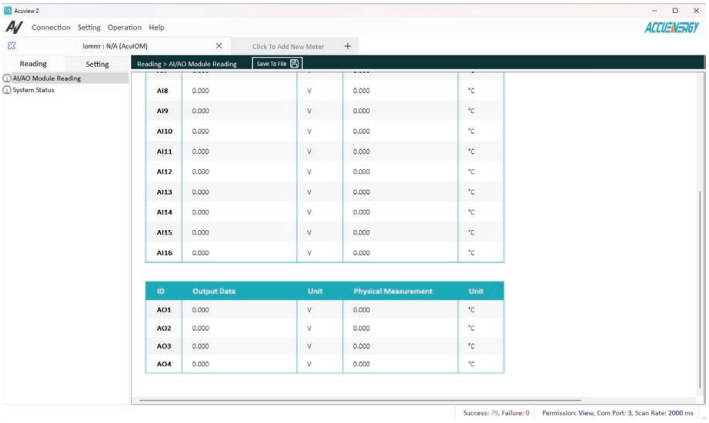

Figure 3-13 AI/AO Module Reading Page

3.4.2 Digital Signals

The DI/DO/RO Module Reading screen displays:

- Input status: ON/OFF
- Pulse counts, if enabled
- Output states

NOTE When DI is configured as a status input, only the DI status is displayed, and all other information is ignored. When DI is configured for pulse metering, the pulse constant, pulse count, and converted measurement value with unit are displayed. The DI status is ignored.

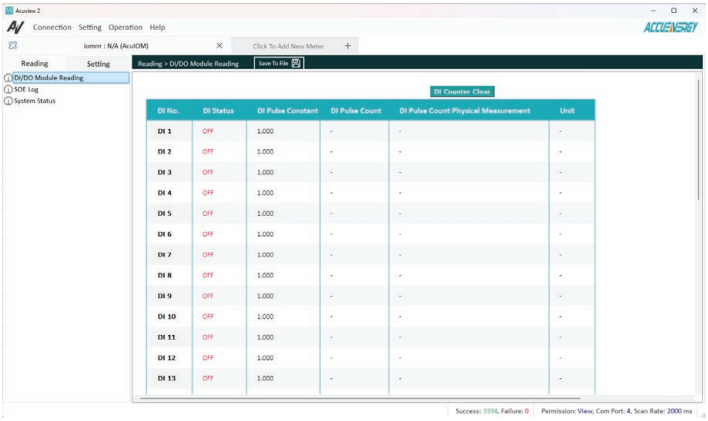

Figure 3-14 DI/DO Module Reading Page showing Digital Inputs

If DO/RO is set as a pulse output, the channel status is disregarded. In manual mode, the channel's real-time status is displayed and can be manually operated. When the status is ON, clicking the control button turns it OFF, and vice versa. In practical applications, the output can also be modified in real-time through the communication protocol. It is usually carried out by third-party devices, such as PLCs, DCSs, or gateway devices.

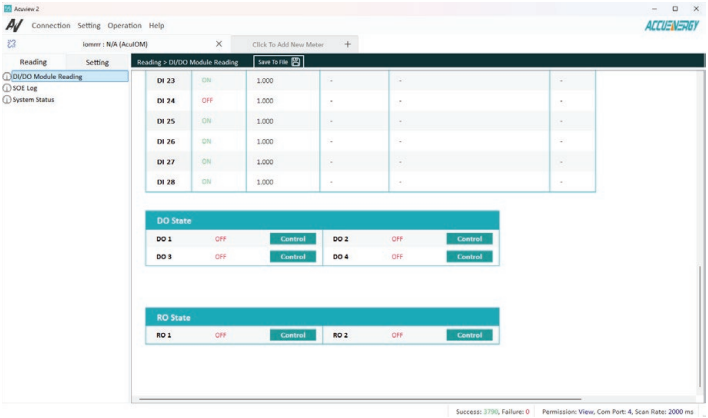

Figure 3-15 DI/DO Module Reading Page

3.4.3 SOE Log Reading

In this interface, users can monitor the status changes of all the digital inputs (DI), with each event recorded along with a timestamp. The module can store up to 200 event records. Users can select the number of latest records to read via a dropdown menu. The available options are 20, 60, and 200.

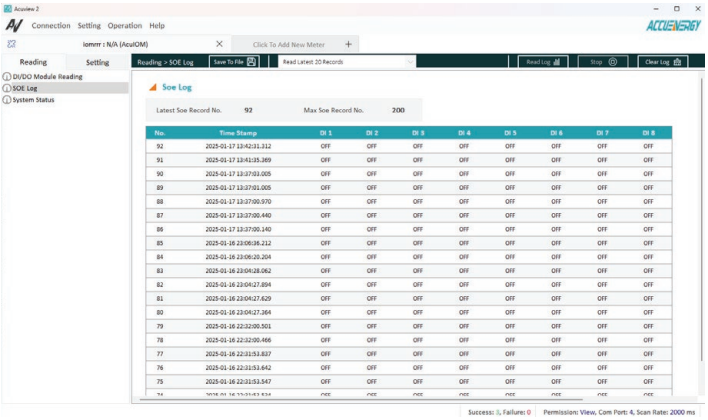

Figure 3-16 SOE Log Page

Users can also store SOE files here and clear all SOE logs.

3.4.4 System Status

The system status displays and controls system-level information such as:

- Device time: synchronized with PC or manually set
- Device runtime and load time
- System reset and restart functions

In this interface, the system can either **Use PC Time** or **the user can set up Custom Time.** The time format is **YYYY-MM-DD HH:MM:SS.** After selecting the desired method, click **Set Time** to apply the setting.

The **System Status** section displays the **Device Run Time.** The value can be reset using the **Clear** button.

Restore the device using the following methods:

Reset Network: Module network configuration initialized to default settings.

Factory Reset

The module will restore all configurations to factory defaults. All data, including SOE logs, will be cleared. Please proceed with caution.

These methods cannot be used when the device is sealed.

Users can click **Save To File** to export and save the current screen data to the local device.

If a device restart is required, click **Reboot button**.

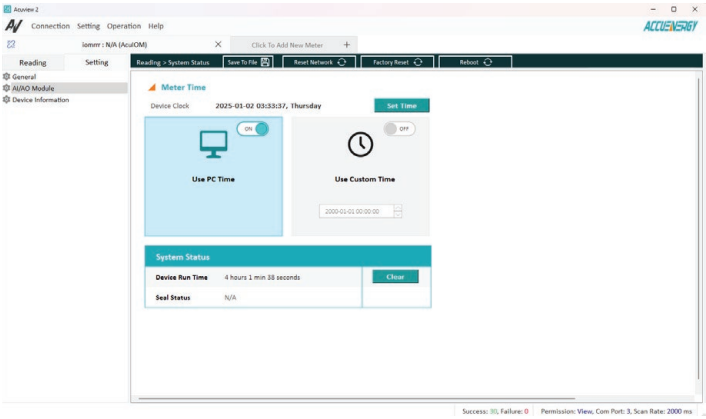

Figure 3-17 System Status Page

3.5 Interaction with Gateway/WEB2 Modules

The AcuIOM is designed to operate in coordination with a gateway module, enabling more advanced and system-level functions. While the AcuIOM provides reliable input/output signal acquisition and control, the gateway delivers higher-level processing, data logging, communication protocol conversion, monitoring, and automation logic. Together, they form a flexible and scalable solution suitable for a wide range of applications.

Use Case Examples

Alarm Handling

A gateway with alarm monitoring functions can link an alarm condition to one of the AcuIOM's digital outputs (DO) or relay outputs (RO). When the alarm is triggered, the gateway commands the selected DO or RO channel to activate, driving an external device such as an alarm light, buzzer, or protective relay.

Analog Input Visualization

The gateway can acquire analog input (AI) values from the AcuIOM and display them on its HMI or web interface. It can also record the data in logs and forward it through other communication protocols. This allows operators to monitor real-time sensor readings like temperature, pressure, flow and enhances system visibility and diagnostics.

Analog Output Control

The gateway can periodically monitor analog input values and use them to control one of the AcuIOM's analog outputs (AO). For example:

- Pressure sensor connected to an AI channel can be read by the gateway, which then regulates a variable-speed pump via an AO channel.
- Power measurement from an electric meter can be processed by the gateway, which then generates a control signal through an AO channel to manage load or power factor correction equipment.

This interaction effectively closes the loop between measurement and actuation, allowing the system to operate in a more intelligent and automated manner.

Chapter 4: Communication

The AcuIOM supports serial Modbus RTU and BACnet MS/TP, as well as Ethernet Modbus TCP/IP.

Modbus TCP/IP is a communication protocol that runs over Ethernet. Unlike Modbus RTU, which uses serial communication and a specific frame format with start/stop bits and CRC checks, Modbus TCP/IP encapsulates the Modbus protocol within TCP/IP packets. Key differences include:

Frame structure

- Modbus RTU: Uses a compact binary frame with a CRC for error checking.
- Modbus TCP/IP: Adds a 7-byte MBAP (Modbus Application Protocol) header before the usual Modbus data; CRC is not needed because TCP/IP already ensures data integrity.

Port

- Modbus TCP/IP typically uses port 502.

Transport

- Modbus RTU is for serial lines including RS485 and RS232.
- Modbus TCP/IP runs over standard Ethernet networks.

Modbus TCP/IP allows traditional Modbus messages to be transmitted reliably over Ethernet, making it easier to integrate with modern networked systems.

BACnet MS/TP (Master-Slave/Token-Passing) is a communication protocol commonly used in building automation systems. It runs over RS485 serial networks and uses a token-passing mechanism to control which device can transmit data at a given time, ensuring orderly communication. BACnet MS/TP supports multiple devices on a single bus and is widely used for connecting HVAC, lighting, and other building control devices.

Key points:

- Transport: RS485 serial line.
- Access method: Token-passing for bus arbitration.
- Application: Building automation e.g. HVAC, lighting, sensors.

AcuIOM supports the mainstream open communication protocol Modbus. The standard configuration is Modbus RTU protocol. This manual only lists the Modbus RTU address table under this protocol. Other items, such as the BACnet MS/TP address table and EPICS, will be provided to customers in a separate document.

4.1 Modbus Protocol Introduction

AcuIOM uses the Modbus RTU communication protocol. The Modbus protocol defines the data characteristics, like check code and data sequence, which are necessary for specific data exchange.

NOTE The full AcuIOM Modbus register map can be downloaded from the Accuenergy website at www.accuenergy.com/acuiom

4.1.1 Transmission Mode

The transmission mode is a series of independent data structures within a data frame and defined rules for data transmission. The transmission mode compatible with the Modbus RTU protocol mode is defined below.

Table 4-1 Modbus RTU Transmission

Coding System	8-bit
Start	1-bit
Stop	1-bit
Data	8-bit
Error Checking	CRC (Cyclic Redundancy Check)
Parity	No Parity/Odd Parity/Even Parity

4.1.2 Protocol

When a data frame arrives at the terminal device, it enters the addressed device through a simple "port". The device removes the envelope, or data header, of the data frame and reads the data. If there is no error, it executes the data transfer and then, the requested task by adding the data it generates to the obtained envelope and returning the data frame to the sender. The returned response data contains the following content: the terminal slave address (Address), the executed command (Function), the requested data (Data) generated by executing the command, and a check code (Check). There will be no successful response if any error occurs.

Frame Format

Table 4-2 Data Frame Format

Address	Function	Data	Check
08-bit	8-bit	N * 8-bit	16-bit

Address Field

The address field is at the start of the frame. It is composed of 1 byte (8 bits). Its decimal value range is 0-247.

A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

Function Field

When a message is sent from a master to a slave device, the function code field tells the slave what kind of action must be performed.

Table 4-3 Function Code

Code	Meaning	Action
01	Read DO Status	Obtain Digital (Relay) Output Status (ON/OFF)
02	Read DI Status	Obtain Digital Input Status (ON/OFF)
03	Read Data	Obtain Current Binary Value from One or More Registers
05	Control DO	Control Digital (Relay) Output (ON/OFF)
16	Preset Multiple Registers	Place Specific Value into a Series of Consecutive Multiple Registers

Data Field

The Data Field contains the data that terminals need to complete the request and the data that terminals provide by responding to the request. This data may be a numerical value, address or setting. For example, Function Code tells the terminal to read one register. Similarly, Data Field needs to specify the register to be read and the number of registers to read.

Error Check Field

This field allows error checks by master and slave devices. As a result of electrical noise and other interferences, a group of data may be changed while transmitting from one location to the other. Error Check ensures master or slave devices do not respond to the distorted data during

the transmission, which enhances system security and efficiency. Error Check uses 16- bit Cyclic Redundancy Check (CRC 16).

4.1.3 CRC

The Cyclic Redundancy Check (CRC) field occupies two bytes and contains a 16-bit binary value. The CRC value is calculated by the transmitting device and then appended to the data frame. The receiving device recalculates the CRC value when receiving the data and compares it with the value in the received CRC field. If the two values are not equal, it will cause an error.

During the CRC operation, a 16-bit register is first preset to all 1s. Then, 8 bits in each byte of the data frame are continuously calculated using the current value of the register. Only 8 data bits participate in generating CRC. Start bit, stop bit, and possible parity bit do not affect CRC. When generating the CRC, the 8 bits of each byte are XORed with the contents of the register, and then the result is shifted to the low bit. The high bit is supplemented with "0", and the least significant bit (LSB) is shifted out and checked. If it is 1, the register is XORed with a preset fixed value i.e. 0xA001H. If the lowest bit is 0, no processing is done.

The above processing is repeated until 8 shift operations are performed. After the last bit/ 8th bit is shifted, the next 8-bit byte is XORed with the current value of the register, and the procedure above is performed. When all the bytes in the data frame are processed, the final value generated is the CRC value.

CRC Process

1. Preset a 16-bit register to 0xFFFFH i.e., all 1s. This is called the CRC register.
2. Perform exclusive OR operation on the 8 bits of the first byte in the data frame and the low byte in the CRC register. Store the result back to the CRC register.
3. Shift the CRC register one bit to the right. Fill the highest bit with 0, move the lowest bit out and check.
4. If the lowest bit is 0, repeat the third step by shifting to the next bit; if the lowest bit is 1, connect the CRC register to a preset value. The fixed value, i.e. 0A001H, is XORed.
5. Repeat the third and fourth steps until 8 shifts. A complete eight bits are processed in this way.
6. Repeat steps 2 to 5 to process the next eight bits until all byte processing ends.
7. Swap the high and low bytes of the CRC register. The result is the CRC value.

4.2 Modbus Communication Format

The examples in this section will use the format shown in Table 4-4 as much as possible. The numbers are in hexadecimal format.

Table 4-4 Protocol Example

Address	Function Data	Data Start Reg Hi	Data Start Reg Lo	Data #of Regs Hi	Data #of Regs Lo	CRC16 Hi	CRC16 Lo
01H	03H	20	00H	00H	02H	CFH	CBH

Addr	Slave device address.
Fun	Function code.
Data start reg hi	Start register address, high byte.
Data start reg lo	Start register address, low byte.
Data #of reg hi	Number of registers, high byte.
Data #of reg lo	Number of registers, low byte.
CRC16 Hi	CRC high byte.
CRC16 Lo	CRC low byte.

4.3 AcuIOM Application Details and Parameter Address Table

The following data types are used in the AcuIOM Modbus register map.

4.3.1 Types of Data

Bit	Refers to binary bits.
Word	16-bit unsigned integer occupying a data address. It contains two bytes. The value range is 0~65535.
Int	16-bit signed integer occupying a data address. It consists of two bytes. The value range is -32768~32767.
Dword	32-bit unsigned integer occupying two data addresses. The high word comes first, and the low word comes after. It has a total of 4 bytes. Value range is 0~4294967295; Rx = high word X65536 + low word.
Float	Single-precision floating-point number occupying two data addresses. It contains a total of 4 bytes. The value range is 0.0~3.402823E+38.

4.3.2 Data Scaling

The communication value of the instrument is not necessarily equal to the actual value. There is a certain conversion relationship between them. This is very important. The production of the upper-level software must make it clear which conversion relationship is being used for the collected parameters. Otherwise, it will lead to wrong results.

ACCUENERGY

MAKE ENERGY USAGE SMARTER

ACCUENERGY INC.

440 Comstock Road,
Toronto, ON M1L 2H6, Canada

TF: 1-877-721-8908
INT: +1-416-497-4100
FAX: +1-416-497-4130
E: marketing@accuenergy.com

ACCUENERGY SOUTH AFRICA (PTY) LTD

Castle Walk Corporate Park,
Block B, Cnr. Nossob & Swakop Street
Erasmuskloof, Pretoria, 0181
South Africa

TF: +27 (0) 87 802 6136

Revised: June 2026