

Acuvim II Series Power Meter

User Manual







ACCUENERGY

Copyright © 2026 V: 3.2.17

This manual may not be altered or reproduced in whole or in part by any means without the expressed written consent of Accuenergy.

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

Please read this manual carefully before installation, operation and maintenance of the Acuvim II Series Power Meter. The following symbols in this manual are used to provide warning of danger or risk during the installation and operation of the equipment.



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.

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 have experience with high voltage and current devices. Accuenergy shall not be responsible or liable for any damages or injuries caused by improper meter installation and/or operation.

Table of Contents

Chapter 1: Introduction 7

1.1 Meter Overview 7
1.2 Areas of Application 8
1.3 Functionality 9

Chapter 2: Installation 14

2.1 Appearance and Dimensions 16
2.2 Installation Methods 18
2.3 Wiring 22
2.3.1 Power Requirement 22
2.3.2 Voltage Input Wiring 24
2.3.3 Current Input Wiring 28
2.3.4 Supported Wiring Methods 31
2.3.5 Communication 34

Chapter 3: Meter Display & Parameter Settings 37

3.1 Display Panel and Keys 37
3.2 Metering Data 39
3.2.1 Voltage and Current Data 39
3.2.2 Power, Power Factor, and Frequency 42
3.2.3 Phase Angles and Unbalance 43
3.2.4 Energy 44
3.2.5 TOU Display 46
3.2.6 Load Time 48
3.2.7 Dual Source 48
3.3 Statistical Data 50
3.4 Demand Data 51
3.5 Harmonic Data 52
3.5.1 Power Quality Data 52
3.5.2 Individual Harmonic Data 54
3.6 Expanded I/O Module Data 55
3.6.1 Module Selection 55

3.7 Meter Setting Mode....58
3.7.1 Password Inquiry....58
3.7.2 Parameter Selection Mode....59
3.7.3 System Settings....60
3.7.4 I/O Module Settings....62
3.7.5 Communications Module Settings....64
3.7.6 Alarm Settings....67
3.8 Page Recovery Function....68
Chapter 4: Detailed Functions and Software....69
4.1 Acuview 2 Software....69
4.1.1 Connect using RS485....69
4.2 Basic Analog Measurements....72
4.2.1 High-Speed Monitoring....73
4.2.2 Moving Average Frequency....73
4.3 Demand....74
4.4 Energy....75
4.4.1 Active Energy:....76
4.4.2 Reactive Energy....77
4.4.3 Apparent Energy....78
4.4.4 Four Quadrant Energy....79
4.5 Max/Min....80
4.6 Harmonics and Power Quality Analysis....81
4.6.1 Harmonics & THD....81
4.6.2 Amplitude and Angle....82
4.6.3 Phase Angles....83
4.6.4 Sequence Component and Unbalance Analysis....84
4.6.5 Phase Order....86
4.7 Alarm....87
4.7.1 Alarm Log....91
4.8 Meter Settings....92
4.8.1 Communication....92
4.8.2 Wiring, CT/PT Ratios....94

4.8.3 Demand Settings 95
4.8.4 Energy Reading & Power Factor Settings 95
4.8.5 Load Percentage 96
4.9 Time & Date Configuration 97
4.10 Data Logging 98
4.10.1. Data Log Setting 98
4.10.2 Retrieving Data Log 102
4.11 Time-of-Use (TOU) 103
4.11.1 General TOU Setting 103
4.11.2 Billing & Tariff Setting 105
4.11.3 TOU Seasons 106
4.11.4 TOU Schedule 107
4.11.5 TOU Weekend Schedule 108
4.11.6 Holiday Settings 110
4.11.7 Ten Years Holiday Settings 111
4.11.8 DST Settings 114
4.11.9 Reading the TOU Data 115
4.12 Power Quality Event Logging and Waveform Capture 118
4.12.1 Waveform Capture 118
4.12.2 Power Quality Event Logging 121
4.12.3 Waveform Retrieval 122
4.13 Dual Source Energy 124
4.13.1 Controlling the Energy Direction 125
4.13.2 Bi-Directional Energy Switching Record 126
4.14 Phase Selection 126
4.15 Independent Channel 127
4.15.1 Independent Channel Configuration 127
4.15.2 Independent Channel Reading 130
4.16 Modbus Gateway Passthrough 132
4.16.1 Gateway configuration 133
4.16.2 Read Through Gateway Modbus TCP 136

Chapter 5: Extended Modules 138
5.1 I/O Modules 138
5.1.1 Appearance and Dimensions 138
5.1.2 I/O Functionality 139
5.1.3 Installation Method 142
5.1.3.1 Change I/O Module's Logic Address 144
5.1.3.2 Switch Analog Input and Analog Ouput Type 145
5.1.4 I/O Module Wiring 146
5.1.5 Detection of Remote Signals 151
5.1.6 Pulse Counter 154
5.1.7 Relay Output 157
5.1.8 Digital Output 159
5.1.10 Analog Input 167
5.2 Profibus Module AXM-PROFI 170
5.2.1 Introduction of PROFIBUS Technology 170
5.2.2 PROFIBUS Module Application Notes 170
5.2.3 Appearance and Dimensions 171
5.2.4 Installation Method 171
5.2.5 Definition of DP Interface 172
5.2.6 Cable 172
5.2.7 Bus Terminal 172
5.2.8 Address Setting 173
5.2.9 Baud Rate 174
5.2.10 GSD Files 174
5.2.11 Information Exchange 174
5.2.12 Format of Function Code 01H 175
5.2.13 Format of Function Code 05H 176
5.2.14 Format of Function Code 02H 177
5.2.15 Format of Function Code 03H 179
5.2.16 Format of Function Code 10H 180
5.2.17 32 Word Output Interface 181

5.3 RS485 Module (AXM-485) 182
5.3.1 Communication Parameters Setting 182
5.3.2 Function Description of RS485 module 182
5.3.3 Appearance and Dimensions 183
5.3.4 Installation Method 183
5.3.5 Connection Method 184
5.3.6 Communication Address 185
Chapter 6: Communication 186
6.1 Modbus Protocol Introduction 186
6.2 Communication Format 188
6.3 Data Address Table and Application Details 192
6.3.1 Data Type 192
6.3.2 Relationship between communication value and numerical value. 192
6.3.3 Modbus Register Map 194
6.4 BACnet Protocol 194
6.4.1 BACnet Overview and Introduction 194
6.4.2 BACnet Protocol on the Acuvim II Power Meter Series 195
6.4.3 BACnet MS/TP Communication 195
6.4.4 BACnet IP Communication 199
6.4.5 Acuvim II Series Power Meter's BACnet Objects 201
Appendix 204
Appendix A Technical Data and Specification 204
Appendix B Ordering Information 208

Chapter 1: Introduction

1.1 Meter Overview

Powerful Multi-function Power Meter

The Acuvim II series multi-function digital power meter is designed using MCU (microcontroller unit) and DSP (digital signal processing) technology. It integrates three-phase energy measurements and displays energy accumulation, power quality analysis, over-under alarm, data logging, and network communication. A bright LCD display with large clear characters and a programmable time-of-use backlight that provides real-time data readouts.

Ideal for Electric Automation SCADA Systems

The Acuvim II series meter is the ideal choice for replacing traditional analog meters. In addition to providing clear real-time readings on the meter display, it can also be used as a remote terminal unit (RTU) for monitoring and controlling a SCADA system. Users can access all measurement parameters via the standard RS485 communications port with the Modbus protocol or the optional Ethernet port from a communication module.

Energy Management

The Acuvim II series meter can measure bidirectional energy as well as four quadrant energy (kWh) and reactive energy (kvarh). It provides maximum/minimum records for power usage and power demand parameters. All power and energy parameters can be viewed remotely via software to easily monitor various parameters. In addition, measurement tables can be viewed from our free Acuview 2 software.

Remote Power Control

This meter is designed to measure and monitor power quality parameters. There are different I/O modules that can be added to the meter. This expands the meter's capabilities and provides a very flexible platform for using the meter as a distributed RTU for metering, monitoring, and remote controlling all in one unit.

Power Quality Analysis

By utilizing digital signal processing (DSP) technology, the Acuvim II series meter provides high accuracy power quality analysis and supports remote monitoring via the Ethernet module. The meter continuously

updates the metering results and allows users to access the meter online to monitor parameters such as voltage and current harmonics, voltage and current crest factors, voltage and current unbalance factors along with other parameters.

Data Logging

The Acuvim IIR and Acuvim IIW meters utilize 8MB (megabytes) of on-board memory for data logging and historical trending. Since the meters contain real-time clocks, all events and logged data will include a timestamp of when data is recorded.

Time-of-Use (TOU)

Users can assign up to four different tariffs (sharp, peak, valley, normal) to different time periods within a day according to the billing requirements. The meter will calculate and accumulate energy to different tariffs according to the meters internal clock and TOU settings.

Power Quality Event Logging

When a power quality event occurs, such as voltage sag or swell, the Acuvim IIW meter will record the timestamp and the triggering condition of the event. It can save up to 50,000 power quality events.

Waveform Capture

The Acuvim IIW contains another 8MB (megabytes) of on-board memory for power quality event logging and waveform capture. The Acuvim IIW can record 100 groups of voltage and current waveform. It can log at 40 cycles (20 pre-triggering cycles) with 64 samples per cycle, or at 20 cycles (10 pre-triggering cycles) with 128 samples per cycle. It also supports a settable triggering condition.

1.2 Areas of Application

- Submetering
- Energy Storage,
- Microgrids, and VPPs
- Power Generation
- Load Banks
- PDUs and Data Centers

- Substation and distribution systems
- Transformer Monitoring
- Measurement & Verification
- Industry Automation
- Energy Management Systems
- Electric Switch Gear and Control Panels
- Building Automation

1.3 Functionality

Multi-function

The Acuvim II meter provides powerful data collection and processing functions. In addition to measuring various parameters, the meter can perform demand metering, harmonic analysis, max/min statistic recording, over/under limit alarm, energy accumulation, and data logging.

High Accuracy

The accuracy of voltage and current is 0.1% True-RMS.

The accuracy of power and energy is 0.1% while monitoring all four quadrants.

Compact and Easy to Install

This meter can be installed into a standard ANSI C39.1 (4" round) or an IEC 92mm DIN (square) cut out. With a depth of 51mm after mounting, the Acuvim II series meter can be installed in a small cabinet. Mounting clips are used for easy installation and removal.

Easy to Use

All metering data and setting parameters can be accessed by using the keys on the front panel of the meter or by using Modbus via the communication port. Setting parameters are in the EEPROM (Electrical Erasable Programmable Read-Only Memory) so that content will be preserved when the meter is powered off.

Multiple Wiring Modes

The Acuvim II series meter can be used in high voltage, low voltage, three-phase three wires, three-phase four wires and single-phase systems using different wiring mode settings.

High Safety, High Reliability

The Acuvim II series meter was designed according to industrial standards. It can run reliably under high power disturbance conditions. This meter has been fully tested for EMC and safety compliance in accordance with UL and IEC standards.

Function Comparison of Acuvim II Series Meter

	Items	Parameters	Acuvim IIR	Acuvim IIW
Real-Time Metering	Phase Voltage	V1, V2, V3, VInavg	•	•
	Line Voltage	V12, V23, V31, VIIavg	•	•
	Current	I1, I2, I3, In, Iavg	•	•
	Power	P1, P2, P3, Psum	•	•
	Reactive Power	Q1, Q2, Q3, Qsum	•	•
	Apparent Power	S1, S2, S3, Ssum	•	•
	Power Factor	PF1, PF2, PF3, PF	•	•
	Frequency	F	•	•
	Load Features	L/C/R	•	•
	Four Quadrant Power	Four Quadrant Powers	•	•
Independent channel	System Phase Voltage	V1, V2, V3, VInavg	•	•
	System Line Voltage	V12, V23, V31, VIIavg	•	•
	System Frequency	F	•	•
	Current	Ichannel1, Ichannel2, Ichannel3, Ichannel4, Isum_1avg, Isum_2avg	•	•
	Power	Pchannel1, Pchannel2, Pchannel3, Pchannel4, Psum_1, Psum_2	•	•
	Reactive Power	Qchannel1, Qchannel2, Qchannel3, Qchannel4, Qsum_1, Qsum_2	•	•
	Apparent Power	Schannel1, Schannel2, Schannel3, Schannel4, Ssum_1, Ssum_2	•	•
	Power Factor	PFchannel1, PFchannel2, PFchannel3, PFchannel4, PFsum_1, PFsum_2	•	•
	Load Features	Load Features	•	•
	Four Quadrant Powers	Four Quadrant Powers	•	•
	Energy	Epchannel1_imp, Epchannel2_imp, Epchannel3_imp, Epchannel4_imp Epchannel1_exp, Epchannel2_exp, Epchannel3_exp, Epchannel4_exp, Epsum1_imp, Epsum2_imp, Epsum1_exp, Epsum2_exp, Epsum1_Total, Epsum2_Total, Epsum1_Net, Epsum2_Net	•	•
	Reactive Energy	Eqchannel1_imp, Eqchannel2_imp, Eqchannel3_imp, Eqchannel4_imp Eqchannel1_exp, Eqchannel2_exp, Eqchannel3_exp, Eqchannel4_exp, Eqsum1_imp, Eqsum2_imp, Eqsum1_exp, Eqsum2_exp, Eqsum1_Totoal, Eqsum2_Total, Eqsum1_Net, Eqsum2_Net	•	•

	Items	Parameters	Acuvim IIR	Acuvim IIW
Independent channel	Apparent Energy	Eschannel1, Eschannel2, Eschannel3, Eschannel4, Essum1, Essum2	•	•
	Demand	Dmd_Pchannel1, Dmd_Pchannel2, Dmd_Pchannel3, Dmd_ Pchannel4 Dmd_Qchannel1, Dmd_Qchannel2, Dmd_Qchannel3, Dmd_ Qchannel4 Dmd_Schannel1, Dmd_Schannel2, Dmd_Schannel3, Dmd_ Schannel4, Dmd_Psum1, Dmd_Psum2, Dmd_Qsum1, Dmd_Qsum2 Dmd_ Ssum1, Dmd_Ssum2, Dmd_Ichannel1, Dmd_Ichannel2, Dmd_Ichannel3, Dmd_ Ichannel4	•	•
Energy	Active Energy	Ep_imp, Ep_exp, Ep_total, Ep_net , Epa_imp, Epa_exp, Epb_imp, Epb_ exp, Epc_imp, Epc_exp, Ep_q1, Ep_q2, Ep_q3, Ep_q4	•	•
	Reactive Energy	Eq_imp, Eq_exp, Eq_total, Eq_net, Eqa_imp, Eqa_exp, Eqb_imp, Eqb_ exp, Eqc_imp, Eqc_exp	•	•
	Apparent Energy	Es_imp, Es_exp, Es_total, Es_net, Esa, Esb, Esc, Es_q1, Es_q2, Es_q3, Es_q4	•	•
Dual Source Energy	Energy to Generator	Energy1_Generator, Energy2_Generator, Energy3_Generator	•	•
	Energy to Grid	Energy1_Grid, Energy2_ Grid, Energy3_Grid	•	•
Demand	Current Demand	Dmd_I1, Dmd_I2, Dmd_I3, Dmd_ In	•	•
	Power Demand	Dmd_Psum, Dmd_Qsum, Dmd_ Ssum	•	•
Time	Real Time Clock	Year, Month, Date, Hour, Minute, Second	•	•
Hour	Meter Running Time	Hour	•	•
	Load Running Time	Hour	•	•
Power Quality	Voltage Unbalance	U_unbl	•	•
	Current Unbalance	I_unbl	•	•
	Voltage THD	THD_V1, THD_V2, THD_V3, THD_Vavg	•	•
	Current THD	THD_I1, THD_I2, THD_I3, THD_Iavg	•	•
	Individual Harmonics	Harmonics 2nd to 63rd (50Hz or60Hz)	•	•
	Voltage Crest Factor	Crest Factor	•	•
	TIF	THFF	•	•
	Current K Factor	K Factor	•	•
Sequence	Voltage/Current Sequence	Positive Sequence, Negative Sequence, Zero Sequence	•	•
	Phase Order	ABC, ACB	•	•
Phase Angles	Voltage/Current Phase Angles	Voltage Phase Angle, Current Phase Angle	•	•
Statistics	MAX with Time Stamp MIN with Time Stamp	Each Phase of V & I Total of P, Q, S, PF & F Demand of I1, I2, I3, IN, P, Q, & S Each Phase THD of V & I Unbalance Factor of V & I	•	•

	Items	Parameters	Acuvim IIR	Acuvim IIW
Alarm	Over/Under Limit Alarm	V, I, P, Q, S, PF, V_THD & I_THD Each Phase and Total/Average Unbalance Factor of V& I Load Type Analog and Digital Input of Each Channel Demand of I1, I2, I3, P, Q & S Reverse Phase Sequence	•	•
Waveform Capture	Voltage and Current Waveform	Trigger, Manual,DI change, Sag/Dip, Swell, Over Current		•
Power Quality Event Logging	Power Quality Event with Time Stamp	Voltage SAG and fail, Current overflow, Phase Sequence Error		•
Data Logging	Data Logging 1 Data Logging 2 Data Logging 3 Data Logging 4	Frequency V1, V2, V3, VInavg V12, V23, V31, VIIavg I1, I2, I3, In, Iavg P1, P2, P3, Psum Q1, Q2, Q3, Qsum S1, S2, S3, Ssum Ep_imp, Ep_exp, Ep_total, Ep_net, Eq_imp, Eq_exp, Eq_total, Eq_net, Es_imp, Es_exp, Es_total, Es_net Epa_imp, Epa_exp, Epb_imp, Epb_exp, Epc_imp, Epc_exp Eqa_imp, Eqa_exp, Eqb_imp, Eqb_exp, Eqc_imp, Eqc_exp Esa_imp, Esa_exp, Esb_imp, Esb_exp, Esc_imp, Esc_exp PF1, PF2, PF3, PF U_unbl, I_unbl Load Type THD_V1, THD_V2, THD_V3, THD_Vavg THD_I1, THD_I2, THD_I3, THD_Iavg Harmonics 2nd to 63rd, Crest Factor, THFF, K Factor Sequence, phase angles DI counter, AI, AO Dmd P, Dmd Q, Dmd S, Dmd_I1, Dmd_I2, Dmd_I3	•	•
Time of Use	Energy/Max Demand	TOU, 4 Tariffs, 12 Seasons, 14 Schedules	•	•
	Daylight Saving Time	Two Adjustable Formats	•	•
I/O Module	Switch Status (DI)	Digital Input	○	○
	Power Supply for DI	24V DC	○	○
	Relay Output (RO)	NO, Form A	○	○
	Digital Output (DO)	Photo-MOS	○	○
	Pulse Output (PO)	By Using DO	○	○
I/O Module	Analog Input (AI)	0 (4) – 20mA, 0 (1) – 5V	○	○
	Analog Output (AO)	0 (4) – 20mA, 0 (1) – 5V	○	○

	Items	Parameters	Acuvim IIR	Acuvim IIW
Communication	RS485 Port, Half Duplex, Optical Isolated	Modbus-RTU/BACnet Protocol	•	•
	Ethernet Module	Modbus-TCP, HTTP, SMTP, SNTP, Modbus Gateway Passthrough	∘	∘
	RS-485 Module	Modbus-RTU Protocol	∘	∘
On-board Memory Size	Memory	Bytes	8MB	16MB (8MB Data Logging + 8MB Power Quality)
Display	LCD or DIN Rail		∘	∘
Dimensions	96×96×64.3mm (Opening Size: 92 × 92mm)			

• : Function ∘ : Optional **Blank**: N/A

Chapter 2: Installation

Considerations When Installing Acuvim II

- Installation of the meter must only be performed by qualified personnel who follow standard safety precautions throughout the installation procedures. Those personnel should have the appropriate training and experience with high-voltage electrical devices. Appropriate safety gloves, safety glasses and protective clothing are recommended.
- During normal operation, dangerous voltage may flow through many parts of the meter, including the terminals, any connected current transformers (CTs) or potential transformers (PTs), all I/O modules and their circuits. All primary and secondary circuits can produce lethal voltages and currents. AVOID contact with any current-carrying surfaces.
- The meter and its I/O output channels are **NOT** designed as primary protection devices and can **NOT** be used in primary circuit protection or in an energy-limiting capacity. The meter and its I/O output channels can only be used as a secondary protection. **AVOID** using the meter in situations where failure of the meter may cause injury or death. **AVOID** using the meter for any application where the risk of fire may occur.
- All meter terminals should be made inaccessible after installation.
- Do **NOT** perform a Dielectric (HIPOT) test on any inputs, outputs, or communications terminals. High voltage testing may damage the electronic components of the meter.
- Exceeding more than the maximum voltage the meter and/or its modules can withstand will permanently damage the meter and/or its modules. Please refer to the specifications for all devices before applying voltage.
- When removing the meter for service, use shorting blocks and fuses for voltage leads and power supply to prevent hazardous voltage conditions or damage to CTs. CT grounding is optional.
- Accuenergy recommends using a dry cloth to wipe the meter.

NOTE: IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.

NOTE: THERE IS NO REQUIRED PREVENTIVE MAINTENANCE OR INSPECTION NECESSARY FOR SAFETY. HOWEVER, ANY REPAIR OR MAINTENANCE SHOULD BE PERFORMED BY THE FACTORY.

DISCONNECT DEVICE: The following part is considered the equipment disconnect device:

A SWITCH OR CIRCUIT BREAKER SHALL BE INCLUDED IN THE INSTALLATION. THE SWITCH SHALL BE IN CLOSE PROXIMITY TO THE EQUIPMENT AND WITHIN EASY REACH OF THE OPERATOR. THE SWITCH SHALL BE MARKED AS THE DISCONNECT DEVICE FOR THE EQUIPMENT.

FCC Compliance Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

The installation method is introduced in this chapter. Please read this chapter carefully before beginning installation.

2.1 Appearance and Dimensions

There are two different types of Acuvim II meter designs, either panel mount with an LCD display or DIN rail mount with no display. The following figures provide the front view, side view, and rear view of the two different Acuvim II series meters.

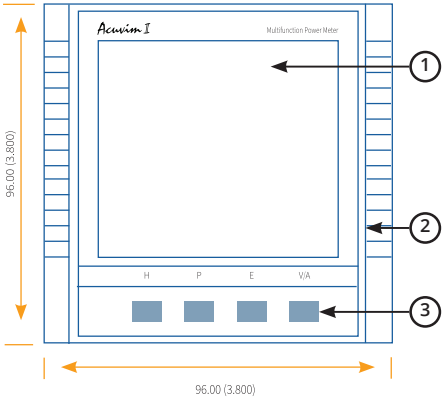


Figure 2-1 Front View of the Meter Display and Remote Display Unit

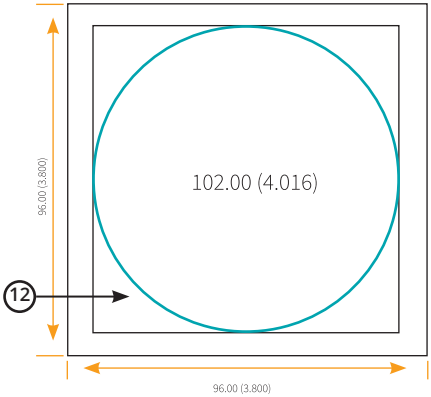


Figure 2-2 Rubber Gasket

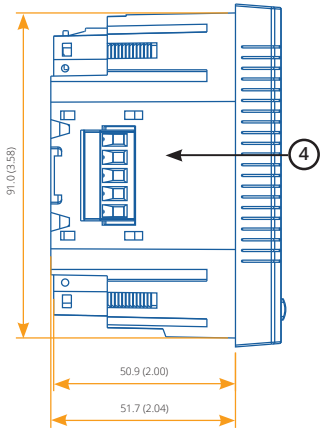


Figure 2-3 Side View of Meter With Display

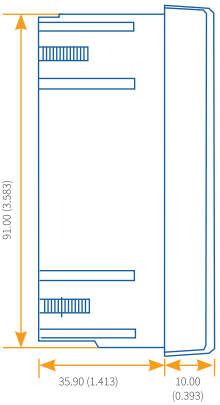


Figure 2-4 Side View of Remote Display Unit

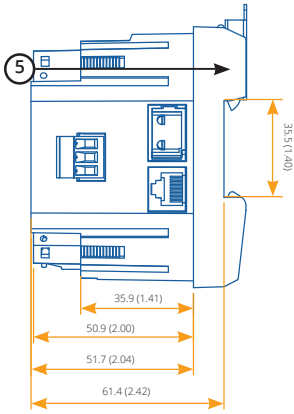


Figure 2-5 Side View of DIN Rail Meter

Unit: mm (inches)

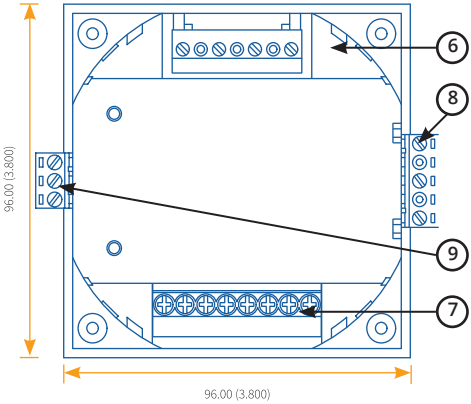


Figure 2-6 Rear View of Acuvim II Meter

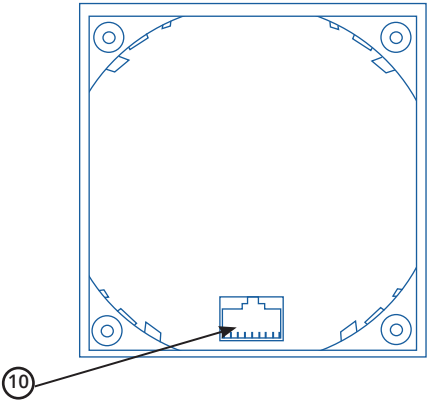


Figure 2-7 Rear View of Remote Display

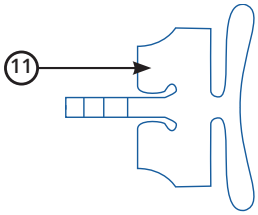


Figure 2-8 Installation Clip

Unit: mm (inches)

The table below specifies the part name and description of the Acuvim II series meter.

Table 2-1 Meter Part Name and Description

Part Name	Description
1) LCD Display	Large bright white backlight LCD display.
2) Front Casing	Visible portion (for display and control) after mounting onto a panel.
3) Key	Four keys are used to navigate through the display and configure settings.
4) Enclosure	The Acuvim II series meter enclosures are made of high-strength, anti-combustible engineering plastic.
5) DIN Rail	Used for installation of 35mm rail of the DIN rail meter.
6) Voltage Input Terminals	Used for voltage input.
7) Current Input Terminals	Used for current input.
8) Power Supply Terminals	The Control Power Input.
9) Communication Terminals	The RS485 communication port on the meter.
10) Interface	Used for connecting the remote display unit to the DIN rail meter.
11) Installation Clip	Used for fixing the meter to the panel.
12) Gasket	Rubber gasket inserted between the meter and the cutout to cover up gaps from the round hole.

2.2 Installation Methods

Environmental

Before installation, please check the environment, temperature, and humidity to ensure that the Acuvim II series meter is being placed where optimal performance will occur.

Temperature

- Operation: -25°C to 70°C (-13˚F to 158˚F)
- Storage: -40°C to 85°C (-40˚F to 185˚F)

Humidity

- 5% to 95% non-condensing

The Acuvim II series meter should be installed in a dry and dust-free environment. Avoid exposing the meter to excessive heat, radiation, or high electrical noise sources.

Installation Steps

The Acuvim II series meter can be installed into a standard ANSI C39.1 (4-inch round) or an IEC 92mm DIN (square) form.

Panel Mount Installation

1. Cut a square hole or round hole on the panel of the switchgear. The cutting size can be seen in Figure 2-9.

Unit: mm (inches)

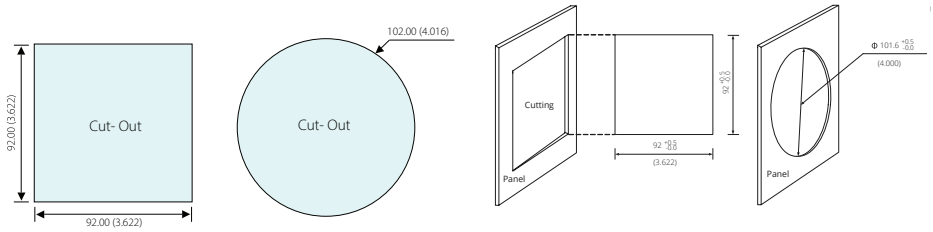


Figure 2-9 Panel Cutout

2. Remove the clips from the meter and insert the meter into the square hole from the front side.

NOTE: Optional rubber gasket must be installed on the meter before inserting the meter into the cutout.

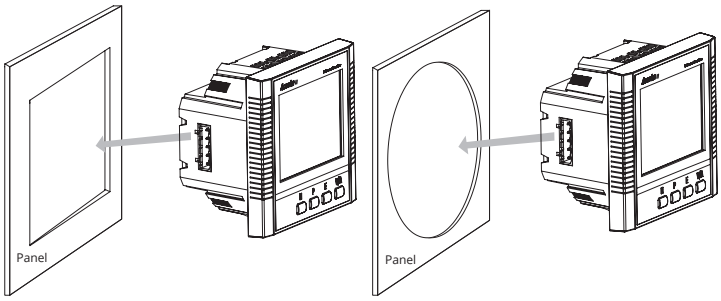


Figure 2-10 Insert Meter into the Opening

3. Install the clips on the back side of the meter and secure tightly to ensure that the meter is affixed to the panel.

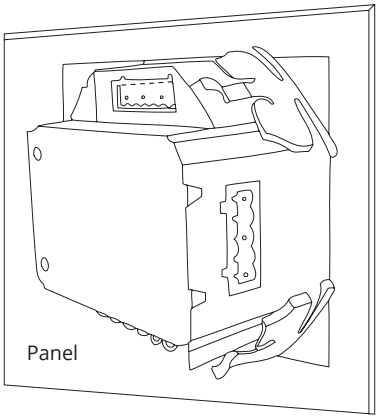


Figure 2-11 Using the Clips to Fix the Meter to the Panel

NOTE: The display of the meter and the remote display unit have the same installation method. The DIN rail meter is simply installed on a 35mm DIN rail.

DIN Rail Installation Method

1. The DIN rail mount option meter is simply installed on a 35mm DIN rail.



Figure 2-12 Acuvim II Mount on DIN Rail

AXM-DIN Installation

The AXM-DIN rail adapter provides an easy installation of panel-mount Acuvim II series meters on DIN rail. Available for all meter models with I/O or communication module options.

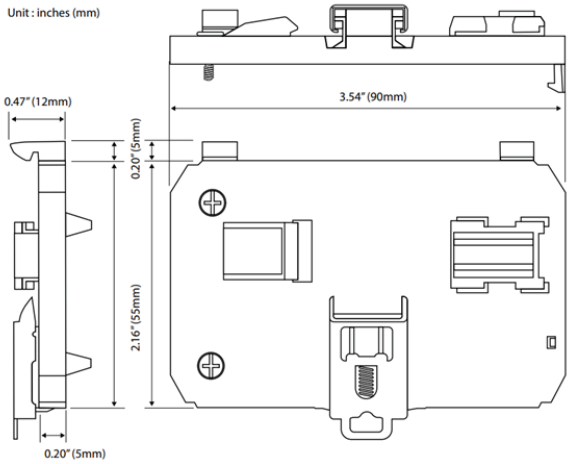


Figure 2-13 Using the Clips to Fix the Meter to the Panel

1. The adapter can be installed directly onto the back of the Acuvim II meter, I/O module, or communications module, if used. Simply hook and then screw the other end into the meter base. Once installed, snap the adapter into the 35mm DIN rail.



Figure 2-14 Installing AXM-DIN Rail Adapter

2. The AXM-DIN rail adapter can be adjusted for horizontal or vertical DIN rail installations.

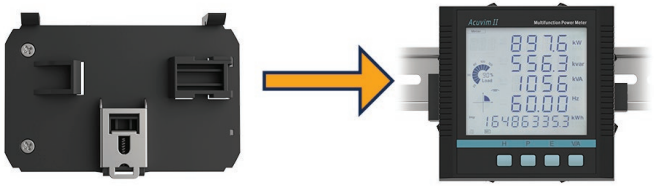


Figure 2-15 Horizontal DIN Rail Installation

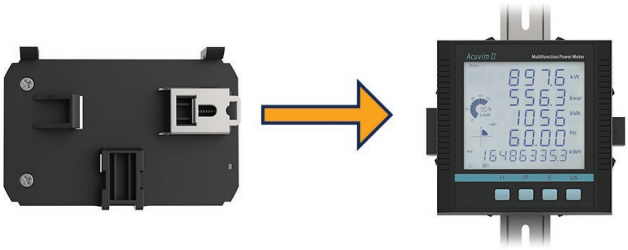


Figure 2-16 Vertical DIN Rail Installation

2.3 Wiring

There are four terminal strips at the back of the Acuvim II series meter, they are the voltage input terminal, current input terminal, power supply terminal and the communication port terminal.

The three-phase voltage and current are represented by using 1, 2, and 3 respectively. These numbers have the same meaning as A, B, and C used in other literature.

NOTE: The Acuvim II terminals have a torque rating of 7lb-in, ensure that this torque is not exceeded to prevent damage to the terminals.

2.3.1 Power Requirement

Control Power

There are two options for the control power in the Acuvim II series meter:

1. Standard: 100~415Vac (50/60Hz) or 100-300Vdc
2. Low Voltage DC Option: 20-60Vdc

The two options must be chosen according to the application. Please refer to the ordering information in the appendix for further information.

NOTE: Ensure that the control power terminal of the meter ground is connected to the safety earth of the switch gear.

The meter typically has a low power consumption and can be supplied by an independent source or by the measured load. A regulator or an uninterrupted power supply (UPS) should be used under high power fluctuation conditions. Terminals for the control power supply are 11, 12, and 13 (L, N, and Ground). A switch or circuit breaker shall be included in the building installation. It shall be in close proximity to the equipment, within easy reach of the operator, and shall be marked as the disconnection device for the equipment.

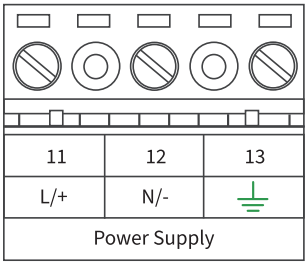


Figure 2-17 Power Supply Terminal Strip

Choice of wire for the power supply is AWG22-16 or 0.32-1.31mm². Typically, a 1A fuse should be used in the auxiliary power supply loop. The fuse voltage rating should be selected according to the actual control power supply and not lower than the applied voltage. Terminal 13 must be connected to the ground terminal of the switch gear. An isolated transformer or EMC filter should be used in the power supply loop if there is a power quality issue with the power supply.

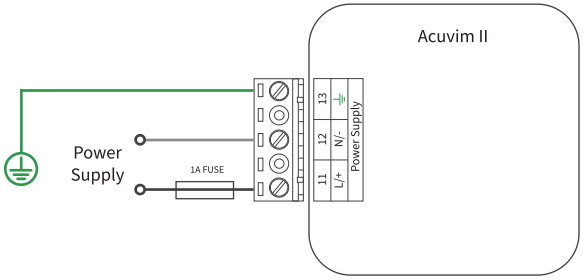


Figure 2-18 Power Supply

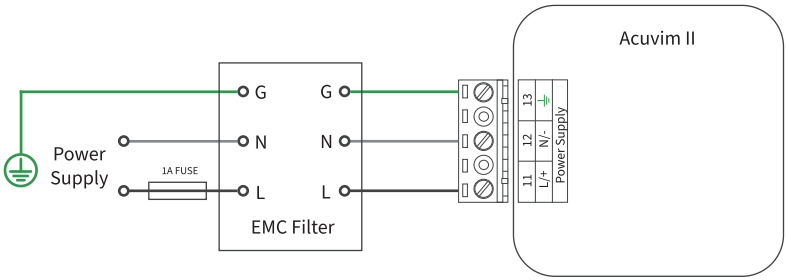


Figure 2-19 Power Supply with EMC Filter

2.3.2 Voltage Input Wiring

Voltage Input Terminal

The voltage input terminal strip consists of four input terminals: V1 (7), V2 (8), V3 (9), and VN (10).

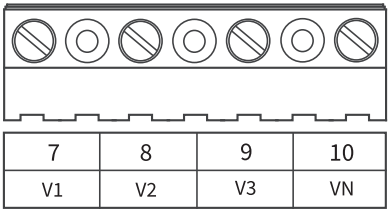


Figure 2-20 Voltage Input

The maximum voltage input for the Acuvim II series meter shall not exceed 400LN/690LL Vac RMS for three-phase or 400LN Vac RMS for single-phase.

In high-voltage systems a potential transformer (PT) must be used. The typical secondary output for PTs shall be over 100V or 120V. Ensure that an appropriate PT is selected to maintain the measurement accuracy of the meter. When connecting with the Wye configuration wiring method, the PTs primary side rated voltage should be equal to or close to the phase voltage of the system to utilize the full range of the PT. When connecting with the delta configuration wiring method, the PTs primary side rated voltage should be equal to or close to the line voltage of the system. A fuse (typical 1A/250Vac) should be used in the voltage input loop. The Voltage Input Wiring Method in the following section depicts a 1A fuse for the meter's voltage input. To ensure safety and protection, a 1A fuse shall be used in the voltage input. Ensure the voltage rating of the fuse selected is according to the actual circuit voltage and not lower than the actual applied voltage. The wire for voltage input is AWG16-12 or 1.31-3.31mm².



NOTE: In no circumstance should the secondary of the PT be shorted. The secondary of the PT should be grounded at one end. Please refer to the wiring diagram section for further details.

Voltage Input Wiring Methods

3-Element 4-Wire Wye Mode (3LN)

3-Phase 4-Wire Wye mode is commonly used in low-voltage electric distribution systems. For voltages lower than 400LN/690LL, the voltage lines can be connected directly to the meter's voltage input terminal as shown in Figure 2-21a.

For high voltage systems (over 400LN/690LL), PTs (potential transformers) are required as shown in Figure 2-21b.

For both scenarios, the meter should be set to 3LN.

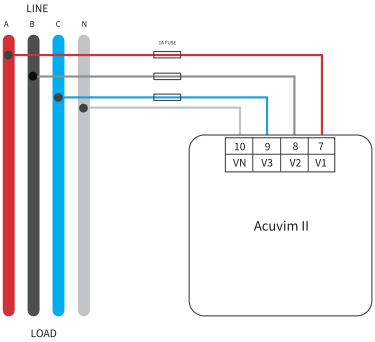


Figure 2-21a 3LN Direct Connection

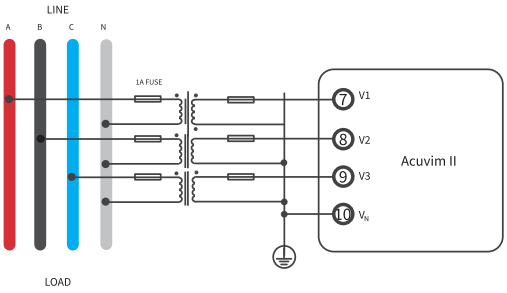


Figure 2-21b 3LN with 3PTs

2 ½ Element 4-Wire Wye Mode (3LN-2.5)

Starting from version 6.21, Acuvim II v3 supports a Wye voltage wiring method labelled as 3LN-2.5, which requires only two potential transformers (PTs) for the calculation of VB. It is crucial to ensure that the system is balanced for this configuration and phase V2 must be grounded.

For voltages lower than 400LN/690LL, the voltage lines can be connected directly to the meter's voltage input terminal as shown in Figure 2-21c.

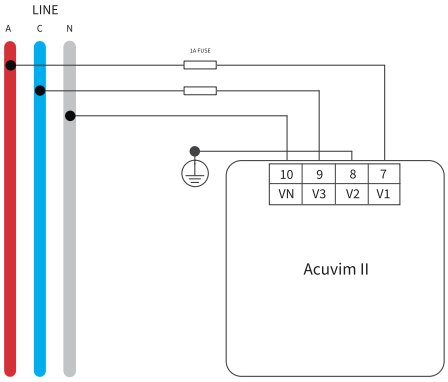


Figure 2-21c 3LN-2.5 Direct Connection

For high voltage systems (over 400LN/690LL), PTs (potential transformers) are required as shown in Figure 2-21d.

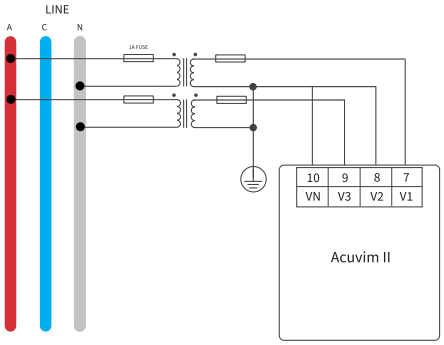


Figure 2-21d 3LN-2.5 with 2PTs

3-Element 4-Wire Delta Mode (3LL)

3-Element 4-Wire Delta mode is commonly used in low-voltage electric distribution systems. For voltages lower than 400LN/690LL, the voltage lines can be connected directly to the meter's voltage input terminal as shown in Figure 2-21e.

For high voltage systems (over 400LN/690LL), PTs (potential transformers) are required as shown in Figure 2-21f.

For both scenarios, the meter should be set to 3LL. Common system voltage for 3-phase delta systems is 480V.

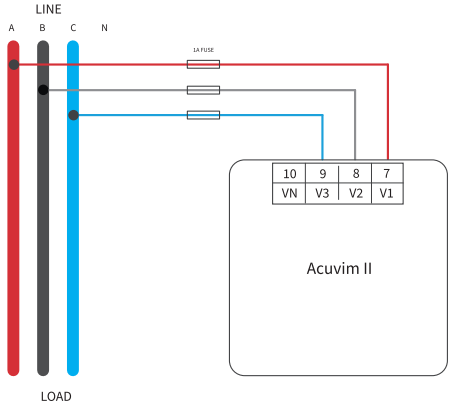


Figure 2-21e 3LL Direct Connection

2-Element 3-Wire Open-Phase Delta (2LL)

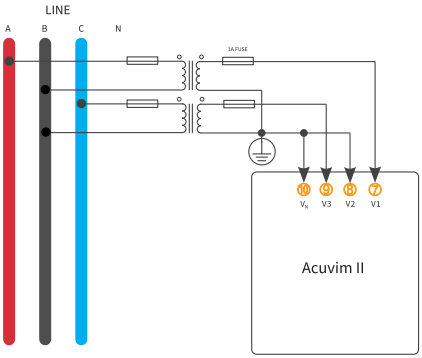


Figure 2-21f 2LL with 2PTs

2-Element 3-Wire 1 Phase (1LL)

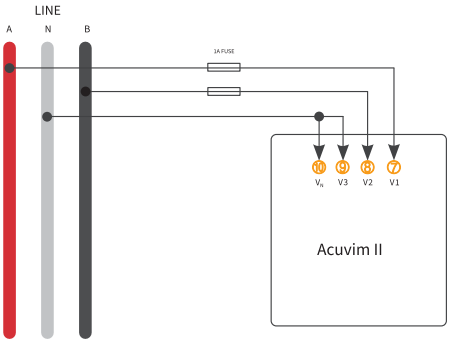


Figure 2-21g 1LL Direct Connection

1-Element 2-Wire Single Phase (1LN)

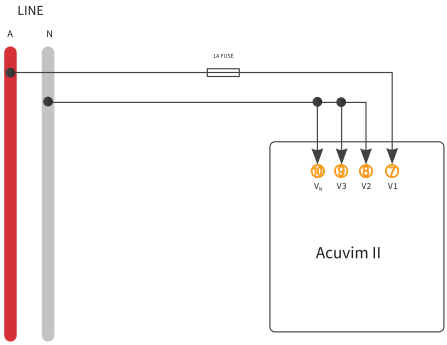


Figure 2-21h 1LN Direct Connection

Vn Connection

Vn is the reference point of the Acuvim II series meter voltage input. Low wire resistance helps improve the measurement accuracy. Different system wiring modes require Vn connection methods. Please refer to the wire diagram section for more details.

2.3.3 Current Input Wiring

Current Input Terminal

Current transformers (CTs) are required for most engineering applications. The typical current rating for the secondary side of the CT shall be 5A (standard) or 1A (optional); please refer to the ordering information appendix for further details. CTs must be used if the system's rated current is over 5A. The recommended accuracy of the CT should be better than 0.5% with a rating over 3VA to preserve the meter's accuracy. The wire between the CT and the meter shall be as short as possible. The length of the wire affects measurement accuracy.

The wire size of the current input is AWG15-10 or 1.65-5.26mm².

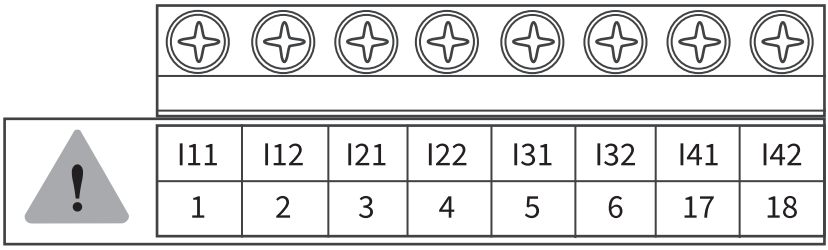


Figure 2-22 Current Input Terminal

On the current input terminal of the Acuvim II, there are eight current input channels for four CTs.

- Terminal 1 (I11) and 2 (I12) are for the phase A current transformer, where the positive lead of the CT is terminated to I11, and the negative lead is terminated to I12.
- Terminal 3 (I21) and 4 (I22) are for the phase B current transformer, where the positive lead of the CT is terminated to I21, and the negative lead is terminated to I22.
- Terminal 5 (I31) and 6 (I32) are for the phase C current transformer, where the positive lead of the CT is terminated to I31, and the negative lead is terminated to I32.
- Terminal 17 (I41) and 18 (I42) are for the neutral current transformer, where the positive lead of the CT is terminated to I41, and the negative lead is terminated to I42.

NOTE: The secondary side of the CT shall not be open circuit in any circumstance when the power is on. There shall not be any fuse or switch in the CT loop. One end of the CT loop should be connected to the ground if using 5A/1A current transformers. If using 333mV/mA/Rogowski coil current transformers, a ground connection is not required.

NOTE: When I N Value setting is set to Measured, I N should be wired.

3CT

The 3CT current wiring configuration can be used when either 3CTs are connected (as shown in Figure 2-23) or when 2 CTs are connected (as shown in Figure 2-24). In either case, there is current flowing through all three circuit terminals.

For any RCT/mV/mA CT, do NOT ground the CTs. The figures below have the current input wiring for both 5A/1A CTs as well as RCT/mV/mA CTs.

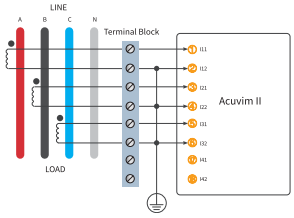


Figure 2-23a 3 CT 5A/1A

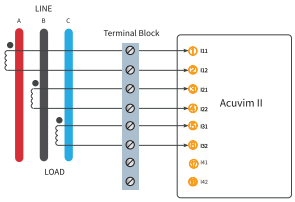


Figure 2-23b 3 CT 333mV/mA

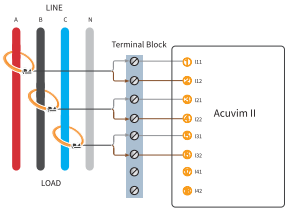


Figure 2-23c 3 CT Rogowski Coil (RCT)

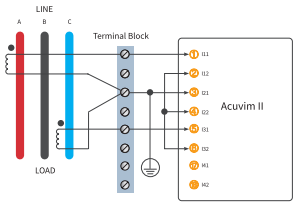


Figure 2-24a 3CT Wiring for 5A/1A CTs with 2CT in Open-Phase Delta Systems

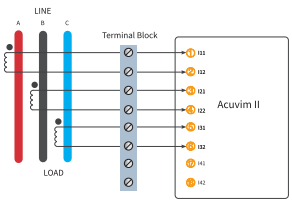


Figure 2-24b 3CT Wiring for 333mV/mA CTs in Open-Phase Delta Systems

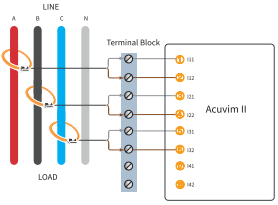


Figure 2-24c 3CT Wiring for Rogowski Coil (RCT) in Open-Phase Delta Systems

2 CT

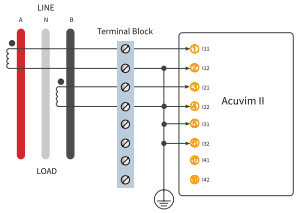


Figure 2-25a 2CT Wiring for 5A/1A CTs in 1LL Split-Phase Systems

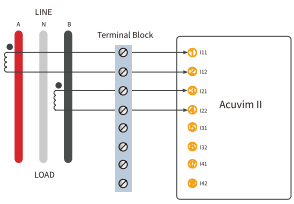


Figure 2-25b 2CT Wiring for 333mV/mA CTs in 1LL Split-Phase Systems

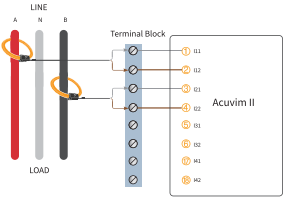


Figure 2-25c 2CT Wiring for Rogowski Coil (RCT) in 1LL Split-Phase Systems

1 CT

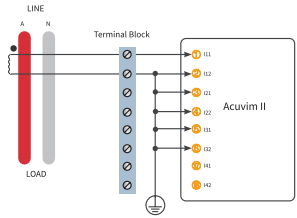


Figure 2-26a 1CT Wiring for 5A/1A CTs in 1LN Single-Phase Systems

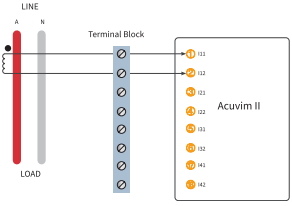


Figure 2-26b 1CT Wiring for 333mV/mA CTs in 1LN Single-Phase Systems

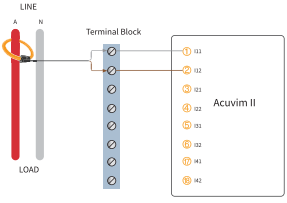


Figure 2-26c 1CT Wiring for Rogowski Coil (RCT) in 1LN Single-Phase Systems

2.3.4 Supported Wiring Methods

This section covers the most common voltage and current wiring combinations, shown in different diagrams. To display measurement readings correctly, please select the appropriate wiring diagram for your setup and application.

The meter supports seven kinds of wiring:

- 3 Element 4 Wire Wye (3LN-3CT)
- 3 Element 4 Wire Delta (3LL-3CT)
- 2 ½ Element 4 Wire Wye (3LN2.5-3CT)
- 2 Element 3 Wire Delta (2LL-3CT)
- 2 Element 3 Wire Network (2LL-2CT)
- 2 Element 3 Wire 1 Phase (1LL-2CT)
- 1 Element 2 Wire (1LN-1CT)

3 Element 4 Wire Wye (3LN-3CT)

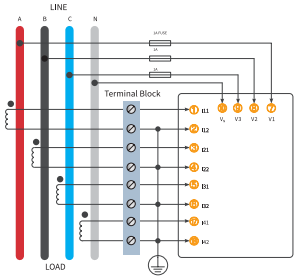


Figure 2-27a 3 Element 4 Wire Wye (3LN-3CT) Wiring Using 5A/1A CTs
(Neutral CT is Optional)

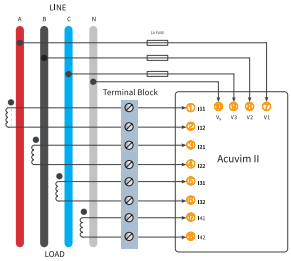


Figure 2-27b 3 Element 4 Wire (3LN-3CT) Wiring Using 333mV/mA CTs
(Neutral CT is Optional)

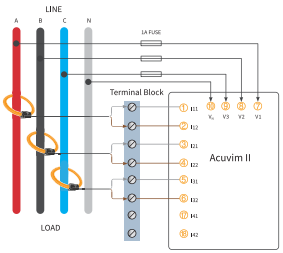


Figure 2-27c 3 Element 4 Wire Wye (3LN-3CT) Wiring Using Rogowski Coils

3 Element 4 Wire Wye (3LN-3CT) using PTs

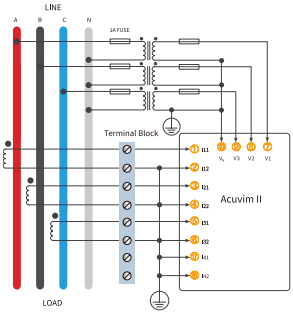


Figure 2-28a 3 Element 4 Wire Wye (3LN-3CT) Configuration with PTs Using 5A/1A CTs

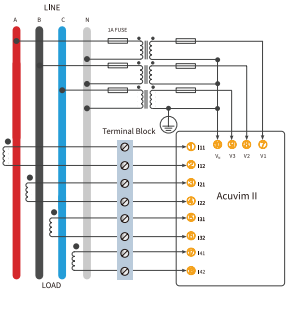


Figure 2-28b 3 Element 4 Wire Wye (3LN-3CT) Configuration with PTs Using 333mV/mA CTs

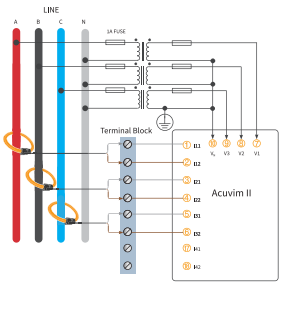


Figure 2-28c 3LN-3CT Configuration with PTs Using Rogowski Coils

3 Element 4 Wire Delta (3LL-3CT)

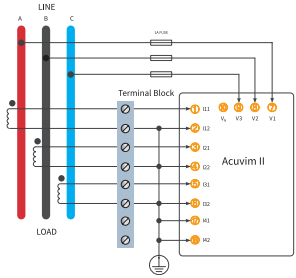


Figure 2-29a 3 Element 4 Wire Delta (3LL-3CT) Configuration Using 5A/1A CTs

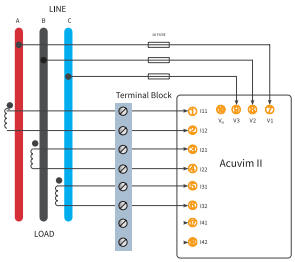


Figure 2-29b 3 Element 4 Wire Delta (3LL-3CT) Configuration Using 333mV/mA CTs

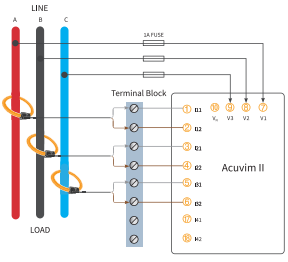


Figure 2-29c 3 Element 4 Wire Delta (3LL-3CT) Configuration Using Rogowski Coils

2 1/2 Element 4 Wire Wye (3LN2.5 -3CT)

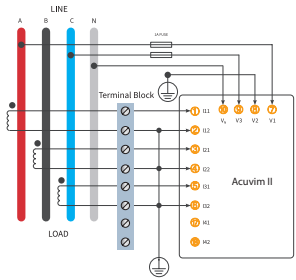


Figure 2-30a 2 ½ Element 4 Wire Wye (3LN2.5 -3CT) Wiring Using 5A/1A CTs

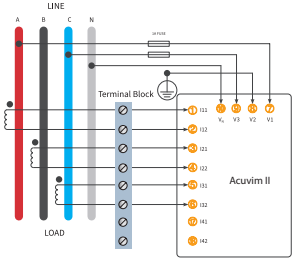


Figure 2-30b 2 ½ Element 4 Wire Wye (3LN2.5 -3CT) Wiring Using 333mV CTs

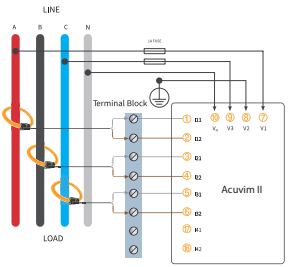


Figure 2-30c 2 ½ Element 4 Wire Wye (3LN2.5 -3CT) Wiring Using Rogowski Coils

2 1/2 Element 4 Wire Wye (3LN2.5 -3CT) Using PTs

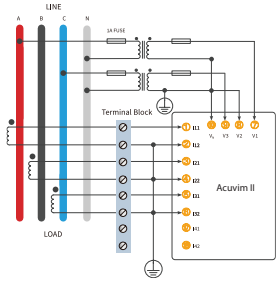


Figure 2-31a 2 ½ Element 4 Wire Wye (3LN2.5 -3CT) with PTs Using 5A/1A CTs

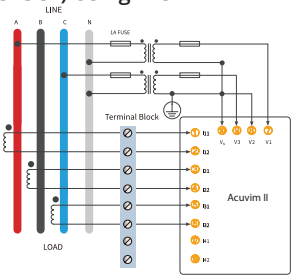


Figure 2-31b 2 ½ Element 4 Wire Wye (3LN2.5 -3CT) with PTs Using 333mV CTs

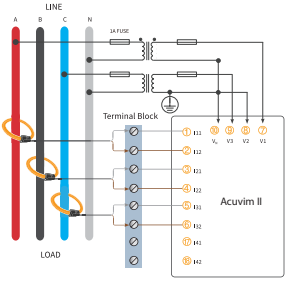


Figure 2-31c 2 ½ Element 4 Wire Wye (3LN2.5 -3CT) with PTs Using Rogowski Coils

2 Element 3 Wire Delta (2LL-3CT)

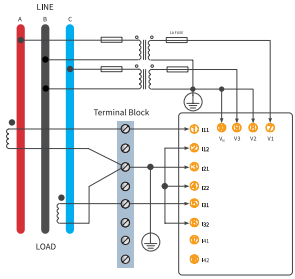


Figure 2-32a 2 Element 3 Wire Delta (2LL-3CT) Wiring with PTs Using 5A/1A CTs

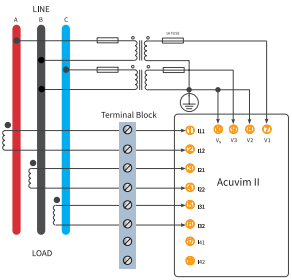


Figure 2-32b 2 Element 3 Wire Delta (2LL-3CT) Wiring with PTs Using 333mV CTs

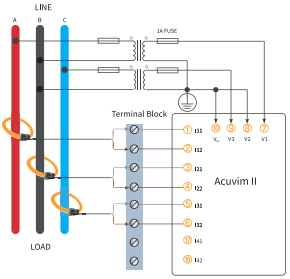


Figure 2-32c 2 Element 3 Wire Delta (2LL-3CT) Wiring with PTs Using Rogowski Coils

2 Element 3 Wire Network (2LN-2CT)

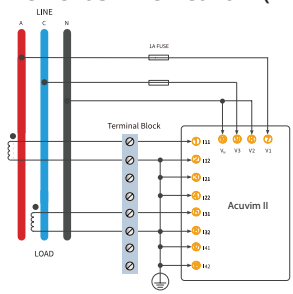


Figure 2-33a 2 Element 3 Wire Network Wiring with PTs Using 5A/1A CTs

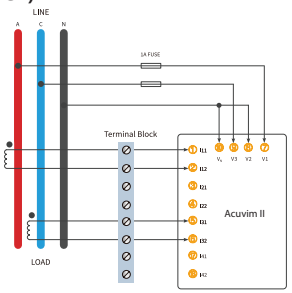


Figure 2-33b 2 Element 3 Wire Network Wiring with PTs Using 333mV CTs

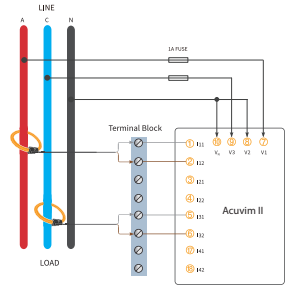


Figure 2-33c 2 Element 3 Wire Network Wiring with PTs Using Rogowski Coils

2 Element 3 Wire 1 Phase (1LL-2CT)

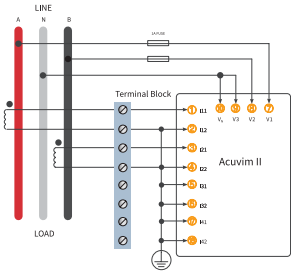


Figure 2-34a 2 Element 3 Wire 1 Phase (1LL-2CT) Configuration Using 5A/1A CTs

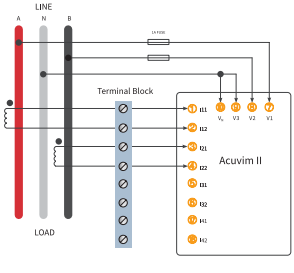


Figure 2-34b 2 Element 3 Wire 1 Phase (1LL-2CT) Configuration Using 333mV/mA CTs

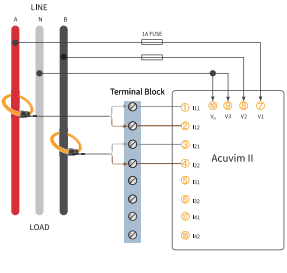


Figure 2-34c 2 Element 3 Wire 1 Phase (1LL-2CT) Configuration Using Rogowski Coils

1 Element 2 Wire (1LN-1CT)

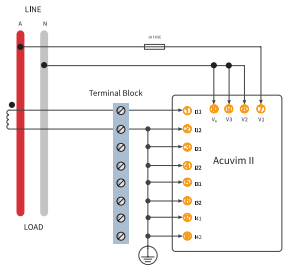


Figure 2-35a 1 Element 2 Wire (1LN-1CT) Configuration Using 5A/1A CTs

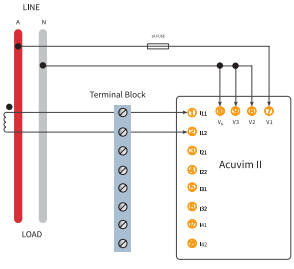


Figure 2-35b 1 Element 2 Wire (1LN-1CT) Configuration Using 333mV/mA CTs

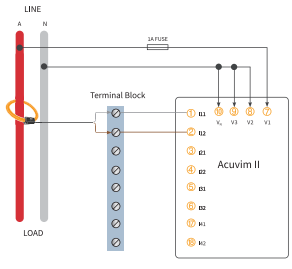


Figure 2-35c 1 Element 2 Wire (1LN-1CT) Configuration Using Rogowski Coils

2.3.5 Communication

The Acuvim II series meter uses RS485 serial communication and the Modbus RTU protocol. The terminals of communication are A, B, and S (14,15,16).

- **A** is the positive differential signal
- **B** is the negative differential signal
- **S** is connected to the shield of the twisted pair cables

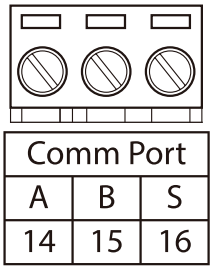


Figure 2-36 Communication Port

Figure 2-37 shows the wiring of the RS485-USB converter to the meter's communication port terminals. There can be a maximum of 32 devices that can be connected on an RS485 bus.

For the wiring, use a good quality, shielded twisted pair cable, AWG22 (0.32mm²) or higher. The overall length of the RS485 cable connecting all devices should not exceed 1200m (4000ft).

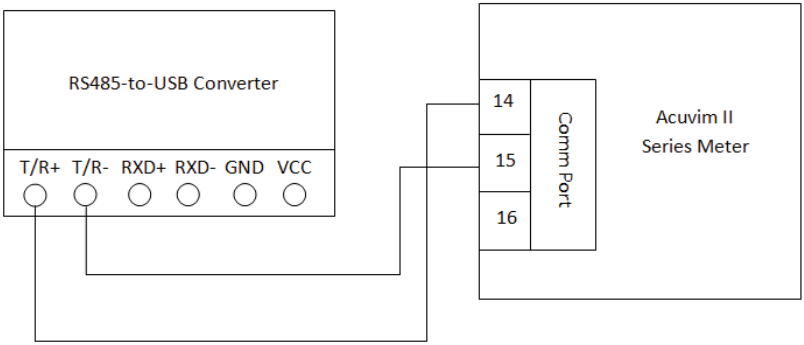


Figure 2-37 RS485-USB Connection to Acuvim II Series Meter

The Acuvim II series meter is used as the slave device of masters such as a PC, PLC, Data Collector, or RTU. If the master does not have an RS485 communication port, a converter (such as a RS232/RS485 or a USB/RS485 converter) will be required. Typical RS485 network topology includes line, circle, and star (Wye). The shield of each segment of the RS485 cable must be connected to the ground at one end only.

Every A(+) should be connected to A(+), B(-) to B(-), otherwise it will affect the network, or may even damage the communication interface.

The connection topology should avoid “T” type topology, meaning there is a new branch, and it does not begin at the beginning point.

Keep communication cables away from sources of electrical noise whenever possible.

When using long communication cables to connect several devices, an anti-reflecting resistor (typical value 120Ω-300Ω/0.25W) is normally added to the end of the cable beside the last meter if the communication quality is distorted.

Use RS232/RS485 or a USB/RS485 converter with an optical isolated output and surge protection.

Chapter 3: Meter Display & Parameter Settings

This chapter describes and explains how to view real time metering data and setting parameters using different key combinations on the meter.

3.1 Display Panel and Keys

The front of the Acuvim II series meter consists of an LCD screen and four control keys. All the display segments are illustrated in Figure 3-1. Users should note that all the segments will not display in a single page under normal conditions.

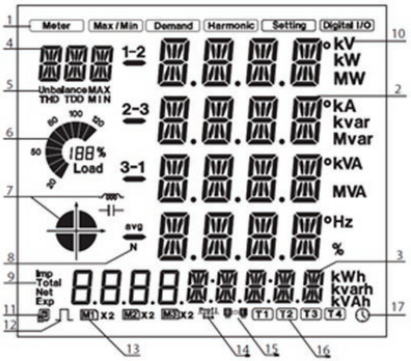


Figure 3-1 All Display Segments

The icons displayed in figure 3-1 is explained in the following table:

Table 3-1 All Display Segments

SN	Display	Description
1	Display Mode	Shows different modes on the display area. *Meter*: real-time measurement *Max/Min*: Statistical data *Demand*: Power demand data *Harmonic*: Harmonic data *Setting*: Parameter/meter settings *Digital I/O*: Viewing IO module data.
2	Four lines of "MAX MIN" digits in the metering area	The numeric metering data will be displayed here.
3	Four "8" and five "MAX MIN" digits	

SN	Display	Description
4	Three "" digits	Item Icons: *U* for voltage *I* for current *P* for active power *Q* for reactive power *S* for apparent power *PF* for power factor *F* for frequency ∠ for phase angles *DMD* for demand *Mxx* for expanded I/O module type and display setting page number.
5	Unbalance, THD, MAX, MIN	Item Icons: *Unbalance* for unbalance of the voltage and current; *THD* for total harmonics distortion; *MAX* for maximum and *MIN* for minimum.
6	Load Rate 	Displays the percentage of load to the rated current or power.
7	Four Quadrant Icon:  Load Type Icon: 	: Quadrant of the system power : Inductive Load : Capacitive Load
8	1-2, 2-3, 3-1, avg, N	*1, 2, 3*: Represents 3 phases *A, B, C* *1-2, 2-3, 3-1*: Represents 3 phase line to line *AB, BC, CA* *avg*: Represents the average *N*: stands for neutral
9	Energy icon: Imp, Total, Net, Exp	*Imp*: Import Energy *Total*: Absolute sum of Import and Export energy *Net*: Algebraic sum of Import and Export energy *Exp*: Export Energy
10	Units Measured	Voltage: *V, kV* Current: *A, kA* Active Power: *kW, MW* Reactive Power: *kvar, Mvar* Apparent Power: *kVA, MVA* Frequency: *Hz* Active Energy: *kWh* Reactive Energy: *kvarh* Apparent Energy: *kVAh* Percentage: *%* Phase Angle: *°*
11	Communication Icon 	No Icon: no communication One Icon: query sent Two Icons: query sent, and response received

SN	Display	Description
12	Energy pulse output indicator	No Icon: no pulse output With Icon: icon blinks when sending pulse output
13	Expanded I/O module indicator M1 x2 M2 x2 M3 x2	*M1*: one AXM-IO1 connected *M1x2*: two AXM-IO1 connected *None*: no AXM-IO1 connected *M2*: one AXM-IO2 connected *M2x2*: two AXM-IO2 connected *None*: no AXM-IO2 connected *M3*: one AXM-IO3 connected *M3x2*: two AXM-IO3 connected *None*: no AXM-IO3 connected
14	Profibus Module Indicator Profi bus	Icon: Profibus module connected No Icon: Profibus module not connected
15	Ethernet Module Indicator	No Icon: Ethernet module not connected With Icon: AXM-Web-Push module connected when the Second Communication Protocol is set as Other. AXM-Web2 module connected when the Second Communication Protocol is set as Web2.
16	T1 T2 T3 T4	Current Tariff
17	Time Icon	Time Display

There are four keys on the front panel of the meter, labelled ***H, P, E, V/A*** from left to right. These four keys are used to read the real-time metering data, set parameters, and navigate the meter.

3.2 Metering Data

To view the metering data, press ***H*** and ***V/A*** simultaneously for about one second and release; this will activate the display mode selection, and the cursor will begin flashing. Press ***P*** or ***E*** to move the flashing cursor right or left. To enter the metering mode, move the cursor to ***Meter*** then press ***V/A***. In the metering mode, the meter displays measurements such as voltage, current, power, power factor, phase angle, unbalance.

3.2.1 Voltage and Current Data

To view the voltage and current, press ***V/A*** while in metering mode.

The screen will roll to the next page when ***V/A*** is pressed again. It will go back to the first screen if you press ***V/A*** at the last screen. The following figure shows the screen sequence:

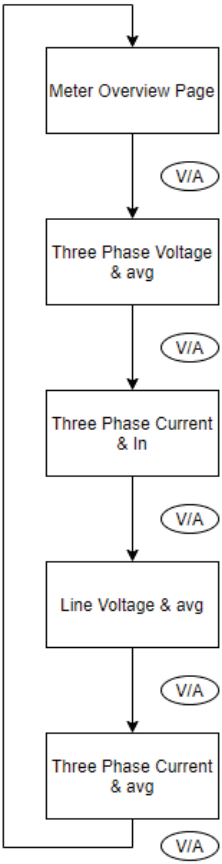


Figure 3-2 - Voltage and Current Screen Sequence

NOTE: When the meter is set to 2LL or 3LL, there will be no phase voltage or neutral current displayed. Therefore, only the third screen (line voltage & avg) and the fourth screen (three phase current & avg) will be displayed. When the meter is set to 1LN, only phase A voltage and phase A current will be displayed, and no other screens will be displayed. When the meter is set to 1LL, there will be no phase C voltage and phase C current displayed.

Figure 3-3 shows an image of the three-phase voltage reading, where **1** represents phase A, **2** represents phase B, **3** represents phase C, and **avg** represents the average phase voltage.

Similarly in Figure 3-4, the three-phase current and their average can be seen in the same representation.

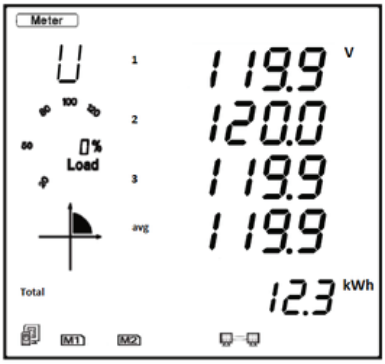


Figure 3-3 Three-Phase Voltage Page

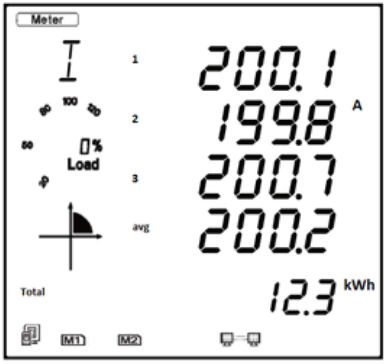


Figure 3-4 Three-Phase Current Page

In the voltage and current screen sequence, the very first page provides users with an overall summary of the metering values for the Acuvim II meter. Figure 3-5 shows the main summary page of the Acuvim II where the top line of data refers to the average line-to-line voltage, the second line refers to the total power of the system, the third line refers to the average current, the fourth line refers to the total system power factor, and the very last line refers to the total energy.

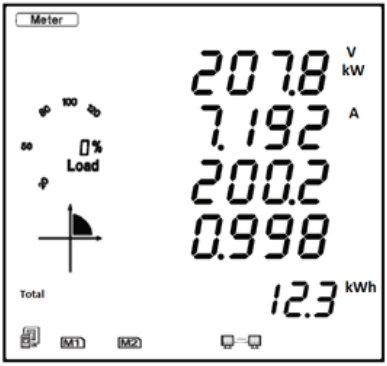


Figure 3-5 Meter Summary Page

3.2.2 Power, Power Factor, and Frequency

To view all power related data, press ***P*** while in metering mode.

The screen will roll to the next page when ***P*** is pressed again. It will return to the first screen when ***P*** is pressed on the last screen. The following figure shows the screen sequence:

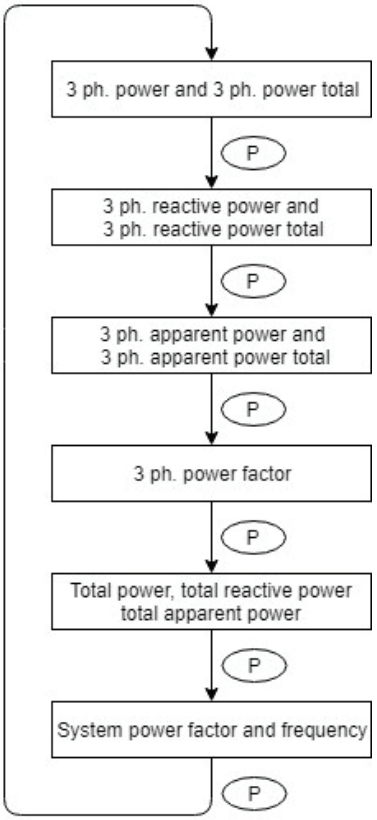


Figure 3-6 Power, Power Factor, and Frequency Screen Sequence

NOTE: When the meter is set to 2LL or 3LL, only the fifth screen (system power) and the sixth screen (system power factor & frequency) will be displayed. When the meter is set to 1LN, only phase A power and phase A power factor will be displayed. When the meter is set to 1LL, there will be no phase C power and phase C power factor displayed.

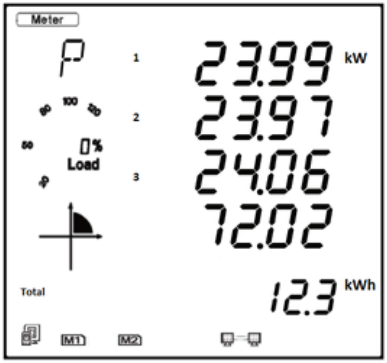


Figure 3-7 Three Phase Power Page

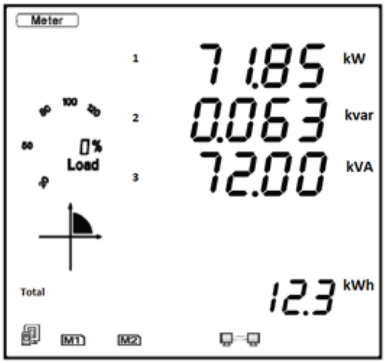


Figure 3-8 Total System Power Page

3.2.3 Phase Angles and Unbalance

To view the phase angle and unbalance data, press ***H*** while in metering mode.

The screen will roll to the next page when ***H*** is pressed again. It will return to the first screen when ***H*** is pressed on the last screen. The following figure shows the screen sequence:

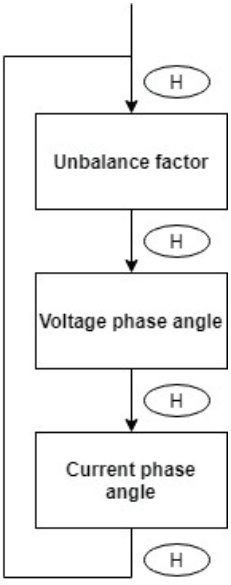


Figure 3-9 Phase Angle and Unbalance Screen Sequence

NOTE: When using 2LL or 3LL wiring modes, the voltage here stands for line-to-line voltage. Otherwise, the voltage stands for line-to-neutral voltage. When the meter is set to 1LN, only phase A current to phase A voltage angle will be displayed. When the meter is set to 1LL, there will be no phase C voltage or current to phase A voltage angle displayed.

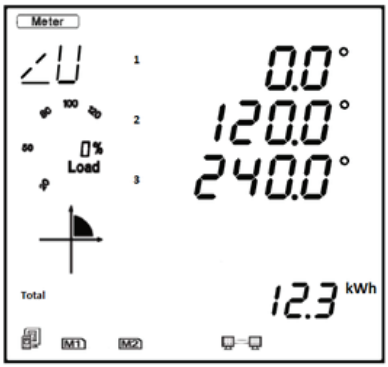


Figure 3-10 Voltage Phase Angle Page

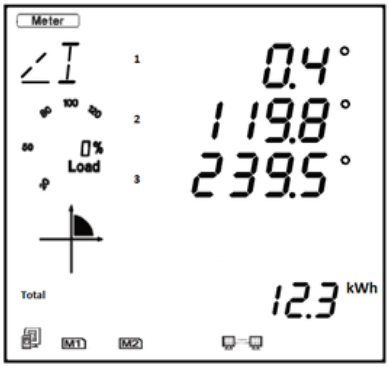


Figure 3-11 Current Phase Angle Page

3.2.4 Energy

To view the energy and real time clock on the meter, press the ***E*** button. The screen will roll to the next page when ***E*** is pressed again. It will return to the first screen when ***E*** is pressed on the last screen.

The Acuvim II series meter can be set to record either primary or secondary energy. The unit of energy is kWh for active energy, kvarh for reactive energy, and kVAh for apparent energy. The running time has a resolution of 0.01h. The meter begins accumulating time upon initial powering of the unit. The accumulated time is stored in the non-volatile memory and can be reset via communication or from the meters display.

The energy reading on the Acuvim II meter can be read at the bottom of the display, where users can cycle between different types of energy on any metering page on the meter except for the Meter Summary page. The metering summary page only displays the Total energy (kWh). The following flow chart shows the screen sequence for the energy readings.

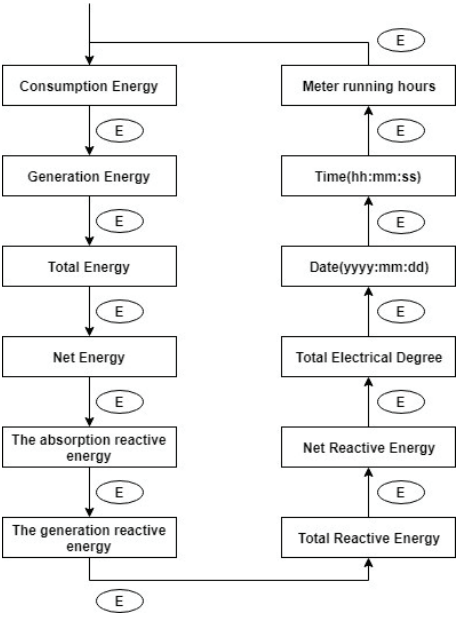


Figure 3-12 Energy and Real Time Clock Screen Sequence

There are different types of energy that the Acuvim II meter can measure, Figure 3-13 shows the Import Active Energy represented by the ***IMP*** icon and the ***kWh*** unit.

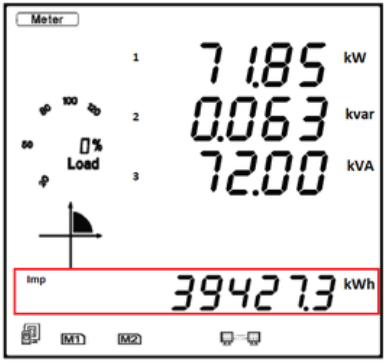


Figure 3-13 Import Active Energy Reading

Table 3-2 shows the different icons and units for all the energy measurements in the Acuvim II meter.

Table 3-2 Energy Parameter Table

SN	Parameter	Unit
Imp	Import Energy	kWh
Exp	Export Energy	kWh
Net	Net Energy	kWh
Total	Total Energy	kWh
Imp	Import Reactive Energy	kvarh
Exp	Export Reactive Energy	kvarh
Net	Net Reactive Energy	kvarh
Total	Total Reactive Energy	kvarh
	Apparent Energy	kVAh

The meter's time can be found in the energy screen sequence. Figure 3-14 shows the date displayed on the meter screen. The date is read as YYYY.MM.DD; the figure below shows the date as April 28th, 2020. Additionally, when viewing the time/date on the meter display, the time icon will be displayed on the bottom right corner of the meter screen.

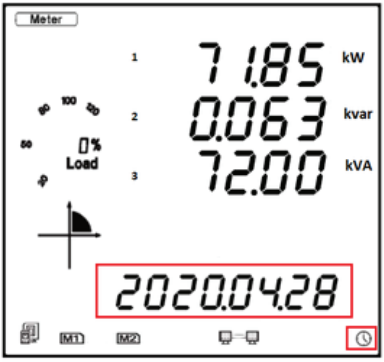


Figure 3-14 Time & Date Reading

3.2.5 TOU Display

In the metering mode, press ***P*** and ***E*** simultaneously to enter the TOU (Time-of-Use) mode. In the TOU mode, the meter displays the energy, maximum demand, and its time in different tariffs.

The screen sequence for the TOU data can be seen in Figure 3-15.

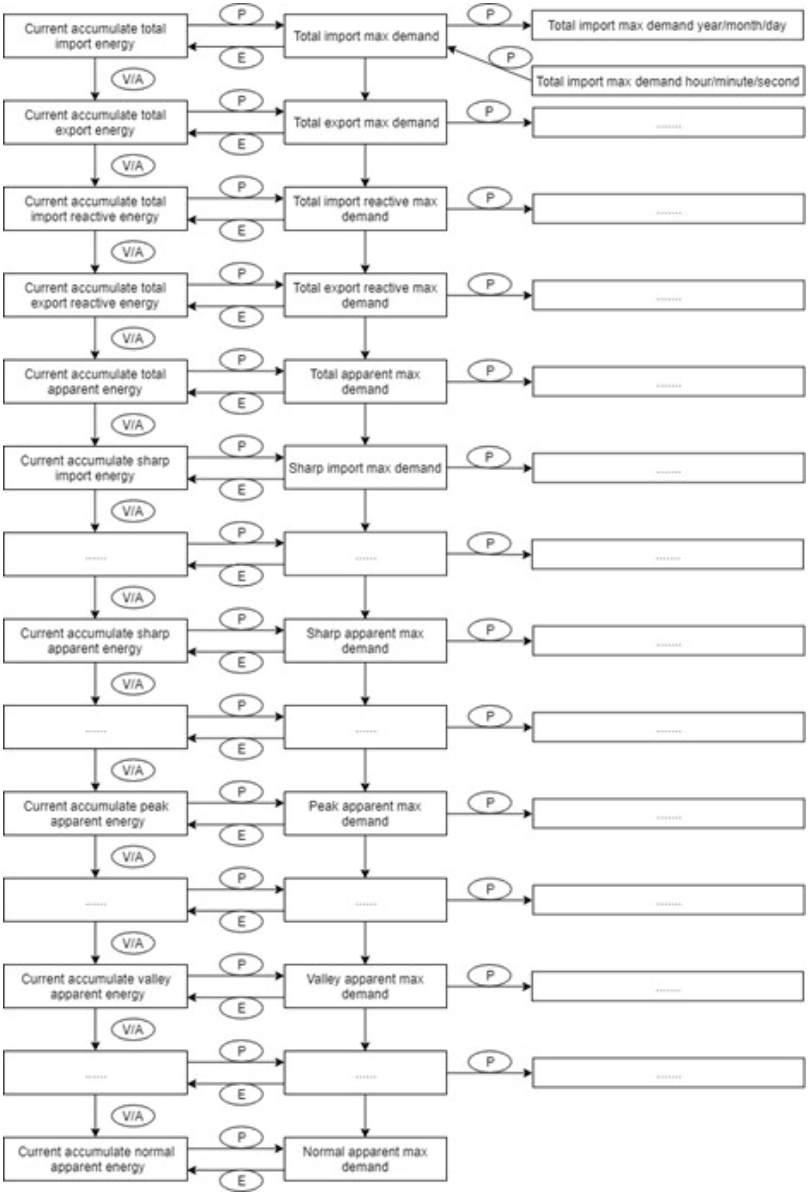


Figure 3-15 TOU Screen Sequence

3.2.6 Load Time

In the metering mode, press H and P simultaneously to enter the Load Time mode. In the Load Time mode, the meter displays the AcuvimII's running hours. To exit Load Time mode, simply press 'H' and 'P' simultaneously.

The figure below shows the device running for 728.38 hours.

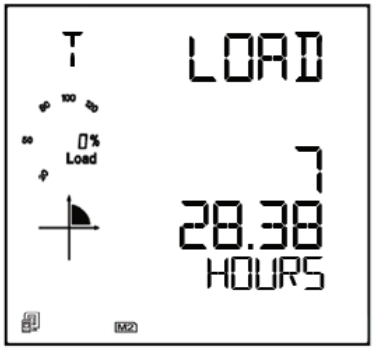


Figure 3-16 Load Time Display

3.2.7 Dual Source

In the metering mode, press E and V/A simultaneously to enter the Dual Source mode. In the Dual Source mode, the meter displays the dual source energy measurements. To exit Dual Source mode, simply press 'E' and 'V/A' simultaneously."

The screen sequence for the Dual Source energy readings can be seen in Figure 3-17. The HMI screen displays for "Energy 1 (To Grid)" and "Energy 1 (To Generator)" can be seen in Figure 3-18 and 3-19 respectively. "Energy 1 (To Grid)" is displayed as "E1 - G" ("E1 – 6"), while "Energy 1 (To Generator)" is displayed as "E1 - A".

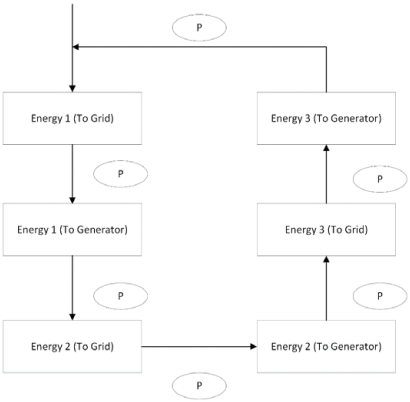


Figure 3-17 Dual Source Screen Sequence

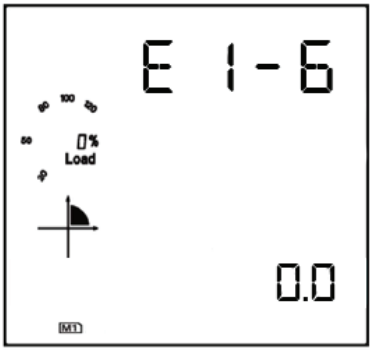


Figure 3-18 Energy 1 (To Grid) Display

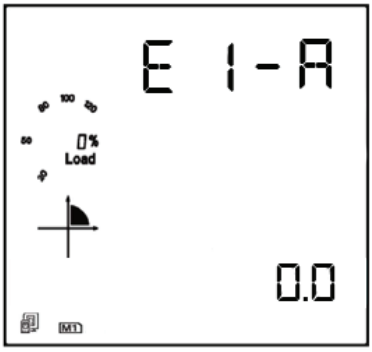


Figure 3-19 Energy 1 (To Generator) Display

3.3 Statistical Data

In the statistical data mode, the meter displays the maximum and minimum values for voltage, current, power, power factor, unbalance, demand, THD, and other parameters. To change the mode of the Acuvim II meter to view statistical data, press ***H*** and ***V/A*** keys simultaneously for about one second and release, the screen will go blank, and the cursor will be flashing. Press either ***P*** or ***E*** to move the flashing cursor over to ***Max/Min*** and press ***V/A*** to enter and view the statistical data.

When ***P*** is pressed, the screen will roll to the next page, and will roll back to the first screen when ***P*** is pressed at the last page. When ***E*** is pressed, the screen will roll back to the previous page, and will roll back to the last screen when pressed at the first page.

Press ***V/A*** to switch the view between maximum and minimum. For example, if the current display shows the maximum phase voltage value, then when ***V/A*** is pressed, the display will show the minimum phase voltage value. If ***V/A*** is pressed again, the display will switch back to show the maximum phase voltage value. The following figure shows the screen sequence:

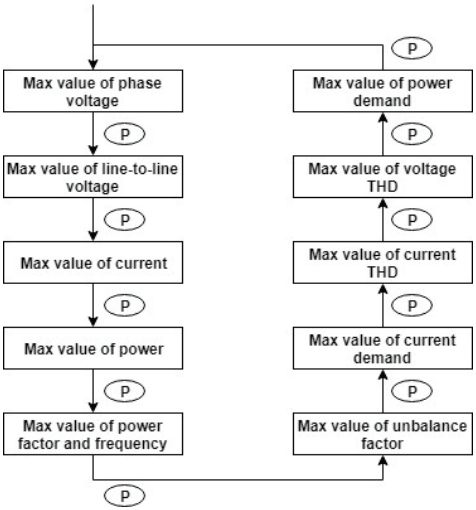


Figure 3-20 Max/Min Screen Sequence

NOTE: The figure shows the rolling sequence when P is pressed. The sequence will be reversed if users press E to roll between screens. When the meter is set to 2LL or 3LL, the first screen (max value of phase voltage) will not be displayed. When the meter is set to 1LL, certain displays are not available, such as phase C voltage, Ubc and Uca line voltage, phase C current, three phase voltage and current unbalance factor, Uc and Ic THD, phase C current demand, and so forth.

NOTE: The timestamp for the max/min parameters can be viewed only from the Acuview 2 software or through Modbus communication. There are no commands associated with the H button in the Max/Min display mode.

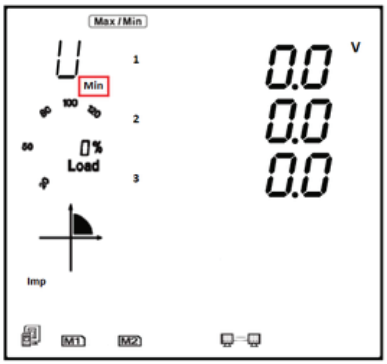


Figure 3-21 Acuvim II Minimum Readings

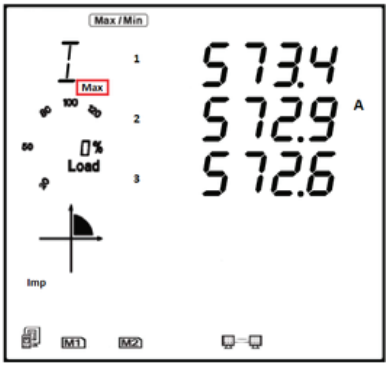


Figure 3-22 Acuvim II Maximum Readings

3.4 Demand Data

To view the demand data, press ***H*** and ***V/A*** keys simultaneously for about one second and release, the screen will go blank, and the cursor will be flashing. Press either ***P*** or ***E*** to move the flashing cursor over to ***Demand*** and press ***V/A*** to view the meters demand data. The first screen that is shown is the demand of active power, reactive power, and apparent power. Press either ***P*** or ***E*** key to view the current demand of phase A, phase B, and phase C. The power demand and current demand are the only two screens that can be read in the demand mode.

NOTE: When the meter is set to 1LL, there will be no phase C current demand displayed. When the meter is set to 1LN, there will be no phase B and C current demand displayed.

NOTE: There are no commands associated with the V/A and H key in the demand readings page.

Figure 3-23 shows the power demand screen that has a system active power demand of 112.7 kW, system reactive power demand of 0.063 kvar, and a system power demand of 115.1 kVA.

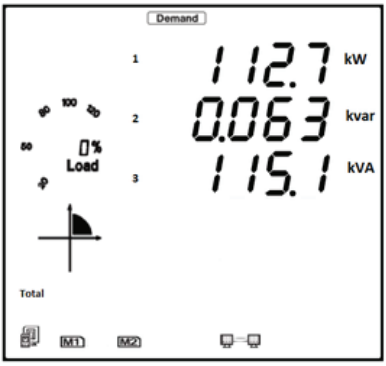


Figure 3-23 Power Demand Screen

3.5 Harmonic Data

In the Harmonic data mode, the meter displays the individual harmonic data for voltage and current, Total Harmonic Distortion, odd Harmonic Distortion, even Harmonic Distortion, Crest Factor, and K Factor. To view the Harmonic data, press ***H*** and ***V/A*** keys simultaneously for about one second and release, the screen will go blank, and the cursor will be flashing. Press either ***P*** or ***E*** key to move the flashing cursor over to **Harmonic** and press ***V/A*** to view the Harmonic data of the meter.

3.5.1 Power Quality Data

While in the Harmonic data mode, press ***H*** to display the power quality data. By pressing ***H*** again, the screen will roll to the next page and will roll back to the first screen when ***H*** is pressed at the last page.

The figure below shows the screen sequence for the power quality parameters.

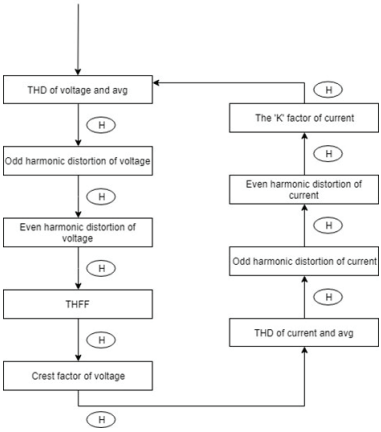


Figure 3-24 Power Quality Screen Sequence

NOTE: When the meter is set to 1LN, only phase A will be displayed for voltage THD, voltage odd harmonic distortion, voltage even harmonic distortion, THFF, voltage crest, current THD, current odd harmonic distortion, current even harmonic distortion, and current K factor. When the meter is set to 1LL, phase C will not be displayed.

Figure 3-25 below shows the Total Harmonic Distortion for Voltage, where Phase A THD is 2.050%, Phase B THD is 1.990%, Phase C THD is 1.920%, and the Average Phase Voltage THD is 1.986%.

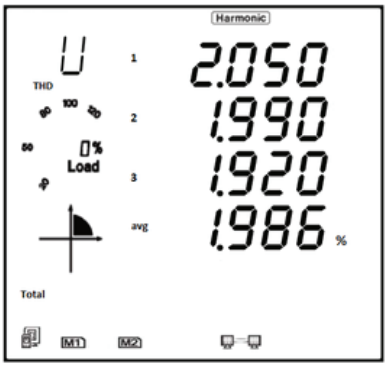


Figure 3-25 Harmonic Distortion Reading

3.5.2 Individual Harmonic Data

While in harmonic mode, press ***V/A*** to switch from the THD parameters to the individual harmonic data display.

In the harmonic data display, the harmonic order will increase by one each time ***P*** is pressed and will return to the 2nd Harmonic when ***P*** is pressed at the 63rd harmonic. The harmonic order will decrease by one each time ***E*** is pressed and will return to the 63rd when ***E*** is pressed at the 2nd harmonic.

Press ***V/A*** to switch the display between voltage harmonics and current harmonics.

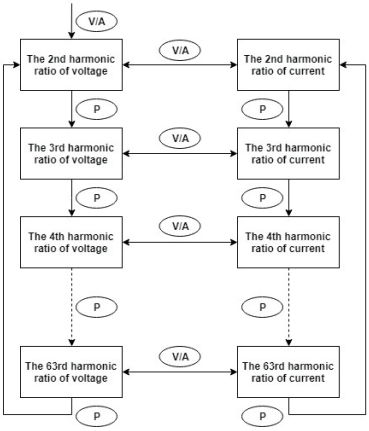


Figure 3-26 Individual Harmonic Data Screen Sequence

NOTE: The figure shows the rolling sequence when pressing P. If the E key is pressed, the sequence will be reversed. When the meter is set to 1LN, only phase A will be displayed for voltage and current harmonic magnitudes. When the meter is set to 1LL, phase C will not be displayed for voltage and current harmonic magnitudes.

Figure 3-23 shows the 5th order harmonic readings for current: Phase A is 12.35%, Phase B is 4.940%, and Phase C is 7.541%.

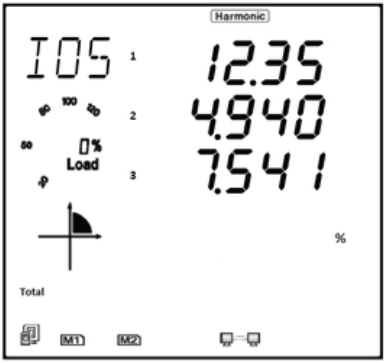


Figure 3-27 Individual Harmonic Reading

3.6 Expanded I/O Module Data

To view the data from the expanded I/O modules, press ***H*** and ***V/A*** keys simultaneously for about one second and release, the screen will go blank, and the cursor will be flashing. Press either ***P*** or ***E*** key to move the cursor right or left until it is on **Digital I/O**, then press ***V/A*** to view the I/O data.

In the expanded I/O module data mode, the meter displays the data from the expanded I/O modules such as the DI status, DI pulse counter, relay status, analog input, analog output.

In this mode the first page is the module selection. You can choose to view the available modules that are attached to the meter. If no expanded I/O modules are connected, the screen will display ***NO IO***.

3.6.1 Module Selection

In the module selection screen, press ***P*** to move the cursor downwards. The cursor will return to the top when it reaches the bottom. If only one module is connected, pressing ***P*** will have no effect.

Press ***E*** to move the cursor upwards, and the cursor will skip to the bottom when it reaches the top. If only one module is connected, pressing ***E*** will have no effect.

Press ***V/A*** to select the module and enter the I/O module data selection mode.

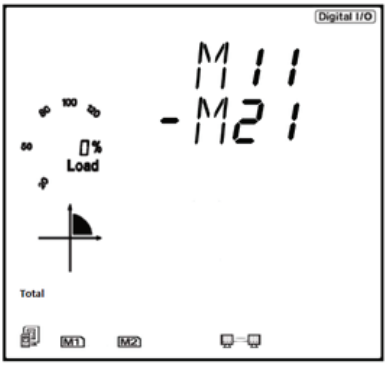


Figure 3-28 Module Selection Screen

As shown in figure 3-28, AXM-IO1-1 and AXM-IO2-1I/O modules are connected and indicated by M11 and M21 respectively. The cursor in the figure points to M21. The following table lists all the I/O modules and the associated codes.

Table 3-3 I/O Module Representation

Code	Module
M11	AXM-IO1-1
M12	AXM-IO1-2
M21	AXM-IO2-1
M22	AXM-IO2-2
M31	AXM-IO3-1
M32	AXM-IO3-2

I/O Module Data Display

In the I/O Module Data selection screen, press ***P*** to move the cursor downwards, and the cursor will return to the top when it reaches the bottom. Please note that there are three parameters for the AXM-IO1, three parameters for the AXM-IO2, and four parameters for the AXM-IO3.

Press ***E*** to move the cursor upwards. The cursor will skip to the bottom when it reaches the top.

Press ***V/A*** to select the parameter and enter the display of the data.

Press ***H*** to return to the module selection screen.

The following figures display the screen sequence for each I/O module supported on the Acuvim II.

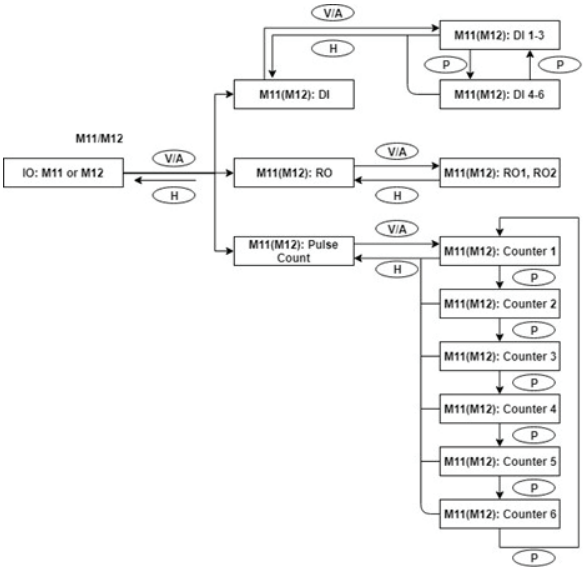


Figure 3-29 AXM-IO1 Data Display Screen Sequence

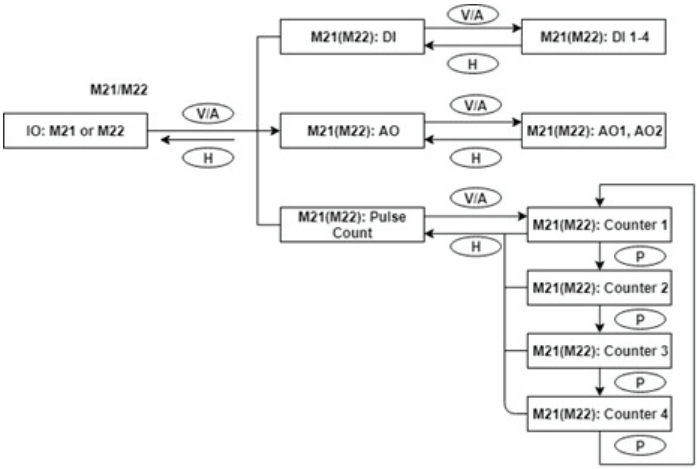


Figure 3-30 AXM-IO2 Data Display Screen Sequence

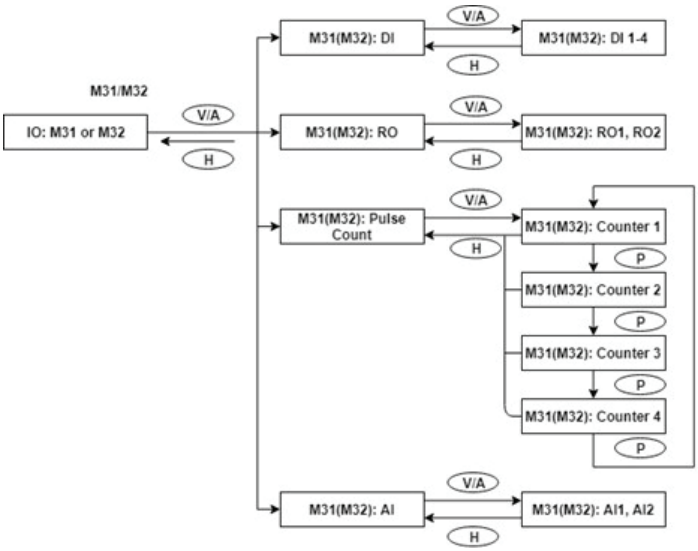


Figure 3-31 AXM-IO3 Data Display Sequence

3.7 Meter Setting Mode

In the settings mode, the system parameters, expanded I/O module parameters, alarm parameters, and communications module parameters can be read and modified. To access the settings mode, press ***H*** and ***V/A*** keys simultaneously for about one second and release, the screen will go blank, and the cursor will be flashing. Press either ***P*** or ***E*** key to move the flashing cursor over to **Setting** and press ***V/A*** to enter the meter settings.

3.7.1 Password Inquiry

To access the meter's settings, the user must enter a four-digit password. By default, the meter password is **0000**. The following figure shows the password screen.



Figure 3-32 Password Inquiry Page

To input password:

- Press ***H*** to move the flashing cursor to the next position.
- Press ***P*** to increase the number by 1.
- Press ***E*** to decrease the number by 1.
- Press ***V/A*** to confirm the password.

NOTE: If the meter's password is unknown or forgotten, please contact Accuenergy Technical Support.

3.7.2 Parameter Selection Mode

Once the password has been entered correctly, there are four options to choose from in the parameter selection mode:

- System
- I/O
- NET
- Alarm

To navigate in the parameter selection mode, press ***P*** to move the cursor downwards. The cursor will return to the top when it reaches the bottom. Press ***E*** to move the cursor upwards. The cursor will skip to the bottom when it reaches the top. Press ***V/A*** to select and enter the setting.

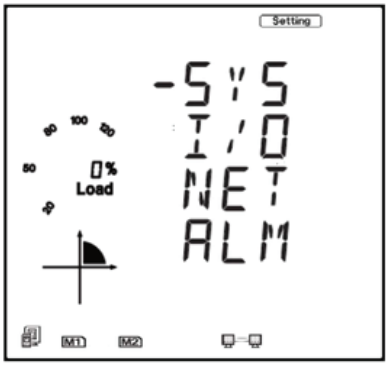


Figure 3-33 Parameter Selection Page

3.7.3 System Settings

Users can select and modify system parameters in the system parameter setting mode.

Key functions for selecting a parameter:

- The screen will roll to the next page each time P is pressed and will return to the first page when P is pressed at the last page.
- The screen will roll to the previous page each time ***E*** is pressed and will skip to the last page when ***E*** is pressed at the first page.
- Press ***V/A*** to modify the selected parameter.
- Press ***H*** to return to the parameter selection mode.

Key functions for modifying the parameter:

- Press ***H*** to move the flashing cursor to the next position.
- Press ***P*** to increase the number by 1.
- Press ***E*** to decrease the number by 1.
- Press ***V/A*** to confirm the modification and return to parameter selection mode.

The following figure shows the page sequence for the system parameter settings.

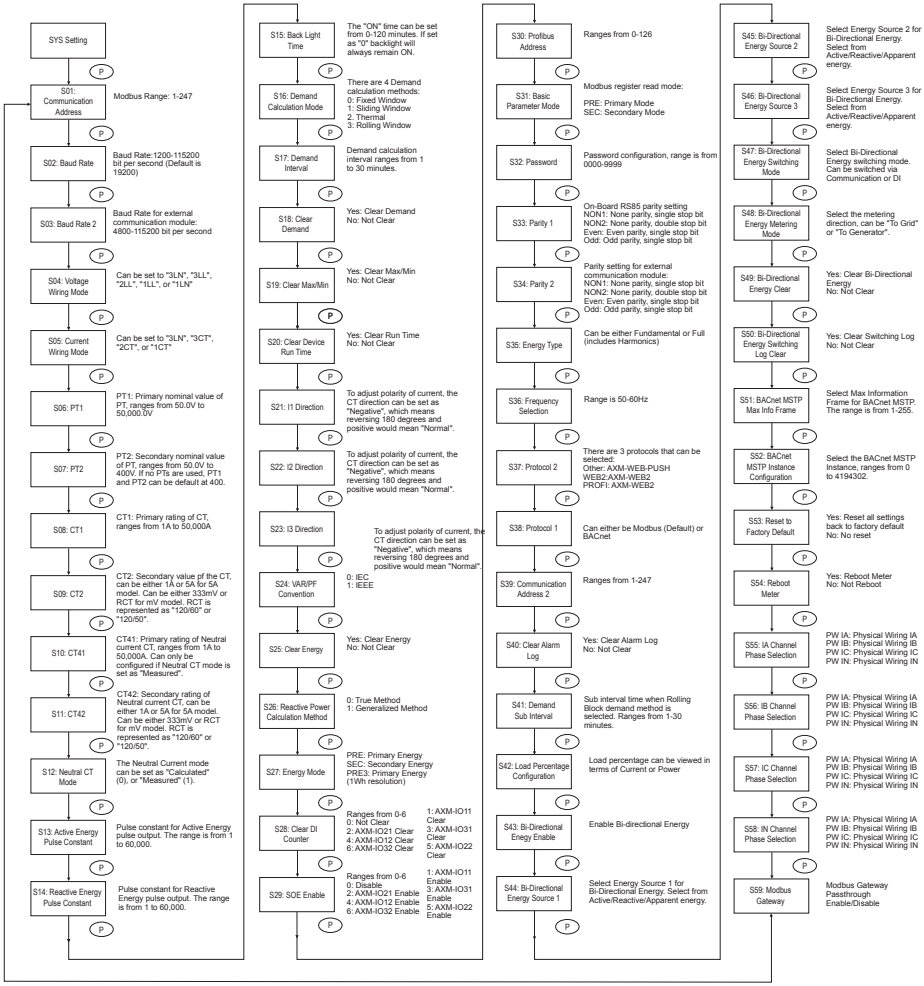


Figure 3-34 System Parameters Page Sequence

3.7.4 I/O Module Settings

In the expanded I/O module parameter mode, there will be an option to view the available modules attached to the meter and modify parameters. If no expanded I/O modules are connected, the screen will display **NO IO**. To return to the system parameter setting menu, press ***H***.

Key functions for I/O module selection:

- Press ***H*** to return to parameter selection mode.
- Press ***P*** to move the cursor downwards. The cursor will return to the top when it reaches the bottom. If there is only one module connected, pressing ***P*** will have no effect.
- Press ***E*** to move the cursor upwards. The cursor will skip to the bottom when it reaches the top. If there is only one module connected, pressing ***E*** will have no effect.
- Press ***V/A*** to select the module and enter the I/O module parameter setting mode.

Key functions for modifying the parameter:

- Press ***H*** to move the flashing cursor to the next position.
- Press ***P*** to increase the number by 1.
- Press ***E*** to decrease the number by 1.
- Press ***V/A*** to confirm the modification and return to parameter selection mode.

The following figures will show the sequence for the I/O module settings:

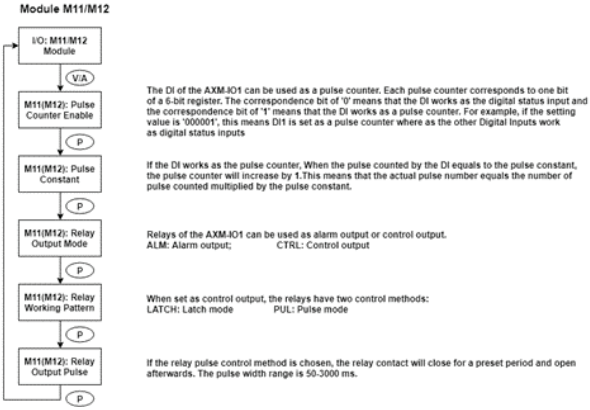


Figure 3-35 - Screen Sequence for AXM-IO11/IO12

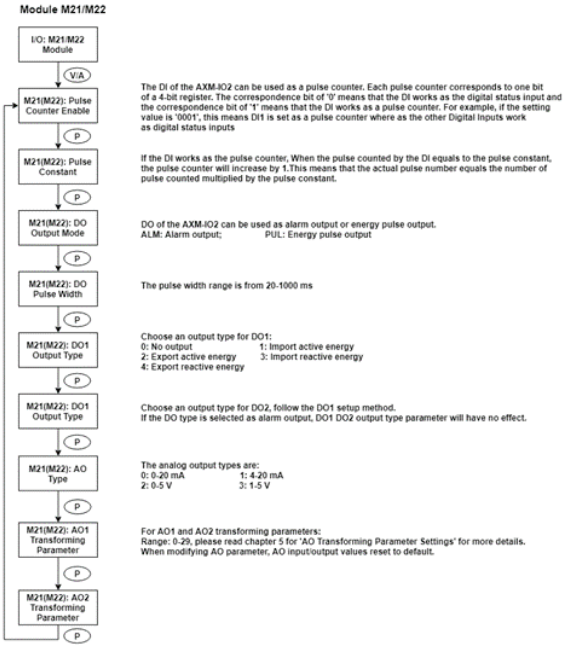


Figure 3-36 - Screen Sequence for AXM-IO21/IO22

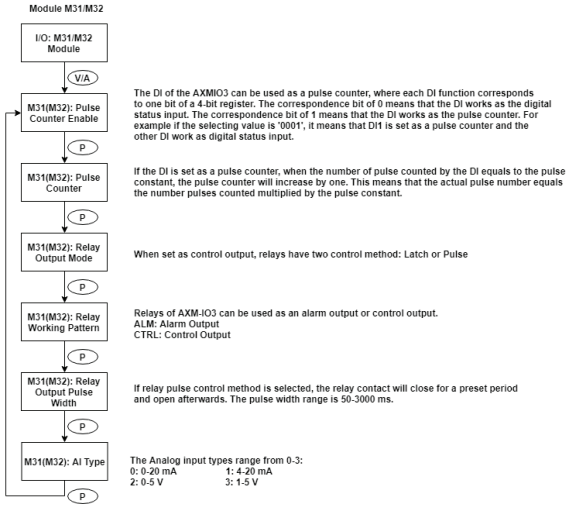


Figure 3-37 - Screen Sequence for AXM-IO31/IO32

NOTE: Figures 3-34 to 3-37 will show the rolling sequence using the P key. If you are using the E key for scrolling across the pages, the sequence will be reversed.

3.7.5 Communications Module Settings

When the second communication protocol is set to **OTHER**, there will be pages displayed related to the AXM-WEB-PUSH and AXM-RS485 module. The default second communication protocol setting is **OTHER.**

When the second communication protocol is set to **WEB2**, there will be pages displayed related to the AXM-WEB2 module.

When the second communication protocol is set to **PROFI**, there will be pages displayed related to the AXM-PROFI module.

Key functions for finding the I/O module parameters:

- Press ***H*** to return to parameter selection mode.
- The screen will roll to the next page each time ***P*** is pressed and will return to the first page when ***P*** is pressed on the last page.
- The screen will roll to the previous page each time ***E*** is pressed and will skip to the last page when ***E*** is pressed at the first page.
- Press ***V/A*** to modify the selected parameter.

Key functions for modifying the module parameters:

- Press ***H*** to move the flashing cursor to the next position.
- Press ***P*** to increase the number by 1.
- Press ***E*** to decrease the number by 1.
- Press ***V/A*** to confirm the modification and return to parameter selection mode.

The following figures will show the screen sequence for the supported communication protocols:

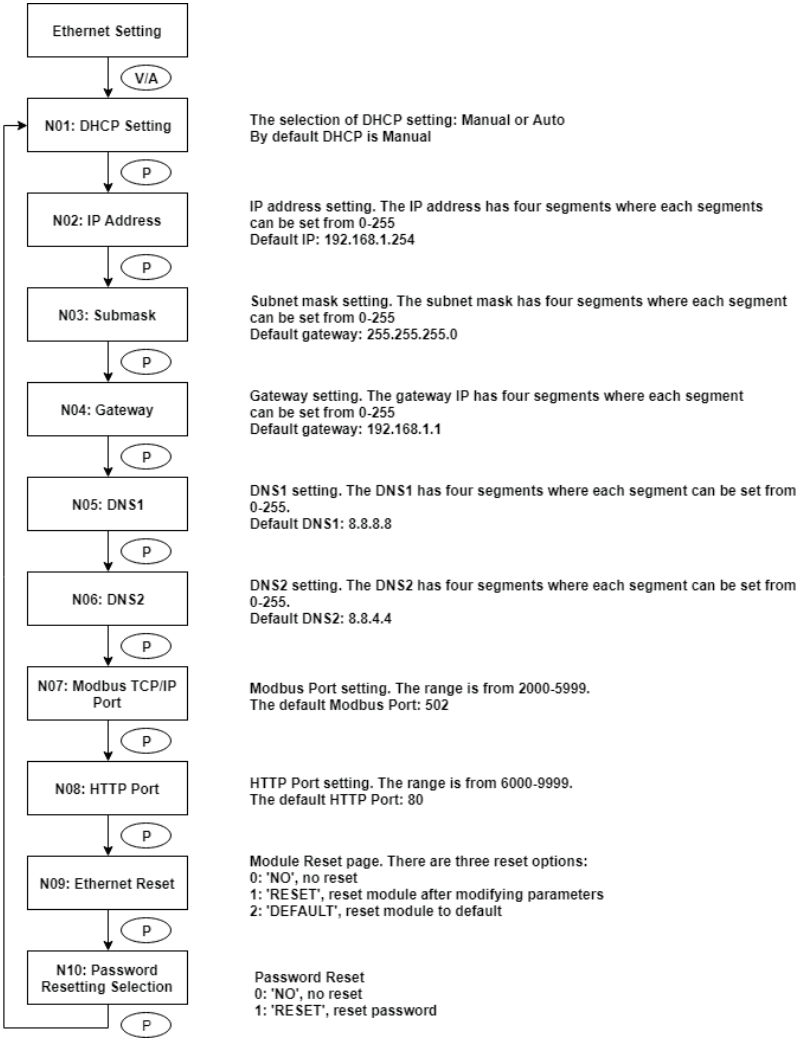


Figure 3-38 Ethernet Module Net Settings Screen Sequence

NOTE: This figure shows the rolling screen sequence using the P key. If using the E key for rolling to the next page the sequence will be reversed.

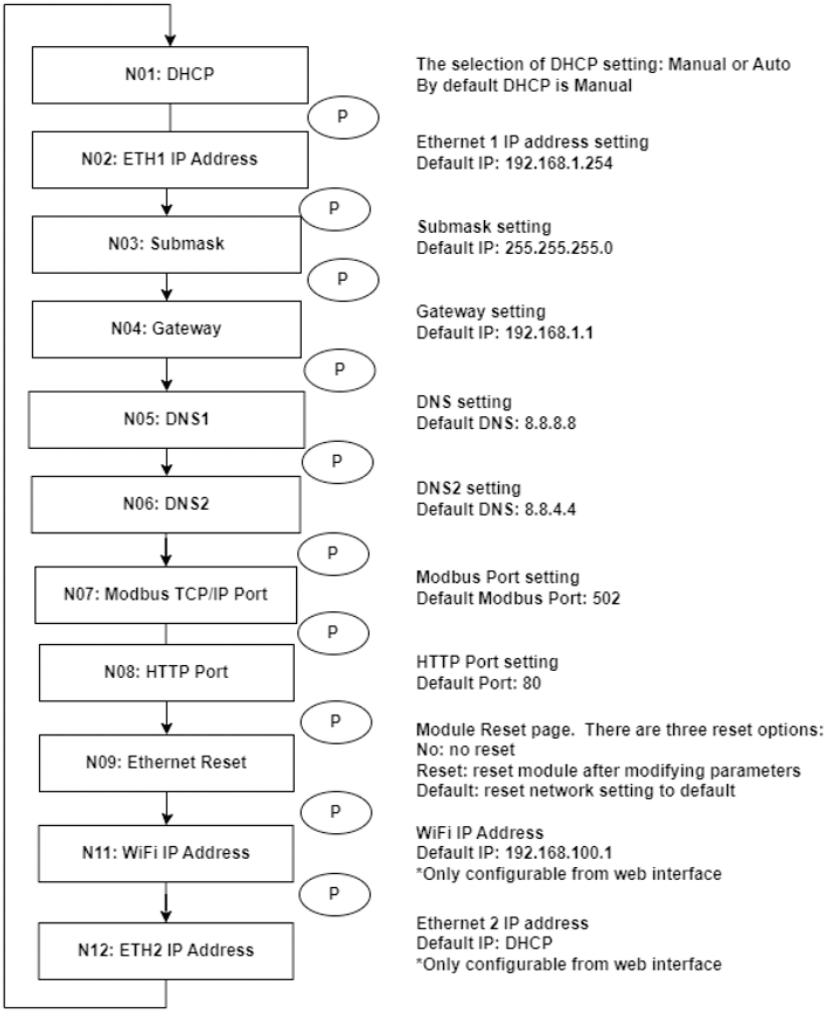


Figure 3-39 - AXM-WEB2 Rolling Screen Sequence

3.7.6 Alarm Settings

In the alarm parameter mode, the parameters can be viewed and modified.

Key functions for finding the alarm parameter:

- Press ***H*** to return to parameter selection mode.
- The screen will roll to the next page each time ***P*** is pressed and will return to the first page when ***P*** is pressed on the last page.
- The screen will roll to the previous page each time ***E*** is pressed and will return to the last page when ***E*** is pressed at the first page.
- Press ***V/A*** to modify the selected parameter.

Key functions for modifying the parameter:

- Press ***H*** to move the flashing cursor to the next position.
- Press ***P*** to increase the number by 1.
- Press ***E*** to decrease the number by 1.
- Press ***V/A*** to confirm the modification and return to parameter selection mode.

The following figure shows the sequence:

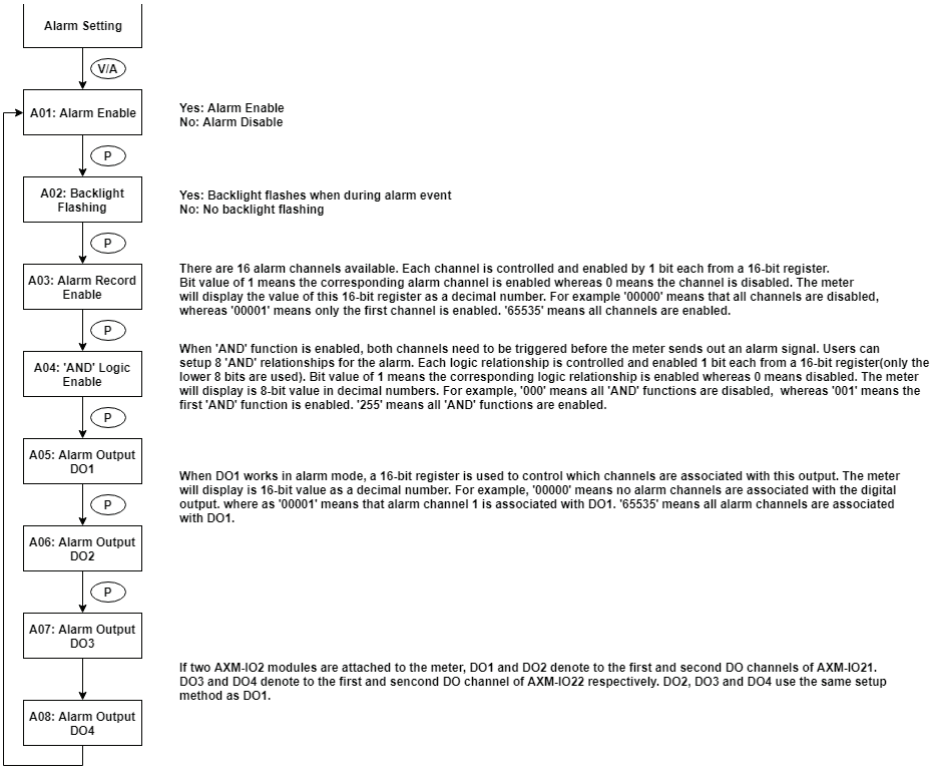


Figure 3-40 Screen Sequence for Alarm Settings

3.8 Page Recovery Function

The Acuvim II series meter includes a page recovery function. This instructs the meter to store the current display page in the non-volatile memory upon power loss and reloads the page when power is recovered. If power is lost when viewing the parameter setting mode, the meter will show voltage displayed when the power is recovered. If power goes off when viewing under the expanded I/O module data mode, and if this expanded I/O module is not connected when power recovers, the meter will show the voltage display page instead.

Chapter 4: Detailed Functions and Software

The Acuvim II series meter contains advanced metering tools capable of measuring a multitude of power, energy, and power quality parameters. Some advanced functions are not accessible directly from the meter front display; therefore, every meter can connect to the Acuview 2 Meter Data Management Software to access the information. This chapter introduces these functions and software.

4.1 Acuview 2 Software

The Acuview 2 software is a free data management software that can be used to read and log the meters data, as well as configure and view settings. This software is free to download at www.accuenergy.com/acuview2.

The software uses the Modbus protocol to communicate with the meter. Users can connect to the software via the built-in RS485 communication port or by Modbus TCP via communications module.

NOTE: The Acuview 2 software is only compatible with Acuvim II devices running firmware versions 6.15 and above.

4.1.1 Connect using RS485

The meter's RS485 communication port can be used to connect to the software using an RS485-to-USB converter. The RS485 port on the meter has three terminals where 14 is labelled A (Positive), terminal 15 is B (Negative), and terminal 16 is S (Shield). The communication port uses half-duplex two-wire RS485 communication where the data is passed in one direction at a time, and the send (TX) and receive (RX) signals are shared between the two wires.

The figure below depicts how the RS485-USB converter should be wired into the meter, the T/R+ on the converter connected to terminal 14(A) on the Acuvim II meter, and T/R- on the converter connected to terminal 15(B) on the meter.

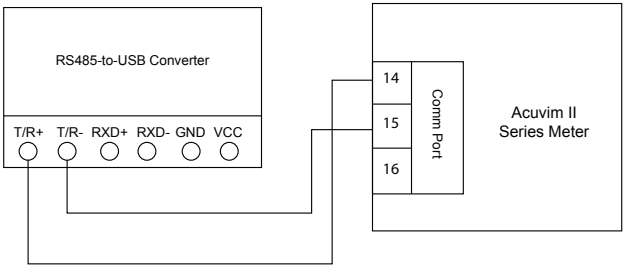


Figure 4-1 RS485-USB Converter Connection to Acuvim II Meter

Once the physical wiring is connected between the converter cable and the Acuvim II meter, the meter's communication settings need to be confirmed. The communication settings in this case are the meter's Modbus device address (slave ID), the communication speed or baud rate, and the parity. By default, the meter has the following communication settings:

- **Modbus Device Address**: 1
- **Baud Rate:** 19200
- **Parity:** Non1 (no parity, 1 stop bit)

NOTE: If users are connecting to a meter with no display (DIN rail mount model), the default baud rate of the meter is 9600 on the first power up. After one minute of being powered, the default baud rate will change to 19200.

The COM port must then be confirmed on the computer that is being used to connect to the meter. To determine the COM port that is assigned, open the Device Manager on the computer. Under the ***Port (COM & LPT)*** heading, find the COM port number. For example, in the figure below, COM4 has been assigned to the RS485-USB converter. Note the COM port number as it is required to connect to the software.

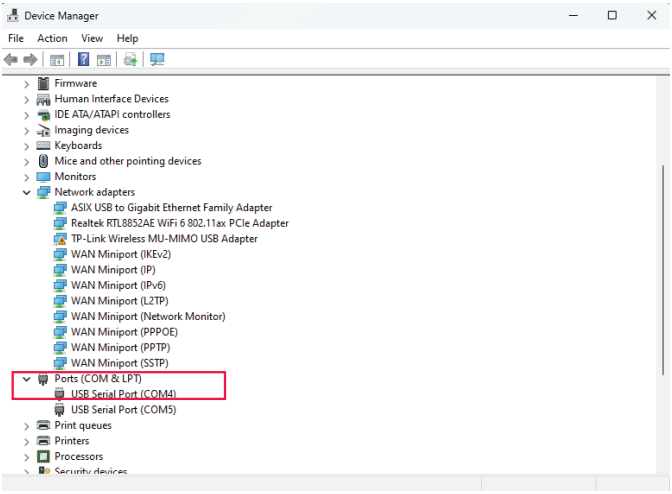


Figure 4-2 COM Port Number Assigned to USB Converter

Open the **Acuview 2** software, the following Connection screen will appear where users can either select the meter from the list for connection or add a new meter.

To add a new meter, click on the **Add** button, then the Add Device page will appear where users will have to input the necessary information required for establishing communication.

In the Meter section, specify the name for the meter, choose **Acuvim II-V3** as meter model from the drop-down menu, and select **Modbus RTU** as the Connect Way. In the Connection section, users can configure the Timeout and Scan Rate. Both Timeout and Scan Rate can be left at the default values of 2000ms.

Proceeding to the Modbus RTU section, enter the Com Number assigned to the USB converter cable (as found in the Device Manager), along with specifying the Slave Address, Baud Rate, and Parity settings for the meter.

Click on **Save** after all settings have been completed, and the meter will be successfully added to the list.

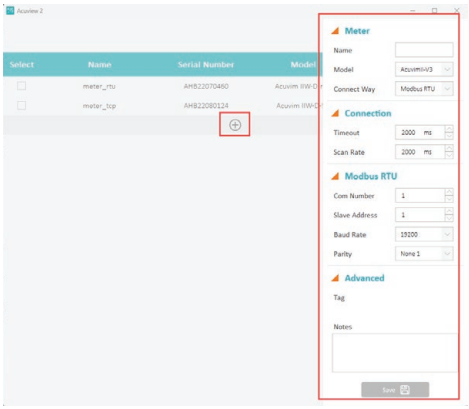


Figure 4-3 Creating New Connection Using the Acuview 2 Software

Once the desired meter has been successfully added to the software, the connection can be established by selecting the meter and clicking on the **Connect** button located in the upper right corner of the screen, and the meter should automatically connect to the software.

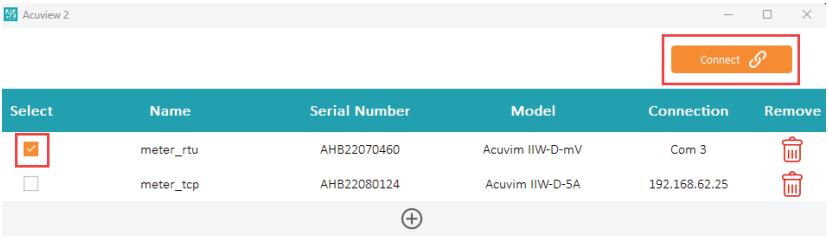


Figure 4-4 Connecting Acuvim II Device to the Software

Users should observe data appearing on the main screen of the Acuview 2 software once the meter is connected successfully. If the meter does not connect initially, click on the **Connection** menu, and select **Connect**.

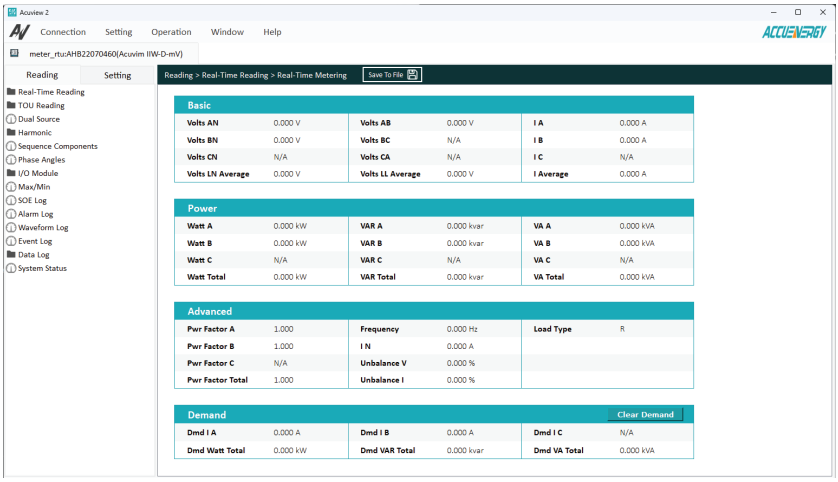


Figure 4-5 Acuview 2 Software Interface When Connected to the Meter

NOTE: For methods on how to connect to the software using Modbus TCP via communication module, please refer to the AXM-WEB2 or AXM-WEB-PUSH User Manual which can be found on our website www.accuenergy.com.

4.2 Basic Analog Measurements

The Acuview 2 software allows users to view all real-time analog measurements with high accuracy.

The real-time parameters that the meter can measure include voltage, current, power, frequency, power factor, demand, and other data.

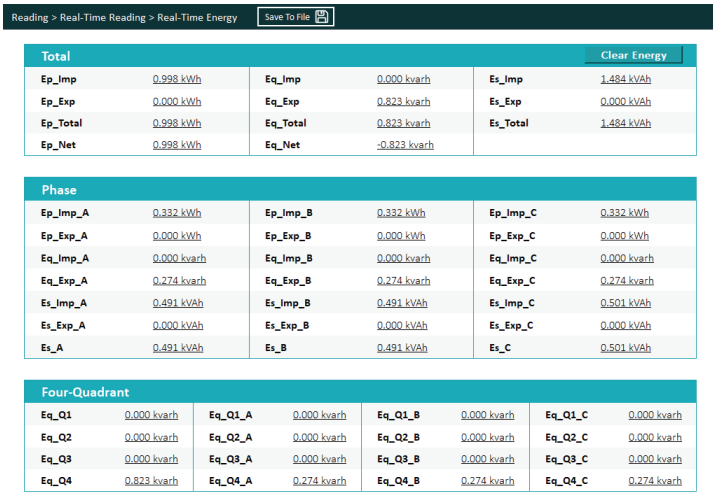


Figure 4-6 Real-Time Metering

4.2.1 High-Speed Monitoring

The Acuvim II V3 model supports High-Speed Monitoring.

In the Acuview 2 software, users can access the high-speed parameter readings as a reference.

For more precise readings obtained at higher sampling rates, users can enable the Fast Read Mode using WEB2 and directly read from the corresponding Modbus registers. There are two available sampling rates: 100ms and 50ms. The high-speed parameters include most real-time parameters at the 100ms sampling rate, while at the 50ms sampling rate, the meter only supports voltage, current, total active/reactive power, and frequency. Once the desired sampling rate is selected, users can view the Modbus address corresponding to the high-speed parameters on the WEB2.

NOTE: Configure the Fast Read Mode using WEB2 will require the users to use AXM-WEB2 as the second communication protocol.

4.2.2 Moving Average Frequency

Starting from Acuvim II v3 v6.20 or later, the frequency is determined using a specialized moving average algorithm. This algorithm, tailored for specific applications, contributes to smoothing

frequency readings, mitigating noise, and improving the resolution for abnormal frequency detection.

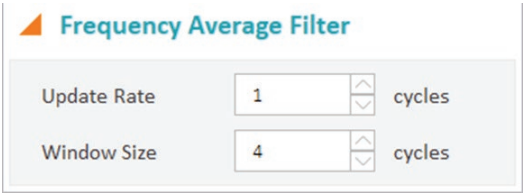


Figure 4-7 Frequency Average Filter Setting Page

Users have the flexibility to configure the **update rate**, ranging from 1 cycle to 4 cycles. Additionally, the **window size** can be adjusted from 1 cycle to 50 cycles. The default configuration sets the update rate to 1 cycle and the window size to 4 cycles. These customizable settings allow users to tailor the frequency measurement process according to their specific requirements.

4.3 Demand

This meter can support demand measurements, consisting of power and current demand readings. The demand can be found in the real-time section as outlined in Figure 4-8 below.

The demand will be calculated using the demand calculation method configured in the meter. The calculation types include:

- **Fixed Block**: The demand is calculated based on selecting the calculation period **(Window Interval)** between 1 to 30 minutes. The meter will calculate and update the demand values at the end of each calculation period.
- **Sliding Block**: The demand is calculated by selecting the calculation period **(Window Interval)** between 1 to 30 minutes. The meter will average the energy accumulated within this time period and the demand value is updated every minute.
- **Thermal**: The demand is calculated based on thermal response, used in thermal demand meters. This method uses a sliding window to update the demand value at the end of each calculation period **(Window Interval)**.
- **Rolling Block**: The demand is based on selecting a calculation period **(Window Interval)** between 1 to 30 minutes, a sub interval **(Calculation Interval)**, and the demand value updated at each sub interval. The sub interval must be a factor of the calculation period. For example, with a calculation period of 15 minutes, the sub interval can be configured as 5 minutes.

The demand calculation type and interval can be configured in the meter settings on either the Acuview 2 software, which will be discussed in the software settings portion of this chapter, or from the front display of the meter (refer to Chapter 3 for accessing the demand settings).

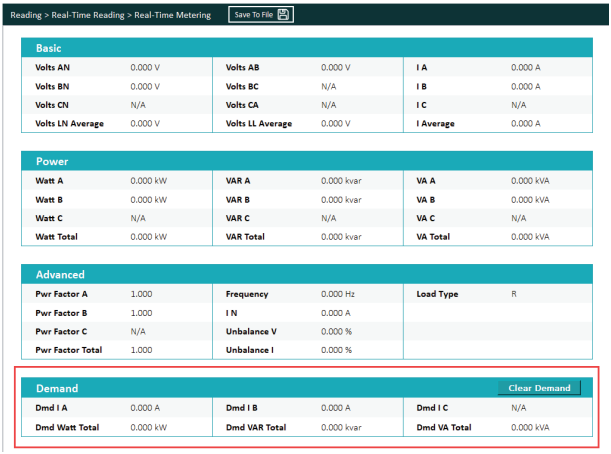


Figure 4-8 Demand Readings

4.4 Energy

The Acuvim II meter supports the writing of energy values, and this can be done via either software or Modbus. This is used to configure the meter to start accumulating from a certain energy value. However, it is important to note that the energy values cannot be written directly from the meter's display.

Energy Calculating Mode

1. Users can select different energy calculating modes, fundamental based or full-wave based, either from the meter-front or via communication. The fundamental based calculating is used to accumulate energy without taking harmonics into consideration, while the full-wave based calculating is used to accumulate energy including fundamentals and harmonics.

NOTE: When fundamental based calculating mode is selected, the PF calculation will be based on the fundamental wave.

2. The energy reading can be set as either Primary or Secondary. The Primary displays the energy accumulation in terms of the Primary measurement, and the Secondary displays the energy accumulation in terms of the Secondary measurement with resolution of up to 1Wh. Users can

configure this setting either by pressing keys from the meter-front (refer to chapter 3), or via communication through Acuview 2 software or Modbus registers.

NOTE: Acuvim II can display either primary energy or secondary energy on the LCD screen. However, it is only able to send out pulses according to secondary energy via the AXM-IO module.

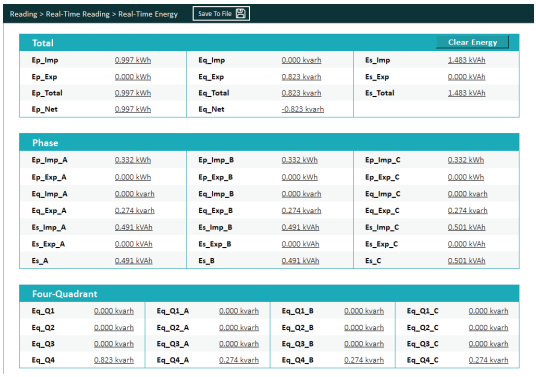


Figure 4-9 Energy Readings

4.4.1 Active Energy:

Energy represents the cumulative quantity of power consumed or produced over time. It is the integral of power with respect to time. In Acuvim IIV3, active energy is measured in kilowatt-hours (kWh). The relationship between active energy (EP), power (P), and time (t) is given by formula:

$$E_P = \int_{t1}^{t2} P(t)dt$$

Import Active Energy

Under this category, only the active energy with positive power (consumed by the load) is accumulated. The formula for import active energy is:

$$E_{Pimp} = \int_{t1}^{t2} P_{imp}(t)dt$$

Export Active Energy

Here, only the active energy with negative power (generated by the load) is accumulated. The formula for export active energy is:

$$E_{Pexp} = \int_{t1}^{t2} P_{exp}(t)dt$$

Total Active Energy

Total active energy refers to the overall amount of active energy associated with the connected system. It is the sum of the import active energy and export active energy:

$$E_{Ptotal} = E_{Pimp} + E_{Pexp}$$

Net Active Energy

Net active energy is the total electrical active energy remaining after accounting for losses and subtracting any exported active energy:

$$E_{Pnet} = E_{Pimp} - E_{Pexp}$$

4.4.2 Reactive Energy

Reactive Energy is the energy consumed or generated by a reactive load such as inductor and capacitor. In Acuvim IIV3, reactive energy is measured in kilovolt-ampere reactive-hours (kVarh). The relationship between reactive energy (EQ), reactive power (Q), and time (t) is given by formula:

$$E_Q = \int_{t1}^{t2} Q(t)dt$$

Import Reactive Energy

Under this category, only the reactive energy with positive reactive power (consumed by reactive load) is accumulated. The formula for import reactive energy is:

$$E_{Qimp} = \int_{t1}^{t2} Q_{imp}(t)dt$$

Export Reactive Energy

Here, only the reactive energy with negative reactive power (generated by reactive load) is accumulated. The formula for export reactive energy is:

$$E_{Qexp} = \int_{t1}^{t2} Q_{exp}(t)dt$$

Total Reactive Energy

Total reactive energy refers to the overall amount of reactive energy associated with the connected system. It is the sum of the import reactive energy and export reactive energy:

$$E_{Qtotal} = E_{Qimp} + E_{Qexp}$$

Net Reactive Energy

Net reactive energy is the total electrical reactive energy remaining after accounting for losses and subtracting any exported reactive energy:

$$E_{Qnet} = E_{Qimp} - E_{Qexp}$$

4.4.3 Apparent Energy

Apparent power is the combination of active power and reactive power, it defines the amount of total power flowing within a system. Apparent energy is the integral of apparent power with respect to time. In Acuvim IIV3, apparent energy is measured in kilovolt-ampere-hours (kvah). The relationship between apparent energy (ES), apparent power (S), and time (t) is given by formula:

$$E_S = \int_{t1}^{t2} S(t)dt$$

Import Apparent Energy

Import Apparent Energy is the accumulated apparent energy only if apparent power vector lies in Quadrant I or 4IV, (active power P >=0).

$$E_{Simp} = \int_{t1}^{t2} S_{imp}(t)dt$$

Export Apparent Energy

Export Apparent Energy is the accumulated apparent energy only if apparent power vector lies in Quadrant II or III (active power P < 0).

$$E_{Sexp} = \int_{t1}^{t2} S_{exp}(t)dt$$

Total Apparent Energy

Total apparent energy refers to the overall amount of apparent energy associated with the connected system. It is the sum of import apparent energy and export apparent energy:

$$E_{Stotal} = E_{Simp} + E_{Sexp}$$

4.4.4 Four Quadrant Energy

For power system, the relationship between apparent power, active power and reactive power often defines as:

$$S = P + jQ$$

where reactive power (Q, in Var units) is plotted on the ordinate axis, and active power (P, in Watts) is plotted on the abscissa. This coordinator has been defined as a four-quadrant system and indicates the power-flow concept of energy. The flow of power will result in the registration of energy in quadrants that correspond to the power vector location.

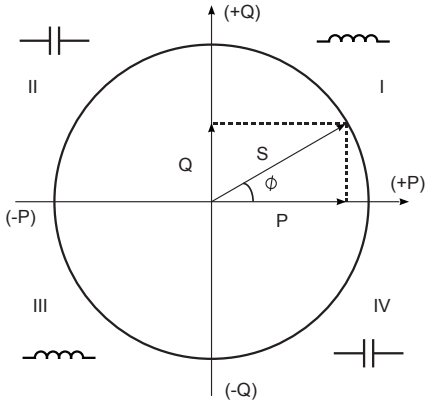


Figure 4-10 Four Quadrant Load Type and Power

In Acuvim IIV3 four quadrant energy section, the meter will accumulate energy based on the apparent power vector's location. For example:

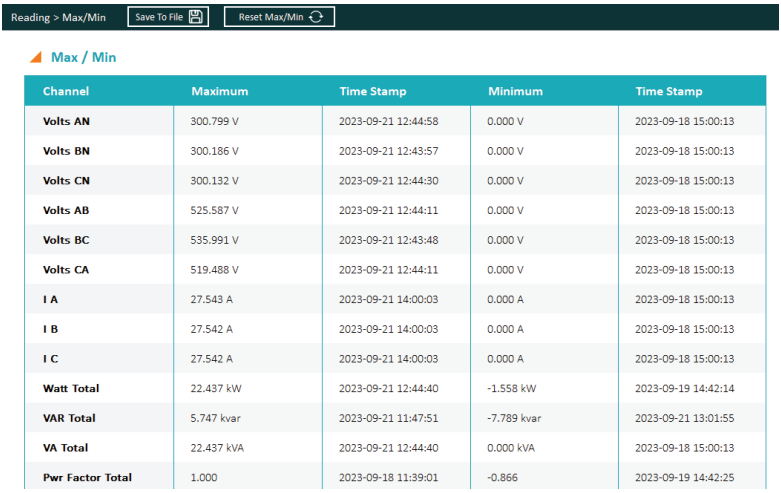
Quadrant I is defined as an area where both energies flow positively, so Eq_Q1 will only accumulate energy when P and S are both positive. The formula is shown below:

$$Eq_{Q1} = \int_{t1}^{t2} Q(t)dt \ when \ P \geq 0 \& Q \geq 0$$

4.5 Max/Min

Acuvim II series meter logs maximum and minimum value statistics for all real time, demand, THD parameters as well as the time that it occurred. All data is stored in non-volatile memory so all statistical information can be preserved even when the meter loses power or gets shut off. All maximum and minimum data can be accessed either via communication or from the meter front. However, time stamps information can only be accessed via communication.

Statistical data can be cleared via communication or from the meter front.



Channel	Maximum	Time Stamp	Minimum	Time Stamp
Volts AN	300.799 V	2023-09-21 12:44:58	0.000 V	2023-09-18 15:00:13
Volts BN	300.186 V	2023-09-21 12:43:57	0.000 V	2023-09-18 15:00:13
Volts CN	300.132 V	2023-09-21 12:44:30	0.000 V	2023-09-18 15:00:13
Volts AB	525.587 V	2023-09-21 12:44:11	0.000 V	2023-09-18 15:00:13
Volts BC	535.991 V	2023-09-21 12:43:48	0.000 V	2023-09-18 15:00:13
Volts CA	519.488 V	2023-09-21 12:44:11	0.000 V	2023-09-18 15:00:13
I A	27.543 A	2023-09-21 14:00:03	0.000 A	2023-09-18 15:00:13
I B	27.542 A	2023-09-21 14:00:03	0.000 A	2023-09-18 15:00:13
I C	27.542 A	2023-09-21 14:00:03	0.000 A	2023-09-18 15:00:13
Watt Total	22.437 kW	2023-09-21 12:44:40	-1.558 kW	2023-09-19 14:42:14
VAR Total	5.747 kvar	2023-09-21 11:47:51	-7.789 kvar	2023-09-21 13:01:55
VA Total	22.437 kVA	2023-09-21 12:44:40	0.000 kVA	2023-09-18 15:00:13
Pwr Factor Total	1.000	2023-09-18 11:39:01	-0.866	2023-09-19 14:42:25

Figure 4-11 Max and Min Readings

4.6 Harmonics and Power Quality Analysis

4.6.1 Harmonics & THD

Acuvim II series meter can measure and analyze several power quality parameters, which is useful for further analysis of the voltage and current signals measured by the meter.

Total Harmonic Distortion: A ratio of the sum of powers in all harmonic components to power of the fundamental frequency. The Acuvim II meter also supports even and odd order THD, where even order harmonics are 2nd, 4th, 6th, and so on, and odd order harmonics are 3rd, 5th, 7th, and so on.

Crest Factor: The ratio between either the peak current or voltage and the RMS value.

THFF: Stands for Telephone Harmonic Form Factor and is the ratio of the square root of the sum of the squares for all the sine wave components (including both fundamental and harmonic alternating current waves) to the RMS value of the entire wave form.

K Factor: A measure of the heating effect caused by current harmonics, which helps determine the linearity of a load. A K factor value of 1 indicates that the load is linear, and there are no harmonics present. However, a K factor value greater than one means that the load is not linear, and there is a higher heating effect caused by the harmonics in the system.

Harmonics are essentially high frequency waveforms that are combined with or superimposed over the fundamental frequency. The fundamental frequency is the circuit frequency which is 50 or 60Hz depending on the system that is being monitored. The Acuvim II meter supports individual voltage and current harmonics up to the 63rd order. This means that the meter can monitor the percentage of harmonics present up to the 63rd order (63 times the fundamental frequency). This provides users with an in-depth examination of the power quality for the system they are monitoring.

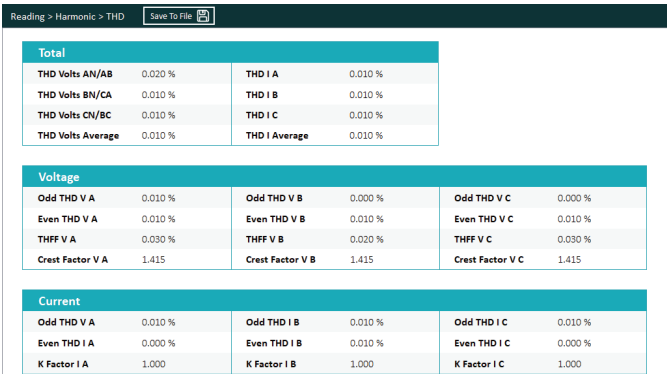


Figure 4-12 THD Reading

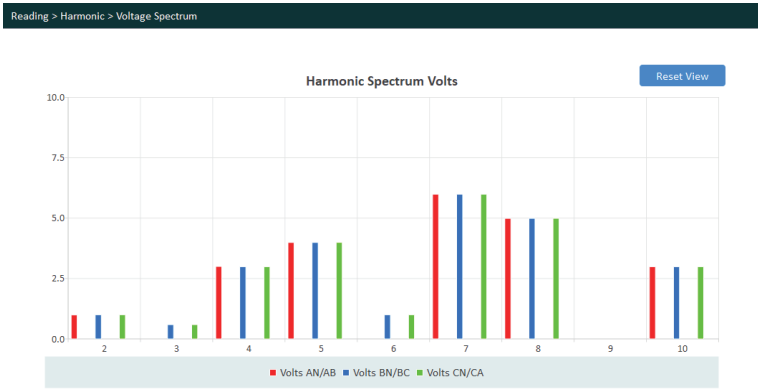


Figure 4-13(a) Harmonic Voltage Spectrum

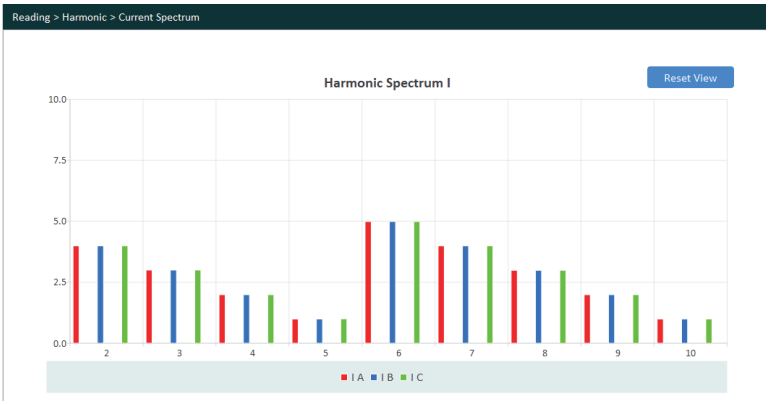
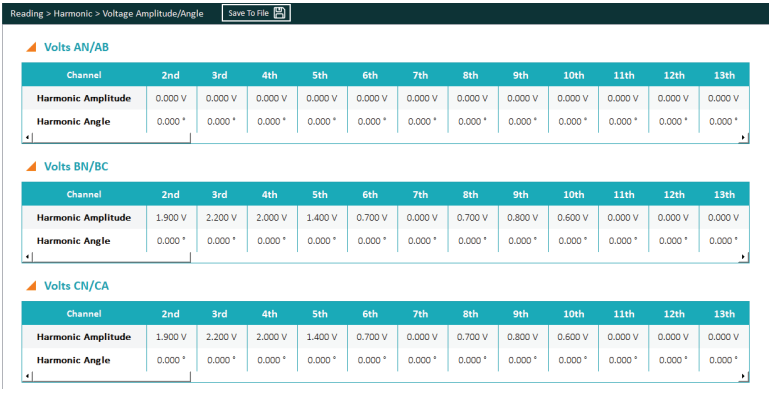


Figure 4-13(b) Harmonic Current Spectrum

4.6.2 Amplitude and Angle

This section provides users with the amplitude and phase angle details of the harmonics being measured by the meter. For example, if the voltage input to the meter is 120V and there is a harmonic reading of 10% for the 2nd order harmonic, the amplitude in this case will show 12V. Both voltage harmonics and current harmonic amplitude/angles can be viewed. Users can view from the 2nd to 63rd order by horizontally scrolling on the software screen.

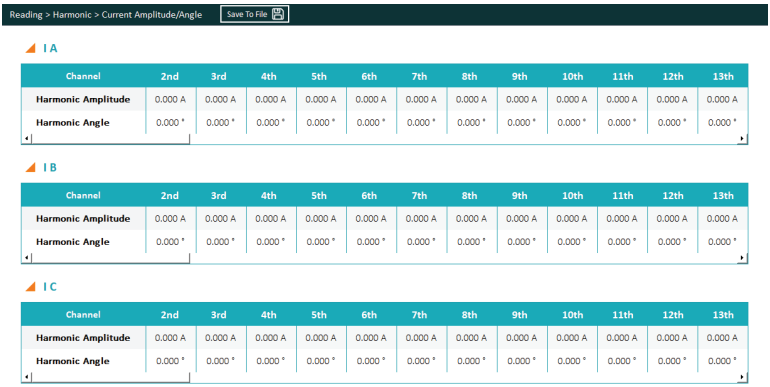


Channel	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Harmonic Amplitude	0.000 V	0.000 V	0.000 V	0.000 V	0.000 V	0.000 V	0.000 V	0.000 V	0.000 V	0.000 V	0.000 V	0.000 V
Harmonic Angle	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °

Channel	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Harmonic Amplitude	1.900 V	2.200 V	2.000 V	1.400 V	0.700 V	0.000 V	0.700 V	0.800 V	0.600 V	0.000 V	0.000 V	0.000 V
Harmonic Angle	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °

Channel	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Harmonic Amplitude	1.900 V	2.200 V	2.000 V	1.400 V	0.700 V	0.000 V	0.700 V	0.800 V	0.600 V	0.000 V	0.000 V	0.000 V
Harmonic Angle	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °

Figure 4-14(a) Voltage Amplitude/Angle



Channel	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Harmonic Amplitude	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A
Harmonic Angle	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °

Channel	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Harmonic Amplitude	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A
Harmonic Angle	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °

Channel	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Harmonic Amplitude	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A
Harmonic Angle	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °	0.000 °

Figure 4-14(b) Current Amplitude/Angle

4.6.3 Phase Angles

Phase angle indicates the angle between phase A voltage and other voltage/current parameters, measured in a range from 0 to 360 degrees. These readings allow the users to analyze the phase angle difference between each phase and also determine if current/voltage are incorrectly out of phase, which tends to be related to wiring/installation issues with the meter.

- When the wiring is set to 2LL or 3LL, the meter provides the phase angles of V BC, V CA, I A, I B, I C corresponding to V AB (reference angle).
- When the wiring is set to 3LN, the phase angles are V BN, V CN, I A, I B and I C where V AN is the reference angle.

- When the wiring is set to 1LL, the meter has phase angle of V BN, I A, I B where V AN is the reference angle.

The phase angle readings from the Acuview 2 software are shown in Figure 4-13. The image provides the phase angle reading of a three-phase four-wire system (3LN), where the three-phase voltage is 120 degrees apart. The current phase angle for three-phase four-wire balanced systems is usually aligned with the voltage phase angles.

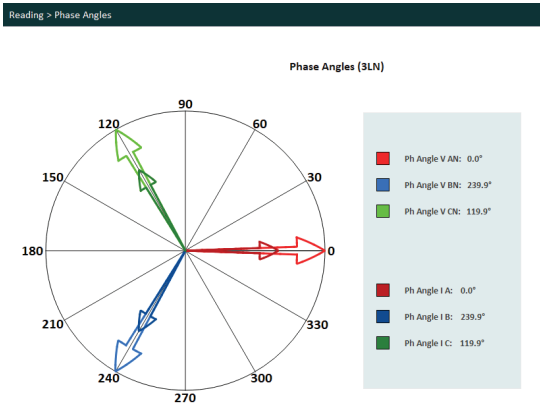


Figure 4-15 Phase Angle Diagram & Readings

4.6.4 Sequence Component and Unbalance Analysis

Acuvim II series meter can perform sequential analysis for the input signal. The sequence components allow users to represent three-phase systems as individual into three single phase networks, where these networks can be described as the positive sequence, negative sequence, and zero sequence.

Positive Sequence: Three phasors of the positive sequence are equal in magnitude and are spaced 120 degrees apart. The phase rotation for positive sequence is when phase B lags behind phase A.

$$I_+ = \frac{1}{3} \times (I_a + aI_b + a^2 I_c)$$
$$V_+ = \frac{1}{3} \times (V_a + aV_b + a^2 V_c)$$
$$a = 1 \angle 120°$$
$$a^2 = 1 \angle 240$$

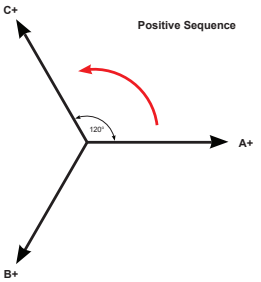


Figure 4-16 Positive Sequence Phasor Diagram

Negative Sequence: The negative phase-sequence phasors are equal in magnitude and spaced 120 degrees apart. The main difference between the positive and negative sequence is the phase rotation. In the negative sequence, phase B leads phase A, whereas in the positive sequence, phase B lags behind phase A.

$$I_- = \frac{1}{3} \times (I_a + a^2 I_b + aI_c)$$
$$V_- = \frac{1}{3} \times (V_a + a^2 V_b + aV_c)$$
$$a = 1 \angle 120°$$
$$a^2 = 1 \angle 240$$

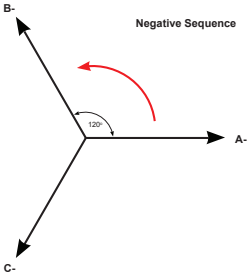


Figure 4-17 Negative Sequence Phasor Diagram

Zero Sequence: Combines a set of three phasors that are equal in magnitude and in-phase with each other. Unlike the positive sequence and negative sequence, there is no rotation associated with the zero sequence.

$$I_0 = \frac{1}{3} \times (I_a + I_b + I_c)$$
$$V_0 = \frac{1}{3} \times (V_a + V_b + V_c)$$

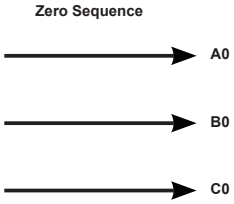


Figure 4-18 Zero Sequence Phasor Diagram

Unbalance Factor

The unbalance factor allows users to understand the percentage in which the voltage and current are unbalanced. The factor is a percentage of the ratio of the negative/zero sequence component to the positive sequence component. It indicates that the magnitude, as well as the phase angles, of the three-phase voltage/current are not equal. Figure 4-19 shows the unbalance and sequence component reading from the Acuview 2 software.

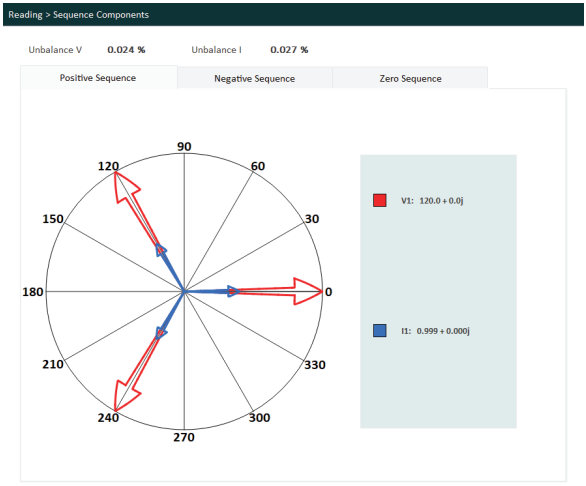


Figure 4-19 Unbalance and Sequence Component Reading

4.6.5 Phase Order

"Phase Order" signifies the sequence in which the voltage waveforms of a multi-phase system reach their peak values. Starting from Acuvim II V3 v6.20 or later, users have the flexibility to choose the Phase Order based on their specific conditions, opting for either ABC or ACB. The "Phase Order" configuration will only affect the evaluation of the symmetric sequence of the three-phase system. This change will impact only the sequence diagram and display of sequence parameters; it will not affect the phase angle readings.

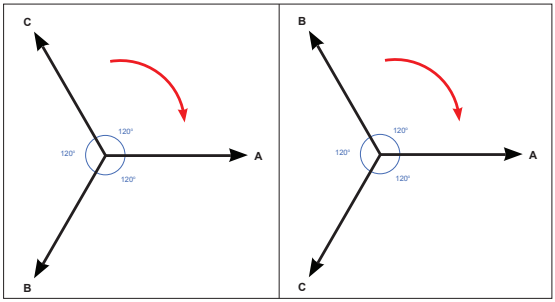


Figure 4-20 Phase Order ABC and ACB

In the case of selecting an opposite Phase Order, the **voltage unbalance** reading, and **current unbalance** reading will register at 150%.

Advanced					
Pwr Factor A	1.000	Frequency	59.972 Hz	Load Type	R
Pwr Factor B	1.000	I N	500.158 A		
Pwr Factor C	1.000	Unbalance V	150.000 %		
Pwr Factor Total	1.000	Unbalance I	150.000 %		

Figure 4-21 Acuview 2 Advanced Reading Page with 150% Unbalanced Reading

4.7 Alarm

Acuvim II series meter supports an over/under limit alarm function. When the monitored parameter goes over or under the preset threshold and remains at the level over the preset time delay, the alarm will be triggered. The alarm can be configured directly from the meter display, the Acuview 2 software, or via Modbus communication.

The meter can have a maximum of 16 alarm channels configured. If the extended I/O modules are attached, the alarms can trigger different functions, such as a relay output or digital output to activate downstream devices such as a beacon light or buzzer. There is an option to have the meter's display flash when an alarm is triggered, which provides users a visual cue that an alarm condition has been triggered.

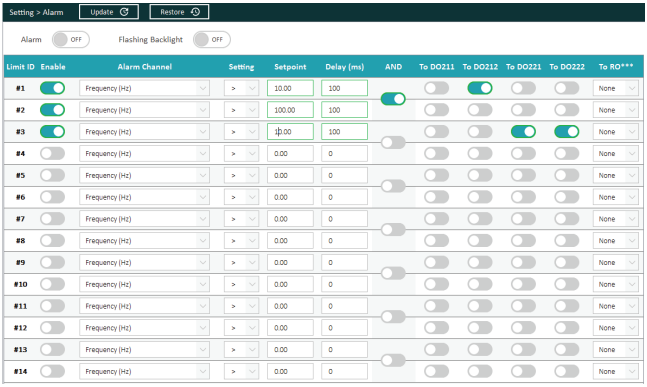


Figure 4-22 Alarm Setting

Before using the alarm function, alarm conditions such as logic dependency, target setpoint, and time delay must be correctly set. Settings can be accessed and modified from the software via the communication connection as shown in Figure 4-22. To access the alarm settings from the meter display, refer to Chapter 3 for the screen sequence. To configure the alarms using Modbus refer to Chapter 6 to view the register list.

Alarm Channel/Parameter Code: Users can select the desired parameter from the drop-down menu for the alarm in the alarm settings page. If setting the alarms using Modbus or from the meters display, enter the alarm code for the desired parameter The alarm code table can be found in table 4-3. For example, "0" represents frequency and "17" represents Total System Power.

Comparison Mode: Users can select three different alarm conditions:

1. Greater than (>)
2. Equal to (=)
3. Lesser than (<)

For example, if you choose the target parameter to be "Frequency", condition to be "greater than", and set point to be "50", the alarm will be triggered when the frequency is greater than 50Hz and will come out of the alarm condition when the frequency is less than 50Hz.

Setpoint: The setpoint is the parameter value used in the alarm condition. It represents the threshold for triggering the alarm, whether itis below, under, or equal to the setpoint value of the parameter.

Delay Time: If the alarms condition lasts for the preset time period, the alarm signal will be triggered. The delay range is from 0 to 30000 (unit: ms). If it is set to 200, there will be a 200ms delay before the alarm is triggered. When it is set to 0, there is no delay, and the alarm will be triggered immediately when the alarm condition is met.

Output to Digital Output: If using an AXM-IO2 module, users have the option to generate a pulse signal to the selected DO channel when an alarm is triggered.

Table 4-1 - Digital Output Alarm Translation

DO Code	DO Channel	IO Module
DO211	DO1	AXM-IO2-1
DO212	DO2	AXM-IO2-1
DO221	DO1	AXM-IO2-2
DO222	DO2	AXM-IO2-2

Output to Relay Output: If using an AXM-IO1 or AXM-IO3 module, users have the option to send a signal to the relay output when an alarm is triggered. Select one of the following options in the RO drop down menu:

Table 4-2 - Relay Output Alarm Translation

RO Code	RO Channel	IO Module
111	RO1	AXM-IO1-1
112	RO2	AXM-IO1-1
121	RO1	AXM-IO1-2
122	RO2	AXM-IO1-2
311	RO1	AXM-IO3-1
312	RO2	AXM-IO3-1
321	RO1	AXM-IO3-2
322	RO2	AXM-IO3-2

NOTE: If RO is under alarm mode, it can only work in the “latch” mode.

Table 4-3 - Alarming Parameter Code Table

Alarming Parameter Code	Alarming Parameter	Alarming Parameter Code	Alarming Parameter	Alarming Parameter Code	Alarming Parameter	Alarming Parameter Code	Alarming Parameter
0	Frequency	21	Total Reactive Power	42	Analog Input Channel 2 (AXM_IO3-1)	63	DI2 (AXM-IO3-1)

Alarming Parameter Code	Alarming Parameter	Alarming Parameter Code	Alarming Parameter	Alarming Parameter Code	Alarming Parameter	Alarming Parameter Code	Alarming Parameter
1	Phase A Voltage	22	Phase A Apparent Power	43	Analog Input Channel 1 (AXM-IO3-2)	64	DI3 (AXM-IO3-1)
2	Phase B Voltage	23	Phase B Apparent Power	44	Analog Input Channel 2 (AXM-IO3-2)	65	DI4 (AXM-IO3-1)
3	Phase C Voltage	24	Phase C Apparent Power	45	Active Power Demand	66	DI1 (AXM-IO1-2)
4	Average Phase Voltage	25	Total Apparent Power	46	Reactive Power Demand	67	DI2 (AXM-IO1-2)
5	Line Voltage AB	26	Phase A Power Factor	47	Apparent Power Demand	68	DI3 (AXM-IO1-2)
6	Line Voltage AC	27	Phase B Power Factor	48	Phase A Current Demand	69	DI4 (AXM-IO1-2)
7	Line Voltage BC	28	Phase C Power Factor	49	Phase B Current Demand	70	DI5 (AXM-IO1-2)
8	Average Line Voltage	29	Total Power Factor	50	Phase C Current Demand	71	DI6 (AXM-IO1-2)
9	Phase A Current	30	Voltage Unbalance Factor	51	Reverse Phase Sequence	72	DI1 (AXM-IO2-2)
10	Phase B Current	31	Current Unbalance Factor	52	DI1 (AXM-IO1-1)	73	DI2 (AXM-IO2-2)
11	Phase C Current	32	Load Characteristic	53	DI2 (AXM-IO1-1)	74	DI3 (AXM-IO2-2)
12	Average Current	33	Phase A (Vab) THD	54	DI3 (AXM-IO1-1)	75	DI4 (AXM-IO2-2)
13	Neutral Current	34	Phase B (Vac) THD	55	DI4 (AXM-IO1-1)	76	DI1 (AXM-IO3-2)
14	Phase A Power	35	Phase C (Vbc) THD	56	DI5 (AXM-IO1-1)	77	DI2 (AXM-IO3-2)
15	Phase B Power	36	Average Voltage THD	57	DI6 (AXM-IO1-1)	78	DI3 (AXM-IO3-2)
16	Phase C Power	37	Phase A Current THD	58	DI1 (AXM-IO2-1)	79	DI4 (AXM-IO3-2)
17	Total System Power	38	Phase B Current THD	59	DI2 (AXM-IO2-1)		
18	Phase A Reactive Power	39	Phase C Current THD	60	DI3 (AXM-IO2-1)		

Alarming Parameter Code	Alarming Parameter	Alarming Parameter Code	Alarming Parameter	Alarming Parameter Code	Alarming Parameter	Alarming Parameter Code	Alarming Parameter
19	Phase B Reactive Power	40	Average Current THD	61	DI4 (AXM-IO2-1)		
20	Phase C Reactive Power	41	Analog Input Channel 1 (AXM-IO3-1)	62	DI1 (AXM-IO3-1)		

4.7.1 Alarm Log

Acuvim II series meter has built-in alarm logging capabilities where sixteen entries in total can be recorded.

The record No. sequence of these entries does not indicate the order of the alarm events. The meter begins logging alarm status starting from the first record location to the last one. Alarm logs are recorded in a "cycle" fashion where the latest time stamp event will overwrite the oldest recorded time stamp event.

When over/under alarm limit parameters return to normal, its value and timestamp will be recorded allowing the over/under limit duration to be determined by subtracting the time difference.

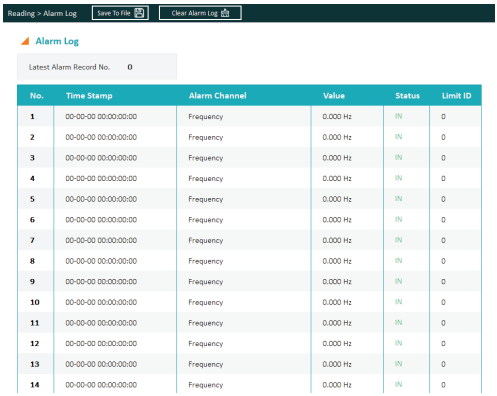


Figure 4-23 Alarming Records

NOTE: There are a total of sixteen (16) alarm numbers in the Alarm Log, and each number corresponds to an alarm event. For example, the newest alarm record entry in Figure 4-23 is from No. 12.

Time Stamp: The Acuvim II meter can log the timestamp to determine when the alarm event occurred. The timestamp format is YYYY-MM-DD hh:mm:ss:ms.

Alarm Channel: This column specifies what parameter triggered the alarm event.

Value: Displays the parameter value that triggers the alarm condition as well as the value that returns the alarm back to its normal condition.

Status: Indicates whether the alarm is triggered or not. When the status is ***OUT,*** the alarm has been triggered. When the alarm status is ***IN,*** the alarm returns to its normal condition.

Limit ID: Refers to the alarm (1-16) that was configured in the alarm settings.

Users can check if there is a new alarm record as well as the log number associated with the newest alarm record. The alarm event log can also be reset from the software, the meter display (refer to Chapter 3 for screen sequence), or through Modbus communication (refer to Chapter 6).

The alarm logs can be saved from the Acuview 2 software as a CSV file.

4.8 Meter Settings

The meter settings can be configured from the meter display (refer to Chapter 3 for screen sequencing), through the Modbus registers (refer to Chapter 6), and from the Acuview 2 software. The meter settings need to be configured correctly for the Acuvim II meter to read data. After configuring any of the meter settings, users will need to click on the ***Update*** button located at the top of the settings page for the setting to take effect.

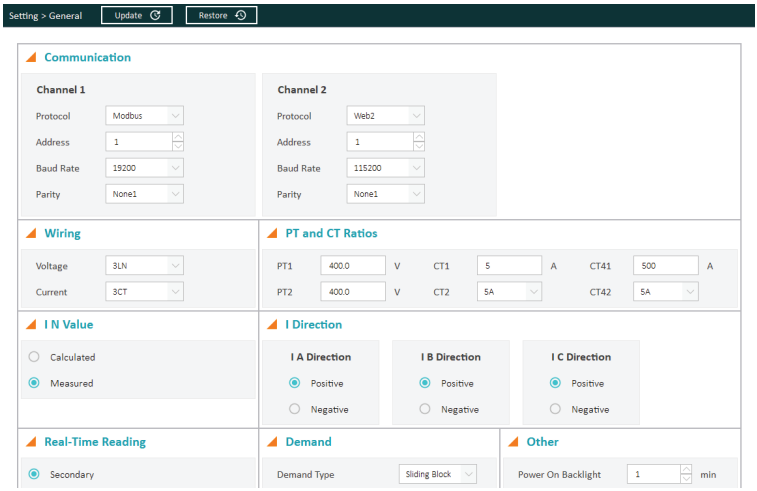


Figure 4-24 Basic Meter Settings

4.8.1 Communication

- **Communication Channel 1** - Refers to the meter's RS485 communication port, and the

settings are relative to Modbus RTU or DNP over serial communication.

- **Protocol** - Can be set as **Modbus** or **BACnet**. Modbus is the default protocol.
- **Address** - This is the slave ID, with the default value being 1.The allowable range is from 1 to 247.
- **Baud Rate** - The communication speed measured in bits per second. The default value is 19200, and the range is from 2400 to 115200.
- **Parity** - The communication parity default setting is None1, indicating no parity and 1 stop bit.

- **Communication Channel 2** - Refers to the secondary communication of the meter, typically involving a communications module such as AXM-WEB2 or AXM-WEB-PUSH.
  - **Protocol** - Can be set as **Other, PROFI,** or **WEB2.**
  - **Other** is the default protocol with a default baud rate of 38400. Its baud rate can be changed from 4800 to 115200. This protocol can be used with AXM-WEB-PUSH and AXM-WEB2 without Fast Read.
  - **WEB2** protocol will fix the baud rate at 115200, which is the only allowable rate to access fast read mode. Users can still access the Webpage with the Other protocol and a customized baud rate. However, if users want to access Fast Read, they must change the baud rate. Keep in mind that the meter and the AXM-Web2 module need a power cycle to match the baud rate again. Therefore, it is strongly recommended that users change communication channel 2 to Web2 before connecting to the AXM-Web2 module.
  - **Address** - The address is used as an identifier to access the meter via the communication protocol. For example, if using an Ethernet module and accessing the meter via Modbus TCP, this address would be used as the slave ID.
  - **Baud Rate** - The baud rate is the communication speed required for communication between meter and communications module. By default, this is set for 38400 which is compatible with AXM-WEB2 and AXM-WEB-PUSH modules.
  - **Parity** - The default setting is None1, which is required for communication with external communication modules.

NOTE: Resetting to the factory settings will reset both Communication Channel 1 and Communication Channel 2. The baud rate for Communication Channel 1 will be reset to 19200, and its protocol will be reset to Modbus. The baud rate for Communication Channel 2 will be reset to 38400, and its protocol will be reset to Other. The parity for both channels is NONE1. The default address (slave ID) is 1.

4.8.2 Wiring, CT/PT Ratios

- **Wiring Mode**
  - **Voltage** - The Voltage wiring refers to the type of system that is being monitored by the Acuvim II meter. By default, the wiring is set to 3LN (3 line and neutral) connection. For more information regarding wiring, refer to Chapter 2.
  - **Current** - The Current wiring setting refers to the number of current transformers being used. By default, the meter is set to 3CT. For more information regarding CT wiring, see Chapter 2.
- **CT/PT Ratio**
  - **PT1** - If using potential transformers with the meter at the voltage input, this setting refers to the Primary side rating of the transformer. The range is from 50.0-1000000.0. If PTs are not being used with the meter, this setting can be left as the default, which is 400.0.
  - **PT2** - If using potential transformers with the meter at the voltage input, this setting refers to the Secondary side rating of the transformer. The range is from 50.0-400.0. If PTs are not being used with the meter, this setting can be left as the default, which is 400.0.
  - **CT1** - The CT1 setting refers to the Primary side rating of the current transformers being used with the meter. For example, if the CTs being used have a ratio of 200:5A, the CT1 setting should be configured as 200. The allowable range for the CT1 setting is from 5 to 50000. The default CT1 value is 5 for 5A current input meters, 1 for 333mV/mA current inputs meters, and 1000 for RCT current input meters.
  - **CT2** - The CT2 setting refers to the secondary output of the current transformers. By default, the CT2 setting is already configured based on the current input type for the Acuvim II meter. For example, the CT2 value will be configured to 5 for a 5A current input meter, 333 for a 333mV current input meter, and 120/60 (120mV per 60Hz) for an RCT current input meter.

NOTE: For 5A current input meters, the CT2 value can be changed from 5A to 1A to support 1A secondary output CTs. The mA type current input meters can change the CT2 value from 80mA/100mA/200mA.

- **Real-Time Reading** - The real-time reading setting affects the Modbus registers readout from the Acuvim II meter. By default, the meter is set to Secondary mode, which requires the application of a multiplier to the register readout to obtain the reading. When the meter is switched to Primary mode, no multiplier is required for register readout, providing direct and unadjusted values.

NOTE: The real time reading setting does not affect the reading on the meters display. It only affects the Modbus register reading of the meter when polling from the Modbus registers.

- **Neutral Current Value Setting (I N Value)** - The neutral current value can be configured as either Calculated or Measured.

NOTE: When I N Value setting is set to Measured, I N should be wired.

- **Current Direction Setting (I Direction)** - The Acuvim II supports a setting that allows users to change the current direction in the meter. This feature is beneficial if the CTs have been installed in the reverse direction or if the leads have been terminated with reverse polarity at the meter. By default, the current direction is configured as positive for I1, I2 and I3. Changing the current direction to negative essentially adjusts the phase angle of the current by 180 degrees, allowing for correct adjustment if there is an installation error.

4.8.3 Demand Settings

- **Demand Calculation Type** - There are four types of demand that the Acuvim II meter supports: Fixed Block, Sliding Block, Thermal, and Rolling Block. See section 4.3 for a detailed description of each calculation method.
- **Average Interval Window** - The averaging time used in the demand calculation method. The default is 15 minutes, and the range is from 1 to 30 minutes.
- **Window Interval** - The window sub-interval time is used in the rolling block method, where the sub-interval must be a factor of the averaging interval window. The default is 1 minute, and the range is from 1 to 30 minutes.

4.8.4 Energy Reading & Power Factor Settings

- **Energy Type** - Users can configure the energy type as either fundamental or fundamental + harmonics.
- **Energy Reading** - The energy reading affects the meter calculation. If set to Primary, the meter will accumulate energy based on the primary usage. If configured as Secondary, the meter will use the secondary values for the energy accumulation, providing a resolution of 1 Wh.
- **VAR/PF Convention** - Users can select the convention as either IEC or IEEE.
- **VAR Calculation Method** - There are two ways to calculate reactive energy (power)

  1. True Method - This method uses the Budeanu Concept to calculate the True reactive power. This method generally uses the harmonic components to do the calculation instead of using the power vector triangle method. The most common definition of reactive power is Budeanu's definition, given by following expression for single phase circuit:

$$Q_b = \sum_{k=1}^{+\infty} I_{k,RMS} \cdot V_{k,RMS} \cdot \sin(\theta_k - \psi_k)$$

Budeanu proposed that apparent power consists of two orthogonal components, active power and nonactive power, which are divided into reactive power and distortion power:

$$D_b = \sqrt{S^2 - P^2 - Q_b^2}$$

2. Generalized Method - The method uses Fryze's concept to calculate the Generalized reactive power. This method separates instantaneous current into two components, active and reactive currents. Active current is calculated as:

$$i_a(t) = \frac{P}{V_{RMS}^2} v(t)$$

And reactive current as:

$$i_r(t) = i(t) - i_a(t)$$

Active and reactive powers are as follows, where Ia and Ir represents RMS values of instantaneous active and reactive currents:

$$P = V_{RMS} \cdot I_a \qquad Q_f = V_{RMS} \cdot I_r$$

4.8.5 Load Percentage

The rated load can be represented in terms of either power or current.

- If current is selected, the rated current that is used would be the CT1 setting value in the PT/CT ratio settings. For example, if CT1 is set for 1000A and the average current monitored by the meter is 500A, the load percentage would be 50% (500/1000).
- If power is selected, the rated primary power would be used in the load percentage calculation. The max primary power can be calculated as follows:

Max Primary Power without using PTs = 3 x (480) X (CT1)

Max Primary Power using PTs = 3 x (PT1) x (CT1).

The max primary power would be the power that is entered in the **Rated Watt Total** setting.

The load percentage is displayed on the front of the Acuvim II meter display. The load percentage is calculated based on the following equation:

$$Load\ Percentage = \left(\frac{Active\ system\ power}{(5A\ or\ 1A) \times\ User\ setting}\right) \times 100\%$$

Whether the meter will have either a 5A or 1A current input. If users have Acuvim II meters with Rogowski Coil (RCT), 333mV and mA type Current Inputs, then 1A is used in this equation.

For example, if the max primary power of the system is 576000W (or 576kW), the system is currently using 211kW and the meters current input type is 5A, then the load percentage would be calculated as follows:

$$Load\ Percentage\ = \left(\frac{211kW}{5 \times 576kW}\right) \times 100\ =\ 7\%$$

The load percentage can only be viewed on the front LCD display of the Acuvim II meter. Figure 4-21 shows where it is located on the display.

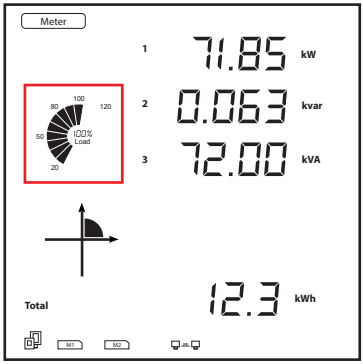


Figure 4-25 Load Percentage

4.9 Time & Date Configuration

The meter can have its time and date configured from the Acuview 2 software or by writing to the Modbus registers (refer to Chapter 6). Please note that this is not configurable from the meter display. From the Acuview 2 software in the ***System Status*** section under the Reading tab, users can configure the time and date for the meter.

The meter's time can be saved when the meter is powered off. However, if the meter is powered off for seven days or longer, it will reset to the default time.

Users have the option to configure the date and time manually or synchronize it with the PC's system clock. Simply select the desired option and click on the ***Set Time*** button for the setting to take effect.

NOTE: If users have a communication module, they will also need to configure the date and time from the module's web interface for the time to take effect.

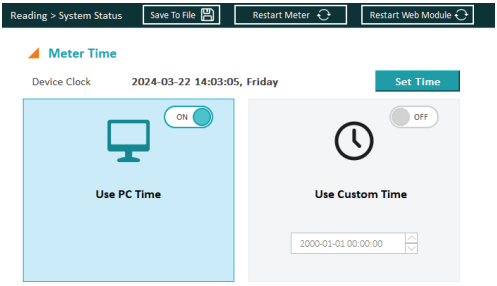


Figure 4-26 Meter Time Configuration

4.10 Data Logging

The Acuvim IIR/IIW models utilize 8MB of the meter's built-in memory for data logging. The base model Acuvim II does not include internal memory and does not support data logging capabilities. The meter can log data and store it on to the meter's internal memory, where users can read and pull the data from the memory. The data is logged with timestamps to allow users to monitor the exact time each record was logged. Data logging allows analysis using the meter's data to further research and billing purposes.

NOTE: If users have the base Acuvim II model, they can log data onto the computer's memory. However the Acuview 2 software must be running at all times for this to occur.

4.10.1. Data Log Setting

The Acuvim IIR/IIW meters have four data logs available where each log can be independently programmed with individual settings. This allows each data log to monitor different types of parameters, where the users can program up to 114 parameters per log for Data Log 1, 2, and 3, and up to 38 parameters per log for Data Log 4.

It is important to note that Data Log 4 is used specifically for trend log. It can capture parameters' maximum, minimum, and average values.

Data Logging Parameters - Users can select the data logging parameters on the software from the parameter box located on the left of the interface. Users can select different types of measurement options by selecting the parameter type from the drop-down menu. The following parameter types are available for data logging:

- **Real-Time Metering** - Include real time parameters such as voltage, current, power, and so forth.

- **Demand** - Includes both power and current demand parameters.
- **Energy** - Includes all energy types such as import, export, net, total, reactive, etc.
- **THD -** Includes all THD parameters such as THF, Crest Factor, THFF, etc.
- **Voltage & Current Harmonics** - Includes all individual harmonic parameters (2nd to 63rd order harmonics for each voltage and current phase).
- **Sequence Components** - Includes positive, negative and zero sequence components.
- **Phase Angle** - Includes Voltage and Current phase angle parameters.
- **DI Counter** - If using an external I/O module, the user can log the DI counter value.
- **Analog Output/Input Raw & Scaled Values** - Users have the option to log the AO/AI values, both the raw values as well as the scaled values. More information on scaling for AO/AI can be found in Chapter 5.
- **Dual Source** - Includes dual source energy parameters.
- **Independent Input Channel Parameters** - Includes parameters from Independent Wiring Reading.

Users can select the parameters they want to log, then click on the **Add** button to add the parameters. Parameters can be deleted by selecting the parameter and clicking on the **Remove** button. Users can clear the entire data log by clicking on the **Clear All** button.

Memory Usage - As parameters are added to the data log, there is a **Space Allocation** section from the software that allows users to monitor the memory usage. Each data log, including Data Log 1, 2, and 3, can accommodate up to 228 bytes of data, while Data Log 4 can accommodate 76 bytes of data. Each parameter uses roughly 2 to 4 bytes of memory. The Max records will be dependent on the sector percentage that is configured for the data log. A higher sector percentage will result in more records being available to store in the data log.

Registers & Sectors - In this section, users can set the **Sectors** value to an appropriate value for Data Log 1, 2, and 3. The sector ranges from 0 to 100. Setting the value to 100 causes the data log to use the entire memory capacity of the meter. It is important to note that the combined total sector number for Data Log 1, Data Log 2, and Data Log 3 must not exceed 100.

For example:

- If you are only using Data Log 1, the sector can be set up to 100.
- If you are using Data Log 1 and Data Log 2, both sectors can be set to 50.
- If you are using Data Log 1, Data Log 2, and Data Log 3, the sectors can be set to 30, 30 and 40.
- The Sectors value for Data Log 4 is fixed at 50.

Logging Interval - The logging interval determines how often the data is recorded in the data log. The logging interval can be configured within the range of 1 to 1440 minutes. If the interval is set to 0, the data log is disabled. If users wish to log data at a faster rate, they will need to use a communication module (AXM-WEB2 or AXM-WEB-PUSH) with the Acuvim II meter to log as frequently as every 1 second.

Logging Mode - There are three different types of logging modes that can be configured. Please note that the time will need to be configured correctly on the meter for the data to log successfully.

- **Start Logging Immediately** - This mode starts logging immediately and does not stop. When the memory is full, the meter starts to overwrite the data from the oldest data log entry (first-in first-out method).
- **Start Logging Time** - This mode has a specific start time for the data log to begin logging. Users will need to specify the start time by selecting the hour and minute. Once the data starts to log, it does not stop, and similar to the immediate logging mode, the data will start to overwrite the oldest data log entry when the memory is full.
- **Logging Scheduler** - The meter logs data within a specific time interval. Users will need to specify both the start and end time for the data log. The meter will continue to log data until it reaches the end time or until the memory is full, whichever comes first.

Once all configuration is complete, users must click on the **Update** button located at the top of the page. Please note that updating Data Log 1, 2, or 3 will result in the erasure of all three data logs. It is crucial for users to download and save all data logs before changing the configuration. Additionally, updating Data Log 4 does not affect Data Log 1, 2, and 3, and vice versa.

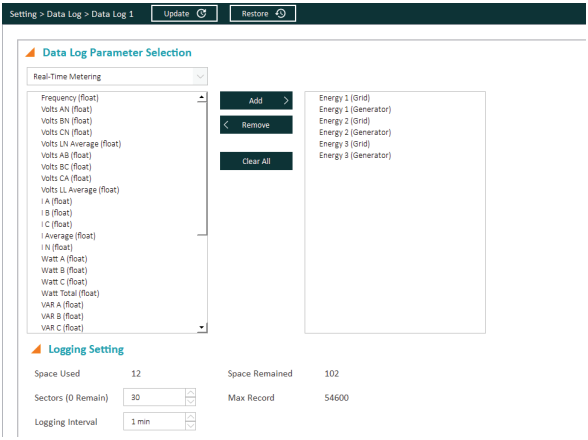


Figure 4-27(a) The Data Log 1 Setting

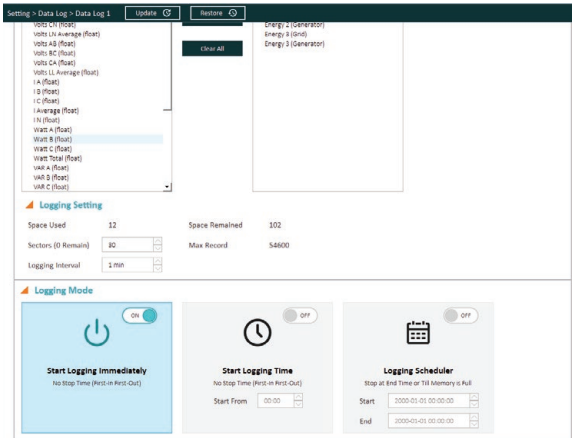


Figure 4-27(b) The Data Log 1 Setting

NOTE: If the memory of the historical data log is full, the meter will erase the first sector in which the memory size is 65536 bytes (64kb). The following sector (the second sector) will become the first sector and the data from the erased sector will not be recoverable. Therefore, the user should save the whole log before the memory is full to maintain all data.

4.10.2 Retrieving Data Log

The data logs can be retrieved directly from the Acuview 2 software or by Modbus (refer to Chapter 6). In the Acuview 2 software, under the **Reading** tab, select **Data Log**. The top of the screen will show an overview of the three data logs which include the Max number of records for the data log, the number of used records, the record size, the window status, and the first/last recorded timestamp.

In the drop-down menu, users can select which data log to retrieve the data from. By default, Data Log 1 will appear. Use the drop-down menu to switch between Data Log 1, 2, 3, and 4.

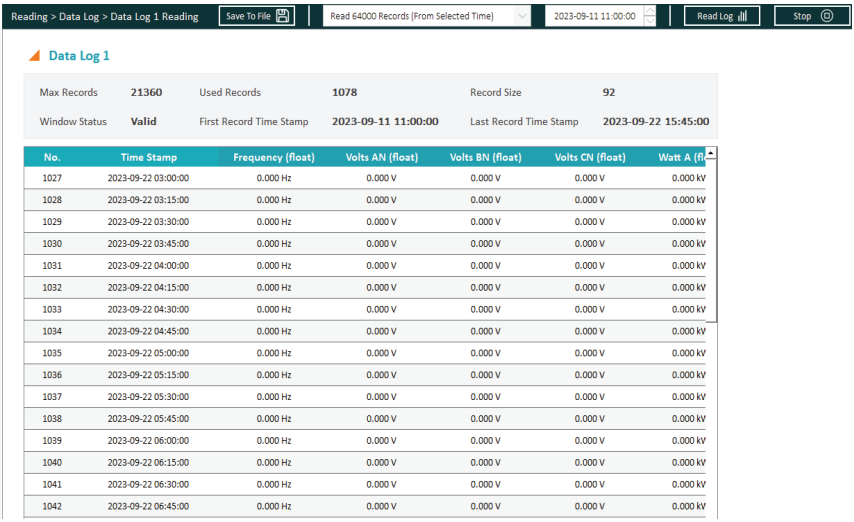
In the second drop-down menu, users can select the number of records, or a specific range of records they wish to view. The following options are available:

- Read newest 50 records
- Read 1000 records (From Selected Record)
- Read 64000 records (From Selected Record)
- Read 1000 records (From Selected Time)
- Read 64000 records (From Selected Time)

After selecting the viewing option, users can select a specific record number or input a specific time to begin reading the data log. It is important to note that this option is not valid when reading the newest 50 records, but it is applicable to all other reading options.

Once the data log settings are configured, click on **Read Log** located in the upper right corner of page, and the data will begin to populate. The time taken for data population will vary depending on the number of records selected to read, so it may take several minutes. The data will be displayed in a tabular format, allowing users to scroll through the data. Figure 4-24 shows the data retrieval.

Users can click on the **Save To File** button to save the data log as a CSV file.



No.	Time Stamp	Frequency (float)	Volts AN (float)	Volts BN (float)	Volts CN (float)	Watt A (fl
1027	2023-09-22 03:00:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1028	2023-09-22 03:15:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1029	2023-09-22 03:30:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1030	2023-09-22 03:45:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1031	2023-09-22 04:00:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1032	2023-09-22 04:15:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1033	2023-09-22 04:30:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1034	2023-09-22 04:45:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1035	2023-09-22 05:00:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1036	2023-09-22 05:15:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1037	2023-09-22 05:30:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1038	2023-09-22 05:45:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1039	2023-09-22 06:00:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1040	2023-09-22 06:15:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1041	2023-09-22 06:30:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV
1042	2023-09-22 06:45:00	0.000 Hz	0.000 V	0.000 V	0.000 V	0.000 kV

Figure 4-28 Data Log Retrieval Page

4.11 Time-of-Use (TOU)

Most utility companies bill customers according to their Time-of-Use rates. Customers are billed at certain rates based on the time of day the energy usage occurs. The Acuvim II meter supports a Time-of-Use function that allows users to assign up to four different tariffs to different time periods within the same day according to their billing requirements. The meter will calculate and accumulate energy to each of the different tariffs configured based on the meter's time/date and TOU settings.

The Time-of-Use (TOU) must be configured from the Acuview 2 software by selecting the **TOU** page under the **Setting** tab.

4.11.1 General TOU Setting

Users can enable the TOU function in the Acuvim II meter by turning on the feature in the TOU page under the Setting tab.

The TOU general setting page includes the following:

- **Setting Status** - Display the presence of error in the TOU settings. "Valid" indicates that all settings are correct. If there are multiple errors in the TOU settings, please hover your cursor over the text to view detailed error information.

- **Billing & Tariff Setting** - Monthly Billing Mode and Tariff.
- **TOU Seasons**
- **TOU Schedules**
- **TOU Holidays**
- **TOU Weekends**

TOU Settings include the configurations for the following:

Seasons Setting

This setting allows the division of a year into seasons, with each season mapped to a specific schedule. A maximum of twelve (12) seasons can be configured, and each operates according to its designated TOU Schedule.

Schedule Setting

Each schedule divides a day (24 hours) into segments, mapping each segment to a tariff. This parameter determines the number of available TOU schedules for the TOU calendar setting, with a maximum limit of fourteen (14) schedules. Each schedule can be further divided into time segments, each assigned a tariff.

Segment Setting

Segments are part of a schedule, and each schedule can accommodate a maximum of fourteen (14) time segments. Each segment is assigned a specific tariff.

Tariff Setting

The meter supports up to four tariffs in the TOU function. Users can select the desired number of tariffs for TOU configurations.

Weekend Setting

Users can designate specific day(s) of the week as weekends and configure which schedule to apply during the weekends.

Holiday Setting

The setting allows programming a maximum of thirty (30) holidays into the TOU calendar. Users can assign a schedule for each holiday.

To configure the TOU settings, users are advised to follow these steps:

1. Select the desired number of tariffs in the Tariff Setting.
2. Configure the schedule(s) in the Schedule Settings. Edit each schedule to define the segments included in the schedule.
3. Set the seasons in the TOU seasons Setting and assign each season with a previously configured schedule.

4. Specify the weekend days in the Weekend Schedule Setting and configure the holidays in the Holiday Settings.

After configuring the TOU settings, users should click on the **Update** button located at the top of the page to save the changes. Users also have the option to restore the TOU setting back to its default settings using the **Reset To Default** button.

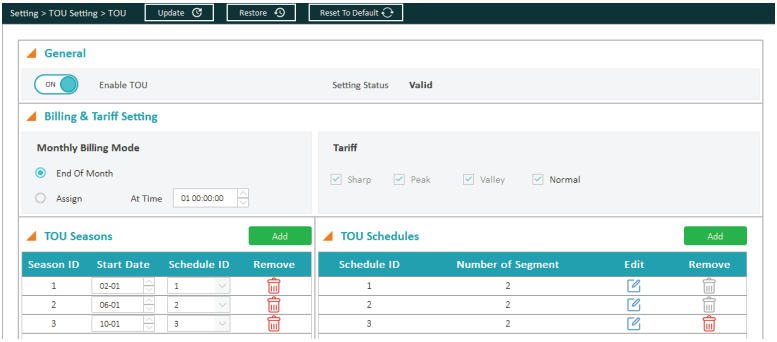


Figure 4-29(a) TOU Settings

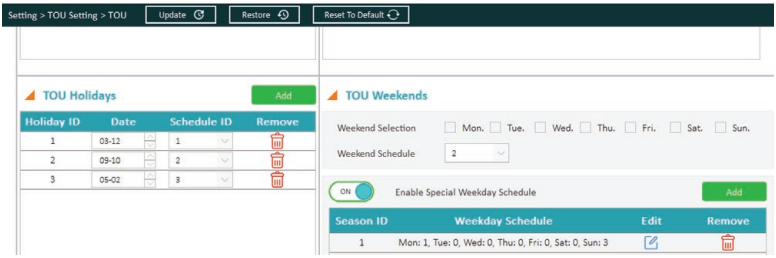


Figure 4-29(b) TOU Settings

4.11.2 Billing & Tariff Setting



Figure 4-30 TOU Billing & Tariff Setting

Monthly Billing Mode

Users can select the monthly billing that matches their billing requirement, and there are two available billing modes:

- **End Of Month:** Bill at end of every month.
- **Assign:** Bill at the desired time selected by the users. Input the specific time and date (DD HH:MM:SS) for every month.

Tariff Setting

The Acuvim II meter's TOU function accommodates up to four different tariffs. Users can set the tariffs by selecting the desired number of tariffs for TOU configurations. The following four options are available:

- 1 Tariff - Sharp
- 2 Tariffs - Sharp, Peak
- 3 Tariffs - Sharp, Peak, Valley
- 4 Tariffs - Sharp, Peak, Valley, Normal

4.11.3 TOU Seasons

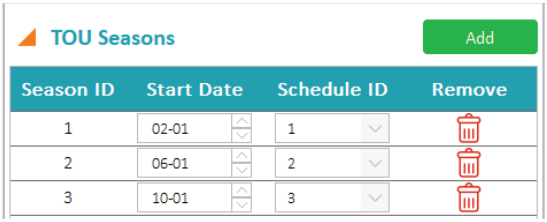


Figure 4-31 TOU Season Configuration

There can be a maximum of 12 seasons configured in the Acuvim II for the TOU settings. Each season will operate based on the TOU Schedule it is configured with.

To add a new season, use the Add button. To remove a season from the table, click on the corresponding garbage bin icon under the Remove column.

Enter the start date of each season into the TOU Seasons table slot following the format MM-DD:

- MM represents the month (ranges from 1 to 12)
- DD represents the day (ranges from 1 to the maximum number of days in selected month)

For each season in the table, select the corresponding TOU schedule that should run during that season. The available TOU schedules can be added or configured in the TOU Schedule table, with

a maximum of 14 schedules.

Organize the dates in sequential order according to the calendar year, with earlier dates appearing first and later dates appearing late. For example, if the user configures two seasons with start dates on March 31 and November 4 and assigns TOU schedules 1 and 2 respectively, the first TOU season table slot should have "03-31" for Date and "1" for Schedule, and the second slot should have "11-04" for Date and "2" for Schedule. This configuration results in the first season running from March 31st to November 4th, and the second season running from November 4th to the following year's March 31st.

NOTE: If the slot is filled incorrectly, the TOU function will be disabled

4.11.4 TOU Schedule

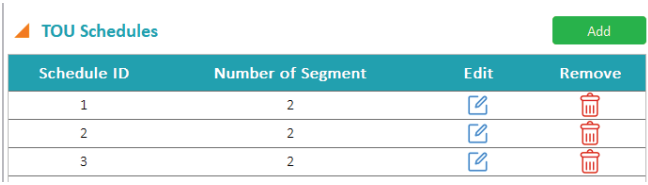


Figure 4-32 TOU Schedule Configuration

The TOU Schedule table, shown in Figure 4-32, supports a maximum of fourteen (14) schedules. The TOU schedules in the table are available for the TOU calendar settings. Each schedule can be divided up into time segments, with each schedule accommodating up to fourteen (14) time segments. Furthermore, each segment is assigned a tariff.

To add a new schedule, use the ***Add*** button. To remove a schedule from the table, click on the corresponding garbage bin icon located under the ***Remove*** column. If users wish to edit a schedule, click on the corresponding edit icon under the ***Edit*** column, then the configuration window for that schedule will be opened.

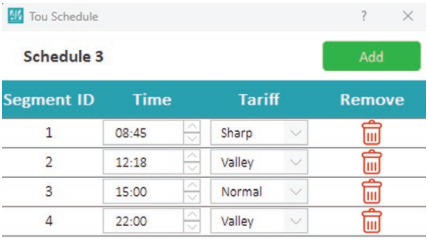


Figure 4-33 TOU Segment Configuration

The TOU Schedule configuration window can be seen in Figure 4-33. Each TOU schedule corresponds to a 24-hour cycle.

To add a new segment, use the Add button. To remove a segment from the table, click on the corresponding garbage bin icon located under the Remove column.

Similar to TOU Seasons format, enter the start time of each segment into the TOU schedule table slot following the format HH:MM:

- HH stands for hour (range is in 24-hour format, 0 to 24 hours)
- MM stands for minutes (range is from 00 to 59 minutes)

For each segment in the table, select the corresponding tariff that should run during that time segment. The available tariffs can be configured in the Tariff setting.

It is essential to ensure that the time segments are organized in chronological order. For example, if 3 segments are configured with timing parameters 01:00, 15:30, 22:45, the order should be one of the following: 01:00, 15:30, 22:45 or 15:30, 22:45, 01:00 or 22:45, 01:00, 15:30. Entering time information in a wrong sequence (for example, entering 15:30, 01:00, 22:45) is an invalid operation and will disable the TOU function.

In Figure 4-29, TOU Schedule 1 is configured as follows:

- From 1:00AM to 3:06PM, all energy consumed will be accumulated under the Sharp Tariff
- From 3:06PM to 4:45PM, all energy consumed will be accumulated under the Peak Tariff
- From 4:45PM to 10:00PM, all energy consumed will be accumulated under the Normal Tariff
- From 10:00PM to the following day's 1:00AM, all energy consumed will be accumulated under the Valley Tariff

4.11.5 TOU Weekend Schedule

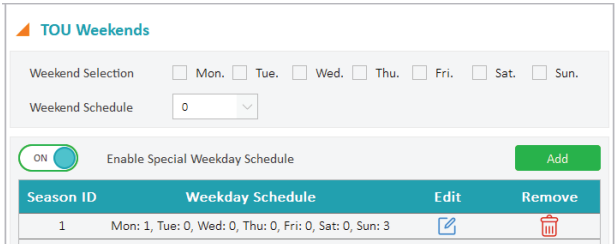


Figure 4-34 TOU Weekend Schedule Settings

The TOU Weekend Schedule settings allow users to assign specific days of the week as weekends. The Weekend Schedule includes Default Weekend Schedule and Alternative Weekend Schedule.

Default Weekend Schedule

Users can choose which days within the week should be considered as default weekend days. For these selected weekend days, users can choose the schedule they want to apply.

Alternative Weekend Schedule

The Alternative Weekend Schedule can be enabled to assign unique schedules for specific days of the week. Each season configured in TOU Seasons can have its distinct Alternative Weekend Schedule. For instance, the Alternative Weekend Schedule 1 is applicable to Season 1 only.

It is important to note that Alternative Weekend Schedules have higher priority than Default Weekend Schedule. If the Alternative Weekend Schedule is not enabled or if specific seasons do not have a unique schedule configured, the Default Weekend Schedule will be followed.

To add a new Alternative Weekend Schedule, use the **Add** button. To remove an Alternative Weekend Schedule from the table, click on the corresponding garbage bin icon located under the Remove column. If users wish to edit an Alternative Weekend Schedule, click on the corresponding edit icon under the **Edit** column, then the configuration window for that weekend schedule will be opened.

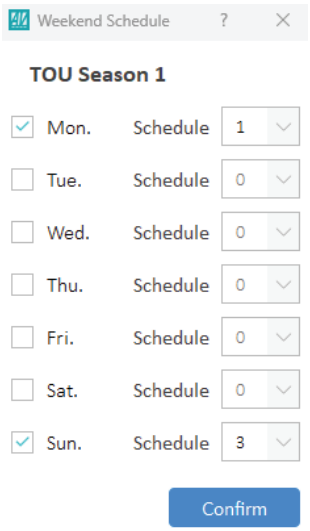


Figure 4-35 Alternative Weekend Schedule Setting

Within the Alternative Weekend Schedule configuration window, users can customize the days of the week for the corresponding season, allowing for unique schedule on those days.

As an example, Figure 4-35 provides a configuration for Alternative Weekend Schedule 1. In this scenario, the user selects Monday and Sunday and assigns TOU Schedule 1 to Monday and 3 to Sunday. The configuration indicates that during the first season, both Monday and Sunday of the week will follow the alternative weekend schedule. Monday will follow Schedule 1, and Sunday will follow Schedule 3.

4.11.6 Holiday Settings

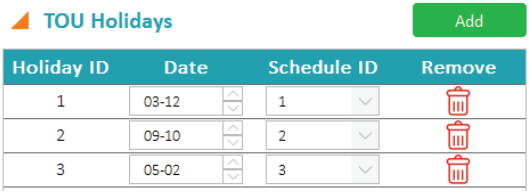


Figure 4-36 TOU Holiday Schedule Configuration

The Acuvim II series meter supports holiday configuration within its TOU function, where a maximum of 30 holidays can be programmed into the TOU calendar.

To add a new holiday, click the **Add** button. To remove a holiday from the table, click on the corresponding garbage bin icon under the **Remove** column.

Enter the date of each holiday into the TOU Holiday Schedule table slot following the format MM-DD:

- MM represents the month (ranges from 1 to 12)
- DD represents the day (ranges from 1 to the maximum number of days in selected month)

For each season in the holiday, select the corresponding TOU schedule that should run during that day. The available TOU schedules can be added or configured in the TOU Schedule table, with a maximum of 14 schedules.

The dates of the holiday schedule do not need to be organized in sequential order. For instance, the first slot can be January 1, the second slot can be December 26, and the third slot can be December 25.

NOTE: The holiday schedule has the highest priority among all the schedules. The weekend schedule's priority is followed by the Holiday schedule. When the holiday schedule is not enabled, the weekend schedule has the highest priority, overriding the normal (weekday) schedule.

4.11.7 Ten Years Holiday Settings

Acuvim IIV3 meters allow users to easily configure Time-of-Use (TOU) holidays for up to ten years. To set up a ten-year holiday schedule, users must first enable TOU. It is crucial to note that the ten-year holiday configuration takes precedence over TOU holiday settings. This means that if the ten-year holiday is enabled, manual editing of TOU holidays cannot be saved. The TOU setting page's holiday calendar will be replaced by the ten-year holiday calendar based on the year. Additionally, the first year's holiday calendar must not be empty.

During the ten-year holiday generation process, users have the option to either manually add holidays one by one or click **Generate Holidays** button to generate holidays using specific holiday codes.

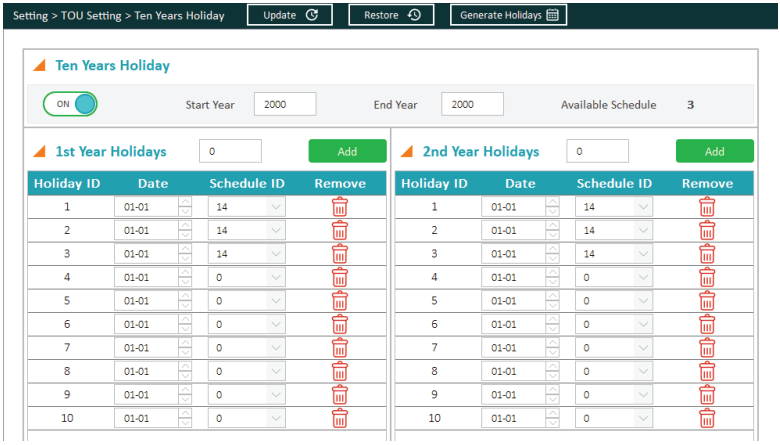


Figure 4-37 Ten Year Holiday Schedule Configuration

Before clicking the '**Generate Holidays'** button, users must ensure that they have **enabled** the 'Ten Years Holiday' option and configured the **Start Year** and **End Year** correctly.

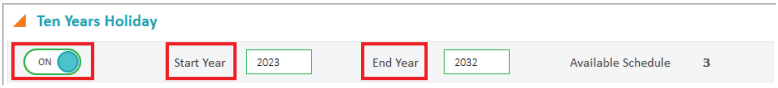


Figure 4-38 Ten Years Holiday Year Configuration

The gap between the start year and end year must be equal or less than years; otherwise, an error message will appear.

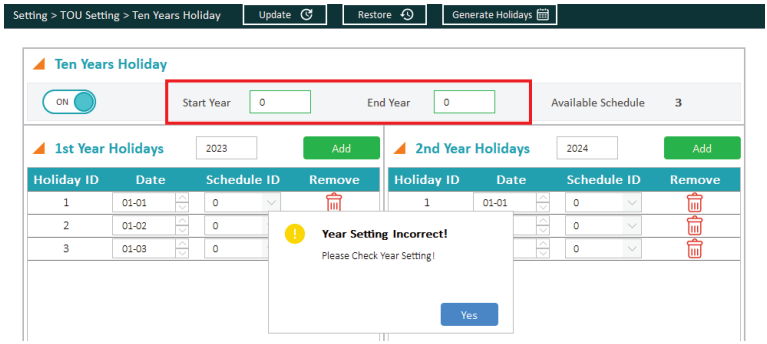


Figure 4-39 Ten Years Holiday Schedule Configuration Error Message

After the user clicks the '**Generate Holidays**' button, a Ten-Year Holiday Auto Generation window will open.

Options include:

- **Schedule**: The schedule is configured on the TOU settings page. However, these schedule settings can be applied during the holiday generation process. Invalid schedule settings are not allowed.
- **Add**: Adds a new holiday to the calendar, with a maximum limit of 30 holidays.
- **Delete**: Removes the selected holiday.
- **Generate**: Applies the holiday settings to the Ten-Year Holiday Calendar.
- **Import**: Allows users to import a Ten-Year Holiday Auto Generation setting file. Users must click 'Generate' after importing to apply the changes.
- **Export**: Exports a .tyh configuration file for Ten-Year Holiday Auto Generation settings.

The 'Holiday codes' section provides users with seven holiday scheduling rules, each offering specific details:

Holiday Code	Details
0	The generated holiday applies only to the first year and occurs once.
1	The generated holiday will repeat itself for ten years.
2	The generated holiday repeats itself every year. If the holiday falls on Sunday, the tariff applies on the upcoming Monday.

Holiday Code	Details
3	The generated holiday repeats itself every year. If the holiday falls on Sunday, the tariff applies on the upcoming Monday. If the holiday falls on Saturday, the tariff applies on the previous Friday.
4	The generated holiday repeats itself every year with a rescheduled calendar. If the applied holiday for the current year is on Sunday, the date remains unchanged. If the same holiday for the target year is not on Sunday, the date automatically changes to the upcoming Sunday.
5	The generated holiday repeats itself every year with a rescheduled calendar. If the applied holiday for the current year is on Monday, the date remains unchanged. If the same holiday for the target year is not on Sunday, the date automatically changes to the upcoming Monday.
6	The generated holiday repeats itself every year with a rescheduled calendar. If the applied holiday for the current year is on Thursday, the date remains unchanged. If the same holiday for the target year is not on Sunday, the date automatically changes to the upcoming Thursday.

NOTE: Holiday Codes 2 to 6 will not take effect for the first year in the ten-year holiday. For example, if the holiday's Holiday Code is 2 and it falls on Sunday, the tariff will be applied on Sunday instead of the upcoming Monday on first year.

Extra example for Holiday Code:

	Holiday Code 4	Holiday Code 5	Holiday Code 6
Setting	12-08	12-06	12-03
2023	12-08 Friday	12-06 Wednesday	12-03 Sunday
2024	12-08 Sunday	12-09 Monday	12-05 Thursday
2025	12-14 Sunday	12-15 Monday	12-04 Thursday
2026	12-13 Sunday	12-14 Monday	12-03 Thursday
2027	12-12 Sunday	12-13 Monday	12-09 Thursday
2028	12-10 Sunday	12-11 Monday	12-07 Thursday
2029	12-9 Sunday	12-10 Monday	12-06 Thursday
2030	12-8 Sunday	12-09 Monday	12-05 Thursday
2031	12-14 Sunday	12-15 Monday	12-04 Thursday
2032	12-12 Sunday	12-13 Monday	12-09 Thursday

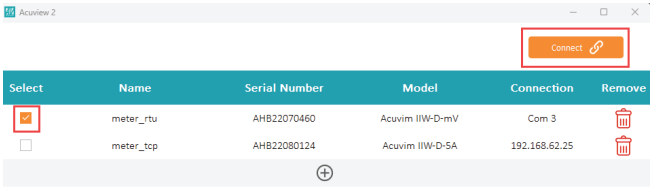


Figure 4-40 Ten Years Holiday Auto Generation

After the user finishes the configuration by clicking the **Generate** button, it is necessary to click **Update** to save the settings. To ensure successful application of the settings, it is recommended for users to check the status by visiting the TOU setting page.

If an error code related to holidays occurs, it is recommended to click the **Update** button to save the current TOU settings. If the error code persists, please review the holiday schedule settings. For further assistance, please export the TOU's holiday settings and contact the Accuenergy Technical Support team.

4.11.8 DST Settings

The Acuvim II series meter can automatically switch to and from the Daylight Savings Time, and this function can be enabled in the **Daylight Saving Time** page under the **Setting** tab from the Acuview 2 software. The DST can then be configured to follow one of two formats:

1. **Fixed date option** - If the fixed date option is chosen, DST is configured by specifying the exact start and end dates and times (in the format: MM-DD HH:MM) for DST, along with the desired adjust time.
2. **Non-Fixed date option** - If the non-fixed date option is chosen, DST is implemented based on a particular day of the week within a specific month. Users should choose a specific day of the week and week number, set the corresponding start and end times for DST (in the format: HH:MM), and specify the desired adjust time.

Setting the DST will cause the meter to automatically switch to daylight saving time. When the clock is set to daylight saving time, the meter will automatically adjust its clock to the correct time. When daylight saving time ends, the meter will automatically adjust the clock back to standard time.

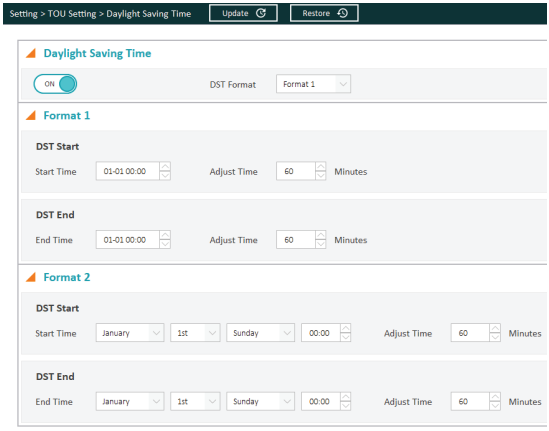


Figure 4-41 DST Settings

4.11.9 Reading the TOU Data

Users can access the TOU readings by clicking on the **TOU Reading** option under the **Reading** tab. In this section, users will be able to view all energy consumption for each tariff as well as the consumption total during the TOU period. Acuvim II series meters can also record maximum power and current demand under different tariffs, as well as the timestamp of the maximum value. In this section, the maximum demand value can be cleared for different tariffs.

TOU Reading includes **Current Month TOU** and **Prior Month TOU.**

The Current Month TOU is divided into two sections: Accumulated and Incremental.

- **Current Month TOU (Accumulated)**: Refers to the TOU energy accumulated in the current month.
- **Current Month TOU (Incremental)**: Refers to the TOU energy recorded during the previous month, which is the difference between the TOU energy accumulated in this month and the TOU energy accumulated in the prior month.

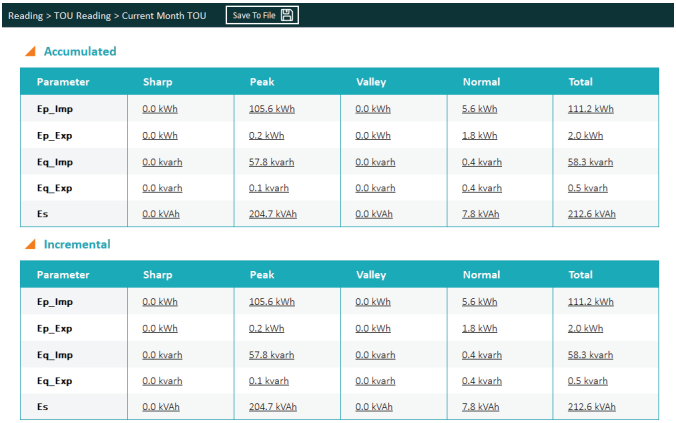


Figure 4-42 Current Month TOU Readings (Accumulated and Incremental)

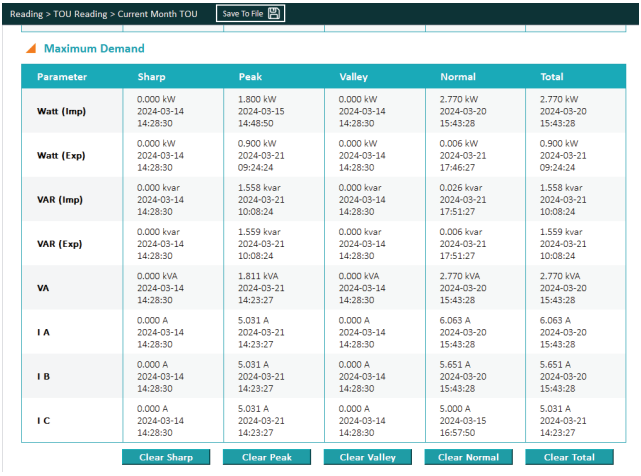


Figure 4-43 Current Month TOU Readings (Maximum Demand)

The TOU function displays the prior month TOU readings from the Acuview 2 software. This allows users to compare the current month and previous month's readings for billing and analytical purposes. Similar to the current month, the prior month also allows users to view the Max Demand readings.

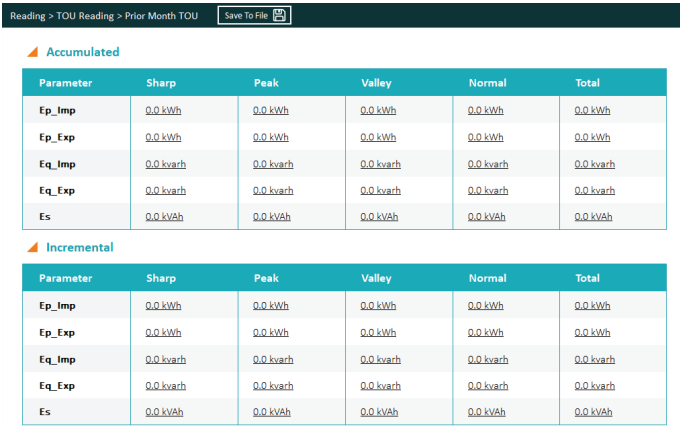


Figure 4-44 Prior Month TOU Readings (Accumulated and Incremental)

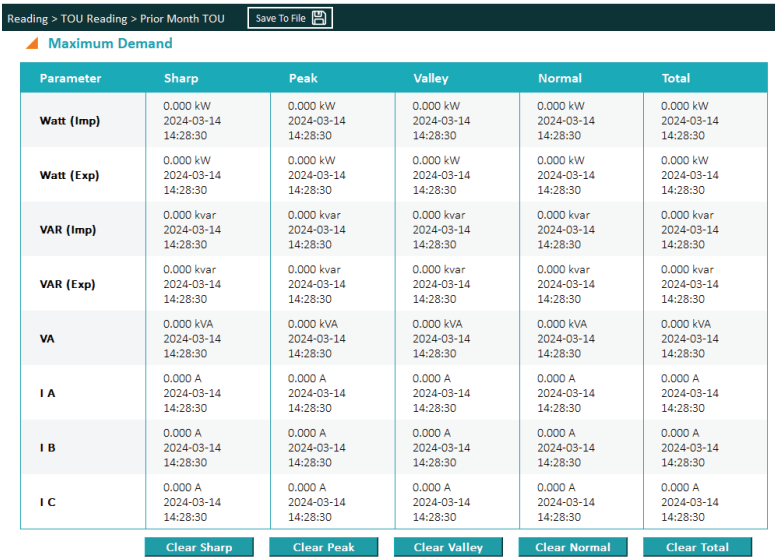


Figure 4-45 Prior Month TOU Readings (Maximum Demand)

When TOU is enabled and properly set up, energy will be accumulated on a month-to-month basis. The current energy usage will be stored under Current Month TOU (or Current Accumulation

Month TOU) and is divided up into different tariffs. When next month (or counting period) starts, all Current Month TOU values will be moved to Prior Month TOU (or Prior Accumulation Month TOU).

The current month TOU will be reset depending on the monthly billing mode specified in the TOU settings, which can be either End of Month or Assigned Clock.

1. End of Month: This is the default method. All values from Current Month TOU will be copied over to Prior Month TOU at the very beginning of each month (the first day of each month at time 00:00:00). Current Accumulation Month TOU will continue to accumulate energy values, and at the beginning of each month (the first day of each month at time 00:00:00), all values from Current Month TOU will be copied over to Prior Month TOU. Then, the values in the Current Month TOU will be cleared and reset to 0.

2. Assigned Clock: Users can select when the values from Current Month TOU would be copied over to Prior Month TOU. Users can set the time in the following format: **DD HH:MM:SS**,where **DD** stands for day, **HH** stands for hour, **MM** stands for minute, **SS** stands for second. Similar to the End of Month method, once Current Month TOU is transferred to Prior Month TOU, Current Month TOU will be cleared and reset to 0.

4.12 Power Quality Event Logging and Waveform Capture

The Acuvim II meter supports a waveform capture function that allows users to monitor and record power quality events, such as voltage swells, voltage sags, and overcurrent. This is very useful for users that are trying to track slow changing variation in electrical waveforms, and it allows them to root out causes of mechanical equipment failure due to these power quality events

Voltage sags and swells are the reduction(sag) and enlargement(swell) of voltage over a short time. Voltage sags are the most common events which can affect power quality significantly and are often the most costly. Power quality events, such as voltage swells/sags, can significantly impact various equipment, including PLCs, relays, and controllers. The voltage sags can lead to overcompensation in the power supply of these devices, potentially causing damage to internal circuits and malfunctions. Although these events are often attributed to the electrical utilities, they can also arise from the issues within the site, including grounding, bonding, coding issues, or from powering different equipment from the same supply.

4.12.1 Waveform Capture

The waveform capture function in the Acuvim IIIW meter allows users to capture twenty cycles of waveforms (ten cycles before and ten cycles after the event) across three channels. The meter's dedicated internal memory can store up to 100 such waveform groupings. It can log at 40 cycles

(20 pre-triggering cycles) with 64 samples per cycle, or at 20 cycles (10 pre-triggering cycles) with 128 samples per cycle. The Acuvim IIW model includes 16MB of internal memory, where 8MB is dedicated for data logging and the other 8MB is dedicated for capturing power quality events.

The Acuvim IIW waveform capture settings can be configured from the Acuview 2 software in the **Waveform** option under the **Setting** tab. Alternatively, the waveform settings can be configured via the Modbus registers, which are listed in chapter 6 of the user manual.

DI Triggering Waveform Capture: The Acuvim II meter can be programmed to capture a waveform based on specific Digital Input settings, such as changes in the DI state (from ON to OFF, or from OFF to ON).

Table 4-4 - DI Waveform Setting Translation

DI Waveform Setting	DI Channel	I/O Module
DI 111 - DI 116	Digital Input 1-6	AXM-IO1-1
DI 211 - DI 214	Digital Input 1-4	AXM-IO2-1
DI 311 - DI 314	Digital Input 1-4	AXM-IO3-1

NOTE: The DI must be set to Digital Status mode to be used for waveform triggering.

Rated Voltage: The rated voltage of the system should be entered here. The range is from 50 to 400V for Wye systems or from 50 to 690V for delta systems.

Voltage Swell: When any phase of the three-phase voltage is higher than the set value (voltage rated value x threshold %), there will be a voltage swell event. When a one-phase voltage swell happens, the other phases will not respond to voltage swell event logging. All phase voltages need to be restored back to normal before a new voltage swell event is recorded.

- **Triggering Waveform Capture and Event Log** - Check the box to enable the capture of voltage swell events.
- **Threshold** - Enter in the percentage of the voltage swell to be captured. The range is from 50 to 140%. For example, if the rated voltage is 277V, and the voltage swell threshold is set for 110%. The swell event would be captured when the voltage is 110% above 277V, which is roughly 304V.

Voltage Sag: When any phase of the three-phase voltage is lower than the set value (voltage rated value x threshold %), there will be a voltage sag event. When a one-phase voltage sag occurs, the other phases will not respond to voltage sag event logging. All phase voltages need to be restored back to normal before a new voltage sag event is recorded.

- **Triggering Waveform Capture and Event Log**- Check the box to enable the capture of voltage sag events.

- **Level Threshold** - Enter in the percentage of the voltage sag to be captured. The range is from 20 to 100%. For example, if the rated voltage is 277V, and the voltage sag threshold is set for 50%. The sag event would be captured when the voltage drops 50% below 277V, which is roughly 138V.

  NOTE: The rated voltage setting is used for both voltage swell and voltage sag events

Rated Current: The rated current for the overcurrent should be entered here. Then the range is from 0.5 to 5.0 A for 5A series meters or 0.5 to 1.2A for other meter types.

Over Current: Will trigger a waveform capture when the current is over the threshold configured.

When overcurrent triggering is enabled, if any phase of the three-phase current is higher than the set value (rated value x threshold %), there will be an overcurrent waveform captured by the Acuvim II meter. If any phase is overcurrent, the other phases will not respond to overcurrent waveform capture. All phase currents need to be restored back to normal before the waveform captures a new respond.

- **Triggering Waveform Capture** - Check the box to enable the capture of overcurrent events.
- **Threshold** - Enter in the percentage of the overcurrent to be captured. The range is from 50 to 150%. For example, if the rated current is 1000A, and the overcurrent threshold is set for 50%. The overcurrent event would be captured when the current is 50% of the rated current, which is 500A.

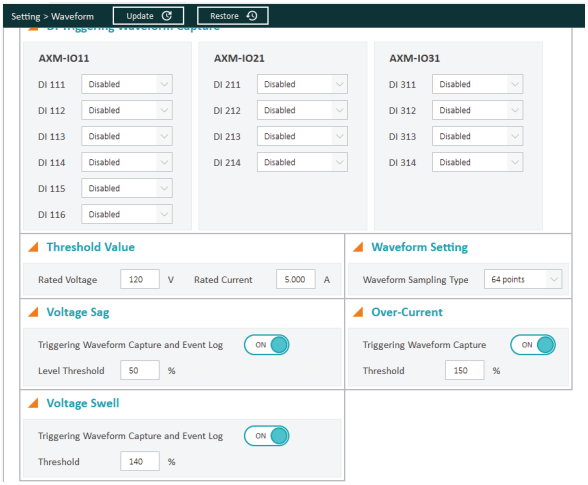


Figure 4-46 Waveform Capture Settings

4.12.2 Power Quality Event Logging

When a power quality event occurs, such as voltage sag and swell, Acuvim IIW meter will record the event timestamp and the triggering condition. It can save up to 50,000 events. The events can be viewed from Acuview 2 software in the **Event Log** located under the **Reading** tab.

The event log displays the newest event number and provides users with three viewing options, which can be selected from the drop-down menu:

- Read Latest 10 Records
- Read Latest 50 Records
- Read 1000 Records (From Selected Records): Users can enter a desired starting record number, and the event log will display 1000 records starting from that record number. The default starting record number is 1.

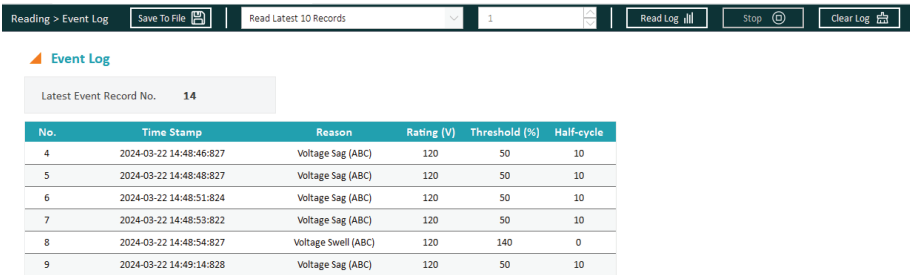
Once the viewing option is selected, users can click on **Read Log** to view the records in the event log.

The event log displays the record number, the timestamp (YYYY-MM-DD hh:mm:ss:ms format) of when the event occurred, a reason for the event (sag or swell), voltage rating, and threshold.

The records can be saved in CSV format. Users can also clear the events log by clicking on **Clear Log** button.

Once the event log reaches 50000 events, no more events will be logged even if the triggering condition happens. The user must clear the event log to continue logging power quality events. After clearing the log, new event will be logged once an event occurs.

NOTE: The event log does not lose data when the power is shut off.

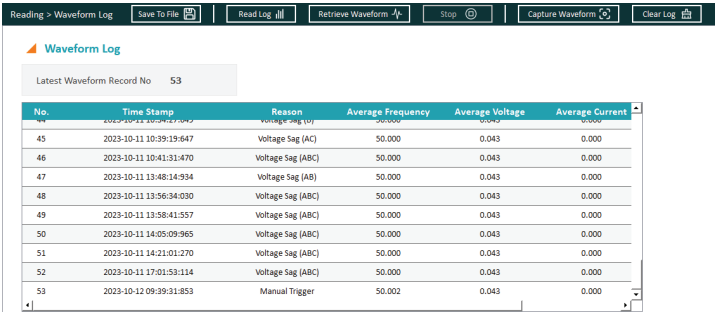


No.	Time Stamp	Reason	Rating (V)	Threshold (%)	Half-cycle
4	2024-03-22 14:48:46:827	Voltage Sag (ABC)	120	50	10
5	2024-03-22 14:48:48:827	Voltage Sag (ABC)	120	50	10
6	2024-03-22 14:48:51:824	Voltage Sag (ABC)	120	50	10
7	2024-03-22 14:48:53:822	Voltage Sag (ABC)	120	50	10
8	2024-03-22 14:48:54:827	Voltage Swell (ABC)	120	140	0
9	2024-03-22 14:49:14:828	Voltage Sag (ABC)	120	50	10

Figure 4-47 Event Log Records

4.12.3 Waveform Retrieval

Once the power quality event is logged, users can retrieve the waveform from either the Acuview 2 software or by polling Modbus registers (discussed later in Chapter 6). In the Acuview 2 software, the waveform can be retrieved from the **Waveform Log** page under the **Reading** tab. Similar to the event log, the waveform log provides users with a log of all power quality events that occurred. Users can navigate and select which waveform record they wish to view, and the selected waveform can be read by clicking on the **Retrieve Waveform** button.



No.	Time Stamp	Reason	Average Frequency	Average Voltage	Average Current
45	2023-10-11 10:39:19:647	Voltage Sag (AC)	50.000	0.043	0.000
46	2023-10-11 10:41:31:470	Voltage Sag (ABC)	50.000	0.043	0.000
47	2023-10-11 13:48:14:934	Voltage Sag (AB)	50.000	0.043	0.000
48	2023-10-11 13:56:34:030	Voltage Sag (ABC)	50.000	0.043	0.000
49	2023-10-11 13:58:41:557	Voltage Sag (ABC)	50.000	0.043	0.000
50	2023-10-11 14:05:09:965	Voltage Sag (ABC)	50.000	0.043	0.000
51	2023-10-11 14:21:01:270	Voltage Sag (ABC)	50.000	0.043	0.000
52	2023-10-11 17:01:53:114	Voltage Sag (ABC)	50.000	0.043	0.000
53	2023-10-12 09:39:31:853	Manual Trigger	50.002	0.043	0.000

Figure 4-48 Waveform Log

Users also have the option to manually capture a waveform on the Acuvim II meter by clicking on **Capture Waveform** in the Acuview 2 software. This may take 1 to 2 minutes to capture the waveform, and the waveform event will show up in the Waveform Log with a Reason description as Manual Trigger (refer to record number 53 in Figure 4-40 above). Manual capture allows users to capture and view the voltage and current waveform at any time once the meter is connected to the Acuview 2 software. This can be useful in comparing the normal waveforms of voltage and current with the power quality event waveforms which show voltage swell, sag or overcurrent.

In the Waveform graph displayed on the Acuview 2 software, users can select which phases for voltage and current they want to view. The figure below displays only Phase B voltage and current waveforms. Waveform Capture can log up to 100 groups of waveform data. Once the 100-group data is full, it does not respond to any waveform triggering condition. Only when all the waveform data is reset or emptied, the waveform capturing function will resume. Once the waveform data is emptied, new waveform data will start from the first group.

NOTE: Since the amount of each waveform group data is large, it takes more time to write into flash memory. Therefore, Waveform Capture only responds to one triggering condition at one time. During the process of writing data into the flash memory, it does not respond to a new triggering condition. After the process of memory writing, it will respond to new waveform

triggering conditions.

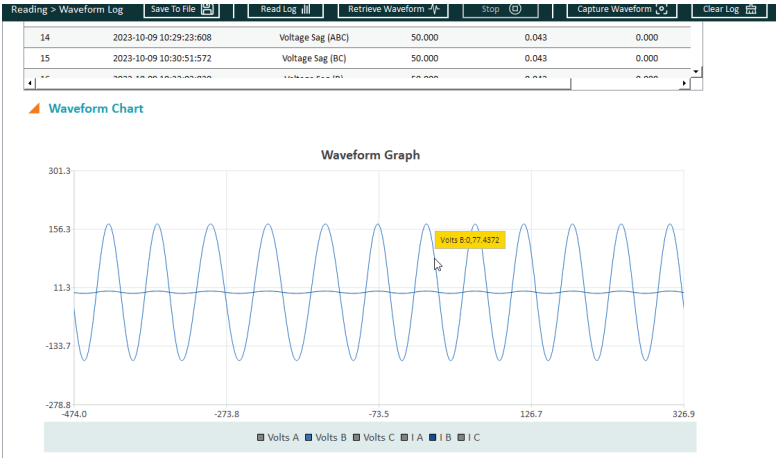


Figure 4-49 Retrieve Waveform Phase B Voltage and Current

Reading the Voltage and Current waveform

When the waveforms are displayed in the Acuview 2 software, the voltage and current are displayed as peak-to-peak values. In order to view the RMS values, users must convert the peak-to-peak values into RMS values.

The RMS voltage and RMS current can be calculated as follows:

$$Vrms = \frac{Vpeak}{\sqrt{2}} \qquad Irms = \frac{Ipeak}{\sqrt{2}}$$

For example, in Figure 4-50, the voltage for phase B reads 155.6V, which is 110V (155.6/√2) when converted to RMS voltage.

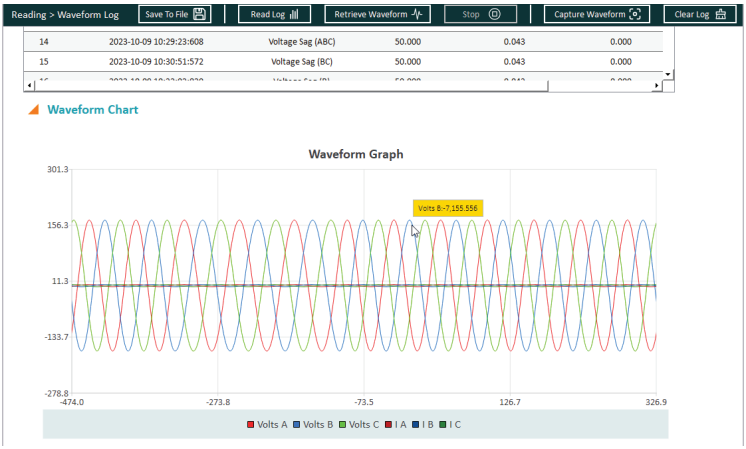


Figure 4-50 Waveform Capture Retrieval Screen

4.13 Dual Source Energy

The Acuvim II series meters have bi-directional energy capability that allows users to control the direction (Grid/Generator) of the energy accumulation. The user can control the direction either by the Digital Input or through communication. There are two directions in which the energy can be changed to, "Grid" and "Generator".

Users can change the direction of the energy based on Active Energy, Reactive Energy and Apparent Energy. Below includes a table that lists all the available parameters for this feature.

Table 4-5 Bi-Directional Energy Parameters

Parameters	Config Option
Active Energy	Ep
Phase A Active Energy	Ep_A
Phase B Active Energy	Ep_B
Phase C Active Energy	Ep_C
Reactive Energy	Eq
Phase A Reactive Energy	Eq_A
Phase B Reactive Energy	Eq_B
Phase C Reactive Energy	Eq_C
Apparent Energy	Es
Phase A Apparent Energy	Es_A
Phase B Apparent Energy	Es_B
Phase C Apparent Energy	Es_C

The bi-directional energy function can be enabled in the General Settings on the Acuview 2 software. Users can select the enabled option and configure the settings accordingly.

Switching Mode: Select the method for changing the direction of the energy. Users can either change the direction using the Digital Input (DI1-DI28), or they can use "Comm." control, which changes the direction via Modbus register write to the control register.

Metering Direction: Can be selected as either "Grid" or "Generator".

Energy 1/2/3: Select the energy parameter desired, refer to table 4-5 for parameter list.

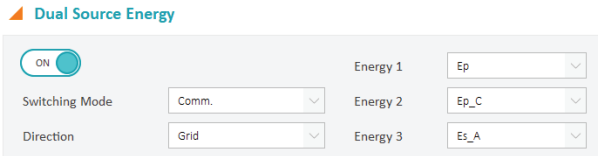


Figure 4-51 Dual Source Energy Settings

4.13.1 Controlling the Energy Direction

There are two methods to control the energy direction: communication and Digital Input. If the communication method is used, users need to write to the Modbus energy direction register, and the details of the register are provided in the table below.

Table 4-6 Dual Source Direction Register

Address (H)	Address (D)	Parameter	Range	Data Type	Access Property
1685H	5765	Bi-Directional Energy Direction	0: "Grid" 1: "Generator"	Word	R/W

When DI1 to DI28 are selected as control inputs, the direction will change when the DI status is ON (High), and it will change again when the status changes to OFF (Low). The following table lists the DI mapping from 1 to 28 with the corresponding I/O modules for the Acuvim II meter.

Table 4-7 DI Mapping for Dual Source Control Input

I/O Module	DI Channel Mapping
AXM-IO11	DI1-DI6
AXM-IO21	DI7-DI10
AXM-IO31	DI11-DI14
AXM-IO12	DI15-DI20
AXM-IO22	DI21-DI24
AXM-IO32	DI25-DI28

4.13.2 Bi-Directional Energy Switching Record

Whenever there is a change in direction for the energy, the Acuvim II meter will keep the historical changes in the Dual Source Log. The record supports 20 event records and will be overwritten from the earliest entry once the records reach the max amount.

The Dual Source Energy readings and log can be saved as a CSV file using Save To File button located on the top of the page. Clear Dual Source Energy allows the users to reset the dual source energy readings, and the Dual Source Log can be cleared by clicking on Clear Log button.

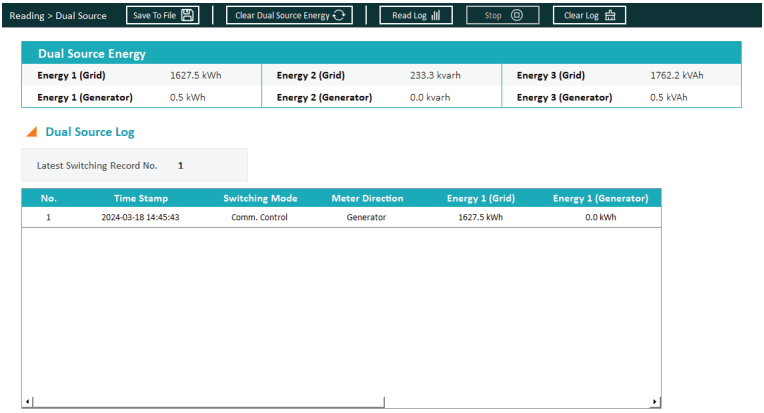


Figure 4-52 - Dual Source Energy Record

4.14 Phase Selection

The Phase Selection function is designed to help users correct their input installation mistakes without altering the physical current wiring. It is important to note that this feature will only work if the correct voltage input is present. Users can configure this feature using Acuview 2 software, WEB2, or the HMI setting pages S55-58.

Please be aware of the following important notices:

- It is technically possible to use this feature in conjunction with the independent channel function. However, it is not recommended to do so.
- This feature cannot be used in conjunction with the independent channel function.
- Any changes made to the phase selection settings will require a power cycle to ensure that the new configuration takes effect.
- Performing a factory reset will reset the phase selection mapping, so users should keep this in mind when considering the reset operation.

For instance, if a user mistakenly swaps current phase A and current phase C during installation, they can configure the phase selection setting accordingly. Please refer to the following picture for an example of the meter configuration:

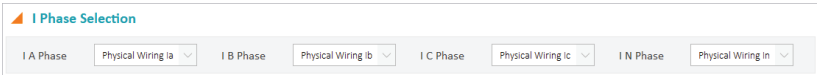


Figure 4-53 Phase Selection Configuration Panel

After the configuration, the Physical wiring on IC is remap to Channel IA, and Physical wiring on IA is remap to Channel IC. After configuring the phase swapping in the meter, it is necessary to perform a power cycle for the feature to work properly.

4.15 Independent Channel

4.15.1 Independent Channel Configuration

For users to enable the Independent Channel feature, there are several prerequisites that the meters need to be met. These prerequisites include:

1. Bootloader version is 6.07 or greater.
2. Phase Selection feature is disabled. (recommend)
3. The configuration of Phase N Current Type (I N value) is set to Measured.
4. The configuration of Modbus Real-Time Reading is set to Primary.
5. Connect to Acuview 2 software, AXM-WEB2 or AXM-WEB-PUSH module.

Important Notice

- When the Independent channel is enabled, the unbalance current reading and the unbalance voltage reading are not available; they will always be 0. Users need to reset the maximum/minimum values and energy every time they enable or disable the independent channel.
- If the input channel is set to None, the corresponding power readings will be empty.
- Waveform, fast read mode, TOU, and alarm functions are not fully supported when the independent channel is enabled. Users can still access those features; however, the results and settings may not be accurate.
- If users disabled the Independent Channel, it is important to change the Data Log parameters to non-Independent Channel parameters. Otherwise, the Data Log will record empty input.

Enable Independent Channel

After meeting the prerequisite, users can enable Independent Channel by selecting ***ON*** for ***Independent Wiring Mode*** in the ***Independent Wiring*** page under the ***Setting*** tab and click on Update button located at the top of the window.

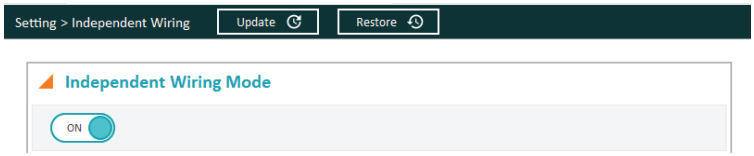


Figure 4-54 Enable Independent Channel

Changes on other functions when Independent Channel is enabled:

- **Dual Source Energy:** When independent channel is enabled, the Phase IN is not supported in dual source energy. However, the dual source energy for phase A, B, C can still be accessed.
- **Datalog:** Data log parameters for independent channels are supported when user enable the independent channel.
- **Independent channel reading:** The independent wiring reading page for Acuview 2 software is hidden unless the user enables the independent wiring feature in the setting page.
- **Alarm:** Independent channel parameters are not fully supported on alarm function. Users can still access the old alarm parameters.

CT configuration

When the Independent channel is enabled, CT's ratio can be configured individually.

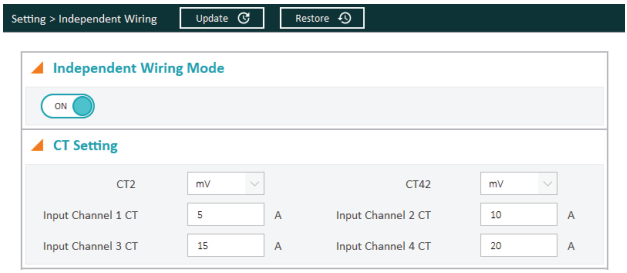


Figure 4-55 Independent Channel CT Configuration

For MV or RCT meters, users have the flexibility to connect the meter with two different configurations.

- Option 1: Users can connect the meter with three current transformers (CT) on Phase A, B, and C, and one Rogowski current transformer (RCT) on Phase N.
- Option 2: Users can connect the meter with three Rogowski current transformers (RCT) on Phase A, B, and C, and one current transformer (CT) on Phase N.

These options provide users with choices according to their specific requirements and the availability of CTs and RCTs.

Voltage Channel ID

In the independent channel mode, users can configure Voltage Channel ID by selecting the corresponding Voltage from the drop-down menu. This setting allows users to access more detailed readings specifically related to the input channel associated with the selected voltage.

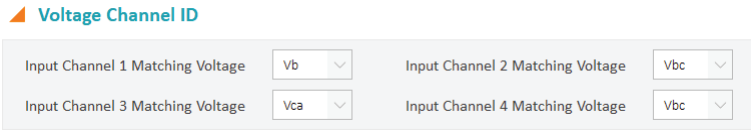


Figure 4-56 Independent Channel Voltage Channel ID Configuration

Please note that the configuration of Input Channel 1 to 4 can be customized without changing the physical wiring. The corresponding wiring diagram can be found in Figure 4-50 below for reference.

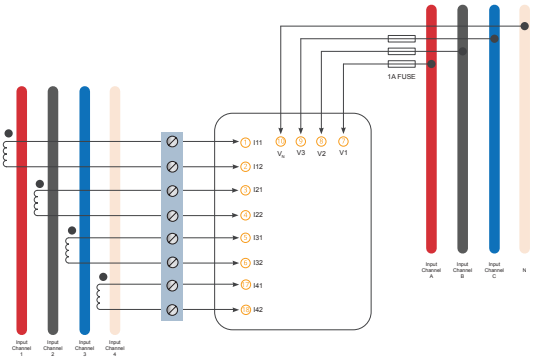


Figure 4-57 Independent Channel Wiring Configuration

Customized Summation

In the independent channel mode, users can configure summation by selecting individual phases. This setting allows the users to calculate the average current reading across the chosen channels as well as obtain the total power readings for those selected channels.

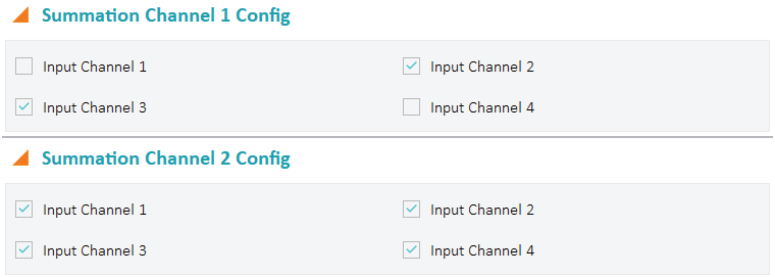


Figure 4-58 Independent Channel Summation Channel Configuration

4.15.2 Independent Channel Reading

Once Independent Channel is enabled, users can access the Independent Channel readings in the ***Independent Wiring Reading*** pages under the ***Reading*** tab.

The Independent Channel readings include the following:

- **Independent Wiring Mode Setting:** Displays all the Independent Channel configurations.
- **System Reading:** Includes voltage and frequency measurements for each phase.
- **Real-Time Reading:** Includes current and power measurements for each input channel.
- **Demand Reading:** Includes current and power demand measurements for each input channel.
- **Energy Reading:** Includes energy measurements for each input channel.
- **Max/Min:** Records maximum and minimum values of each independent channel parameter, along with their corresponding timestamps.

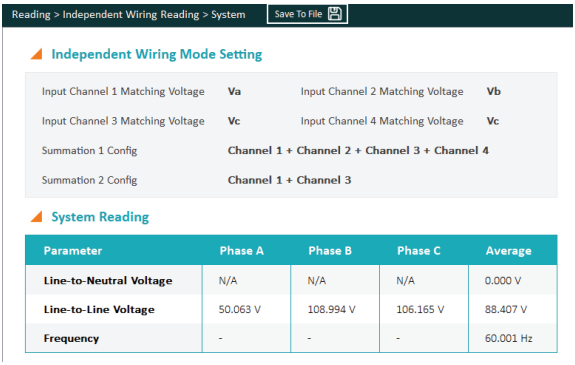


Figure 4-59 Independent Channel System Reading

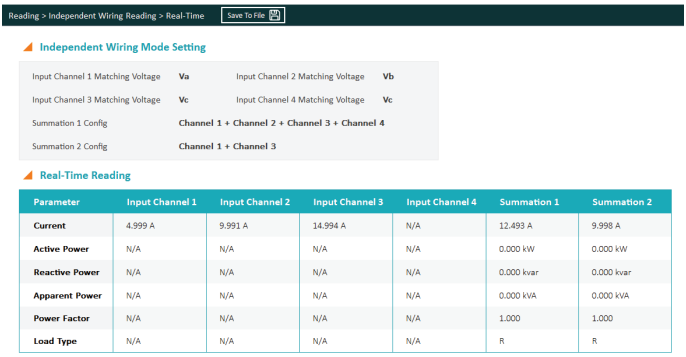


Figure 4-60 Independent Channel Real-Time Reading

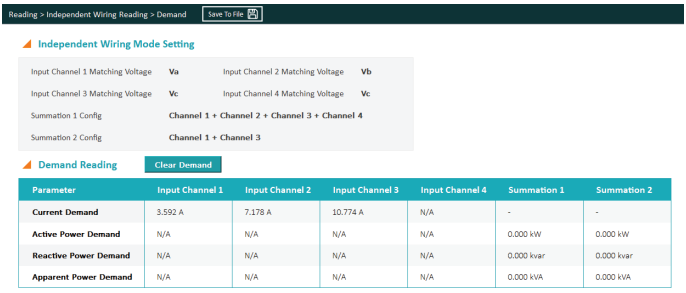


Figure 4-61 Independent Channel Demand Reading

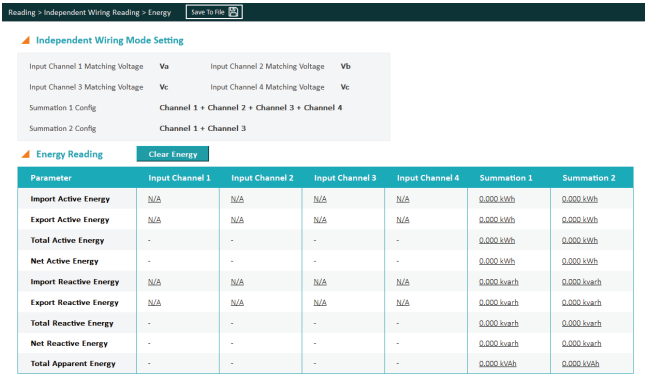


Figure 4-62 Independent Channel Energy Reading

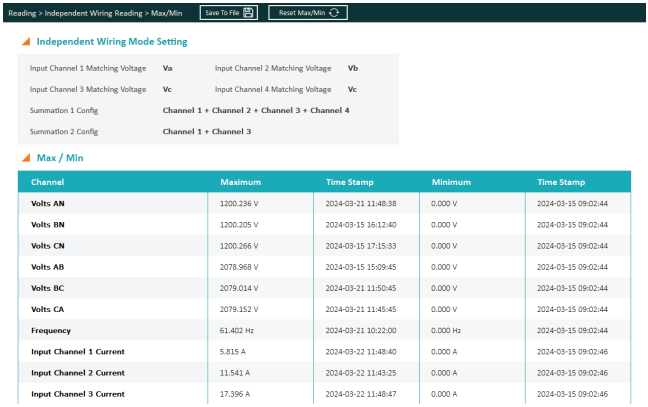


Figure 4-63 Independent Channel Max/Min

4.16 Modbus Gateway Passthrough

The Modbus Gateway Passthrough feature allow users to send Modbus requests to multiple slave meters by utilizing a base meter with AXM-WEB2 installed. These meters are interconnected in a daisy-chain configuration via RS485 using the Modbus Protocol.

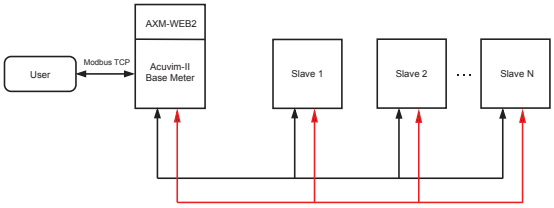


Figure 4-64 Modbus Gateway Passthrough Daisy-Chain

4.16.1 Gateway configuration

The Gateway configuration for Acuvim II v3 meters should be exclusively applied to the base meter and its AXM-WEB2 module.

Configuration on Acuview 2:

Simply enable the Gateway function in the **general** settings. Click the update button to save the changes after enabling this feature.

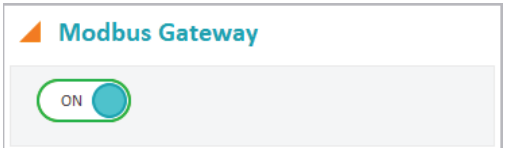


Figure 4-65 Modbus Gateway Enable

Configuration on Acuvim II V3 HMI :

Users can enable the Gateway function through the HMI at Page S59.



Figure 4-66 Modbus Gateway HMI Setting Page

Configuration on AXM-WEB 2:

Start by logging into the base meter 's WEB2 page to enabling the Gateway function by navigating to Settings -> Communication -> Modbus Gateway Function.

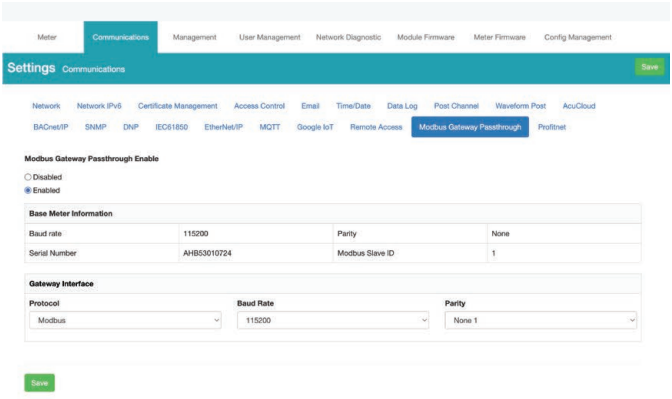


Figure 4-67 Modbus Gateway AXM-WEB2 Setting Page

Base Meter Information:

- **Baud Rate:** Communication Channel 2 Baud Rate.
- **Serial Number:** Base meter's serial number.
- **Parity:** Base meter's communication channel 2 Parity.

- **Modbus Slave ID:** This ID must be distinct from other slave IDs.

Gateway Interface:

- **Protocol:** Modbus is the default setting
- **Baud Rate:** Communication Channel 1 Baud Rate. It's crucial to note that for optimal communication performance, it is recommended to align the Baud Rate of Communication Channel 1 in the Gateway Interface with the Baud Rate of the Base meter's Communication Channel 2. Failing to do so may result in communication blockages, especially when dealing with a high volume of data transmission from numerous slave devices.
- **Parity:** Communication Channel 2 Parity

Upon clicking the **"Save"** button, it's important to note that the applied settings require a reboot to take effect. Following the meter reboot, users can access the Gateway function by navigating to the AXM-WEB2 tab, and subsequently clicking on the **Gateway** tab to enter the Gateway Modbus passthrough page.

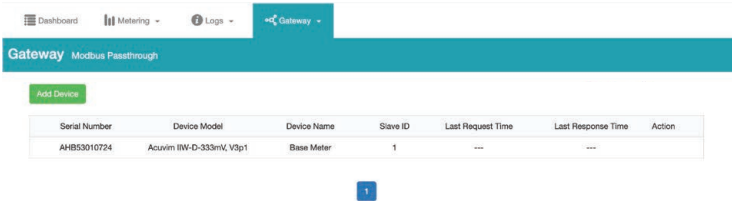


Figure 4-68 AXM-WEB2 Modbus Gateway Passthrough Page

The base meter consistently appears at the top, named as the default device **"Base Meter"**. It's important to note that this default device cannot be deleted or edited by users. To add a new slave address, users can click the **"Add Device"** button. Upon clicking this button, a sub-window will appear, allowing users to input the necessary details for the new device.

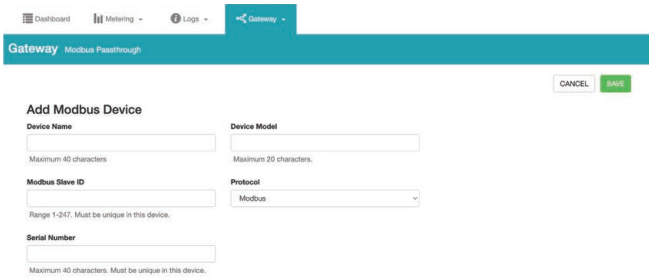


Figure 4-69 AXM-WEB2 Modbus Gateway Passthrough ADD Device Page

In the sub-window for adding a new device, users can provide the following information:

Device Name: The device name for this slave meter, with a maximum of forty characters.

Device Module: The device module type for this slave meter, limited to a maximum of twenty characters.

Modbus Slave ID: A unique identifier within the range from 1 to 247. Users must configure the ID either through the HMI setting page S01 on the slave meter or by accessing the general setting pages via Acuview2 before adding the device.

Protocol: Only Modbus protocol is supported; BACnet is not. Ensure that communication channell 1 for the slave device is set to Modbus before adding the device.

Serial Number: Users must input the serial number for the slave, with a maximum of forty characters, ensuring uniqueness.

After entering these details, click **"Save"** for the updates to take effect. Returning to the Gateway Modbus Passthrough page, users will observe the newly added device to the list.

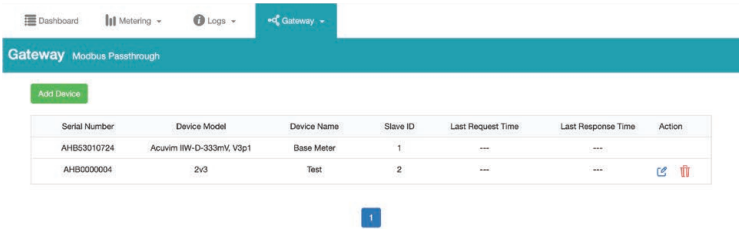


Figure 4-70 AXM-WEB2 Modbus Gateway Passthrough Page Save AND Edit

Users have the ability to manage the added devices by clicking the **"Edit"** button to modify device details or the **"Delete"** button to remove a device from the list.

4.16.2 Read Through Gateway Modbus TCP

To assess the functionality of the Modbus TCP gateway, perform a test by connecting to the AXM-WEB2 using Modbus TCP. Send a "Read Holding Registers" request **(0x03)** to inquire about the frequency at address **0x3200**H (**12800**D) with the assigned slave address **#2**. The accompanying image demonstrates the successful retrieval of the frequency through this Modbus TCP interaction.

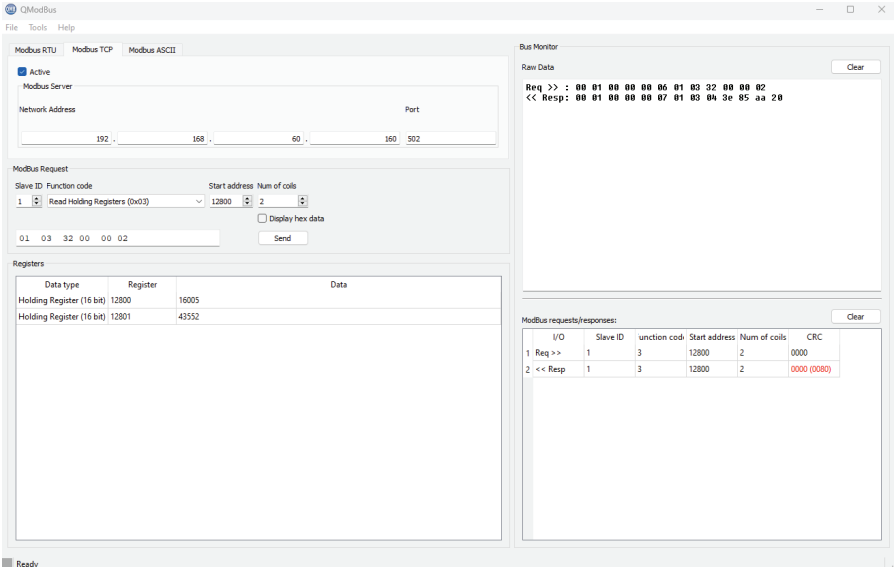


Figure 4-71 ModBus Read Frequency

After returning to the webpage, users will need to **refresh** the website to observe the updated Last Request Time and Last Response Time.

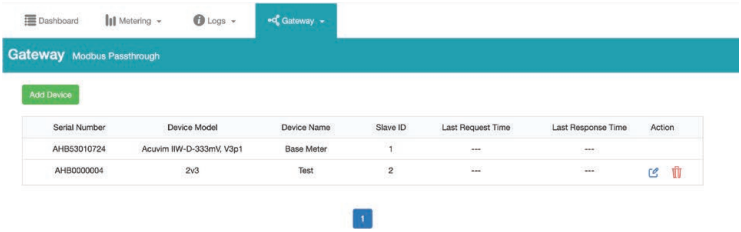


Figure 4-72 AXM-WEB2 Modbus Gateway Passthrough Page

Chapter 5: Extended Modules

5.1 I/O Modules

The standard Acuvim II meter base model does not have any built-in I/O functions. However, with the addition of the extended modules, multiple I/O options can be added. These functions include digital input status, pulse counter, relay output, analog output, and analog input. These I/O functions can be useful for a variety of metering applications, such as counting/outputting pulse signals to/from water/gas meters, outputting 4 to 20mA analog signals to a PLC controller, or measuring the analog signal from a temperature sensor.

The Acuvim II series meter supports three types of I/O modules: AXM-IO1, AXM-IO2 and AXM-IO3. A maximum of three external modules can be attached to the Acuvim II meter, including communication modules. If users have both communication module and I/O modules to install on the meter simultaneously, the communication module is required to be installed onto the meter first, and then the I/O modules should be installed after that. The meter can have a maximum of two I/O modules of the same type attached to the meter. If two I/O modules of the same type are connected to the meter, they must have a unique logic number. For example, if two AXM-IO2 modules are used simultaneously, then an AXM-IO2-1 and an AXM-IO2-2 are required. In this case, the logic numbers are the last digits of the two modules, which are 1 and 2 respectively.

NOTE: When using a communication module with I/O modules, ensure that the communication module is installed on the meter first.

5.1.1 Appearance and Dimensions

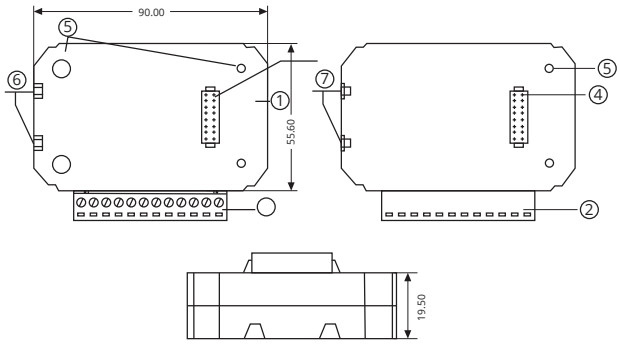


Figure 5-1 I/O Module Dimensions

Table 5-1 I/O Module Description Table

Number	Description
1	Enclosure
2	Wiring Terminals
3	Linking Pins
4	Linking Socket
5	Installation Screw
6	Counterpart of Clip
7	Installation Clip

5.1.2 I/O Functionality

The **AXM-IO1** module is composed of:

- **6 Digital Inputs (DI)**
  - Each digital input can be used in pulse counter or digital status mode. In digital status mode, the DI will be used to detect remote signals and the meter will log the time/date of the detection and store it in the SOE (sequence of events) log of the Acuvim II, if enabled. In pulse counter mode, the DI will be used to count digital pulses.
  - Terminals ***DI1*** to ***DIC*** are the Digital Input terminals, where DIC is the common terminal for DI1 to DI6 circuits.
- **2 Relay Outputs (RO)**
  - The relay outputs can be used in two different modes, control mode or alarm mode, where both relay channels operate in the same mode. In control mode, users can configure the relay to work in either latch mode (ON/OFF) or momentary mode (ON/OFF for a certain time interval). When it operates in alarm mode, the relay will turn ON/OFF based on the status of the alarm configured in the Acuvim II meter.
  - Terminals ***RO1*** to ***ROC*** are the Relay Output terminals, where ROC is the common terminal for RO1 and RO2 circuits.
- **24Vdc Power Supply**
  - Used as an auxiliary power supply for the digital input pulse circuits.
  - The voltage of the DI auxiliary power supply is 24V(1W).
  - Terminals ***V+*** and ***V-*** are the terminals for the 24Vdc power supply.



Figure 5-2 AXM-IO1 Module

The **AXM-IO2** module is composed of:

- **4 Digital Inputs (DI)**
  - Each digital input can be used in pulse counter or digital status mode. In digital status mode, the DI will be used to detect remote signals and the meter will log the time/date of the detection and store it in the SOE (sequence of events) log of the Acuvim II, if enabled. In pulse counter mode, the DI will be used to count digital pulses
  - Terminals ***DI1*** to ***DIC*** are the Digital Input terminals, where DIC is the common terminal for DI1 to DI4 circuits.
- **2 Analog Outputs (AO)**
  - The AXM-IO2 can output an analog voltage or analog current based on certain parameters measured by the Acuvim II meter.
    - When it outputs analog voltage, the range of voltage is from 0 to 5V or from 1 to 5V.
    - When it outputs analog current, the range of current is from 0 to 20mA or from 4 to 20mA.
    - The output mode can be switched from Acuview 2 and AXM-WEB2.
  - Terminals ***AO1+*** to ***AO2-*** are the Analog Output terminals.

NOTE: The AXM-IO2 module can only output one type of analog signal.

- **2 Digital Outputs (DO)**
  - The digital output can be used in either alarm mode or energy pulse output mode, and both DO channels will operate in the same mode. In energy pulse mode, the DO will send digital pulses based on various types of energy (consumed/generated or real/reactive) readings measured by the Acuvim II meter. In alarm mode, the DO will output a digital pulse when an alarm is triggered.
  - Terminals ***DO1*** to ***DOC*** are the Digital Output terminals, where DOC is the common terminal for DO1 and DO2.

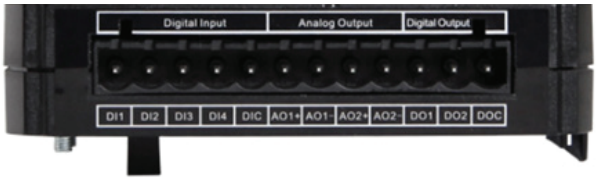


Figure 5-3 AXM-IO2 Module

The **AXM-IO3** module is composed of:

- **4 Digital Inputs (DI)**
  - Each digital input can be used in pulse counter or digital status mode. In digital status mode, the DI will be used to detect remote signals and the meter will log the time/date of the detection and store it in the SOE (sequence of events) log of the Acuvim II, if enabled. In pulse counter mode, the DI will be used to count digital pulses.
  - Terminals ***DI1*** to ***DIC*** are the Digital Input terminals, where DIC is the common terminal for DI1 to DI4 circuits.
- **2 Relay Outputs (RO)**
  - The relay outputs can be used in two different modes, control mode or alarm mode, where both relay channels operate in the same mode. In control mode, users can configure the relay to work in either latch mode (ON/OFF) or momentary mode (ON/OFF for a certain time interval). When it operates in alarm mode, the relay will turn ON/OFF based on the status of the alarm configured in the Acuvim II meter.
  - Terminals ***RO1*** to ***ROC*** are the Relay Output terminals, where ROC is the common terminal for RO1 and RO2 circuits.
- **2 Analog Inputs (AI)**
  - Can detect input analog voltage or analog current.
    - When it detects input analog voltage, the range of voltage is from 0 to 5V or from 1 to 5V.
    - When it detects input analog current, the range of current is from 0 to 20mA or from 4 to 20mA.
    - The input mode can be switched from Acuview 2 and AXM-WEB2.
  - Terminals ***AI1+*** to ***AI2-*** are the Analog Input terminals.

NOTE: The AXM-IO3 can only read input from one type of analog signal.



Figure 5-4 AXM-IO3 Module

Table 5-2 I/O Module Functionality Table

Functions	AXM-IO1	AXM-IO2	AXM-IO3
Detection of remote signals	•	•	•
SOE Recording	•	•	•
Pulse Counting	•	•	•
Relay Control	•		•
Relay Control by Alarm	•		•
Digital Output by Alarm		•	
Digital Pulse Output		•	
Analog Output		•	
Analog Input			•
24Vdc Power Supply	•		

5.1.3 Installation Method

Environment

Please verify that the installation environment meets the following requirements:

Temperature:

Operation: -25°C to 70°C (-13˚F to 158˚F)

Storage: -40°C to 85°C (-40˚F to 185˚F)

Humidity:

5% to 95% non-condensing

Location:

The Acuvim II meter and I/O modules should be installed in a dry and dust-free environment, and

they should be kept away from heat, radiation, and high levels of electrical noise or interference.

Installation Method:

Remove the ***Ext. Port*** cover from the back of the meter and any I/O module so that the linking pins are visible.



Figure 5-5 External Port Cover

NOTE: Use a small, flat screwdriver to remove the external port cover from the back of the meter.

1. Insert the counterpart clips of the module into the Acuvim II meter and then press the module down lightly to establish the linking.
2. Tighten the installation screws.
3. Install other modules following the steps above.

NOTE: Install each module carefully to avoid damage. Under no circumstances should any installation be done with the meter powered on. Failure to do so may damage the meter.

NOTE: The maximum number of modules that can be attached to the meter is three. Ensure a communication module is installed on the meter prior to installing any I/O modules.



Figure 5-6 Installation of I/O Module to Acuvim II Meter

5.1.3.1 Change I/O Module's Logic Address

Starting with AXM-IO hardware version v2.0 or above, its logic address can be changed using Acuview 2 (v1.03p01 or above) and AXM-WEB2 (v1.27 or above).

First, the user needs to click the button to switch to AXM-IO32.

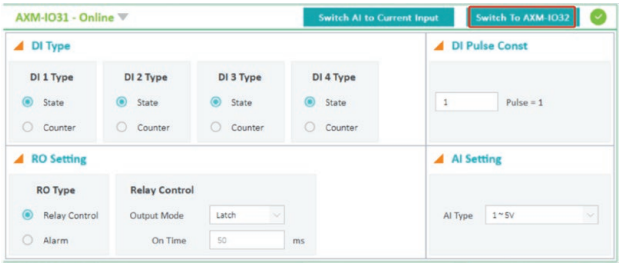


Figure 5-7a Click Switch AXM-IO 3 Logic Number from 3-1 to 3-2 Button

Second, the meter needs a reboot to apply the changes.

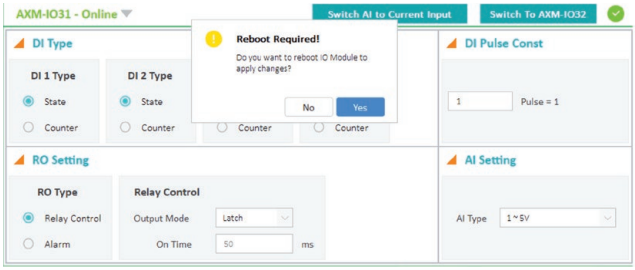


Figure 5-7b Switch AXM-IO 3 Logic Number from 3-1 to 3-2 Reboot Request

In the end, the meter will reboot automatically. Users need to reconnect Acuview 2 after reboot.

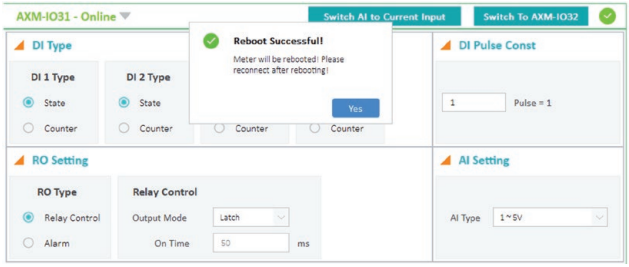


Figure 5-7c Switch AXM-IO 3 Logic Number from 3-1 to 3-2 Reboot Successful

5.1.3.2 Switch Analog Input and Analog Ouput Type

Starting with AXM-IO hardware version v2.0 or above, the AO type of AXM-IO2 and the AI type of AXM-IO3 can be changed using Acuview 2 (v1.03p01 or above) and AXM-WEB2 (v1.27 or above).

Example: Change AI type for AXM-IO 3-1 from Voltage type to Current type.

First, the user needs to click the Switch AI to Current Input button.

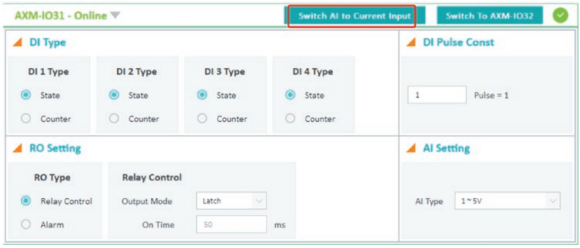


Figure 5-8a Click Switch AXM-IO 3 AI Type from Voltage to Current Button

Second, the meter needs a reboot to apply the changes.

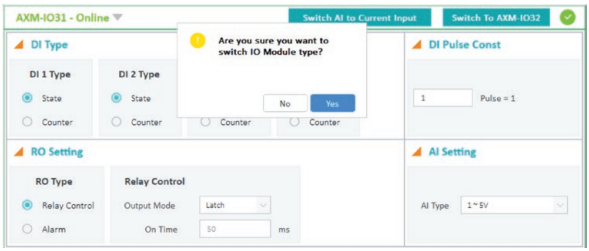


Figure 5-8b Switch AXM-IO 3 AI Type from Voltage to Current Reboot Request

In the end, the meter will reboot automatically. Users need to reconnect Acuview 2 after reboot.

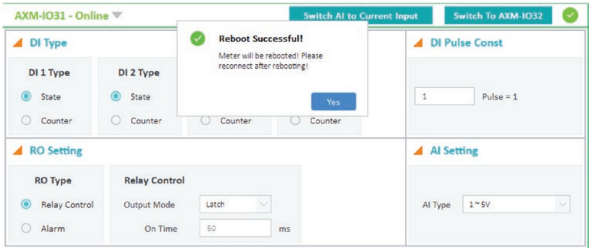


Figure 5-8c Switch AXM-IO 3 AI Type from Voltage to Current Reboot Successful

5.1.4 I/O Module Wiring

Digital Input

Wiring of Digital Input Circuit

There are six DI channels in the AXM-IO1 and four DI channels in the AXM-IO2 and AXM-IO3 modules. The Digital Input circuits within each of the modules are the same for both pulse counter and digital status modes. The digital input circuitry can be described in Figure 5-9 below. From the wiring schematic, when switch K is open, the output OUT is in the high state. When the switch K is closed, the output OUT is in the low state.

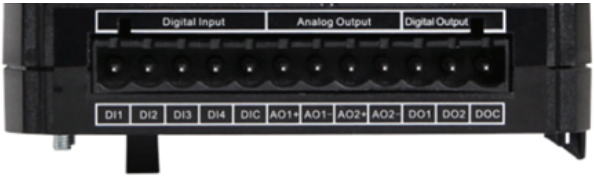


Figure 5-9 Digital Input Wiring Schematic

Digital Input ratings:

- **External Power Supply Rating:** 24-160Vac/Vdc
- **Maximum loop current:** 2mA
- **Max Pulse Frequency:** 100Hz, 50% Duty Cycle (5ms ON and 5ms OFF)

Typical Digital Input Wiring



Figure 5-10 Digital Input Pulse Counter Wiring Using 24Vdc on AXM-IO1 Module



Figure 5-11 Multiple Channel Digital Input Wiring Using 24Vdc on AXM-IO1 Module

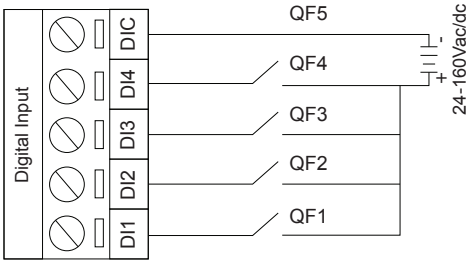


Figure 5-12 Digital Input Wiring Using AXM-IO2 and AXM-IO3 Modules

NOTE: The wire gauge to use with the DI should be chosen between AWG22 and 16.

Relay Output

There are two Relay Output channels in the AXM-IO1 and AXM-IO3 modules. The RO circuits can work in either control mode or alarm mode. The following diagram shows the schematic diagram of the relay output circuit, which is the same regardless of the operating mode.

The relay type is a mechanical form A contact with 3A/250Vac or 3A/30Vdc. When using the relay output, it is recommended that an intermediate relay is used to control the output device.

Relay Output ratings:

- **Switching Voltage (Max):** 250Vac, 30Vdc
- **Load Current:** 5A (R), 2A (L)
- **Set Time:** 10ms (Max)
- **Contact Resistance:** 30mΩ (Max)

- **Isolation Voltage:** 2500Vac
- **Mechanical Life:** 1.5e7

Typical Relay Output Wiring

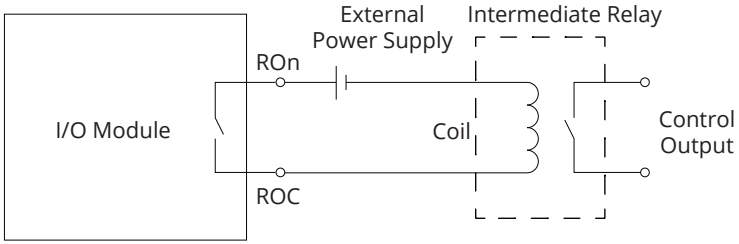


Figure 5-13 Relay Output Diagram

NOTE: The wire gauge to be used with the relay output should be chosen between AWG22 and 16.

Digital Output

There are 2 Digital Output channels on the AXM-IO2 module. The DO circuit can operate in either alarm mode or in energy pulse output mode.

The DO circuit is of Photo-MOS form. The simplified circuit is shown in Figure 5-14.

Digital Output ratings:

- **Voltage Range:** 0-250Vac/dc
- **Load Current:** 100mA (Max)
- **Isolation Voltage:** 2500Vac
- **Output Frequency:** 40Hz, (20ms ON, 5ms OFF)
- **Minimum Pulse Width:** 20ms
- **Minimum Pulse Interval:** 5ms

Wiring of Digital Output Circuit

When the internal signal J is in the low state, the output OUT is also in a low state, resulting in no pulse output. When J is in a high state, the output OUT is in the high state, resulting in a pulse output.

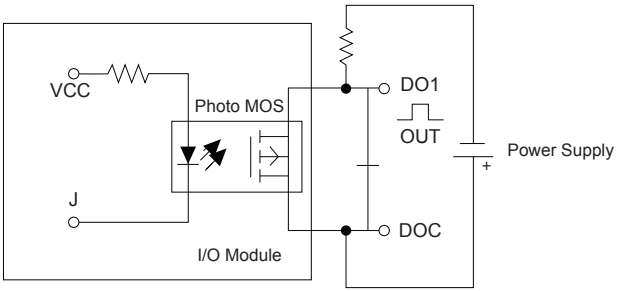


Figure 5-14 Digital Output Circuit

NOTE: The Digital Output is a dry contact and requires a voltage supply to generate the pulse signal.

The circuit for the alarm mode with a buzzer is shown in Figure 5-15.

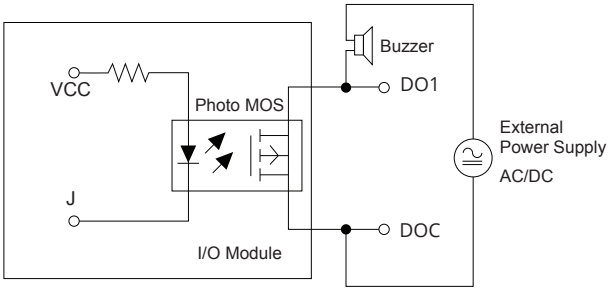


Figure 5-15 Digital Output as Alarm Mode

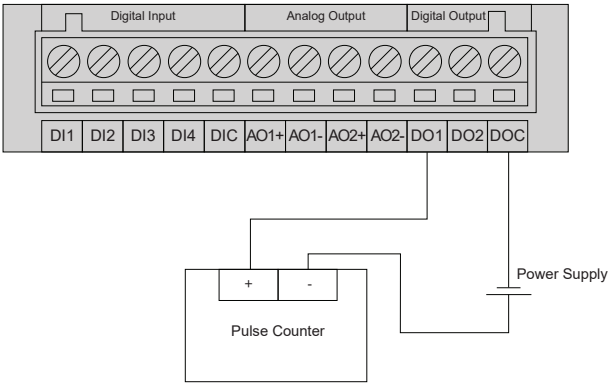


Figure 5-16 Digital Output to a Pulse Counter

NOTE: The power supply can be 0-250Vac/dc.

NOTE: The wire gauge to use for the DO should be chosen between AWG22 and 16.

Analog Output

There are two Analog Output channels on the AXM-IO2 module. The AO circuit can convert metering parameters into an AO signal as either a voltage or current signal. An AXM-IO2 module supports either voltage or current. The AO circuit within this module can provide either a 0-20mA or 4-20mA current output if the module supports current, or a 0-5V and 1-5V voltage output if the module supports voltage.

Wiring of Analog Output Circuit:

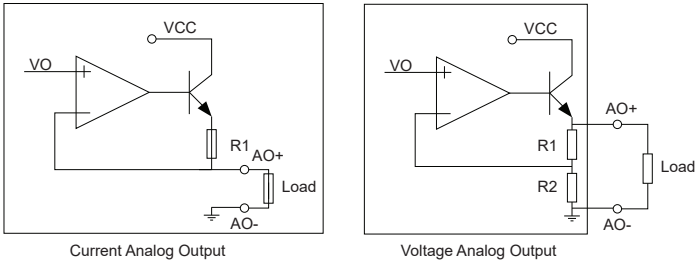


Figure 5-17 Analog Output Circuit for Voltage and Current on AXM-IO2 Module

Analog Output Ratings:

- **For the current output (0-20mA/4-20mA):** The max load resistance is 500Ohms.
- **For the voltage output (0-5V/1-5V):** The max load current is 20mA.
- **Accuracy:** 0.5%
- **Temperature Drift:** 50ppm/°C Typical
- **Isolation Voltage:** 500Vdc
- **Open Circuit Voltage:** 15V

Analog Input

Wiring of Analog Input Circuit:

There are two Analog Input channels on the AXM-IO3 modules. An AXM-IO3 module supports

either voltage or current. The AI circuit within the module can provide either a 0-20mA or 4-20mA current input if the module supports current, or a 0-5V and 1-5V voltage input if the module supports voltage.

The simplified circuit is shown in Figure 5-18.

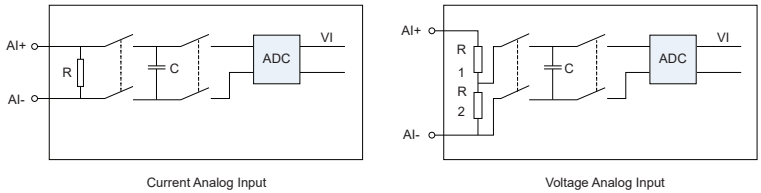


Figure 5-18 Analog Input Circuit for Voltage and Current on the AXM-IO3 Module

5.1.5 Detection of Remote Signals

By default, the Digital Input on all I/O modules are configured in ***State*** mode, where the meter provides a digital signal status (ON/OFF). When the DI circuit detects a sufficient voltage input, it will show a ***1*** on the screen and ***ON*** in the Acuview 2 software. Otherwise, it will show a ***0*** on the screen and ***OFF*** in the software.

Viewing the Digital status from the Meter's Display:

- Press ***H*** and ***V/A*** at the same time. The screen will go blank, and ***Meter*** will be flashing.
- Press the ***P*** or ***E*** key to move the flashing cursor over to ***Digital I/O*** and press ***V/A*** to enter.
- Next, users will see the I/O selection screen, select the appropriate I/O module and press ***V/A***.
- With the cursor on ***DI***, press ***V/A*** to view the Digital Input Status readings.

NOTE: Refer to Chapter 3 section 3.7.4 on how to configure the DI from the meter's display.

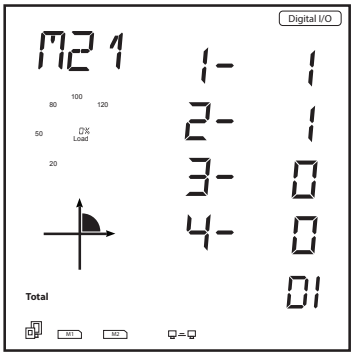


Figure 5-19 Digital Status Reading from Acuvim II Display

Viewing the Digital status from the Acuview 2 software

The Digital Input mode can be configured from the Acuview 2 software, on the ***I/O Modules 1*** or ***I/O Modules 2*** page under the ***Setting*** tab. The difference between I/O pages 1 and 2 is based on the module's logic number. For example, if users have an AXM-IO3-2, they will configure the settings on I/O Modules 2 page.

The DI settings must be set to ***State*** to monitor the Digital Status. If any changes are made to the I/O settings, click on ***Update*** located at the top of the Settings page to save the configurations.

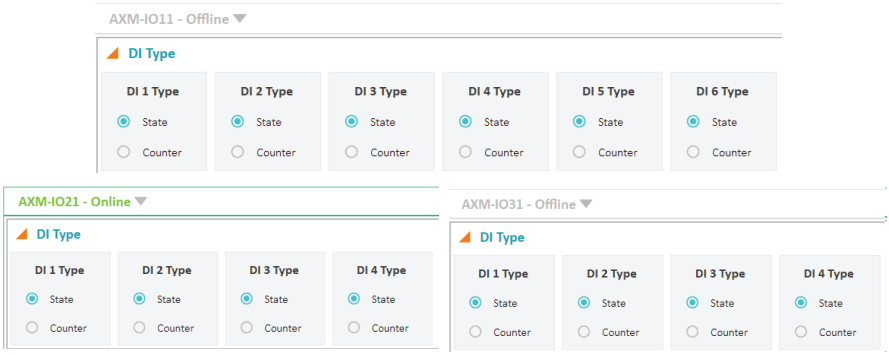


Figure 5-20 Digital Input Status Configuration

Under the ***Reading*** tab, select either ***I/O Modules 1 Reading*** or ***I/O Modules 2 Reading*** depending on the logic number of the I/O module being used. From there, users can see the digital input status on the software as either **ON** or **OFF**.

NOTE: AXM-IO1-1, AXM-IO2-1, and AXM-IO3-1 have logic number 1. AXM-IO1-2, AXM-IO2-2, and AXM-IO3-2 have logic number 2.

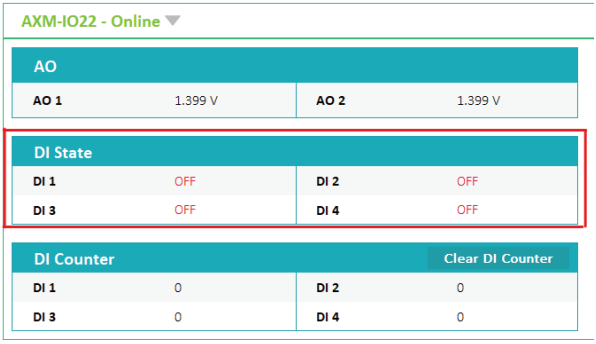


Figure 5-21 Digital Input Status Readings from the Acuview 2 Software

Sequence of Events Record (SOE)

When the Digital Input is configured to detect remote signals, users have the option to monitor the digital status change using the sequence of events log on the Acuvim II meter. Users can select which I/O module to log the status change from the ***General*** page under the ***Setting*** tab in the software. The SOE can also be enabled from the meter's display in the system settings of the Acuvim II meter. Refer to Chapter 3 for more details on configuring the settings from the display.

Users can select which module for recording the status change events, and they can also disable the SOE function by selecting ***None***.

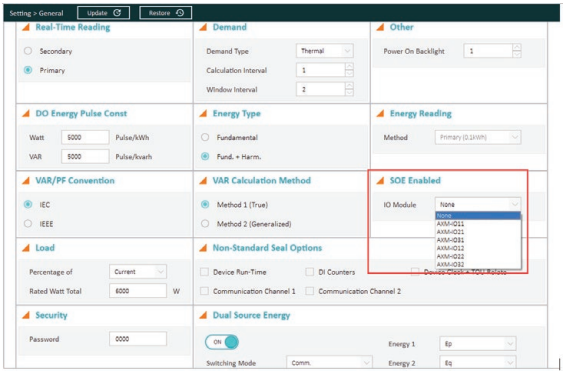


Figure 5-22 SOE Enable Configuration

SOE Records

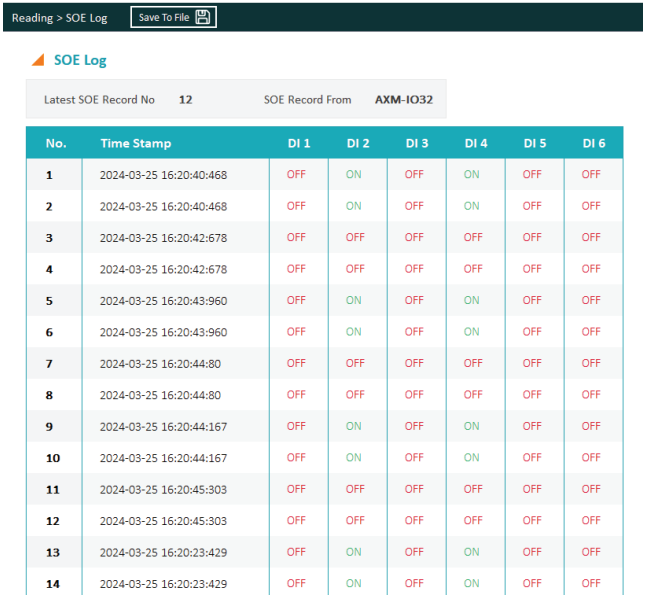
The Sequence of Events log can record up to twenty events. When more than twenty events have been recorded, the SOE will overwrite the record with the oldest time stamp and continue recording. The SOE record includes the status from DI1 to DI6 as well as the time stamp for when the change occurred.

When the Acuvim II series meter is powered, the SOE will begin to record immediately. The data in the SOE Log will not be lost even in the event of a power outage or shutdown.

When a new I/O module is selected to be recorded, the records will be overwritten immediately.

The SOE log can be read from the Acuview 2 software by selecting the ***SOE Log*** under the ***Reading*** tab.

NOTE: The Acuvim II meter will only log SOE events when the DI is configured to Status mode. If the DI is configured to Pulse mode, there will be no change in the SOE Log.



No.	Time Stamp	DI 1	DI 2	DI 3	DI 4	DI 5	DI 6
1	2024-03-25 16:20:40:468	OFF	ON	OFF	ON	OFF	OFF
2	2024-03-25 16:20:40:468	OFF	ON	OFF	ON	OFF	OFF
3	2024-03-25 16:20:42:678	OFF	OFF	OFF	OFF	OFF	OFF
4	2024-03-25 16:20:42:678	OFF	OFF	OFF	OFF	OFF	OFF
5	2024-03-25 16:20:43:960	OFF	ON	OFF	ON	OFF	OFF
6	2024-03-25 16:20:43:960	OFF	ON	OFF	ON	OFF	OFF
7	2024-03-25 16:20:44:80	OFF	OFF	OFF	OFF	OFF	OFF
8	2024-03-25 16:20:44:80	OFF	OFF	OFF	OFF	OFF	OFF
9	2024-03-25 16:20:44:167	OFF	ON	OFF	ON	OFF	OFF
10	2024-03-25 16:20:44:167	OFF	ON	OFF	ON	OFF	OFF
11	2024-03-25 16:20:45:303	OFF	OFF	OFF	OFF	OFF	OFF
12	2024-03-25 16:20:45:303	OFF	OFF	OFF	OFF	OFF	OFF
13	2024-03-25 16:20:23:429	OFF	ON	OFF	ON	OFF	OFF
14	2024-03-25 16:20:23:429	OFF	ON	OFF	ON	OFF	OFF

Figure 5-23 SOE Log Readings

5.1.6 Pulse Counter

The DI channels can also be configured to count pulses. Once the appropriate DI channel is configured to count pulses, the meter will be able to show the pulse count on the meter's display or in the Acuview 2 software.

Viewing the Digital Input pulse count from the Meter's Display:

- Press ***H*** and ***V/A*** at the same time. The screen will go blank, and ***Meter*** will be flashing.
- Press the ***P*** or ***E*** key to move the flashing cursor over to **Digital I/O** and press ***V/A*** to enter.
- Next, users will see the I/O selection screen. Select the appropriate I/O module and press ***V/A***.
- Press either ***P*** or ***E*** to move the cursor down to ***CTR*** and press ***V/A*** to view the Digital Input Pulse Counter readings.
- Once on the Counter page, press ***P*** or ***E*** to navigate between different counters.

NOTE: Refer to Chapter 3, section 3.7.4, on how to configure the DI from the meter's display.

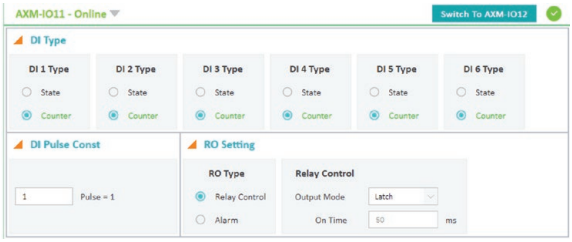


Figure 5-24 Digital Input Pulse Count from Meter's Display

NOTE: The counter value is read from top to bottom on the meter's display. For example, if the count value is 123456789, it will be displayed on the meter as 1 on the top line, 2345 on the second line, and 6789 on the bottom line.

How to view and configure the Pulse Input from the Acuview 2 software:

The Digital Input can be configured as Pulse Counter on the ***I/O Modules 1*** or ***I/O Modules 2*** page depending on the logic number of the module being configured. The DI mode must be set to ***Counter*** for the Digital Input to count the pulse signals. Users can also configure the pulse counter constant. This number represents how many pulses will equate to a single count on the Digital Input. The range for pulse counter constant is from 1 to 65535.





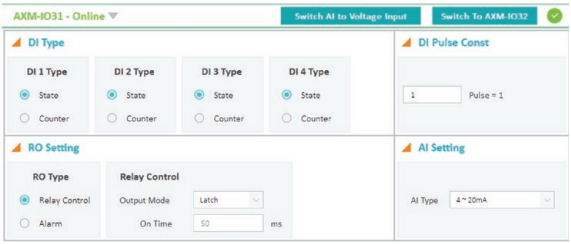


Figure 5-25 Pulse Counter Configuration from Acuview 2 Software

The DI pulse count data can be read on the Acuview 2 software from the ***Reading*** tab by selecting either ***I/O Modules 1 Reading*** or ***I/O Modules 2 Reading*** depending on the logic number of the module that is connected to the meter.

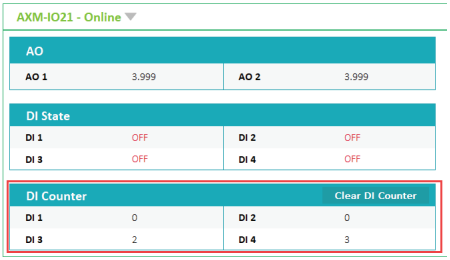


Figure 5-26 Pulse Counter Readings from the Acuview 2 Software

Clearing the Pulse Count

The pulse count can be cleared from the meter's display, Acuview 2 software, or through Modbus registers. For instructions on how to clear the pulse count using the meter's display, refer to Chapter 3. For instructions using Modbus, refer to Chapter 6.

To clear the pulse count from the Acuview 2 software, go to I/O Modules 1 Reading or I/O Modules 2 Reading page under the Reading tab. In the DI Counter reading section, click on Clear DI Counter button to clear the pulse count.



Figure 5-27 Reset DI Counter from Acuview 2 Software

5.1.7 Relay Output

The relay output is supported on the AXM-IO1 and AXM-IO3 modules. Users can read the relay output status from either the meter's display, Acuview 2 software, or through Modbus registers.

Reading Relay Output from Meter's Display:

- Press ***H*** and ***V/A*** at the same time. The screen will go blank, and **Meter** will be flashing.
- Press the ***P*** or ***E*** key to move the flashing cursor over to **Digital I/O** and press ***V/A*** to enter.
- Next users will see the I/O selection screen, select the appropriate I/O module and press ***V/A***.
- Press either ***P*** or ***E*** to move the cursor down to ***RO*** and press ***V/A*** to view the Digital Input Pulse Counter readings.

By default, the relay will be in ***OFF*** state (normally open). When the relay output is triggered, the relay status will switch to ***ON***.

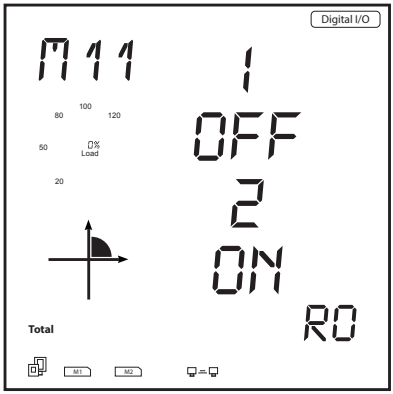


Figure 5-28 Relay Output Status Readings

How to view and configure the Relay Output from the Acuview 2 software:

The Relay Output settings can be configured from the Acuview 2 software on the ***I/O Modules 1*** or ***I/O Modules 2*** page under the ***Setting*** tab, depending on the logic number of the I/O module being used. There are two RO types that the module can be configured to:

- **Relay Control:** When configured as relay control, users can manually switch the relay ON/OFF. After the relay is set to Relay Control, users should select one of the two additional **RO Relay Control Output Mode:** Latch, Momentary
  - **Latch:** When the control mode is set to "Latch", the relay will maintain its current activation state until it is switched to ON/OFF manually by the user.
  - **Momentary:** When the control mode is set to "Momentary", the relay will be switched

ON for a certain time period. The user can configure the time period from 50 to 3000 milliseconds (ms).

- **Alarm:** When configured as alarm, the relay will switch ON/OFF based on the alarm condition set in the Acuvim II meter. Users can configure a certain alarm to trigger the relay if its value is over/under a certain condition.
  - **Latch:** When the control mode is set to "Latch", the relay will maintain its current activation state until the linked alarm status is switched to ON/OFF.
  - **Manual:** When the control mode is set to "Manual," the alarm will be switched ON. It will remain ON until the user manually switches it from ON to OFF.

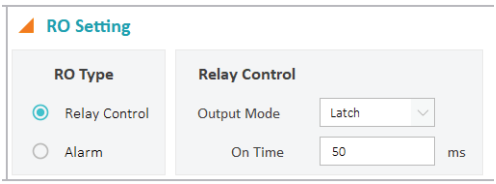


Figure 5-29 Relay Output Configuration from Acuview 2 Software

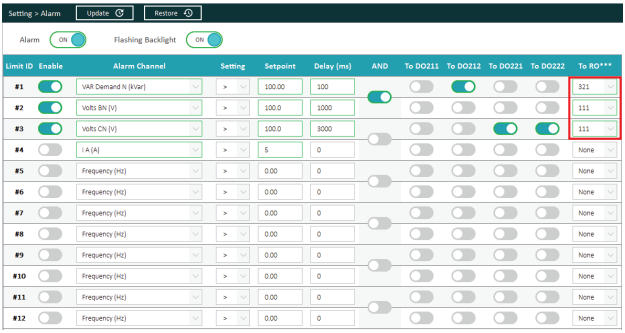


Figure 5-30 Alarm Relay Trigger Configuration from Acuview 2 Software.

To read the status of the relay output from the Acuview 2 software, click on either the ***I/O Modules 1 Reading*** or ***I/O Modules 2 Reading*** page under the ***Reading*** tab depending on the logic number of the I/O module being used. The relay status will read **ON** when the relay switch is closed and will read **OFF** when the relay switch is open.

If the relay is in Relay Control Mode, users can manually turn the relay ON/OFF from the Acuview 2

software by clicking on the ***Control*** button.

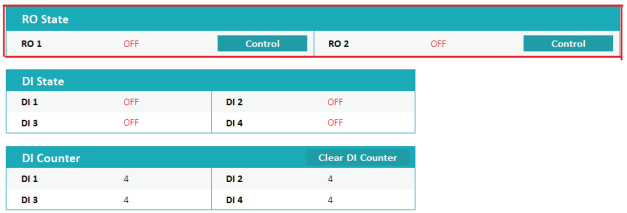


Figure 5-31 Relay Output Readings from Acuview 2 Software

5.1.8 Digital Output

The AXM-IO2 module supports the Digital Output and has two Digital Output channels that can be configured to either Alarm mode or Energy Pulse mode. The DO can be configured from the meter's display (refer to Chapter 3), from the Acuview 2 software, or from the Modbus registers (refer to Chapter 6).



Figure 5-32 Digital Output Configuration from Acuview 2 Software

- **Energy Pulse:** In energy pulse mode, the DO will send pulses based on the energy accumulation that the meter is measuring. When selected, users can configure DO 1 and 2 Output to one of the following:
  - **Ep_Imp:** Import Energy
  - **Ep_Exp:** Export Energy
  - **Eq_Imp:** Import Reactive Energy
  - **Eq_Exp:** Export Reactive Energy
- **Pulse Width:** Users can configure the pulse width from 20 to 1000ms, and the default pulse width is 80ms.
- **Alarm:** When configured in alarm mode, the module will send a pulse signal whenever the alarm is triggered.

When the meter sends a pulse signal, a pulse icon will appear on the meter's display. This icon will

flash whenever a pulse signal is sent out from the digital output. Figure 5-33 shows where and how the pulse signal indicator is displayed.

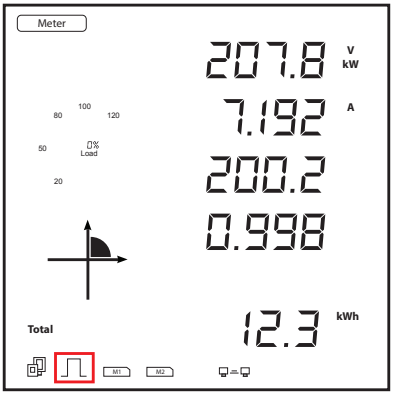


Figure 5-33 Pulse Signal Indicator on Meter's Display

Digital Output Pulse Constant Configuration

If the DO is configured for Energy Pulse Output mode, users will need to configure the pulse constant so that the meter will know how often to send a pulse signal out. To determine the correct pulse constant, users must know the rated current and rated voltage of their system. Below is an example on how to manually calculate the pulse constant.

Manual Pulse Constant Calculator:

The pulse constant must be configured for the meter to output the pulses accurately.

The following shows how to calculate the pulse constant manually:

- Determine how many pulses represent 1kWh, or how many kWh represents 1 pulse.

  Example 1 pulse = 1 kWh

- Multiply the PT ratio and CT ratio i.e., PT1/PT2 * CT1/CT2

  Example: PT ratio is 6600V/120V, and the CT ratio is 2000:5A.

$$\frac{6000}{120} \times \frac{2000}{5} = 22{,}000$$

NOTE: If no PTs are used, enter the default PT ratio of 400/400. If the CT2 output is 333mV, RCT, or 80/100/200mA, use 1 as the CT2 value.

- Divide 1kWh by 22,000, i.e., (1/22000) kWh
- This means 1 pulse = (1/22000) kWh; therefore 22000 pulses = 1 kWh

- Since we get 22000 pulse/kWh, 22000 is the pulse constant.

Once the pulse constant value has been calculated, users can configure the pulse constant setting from the setting menu in the meter's display (refer to Chapter 3), via Modbus registers (refer to Chapter 6), or Acuview 2 software.

In the Acuview 2 software, users can configure the pulse constant by clicking on the ***General*** page under the ***Setting*** tab. Users can configure the pulse constant for either real energy (Pulse/kWh) or reactive energy (Pulse/varh).

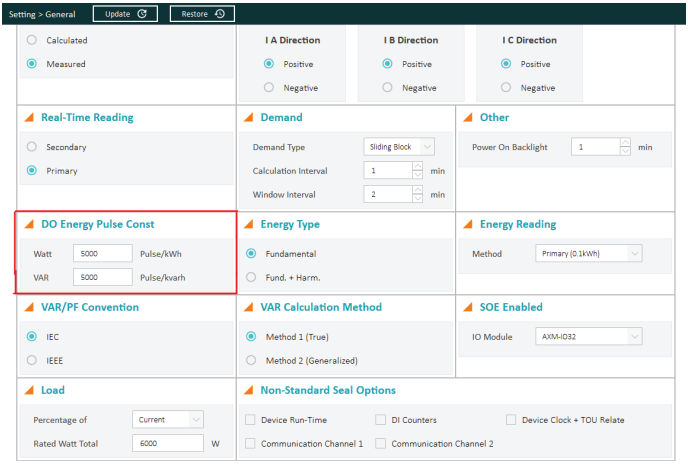


Figure 5-34 DO Energy Pulse Constant Configuration from Acuview 2 Software

Pulse Constant Configuration using Pulse Calculator:

When accessing the meter using the Acuview 2 software, there is a pulse constant calculator tool that can be used to determine the correct pulse constant. Click on the ***Operation*** menu and select ***Calculate Pulse Constant.***

- Under the **PT and CT Ratios** section of the page, enter PT1 and PT2 which represent the rated input and output of the Potential Transformer (PT) that is being used with the meter. If PTs are not being used, leave these settings as default of 400 for both PT1 and PT2.
- Enter the CT1 and CT2 values which represent the rated input and output of the Current Transformer (CT) being used with the meter.
- Enter the value of the **Primary Maximum Power** by performing the following calculation: **3*(PT1*CT1)/1000**
- Next, enter the desired pulse width and minimum interval for the energy pulse. The range

for the pulse width is 20 to 1000ms.

- Once all values are entered, click on ***Calculate***
- The calculator will return the Maximum/Minimum values for the number of pulses as well as how much one pulse will represent with the configured PT/CT ratios and Primary Maximum Power.
- In the ***'Primary: 1 Pulse ='***, enter the amount of energy (kWh) required to represent 1 pulse, then the pulse constant will be displayed in the ***'Secondary: 1 kWh(kvarh) ='*** section of the window.
- Once the pulse constant is determined, it will need to be configured in the general settings. In Figure 5-35, the pulse constant that is entered into the meter is 100.

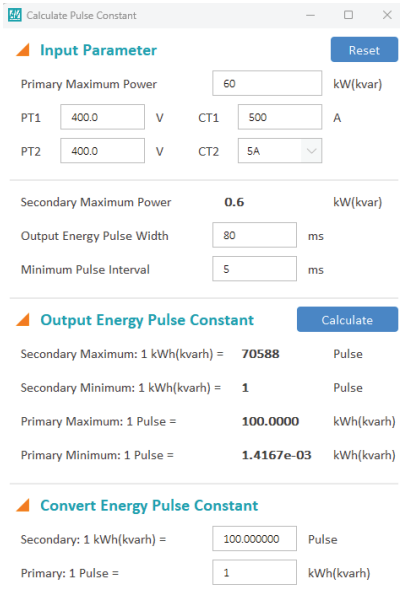


Figure 5-35 Pulse Constant Calculator from Acuview 2 Software

Advanced Pulse Constant

Starting from Acuvim II V3 v6.20 or later, the **Advanced Pulse Constant** function enables users to configure energy pulses with a high resolution of 0.001 pulse/kWh or the energy of active power and 0.001 pulse/kvarh for the energy of reactive power.

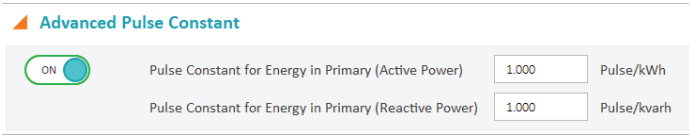


Figure 5-36 Pulse Constant Calculator from Acuview 2 Software

Users have the capability to set a float pulse constant within the range of 0.001 to 800.000 pulses for both accumulated active power and accumulated reactive power.

This function calculates **primary** energy with the **CT** and **PT** ratios. Once this function is enabled, the basic pulse constant setting will be by passed.

5.1.9 Analog Output

The analog output is supported in the AXM-IO2 module where users can convert electrical parameters measured by the meter into an analog voltage (0-5V/1-5V) or current (0-20mA/4-20mA).

Viewing the Digital status from the Meter's Display:

- Press ***H*** and ***V/A*** at the same time. The screen will go blank, and Meter will be flashing.
- Press the ***P*** or ***E*** key to move the flashing cursor over to **Digital I/O** and press ***V/A*** to enter.
- Next, users will see the I/O selection screen. Select the appropriate I/O module and press ***V/A***.
- With the cursor on ***AO,*** press ***V/A*** to view the Analog Output readings.

NOTE: Refer to Chapter 3, section 3.7.4, on how to configure the AO from the meter's display.

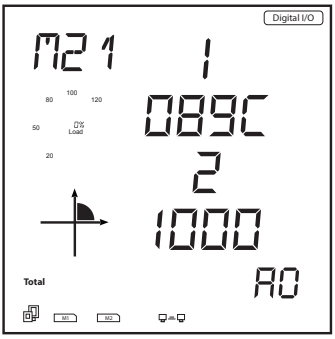


Figure 5-37 Analog Output Readings from the Meter's Display

The values on the meter's display are in hex. The following equations will allow users to convert the displayed value to the corresponding current or voltage value. For example, using the equations below, the value of 089C (0-20mA) for AO1 converts to 10.76mA or 2.69V, and the value of 1000 (0-20mA) for AO2 converts to 20mA or 5V.

If Analog Input ranges from 0-20mA:

$$Real\,Value = \frac{Displayed\ value}{4096} \times 20mA$$

If Analog Input ranges from 4-20mA:

$$Real\,Value = 4mA + \frac{Displayed\ value}{4096} \times 16mA$$

If Analog Input ranges from 0-5V:

$$Real\,Value = \frac{Displayed\ value}{4096} \times 5V$$

If Analog Input ranges from 1-5V:

$$Real\,Value = 1V + \frac{Displayed\ value}{4096} \times 4V$$

Figure 5-38 Analog Output Conversion Equations

How to view and configure the Analog Output from the Acuview 2 software:

The Analog Output settings can be configured from the Acuview 2 software on the ***I/O Modules 1*** or ***I/O Modules 2*** page under the ***Setting*** tab depending on the logic number of the I/O module being used. There are two AO channels that can be configured under the ***Raw Channel of AO*** section.

- **AO1/AO2:** Can be set to any of the parameters in Table 5-3
- **AO Type:** Can be set to 0-20mA/4-20mA (mA model) or 0-5V/1-5V (V model)

NOTE: The Setting Value in Table 5-3 refers to the value configured when setting the analog output from the meter's display.

Table 5-3 Analog Output Parameters

Setting Value	Parameter
0	Frequency
1	Phase A Voltage
2	Phase B Voltage
3	Phase C Voltage

Setting Value	Parameter
4	Average Line-Neutral Voltage
5	Line Voltage AB
6	Line Voltage BC
7	Line Voltage CA
8	Average Line-Line Voltage
9	Phase A Current
10	Phase B Current
11	Phase C Current
12	Average Current
13	Neutral Current
14	Phase A Power
15	Phase B Power
16	Phase C Power
17	Total System Power
18	Phase A Reactive Power
19	Phase B Reactive Power
20	Phase C Reactive Power
21	Total Reactive Power
22	Phase A Apparent Power
23	Phase B Apparent Power
24	Phase C Apparent Power
25	Total Apparent Power
26	Phase A Power Factor
27	Phase B Power Factor
28	Phase C Power Factor
29	Total Power Factor

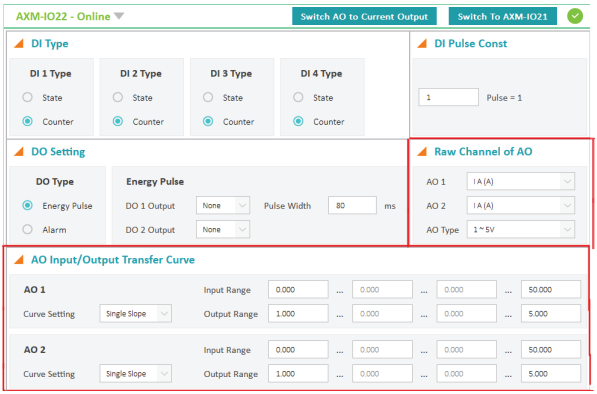


Figure 5-39 Analog Output Settings

In the ***AO Input/Output Transfer Curve*** section, users can configure the scaling of the Analog Output signal relative to the parameter selected.

- **Single Slope:** When Single Slope is selected, only the minimum (X1) and maximum (X4) values are required to be specified to represent the AO signal. For instance, in the case of a 4-20mA signal, the minimum value of the parameter will be 4mA (Y1) and the maximum will be 20mA (Y2).

- **Dual Slope:** When Dual Slope is selected, the minimum (X1), maximum (X4), and middle point (X2) values are required to be specified to represent the AO signal. For instance, in the case of a 4-20mA signal, the minimum value of the parameter will be 4mA (Y1), the middle point of the parameter will be 12mA (Y2) and the maximum will be 20mA (Y2).

- **Triple Slope:** When Triple Slope is selected, four points are required to be specified for both the input parameter and Analog Output. The four points should be configured in increasing order.

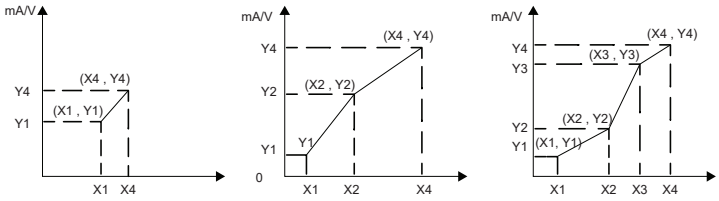


Figure 5-40 Relationship Between Analog Output and Electrical Parameters

Certain parameters have a range that can be configured for the AO.

- Frequency: 45Hz to 65Hz
- Phase Voltage: V1, V2, V3, and Vavg: 0 to 480V
- Line Voltage: V12, V23, V31, and Vavg: 0 to 831V
- Current: I1, I2, I3, and Iavg depend on the current input of the meter
  - 5A: 0 to (CT1*10)/CT2 A
  - 1A: 0 to (CT1*10)/CT2 A
  - 333mV/RCT/mA: 0 to CT1/(CT2/10) A
- Power Factor: -1.0 to 1.0
- Power: -(3*480*I) to (3*480*I), where "I" is the CT1 value
  - Phase Power: -480*I to 480*I, where "I" is the CT1 value

NOTE: The maximum value of the AO will be 1.2 times the range. For example, 6V for analog voltage and 24mA for analog current.

NOTE: When the wiring mode of the meter is 2LL or 3LL, the phase measurements for the voltage, active, reactive, apparent power, and power factor will be 0.

Reading the Analog Output from the Acuview 2 software:

To read the value of the Analog Output from the Acuview 2 software, click on either the I/O ***Modules 1 Reading*** or ***I/O Modules 2 Reading*** page under the ***Reading*** tab depending on the logic number of the I/O module being used.

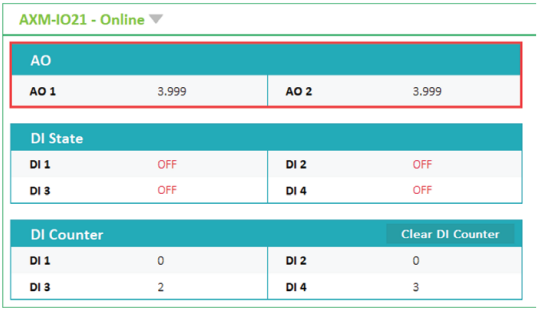


Figure 5-41 Analog Output Readings on the Acuview 2 Software

5.1.10 Analog Input

The AXM-IO3 module supports the Analog Input and has two Analog Input channels that can be configured to measure the input analog current (0-20mA/4-20mA) or voltage (0-5V/1-5V).

Viewing the Analog Input reading from the Meter's Display:

- Press ***H*** and ***V/A*** at the same time. The screen will go blank, and **Meter** will be flashing.
- Press the ***P*** or ***E*** key to move the flashing cursor over to **Digital I/O** and press V/A to enter.
- Next, users will see the I/O selection screen, select the appropriate I/O module and press ***V/A***.
- With the cursor on ***AI***, press ***V/A*** to view the Analog Input readings.

NOTE: Refer to Chapter 3, section 3.7.4, on how to configure the AI from the meter's display.

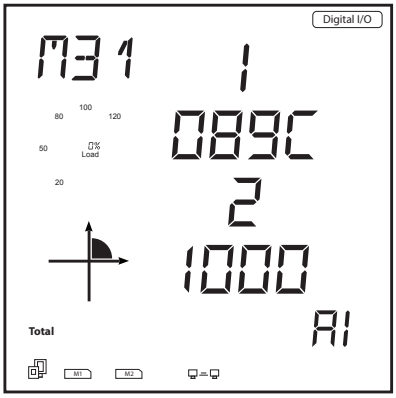


Figure 5-42 Analog Input Reading from the Meter's Display

The analog input value can be displayed from the meter's display as a hex number. The AI value ranges from 0 to 4095.

The figure below shows the relationship between the AI value and the input analog value. Similar to the analog output, the displayed analog input value can be converted to the corresponding current or voltage value using the following equations.

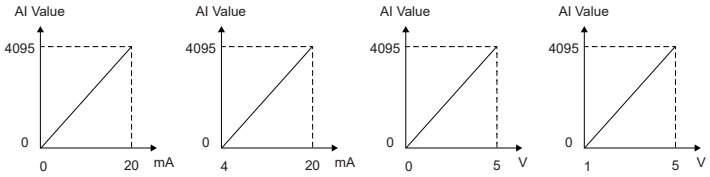


Figure 5-43 Relationship Between AI Calue and Input Analog Value

If Analog Input ranges from 0-20mA:

$$Real\,Value = \frac{Displayed\ value}{4096} \times 20mA$$

If Analog Input ranges from 4-20mA:

$$Real\,Value = 4mA + \frac{Displayed\ value}{4096} \times 16mA$$

If Analog Input ranges from 0-5V:

$$Real\,Value = \frac{Displayed\ value}{4096} \times 5V$$

If Analog Input ranges from 1-5V:

$$Real\,Value = 1V + \frac{Displayed\ value}{4096} \times 4V$$

Figure 5-44 Analog Input Conversion Equation

Viewing the Analog Input Reading from the Acuview 2 software:

The Analog Input settings can be configured from the Acuview 2 software on the ***I/O Modules 1*** or ***I/O Modules 2*** page under the ***Setting*** tab depending on the logic number of the I/O module being used. Users can configure the input signal type. For the current type (mA) module, the input can be configured as 0-20mA/4-20mA. For the voltage type (V) module, the input can be configured as 0-5V/1-5V.

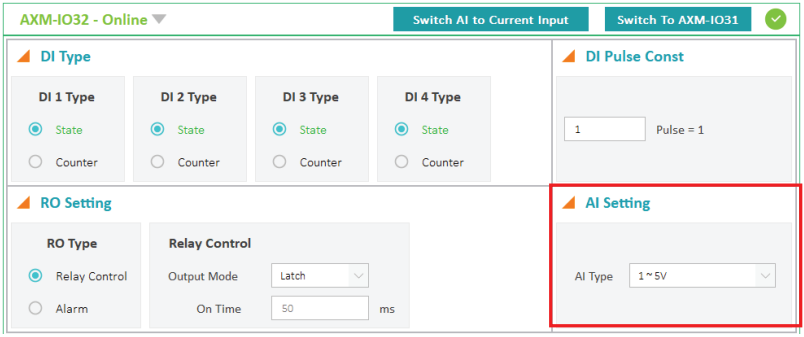


Figure 5-45 Analog Input Type Setting

Reading the Analog Input value from the Acuview 2 software:

Similar to the meter's display, the analog input value is read as a hex number and can be converted to the corresponding current or voltage signal.

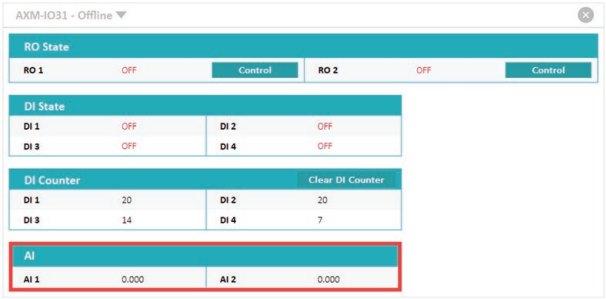


Figure 5-46 Analog Input Readings on the Acuview 2 Software

5.2 Profibus Module AXM-PROFI

5.2.1 Introduction of PROFIBUS Technology

Profibus (Process Field Bus) is an international field bus standard widely used in the automation technology of manufactures and the flow industry. It is a widely used, open digital communication system which is suitable for high-speed, time-critical, and high-reliability communications.

PROFIBUS is an open style field bus standard promoted by SIEMENS Corporation. It was initially established as the German standard DIN19245 in 1989, then it became European standard EN50170 in 1996. Subsequently, it was accepted as part of the international standard IEC 61158 in 1999, and in 2001, it was recognized as the Chinese national standard JB/T 10308.3-2001 for field bus of machinery industry controlling systems.

There are 3 types of PROFIBUS: PROFIBUS-DP (Decentralized Periphery), PROFIBUS-PA (Process Automation), and PROFIBUS (Field Bus Specification Message). All types follow the same protocol.

With optimized, high-speed, low-cost communication links, PROFIBUS-DP is especially used in automatic controlling systems and equipment-level decentralized I/O communication. It can fulfill the requirements for real-time response, stability, and reliability at both equipment and distributed control system levels.

The PROFIBUS module uses the PROFIBUS-DP(V0) protocol.

5.2.2 PROFIBUS Module Application Notes

Before using the AXM-PROFI, the users should read the PROFIBUS technical data and specifications. In addition, familiarity with the Modbus parameter addresses would be an asset.

The AXM-PROFI can only be used as a slave in the PROFIBUS network. The slave address can range from 0 to 126, which can only be set through the entrance. If the address is changed, it will take effect immediately.

The AXM-PROFI can operate with baud rates between 9600 to 12Mbps.

The AXM-PROFI terminals should be connected properly to avoid problems during installation.

Please read the GSD file of the PROFIBUS module carefully before using it. The GSD file contains technical information such as device name, ID number, and other important details.

*Please contact Technical Support (*support@accuenergy.com*) to obtain the GSD file.*

5.2.3 Appearance and Dimensions

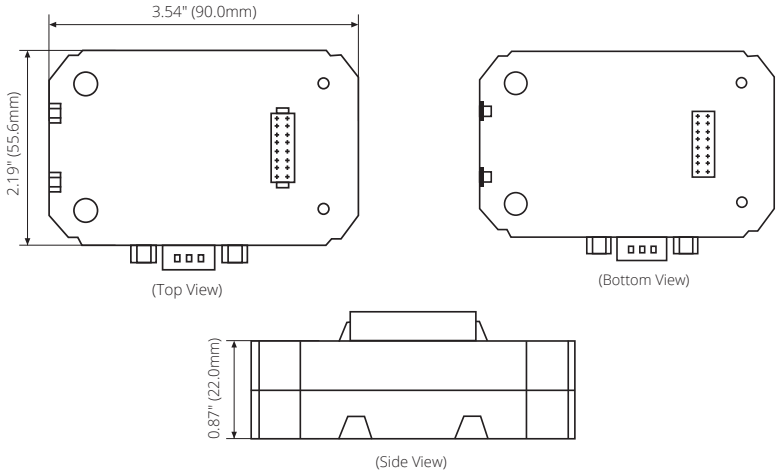


Figure 5-47 AXM-PROFI Dimensions

5.2.4 Installation Method



Figure 5-48 AXM-PROFI Installation to Acuvim II Meter

The AXM-PROFI module is linked to the Acuvim II series meter by a communication plug. Other extended modules, such as the I/O modules, can be linked to the Acuvim II series meter through the AXM-PROFI.

1. Insert the installation clips into the counterpart of the Acuvim II meter, and then press the AXM-PROFI module lightly to establish the linking.
2. Tighten the installation screws.

NOTE: Do not install any modules when power is applied to the meter.

5.2.5 Definition of DP Interface

The AXM-PROFI module uses a standard 9-pin, D-type connector to access the PROFIBUS network. The mechanical and electrical characteristics of the connector are consistent with the requirements of IEC 807-3. The PROFIBUS connector is a socket, and the counterpart connector of cable is a plug.

The connector pins are as followed:

Table 5-4 AXM-PROFI Connector Table

Pins	RS-485	ID	Content	Used by PROFIBUS
1	--	Shield	Power GND	NO
2	--	N24V	-24V output	NO
3	B	RXD/TXD-P	Data P (Receive/Send)	YES
4	--	CNTR-P	Controlling P	YES
5	C	DGND	Digital Ground	YES
6	--	Vp	Positive Voltage	YES
7	--	P24V	+24V output	NO
8	A	RXD/TXD-N	Data N (Receive/Send)	YES
9	--	CNTR-N	Controlling N	NO

NOTE: Pin 4 is used for RTS controlling and TTL, which is optional.

5.2.6 Cable

A shielded twisted pair cable is recommended as reference to the EIA RS-485 standard. If the interference is within the EIA RS-485 standard, then a non-shielded twisted pair cable may be used.

5.2.7 Bus Terminal

Based on the DP standard, the first station and the last station in the PROFIBUS-DP network should connect to the bus terminal (resistor) and it is not necessary for other stations, as shown in the figure below.

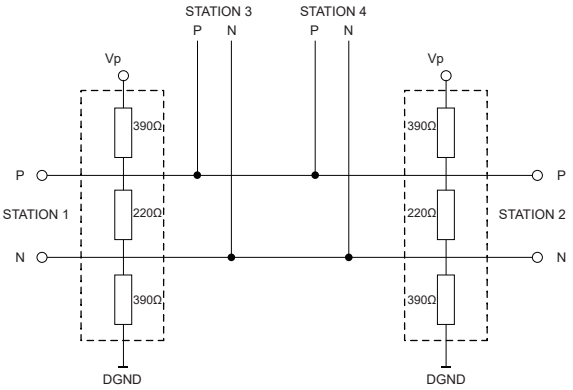


Figure 5-49 DP Station Connection Diagram

The bus terminal is composed of three resistors and a connection wire, where Vp is the supply positive voltage and DGND is the Digital Ground. When the bus is idle, the bus terminal makes the data P level higher than data N, so the bus's idle signal is always 1.

5.2.8 Address Setting

To enable Profibus communication, users need to first configure protocol 2 as PROFI. The figure below illustrates the configuration settings for protocol 2.

The figure below shows the configuration setting for the AXM-PROFI.

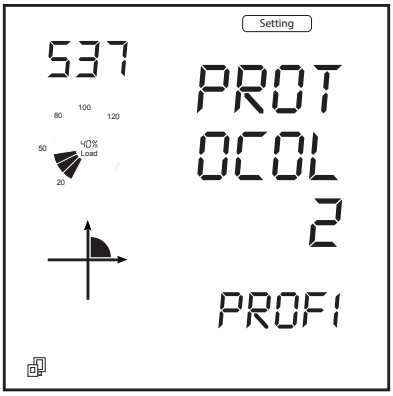


Figure 5-50 Protocol 2 Setting on Meter's Display

The AXM-PROFI module can only be used as a slave in the PROFIBUS network. Its slave address

ranges from 0 to 126, which can only be configured from the meter's display. If the address is changed, it will take effect immediately.

The figure below shows the configuration setting for the AXM-PROFI.

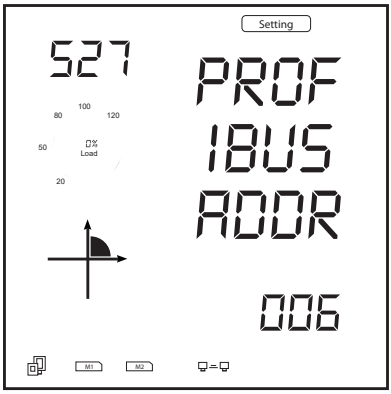


Figure 5-51 AXM-PROFI Address Setting on Meter's Display

5.2.9 Baud Rate

The AXM-PROFI supports baud rates from 9.6kbps to 12Mbps in the PROFIBUS network.

5.2.10 GSD Files

A PROFIBUS-DP Master can exchange data with various slave devices. To identify a slave device, it is not necessary to obtain the technical data of the device itself. The file where the data is described is called the Device Description Data File (GSD).

Because of the importance of the GSD file, please read it carefully before using the AXM-PROFI module. The GSD file is provided in pure text format with detailed comments.

- As a DP slave device, the AXM-PROFI module supports the protocol of V0 revision.
- The AXM-PROFI module data interface is optional. It supports module 1 and module 2. Module 1 is a 16-bit word input/output interface. Module 2 is a 32-bit input with 1 output interface.

5.2.11 Information Exchange

A variety of information from the Acuvim II meter can be transmitted by the AXM-PROFI module, such as electrical measurements and other parameters. The basic communication method of the Acuvim II series meter is RS-485, which uses the Modbus-RTU protocol. To use the same addresses as Modbus, the communication format of PROFIBUS-DP is 16-bit word input/output.

It is recommended to refer to the communication part of the Acuvim II manual (Chapter 6) for the list of Modbus addresses, function codes, the relationship between values, and other details.

Some examples are:

1. Various function codes, such as 01H, 02H, 04H, 05H, and 10H, are used for different categorized parameters. Each function code corresponds to distinct formats for both the query and response frames.
2. There are specific relationships between numerical values in the registers and the real physical value.
3. Different parameters may have different data lengths and data types.

These three points are also suitable for the PROFIBUS-DP protocol in the AXM-PROFI modules

Function codes, such as 01H, 02H, and 03H, are inquiry commands. To quickly switch the inquiry contents, 8 channels are defined ranging from 1 to 8.

5.2.12 Format of Function Code 01H

Function code 01H is used to configure the read relay status. The format of this function code is defined as follows:

Query:

Table 5-5 Function Code 01H Query Format

	Frame Bytes	Caption
1	Byte 1	Channels 1 to 8
2	Byte 2	01H
3	Byte 3	Starting Address high byte
4	Byte 4	Starting Address low byte
5	Byte 5	Quantity of coils high byte
6	Byte 6	Quantity of coils low byte
7	Byte 7-32	0

Here, 16-bit words are usually required for I/O data in GSD file so that all other bytes after Byte 7 are set to 0.

Response:

Below is the response of the slave device sending its information to the master device.

Table 5-6 Function 10 Response Format

	Frame Bytes	Caption
1	Byte 1	The channel of inquiry frame
2	Byte 2	01H

	Frame Bytes	Caption
3	Byte 3	byte count
4	Byte 4	coil status
5	Byte 5~32	0

In the response message, the coils are packed as one coil per bit in the data field. The status is indicated as follows: 1 represents ON and 0 represents OFF. The least significant bit (LSB) of the first data byte contains the output addressed in the query. The rest of the coils continue towards the high-order end within this byte and proceed from the low-order to the high-order in subsequent bytes.

Example: reading Relay1 and Relay2 status (start register address is 0000H). Use 4 channels.

Query:

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7~32
04H	01H	00H	00H	00H	02H	00H

Response:

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7~32
04H	01H	01H	02H	00H	00H	00H

Coil Status:

7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0

MSB LSB

(Relay 1 = OFF, Relay 2=ON)

5.2.13 Format of Function Code 05H

The message with function code (05H) in MODBUS-RTU serves to activate or deactivate a single relay. The data value FF00H will set the relay ON, and the value 0000H will switch the relay OFF. Any other values are invalid and will not affect the status of the relay. In PROFIBUS-DP, the format of function code 05H is defined as follows:

Query:

Table 5-7 Function Code 05H Query Format

	Frame Bytes	Caption
1	Byte 1	FAH
2	Byte 2	05H
3	Byte 3	outputs address high byte
4	Byte 4	outputs address low byte

	Frame Bytes	Caption
5	Byte 5	outputs value high byte
6	Byte 6	outputs value low byte
7	Byte 7~32	0

NOTE: Because PROFIBUS-DP V0 exchanges information periodically, controlling information such as function code 05H should be used carefully.

Response:

The normal response to the command request is to re-transmit the message as received after the relay status has been altered.

Table 5-8 Function Code 05H Response Format

	Frame Bytes	Caption
1	Byte 1	FAH
2	Byte 2	05H
3	Byte 3	outputs address high byte
4	Byte 4	outputs address low byte
5	Byte 5	outputs value high byte
6	Byte 6	outputs value low byte
7	Byte 7~32	0

Example: setting Relay2 on.

Query:

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7~32
FAH	05H	00H	01H	FFH	00H	00H

Response:

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7~32
FAH	05H	00H	01H	FFH	00H	00H

5.2.14 Format of Function Code 02H

Function code 02H is used to read DI status in MODBUS-RTU. In PROFIBUS-DP, the format of function code 02H is defined as follows:

Query:

Table 5-9 Function Code 02H Query Format

	Frame Bytes	Caption
1	Byte 1	Channels can be chosen from 1 to 8
2	Byte 2	02H

	Frame Bytes	Caption
3	Byte 3	starting address high byte
4	Byte 4	starting address low byte
5	Byte 5	quantity of digital inputs high byte
6	Byte 6	quantity of digital inputs low byte
7	Byte 7~32	0

Response:

Table 5-10 Function Code 02H Response Format

	Frame Bytes	Caption
1	Byte 1	The channel of inquiry frame
2	Byte 2	02H
3	Byte 3	byte count
4	Byte 4	inputs status1
5	Byte 5	inputs status2 (or 0)
6	Byte 6	inputs status3 (or 0)
7	Byte 7	inputs status4 (or 0)
8	Byte 8~32	0

In the response message, the digital inputs are packed as one input per bit in the data field. The status is indicated as follows: 1 represents ON and 0 represents OFF. The least significant bit (LSB) of the first data byte contains the input addressed in the query. The rest of the inputs continue toward the high-order end within this byte and proceed from the low order to the high order in subsequent bytes.

Example: reading four DI statuses (starting address is 0000H). Use six channels.

Query:

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7~32
06H	02H	00H	00H	00H	04H	00H

Response:

Byte1	Byte2	Byte3	Byte4	Byte5~32
06H	02H	01H	06H	00H

DI Status:

7	6	5	4	3	2	1	0
0	0	0	0	0	1	1	0

MSB LSB

(DI1 = OFF, DI2=ON, DI3 = ON, DI4 = OFF)

5.2.15 Format of Function Code 03H

This function code 03H is used in MODBUS-RTU to read the contents of a contiguous block of holding registers in the Acuvim II meter. In PROFIBUS-DP, the format of function code 03H is defined as follows:

Query:

Table 5-11 Function Code 03H Query Format

	Frame Bytes	Caption
1	Byte 1	Channels can be chosen from 1 to 8
2	Byte 2	03H
3	Byte 3	starting address high byte
4	Byte 4	starting address low byte
5	Byte 5	quantity of registers high byte
6	Byte 6	quantity of registers low byte
7	Byte 7~32	0

"Quantity of registers" identifies how many words will be read.

Response:

Table 5-12 Function Code 03H Response Format

	Frame Bytes	Caption
1	Byte 1	The channel of inquiry frame
2	Byte 2	03H
3	Byte 3	byte count
4	Byte 4	Register value1 high byte
5	Byte 5	Register value1 low byte
6	Byte 6	.....
7	Byte 7~32	.....

"Byte count" identifies how many bytes will be read.

In the response message, the register data is packed as two bytes per register, with the binary contents properly aligned with each byte. For each register, the first byte contains the high-order bits, and the second contains the low-order bits.

NOTE: The response has a 16-word frame, so the maximum "quantity of registers" should be less than 15. Otherwise, it will return an error result.

Example: Reading three measured data (F, V1, V2) from Acuvim II meter.

The data address of F includes 4000H and 4001H. The data address of V1 includes 4002H and

4003H. The data address of V2 includes 4004H and 4005H. (Uses 7 channels)

Query:

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7~32
07H	03H	40H	00H	00H	06H	00H

Response:

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
07H	03H	0CH	42H	48H	00H	00H	42H

Byte9	Byte10	Byte11	Byte12	Byte13	Byte14	Byte15	Byte16~32
C7H	CCH	CDH	42H	C8H	33H	33H	00H

(F=42480000H(50.00Hz), V1=42C7CCCDH(99.9v), V2=42C83333H(100.1v)).

NOTE: The relationship between the numerical value in the register of the meter and the actual physical value is described in Chapter 6.

5.2.16 Format of Function Code 10H

Function code 10H is used in MODBUS-RTU to write a block of continuous registers in the Acuvim II meter, such as system parameters setting and so on. In PROFIBUS-DP, the format of function code 10H is defined as follows:

Query:

Table 5-13 Function Code 10H Query Format

	Frame Bytes	Caption
1	Byte 1	FAH
2	Byte 2	10H
3	Byte 3	starting address high byte
4	Byte 4	starting address low byte
5	Byte 5	quantity of registers high byte
6	Byte 6	quantity of registers low byte
7	Byte 7	byte count
8	Byte 8	register value 1 high byte
9	Byte 9	register value 1 low byte
10	Byte 10	register value 2 high byte
11	Byte 11	register value 2 low byte
12	.....	.....
13	Byte 32	0

"Quantity of registers" indicates how many words will be written.

"Byte count" indicates how many bytes will be written. If the "quantity of register" is N, then "byte count" is (N×2).

NOTE: The response has a 16-word frame, so the maximum "quantity of registers" should be less than 13. Otherwise, it will return an error result.

Response:

The normal Response returns the function code, starting address, and quantity of registers written.

Table 5-14 Function Code 10H Response Format

	Frame Bytes	Caption
1	Byte 1	FAH
2	Byte 2	10H
3	Byte 3	starting address high byte
4	Byte 4	starting address low byte
5	Byte 5	quantity of registers high byte
6	Byte 6	quantity of registers low byte
7	Byte 7~32	0

Example: Preset the import active energy (EP_imp) to 17807783.3 KWh. Based on the relationship between the register value and the physical value, we can get the register value in hex as 0A9D4089H. The data address of EP_imp includes 4048H and 4049H.

Query:

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10	Byte11	Byte12~32
FAH	10H	40H	48H	00H	02H	04H	0AH	9DH	40H	89H	00H

Response:

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7~32
FAH	10H	40H	48H	00H	02H	00H

Example Projects

To facilitate your understanding of the PROFIBUS module, we have developed a PLC-based DEMO engineering application program. Please read DEMO procedure documentation for specific information. This DEMO is available upon request, please call Technical Support.

5.2.17 32 Word Output Interface

The 32-word output interface is a fixed parameter.

Transmission format is as follows:

Ua_rms(2 bytes), Ub_rms(2 bytes), Uc_rms(2 bytes), Uavg_rms(2 bytes);

Uab_rms(2 bytes), Ubc_rms(2 bytes), Uca_rms(2 bytes), Ulag_rms(2 bytes);

Ia_rms(2 bytes), Ib_rms(2 bytes), Ic_rms(2 bytes), Iavg_rms(2 bytes);

Pa_rms(2 bytes), Pb_rms(2 bytes), Pc_rms(2 bytes), Pavg_rms(2 bytes);

Epa_imp(4 bytes), Epa_exp(4 bytes);

Epb_imp(4 bytes), Epb_exp(4 bytes);

Epc_imp(4 bytes), Epc_exp(4 bytes);

Ep_imp(4 bytes), Ep_exp(4 bytes);

5.3 RS485 Module (AXM-485)

5.3.1 Communication Parameters Setting

RS485, also known as EIA-485, is a telecommunications standard for binary serial communications between devices. RS485 is the most versatile communication standard in the standard series defined by the EIA, and it is a widely used communication interface in data acquisition and control applications where multiple nodes communicate with each other.

The RS485 signals are floating, and each signal is transmitted over a differential signal + line and a differential signal - line. The RS485 receiver compares the voltage difference between both lines, instead of the absolute voltage level on a signal line. To enhance communication performance, the differential signal + and differential signal - lines are twisted. The twisted pair adds immunity against noise. If high noise immunity is needed, the combination of twisting and shielding is often used. For example, shielded twisted pair or foiled twisted pair networking cables can be used in high-noise environments.

5.3.2 Function Description of RS485 module

The AXM-RS485 module uses RS485 serial communication and the Modbus-RTU protocol, just like the on-board RS485 port of the Acuvim II series meter. It provides a second RS485 port for serial communication, and it can work with the on-board RS485 serial communication simultaneously. The terminals of communication are generally A, B, and S, where A is for the differential signal +, B is for the differential signal -, and S is connected to the shield of the twisted pair cables.

- Up to 32 devices can be connected on an RS485 bus without repeaters.
- Use good quality shielded twisted pair cable, AWG22 (0.32mm^2) or higher.

- The overall length of the RS485 cable connecting all devices should not exceed 1200m (4000ft).
- Every A(+) should be connected to A(+), B(-) to B(-). Otherwise, it will influence the network or even damage the communication interface.
- When using a long communication cable to connect several devices, an anti-signal reflecting resistor (typical value 120Ω-300Ω/0.25W) is normally added to the end of the cable beside the last meter to prevent communication quality degradation.

5.3.3 Appearance and Dimensions

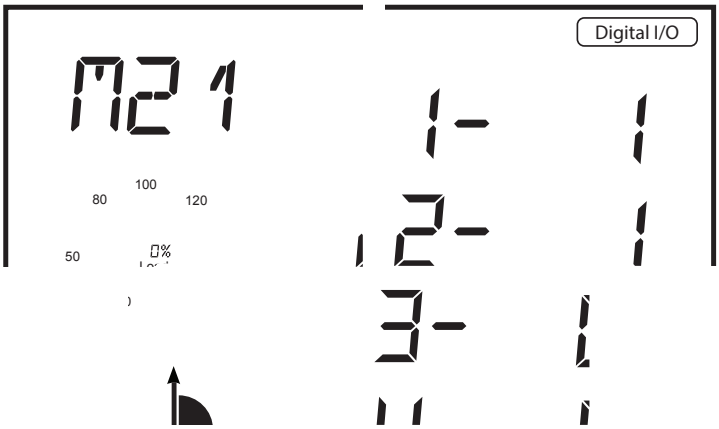


Figure 5-52 AXM-RS485 Dimensions

5.3.4 Installation Method



Figure 5-53 AXM-RS485 Installation to Acuvim II Meter

The RS485 module is linked to the meter by a communication plug. It also can be linked to other extended modules.

1. Insert the installation clips to the counterpart of the meter, and then press the RS485 module lightly to establish the linking.
2. Tighten the installation screws.

NOTE: Install AXM-RS485 Module carefully to avoid damage. Under no circumstances should any installation be done with the meter powered on. Failure to do so may result in injury or death.

5.3.5 Connection Method

The RS485 module uses 2-wire, half-duplex communication mode, which is the same as what the onboard RS485 port is using. If the master does not have an RS485 communication port, a converter (such as an RS232/RS485 or a USB/RS485 converter) will be required. Typical RS485 Network topologies include line, circle, and star. The shield of each segment of the RS485 cable must be connected to the ground at one end only.

The default baud rate of the RS485 module is 38400 bps. Users can change the baud rate in system settings S03 of the Acuvim II series meter.

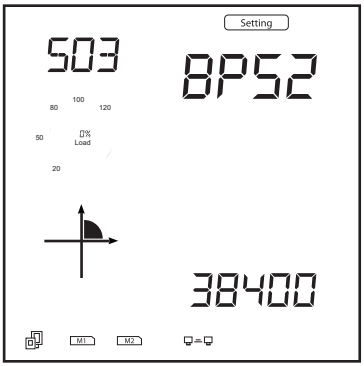


Figure 5-54 Baud Rate Setting for the AXM-RS485 Module

The data format is **start bit + 8n data bit + parity + stop bit.** NON1, NON2, odd and even can be selected for parity mode on S31 of Setting page of Acuvim II meter.

- **NON1:** represents non-parity, single stop bit
- **NON2:** represents non-parity, double stop bit
- **Odd:** represents odd-parity, single stop bit
- **Even:** represents even parity, single stop bit.

The default setting for the parity is NON1.



Figure 5-55 Parity Setting for the AXM-RS485 Module

NOTE: If AXM-WEB/AXM-WEB2 is used, the RS-485 module's parity (PAR2) must be set as None1 so that the meter will recognize the communication module.

5.3.6 Communication Address

The communication address used for the AXM-RS485 module would be located on page S36.

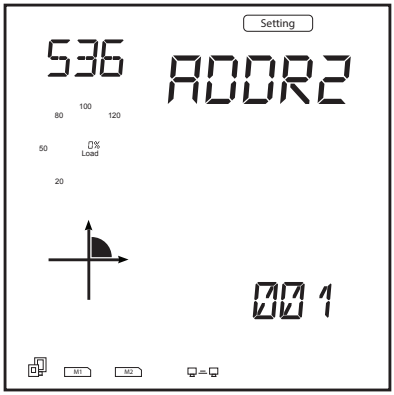


Figure 5-56 Address Setting for AXM-RS485

Chapter 6: Communication

This chapter will mainly discuss how the Acuvim II meter communicates using the Modbus protocol. It is highly recommended to read the previous chapters before proceeding to Chapter 6. Familiarity with Modbus would also be helpful.

6.1 Modbus Protocol Introduction

Modbus RTU is the communication protocol used in Acuvim II series meters. Data format and error check methods are defined in the Modbus protocol. The half-duplex query and respond mode is adopted in the Modbus protocol. There is only one master device in the communication network. The others are slave devices, waiting for the query of the master.

Transmission Mode

The mode of transmission defines the data structure within a frame and the rules used to transmit data. The mode is defined in the following which is compatible with Modbus RTU mode.

Framing

Table 6-1 Data Framing

Address	Function	Data	Check
8-Bits	8-Bits	Nx8-Bits	16-Bits

Coding System	8-Bit Binary
Start Bit	1
Data Bits	8
Parity	No parity, odd parity, even parity
Stop Bit	1 or 2
Error Checking	CC check

Address Field

The address field of a message frame contains eight bits. Valid slave device addresses are within the decimal range of 0 to 247. In the communication, 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 allow the master to identify which slave is responding.

Function Field

The function code field of a message frame contains eight bits. Valid codes are within decimal the range of 1 to 255. When a message is sent from a master to a slave device, the function code field informs the slave the type of action to perform.

Table 6-2 Function Code Transmission

Code	Meaning	Action
01	Read Relay Output Status	Obtain current status of Relay Output
02	Read Digital Input (DI) Status	Obtain current status of Digital Input
03	Read Data	Obtain current binary value from one or more registers
05	Control Relay Output	Force relay state to "ON" or "OFF"
16	Press Multiple-Register	Place specific binary values into a series of consecutive Multiple-Registers

Data Field

The data field is constructed using sets of two hexadecimal digits, in the range of 00 to FF. The data field of messages sent from a master to slave devices contains additional information which the slave must use to take the action defined by the function code. This can include items such as register addresses, the quantity of items to be handled, and the count of actual data bytes presented in the field. For example, if the master writes to a group of registers in the slave (function code 10 hexadecimal), the data field specifies the starting register, how many registers to write, the count of data bytes to follow in the data field, and the data to be written into the registers.

If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken. The data field can be nonexistent (when the length is zero) in certain types of messages.

Error Check Field

Every message incorporates an error checking field based on the Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method that is used for the individual characters of the message. The CRC field is two bytes long, containing a 16-bit binary value. The CRC value is calculated by the transmitting device and is appended to the message. The receiving device recalculates the CRC value during reception of the message and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error will be reported. CRC calculation begins initializing the 16-bit register to 1's. The process involves sequentially applying 8-bit bytes of the message to

the current register contents. Only the eight bits of data in each character are used for the CRC generation; Please note that start and stop bits and the parity bit do not apply to the CRC. When generating the CRC, each 8-bit character is exclusive "ORed" with the register contents. The result is shifted towards the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined, and if the LSB equals to 1, the register is exclusive "ORed" with a preset fixed value; if the LSB equals to 0, no action will be taken. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte is exclusive ORed with the register's current value, and the process repeats for eight more shifts as the process described above. After all the bytes of the message have been applied, the final contents of the register, which should exchange the high-byte and the low-byte, is the CRC value. When the CRC is appended to the message, the low-order byte is appended first, followed by the high-order byte.

6.2 Communication Format

Table 6-3 Explanation of Frame

Address	Function	Data start register HI	Data start register LO	Number of data start registers HI	Number of data start registers LO	CRC 16 HI	CRC 16 LO
06H	03H	00H	00H	00H	21H	84H	65H

1. Reading Relay Status

Function Code 01

This function code is used to read the status of the relay in the meter.

1=On, 0=Off, Relay1's address is 0000H,

Relay2's address is 0001H and so on.

The following query is to read the relay status for the meter with communication address 17.

Query

Table 6-4 Read the Status of Relay1 and Relay2 Query Message

Address	Function	Data start register HI	Data start register LO	Number of data start registers HI	Number of data start registers LO	CRC 16 HI	CRC 16 LO
11H	01H	00H	00H	00H	02H	BFH	SBH

Response

The Acuvim II series meter response includes the meter address, function code, quantity of data

byte, the data, and error checking. An example response for reading the status of Relay1 and Relay2 is shown as Table 6-5. The status of Relay1 and Relay2 are responding to the last 2 bits of the data.

Relay1: bit0, Relay2: bit1

Table 6-5 Relay Status Response

Address	Function	Byte Count	Data	CRC 16 HI	CRC 16 LO
11H	01H	01H	02H	D4H	89H

The content of the data is:

7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0

MSB **LSB**

Relay1 = OFF (LSB), Relay2 = ON (Left to LSB)

2. Read Status of DI

Function Code 02 1=ON, 0=OFF

DI's address is 0000H, D12's address is 0001H, and so on.

The following query is to read the status of 4 DI's of Acuvim II series meter with communication address 17.

Query:

Table 6-6 Read the Status of Relay1 and Relay2 Query Message

Address	Function	Data start register HI	Data start register LO	Number of data start registers HI	Number of data start registers LO	CRC 16 HI	CRC 16 LO
11H	02H	00H	00H	00H	04H	7BH	59H

Response

The Acuvim II series meter response includes the meter address, function code, quantity of data characters, the actual data characters, and error checking. An example response of reading the status of 4 DIs is shown in Table 6-7 below. The DI status corresponds to the last 4 bits of the data.

DI1: bit0; DI2: bit1; DI3: bit2; DI4: bit3

Table 6-7 Relay Status Response

DI1: bit0		DI2: bit1		DI3: bit2		DI4: bit3
Transaction Identifier HI	Transaction Identifier LO	Protocol Identifier Hi	Protocol Identifier LO	Length HI	Length LO	Unit Identifier
11H	02H	00H	00H	00H	04H	7BH

Function	Byte Count	Data
02H	01H	0FH

The content of the data is:

7	6	5	4	3	2	1	0
0	0	0	0	1	1	1	1

MSB **LSB**

3. Read Data (Function Code 03)

Query

This function allows the master to obtain the measurement results from the Acuvim II series meter. Table 6-8 is an example of reading the measured data (F, V1 and V2) from slave device number 17. The data address of F is 4000H; V1's address is 4002H, 4003 and V2's address is 4004H, 4005H.

Table 6-8 Read F, V1, V2 Query Message

Address	Function	Data start register HI	Data start register LO	Number of data start registers HI	Number of data start registers LO	CRC 16 HI	CRC 16 LO
11H	03H	40H	00H	00H	06H	D2H	98H

Response

The Acuvim II series meter response includes the meter address, function code, quantity of data bytes, data, and error checking. An example response of reading F, V1 and V2 (F=42480000H (50.00Hz), V1=42C7CCCDH (99.9V), V2=42C83333H (100.1V)) is shown in Table 6-9 below:

Table 6-9 Read F, V1 and V2 Message

Address	Function	Byte Count	Data1 HI	Data1 LO	Data2 HI	Data2 LO	Data3 HI	Data3 LO	Data4 HI	Data4 LO
11H	3H	0CH	42H	48H	00H	00H	42H	C7H	CCH	CDH

Data5 HI	Data5 LO	Data6 HI	Data6 LO	Data16 HI	Data16 LO
42H	C8H	33H	33H	CAH	7FH

4. Control Relay (Function Code 05)

Query

This message is designed to activate or deactivate a relay. It is capable of switching any relay within the Acuvim II series meter to either "ON" or "OFF" states. The data value FF00H can be used to set the relay to the "ON" state, and the value 0000H can be used to switch the relay to "OFF" state. Any other values will be considered invalid and will have no impact on the relay's status.

The example below is a request to the Acuvim II series meter with the address of 17 to turn on Relay1.

Table 6-10 Control Relay Query Message

Address	Function	DO Address HI	DO Address LO	Value HI	Value LO	CRC 16 HI	CRC 16 LO
11H	05H	00H	00H	FFH	00H	8EH	AAH

Response

The normal response to the command request is to re-transmit the message as received after the relay status has been altered.

Table 6-11 Control Relay Response Message

Address	Function	Relay Address HI	Relay Address LO	Value HI	Value LO	CRC 16 HI	CRC 16 LO
11H	05H	00H	00H	FFH	00H	8EH	AAH

5. Preset/Reset Multi-Register (Function Code 16)

Query

Function code 16 allows the user to modify the contents of a multi-register. Some registers of Acuvim II series meter can have their contents changed by this message. The example below is a request to an Acuvim II series meter with the address of 17 to preset Ep_imp as "17807783.3kWh", while its corresponding hexadecimal value being 0A9D4089H. Ep_imp data address is 4048H and 4049H.

Table 6-12 Preset Multi-Registers Query Message

Address	Function	Data start register HI	Data start register LO	Number of data start registers HI	Number of data start registers LO	Byte Count
11H	10H	40H	48H	00H	02H	04H

Value	Value LO	Value LO	Value LO	CRC HI	CRC LO
0AH	9DH	40H	89H	F1H	6AH

Response

The normal response to a preset multi-register request includes the Acuvim II series meter address, function code, data start register, the number of registers, and error checking.

Table 6-13 Preset Multi-Register Response Message

Address	Function	Data start register HI	Data start register LO	Number of data start registers HI	Number of data start registers LO	CRC 16 HI	CRC 16 LO
11H	10H	40H	48H	00H	02H	D6H	8EH

6.3 Data Address Table and Application Details

There are several rules to follow in using the meter:

6.3.1 Data Type

- "word" represents a 16-bit unsigned integer, using one data address and occupying 2 bytes of memory. Its range spans from 0 to 65535.
- "int" represents a 16-bit integer, using one data address and occupying 2 bytes of memory. Its range spans from -32768 to 32767.
- "dword" represents a 32-bit unsigned integer, using two data addresses and occupying 4 bytes of memory. This is organized with the high word at the front and the low word at the end. Its range spans from 0 to 4294967295. The value is calculated as Rx = high word*65536 + low word.
- "float" represents a 32-bit single value, using two data addresses and occupying 4 bytes of memory. Its range spans from -1.175494E-38 to 3.402823E+38.

6.3.2 Relationship between communication value and numerical value.

It is important to note that the numerical value may not be the same as the communication value. The following table shows how they respond to each other.

- When current output CTs are selected, the value of CT2 is 1A or 5A. When using the relationship of parameters listed in Table 6-14 to determine primary value, the value of CT2 used for the calculation should be the original 1 or 5.
- In situations where CT has a voltage output and the value of CT2 is 333mV, when using the relationship of parameters listed in Table 6-14 to determine primary value, the value of CT2 used for the calculation should be 1 instead of 333.

- When using Rogowski Coil CTs (output 100mV/50Hz or 120mV/60Hz), the value of CT2 is 100. When using the relationship of parameters listed in Table 6-14 to determine primary value, the value of CT2 should be 1 instead of 100.
- For 80/100/200 mA CT selections, the value of CT2 is 80, 100 or 200. When using the relationship of parameters listed in Table 6-14 to determine primary value, the value of CT2 should be 1.

Table 6-14 Relationship of Parameters

Parameters	Relationship	Unit	Format Code
System parameters	Numerical value equals to communication value	No unit	F1
Run-time	T=Rx/100	Hour	F2
Clock	Numerical value equals to communication value	Unit of time	F3
Energy (primary)	Ep=Rx/10	kWh	F4
Reactive energy (primary)	Ep=Rx/10	kvarh	F5
Apparent energy (primary)	Ep=Rx/10	kVA	F6
Energy (secondary)	Ep=Rx/1000	kWh	F7
Reactive energy (secondary)	Ep=Rx/1000	kvarh	F8
Apparent energy (secondary)	Ep=Rx/1000	kVA	F9
Frequency	Ep=Rx/100	Hz	F10
Voltage	U=Rx×(PT1/PT2)/10	V	F11
Current, current demand	I=Rx×(CT1/CT2)/1000	A	F12
Power, demand	P=Rx×(PT1/PT2)×(CT1/CT2)	W	F13
Reactive power, demand	Q=Rx×(PT1/PT2)×(CT1/CT2)	Var	F14
Apparent power, demand	S=Rx×(PT1/PT2)×(CT1/CT2)	VA	F15
Power factor	PF=Rx/100	No unit	F16
Unbalance factor	Unbl=(Rx/1000)×100%	No unit	F17
THD	THD=(Rx/10000)×100%	No unit	F18
Harmonics	HDn=(Rx/10000)×100%	No unit	F19
Total odd HD	HDo=(Rx/10000)×100%	No unit	F20
Total even HD	HDe=(Rx/10000)×100%	No unit	F21
Crest factor	CF=Rx/1000	No unit	F22
K factor	KF=Rx/10	No unit	F23
THFF	THFF=(Rx/10000)×100%	No unit	F24
Phase angle	Phase angle=Rx/10	Degree	F25

IMPORTANT NOTE: Regions from “System parameters settings” to “Data logging 3 settings” are the regions that can be set and modified. Please follow these guidelines when communicating with the meter.

1. When using function code 10H, it is important to note that a single communication command is capable of modifying contents within only one region. These regions include “System parameters settings”, “System status parameter”, “Date and time registers”, “Over/under limit alarming - Global settings”, “Over/under limit alarming - settings”, I/O Modules settings”, “Data logging 1 settings”, “Data logging 2 settings”, and “Data logging 3 settings”. It is important to note that the modification of contents in multiple regions cannot be achieved within a single communication order.
2. When using function code 03H, the rules and limitations described above will not be applied.

6.3.3 Modbus Register Map

For the latest Modbus register map, please visit the **Product Support Documents** page on the Accuenergy website.

https://www.accuenergy.com/support/product-support-documents/.

6.4 BACnet Protocol

6.4.1 BACnet Overview and Introduction

Developed for Building Automation and Control Networks, BACnet is a standard communication protocol (ANSI/ASHRAE Standard 135-1995). The BACnet protocol can be found throughout commercial and industrial buildings because it supports communication and control of systems within a facility such as HVAC, lighting, and fire detection. The protocol was developed to allow devices from a range of manufacturers to interoperate.

The BACnet protocol consists of Objects that contain different kinds of information and defines five groups (or classes) of 35 message types. Each Object has properties that contain data related to it. For example, one class contains messages for retrieving and manipulating object properties such as the common service request "ReadProperty." When the server machine receives this message from a client machine, it locates the requested property of the requested object and sends the value to the client.

Below is the example of an Object for Total Watts:

Object_Name, P_rms

Object_Type, AnalogValue

Object_Instance, 17

Present_Value, watt, tot (value in watts)

For additional information on the BACnet protocol, visit www.bacnet.org.

6.4.2 BACnet Protocol on the Acuvim II Power Meter Series

The Acuvim II Series Power Meter supports the BACnet communication protocol using BACnet MS/TP (Serial) and BACnet IP (Ethernet). BACnet MS/TP communication is supported via RS485, and BACnet IP communication requires the installation of an AXM-WEB2 Module to the meter.

The Acuvim II Series Power Meter's BACnet protocol supports 71 predefined BACnet objects that allow the users to track up to 71 measurements.

Table 6-82 BACnet MS/TP Characteristics

Network Type	Serial RS485 with a Master/Slave Token Passing protocol
Topology	Line topology
Installation	Any cable with at least 3 conductors can be used. Distance between nodes depends on baud rate.
Speed (Baud)	9600 bits/s, 19200 bits/s, 38400 bits/s,57600 bits/s, 76800 bits/s ,115200 bits/s
Max Station	127 MS/TP masters
Data	Up to 480 bytes per telegram frame

Table 6-83 BACnet IP Characteristics

Network Type	Ethernet based network using UDP for data transfer
Topology	Line or star topology (Standard Ethernet topology)
Installation	Ethernet twisted pair cables with RJ45 connectors
Speed (Baud)	10/100 Mbit/s full duplex
Max Station	No network limitation of number of nodes
Data	Up to 1476 bytes per frame

6.4.3 BACnet MS/TP Communication

The BACnet MS/TP module uses a standard RS485 connector to access the network.

Table 6-84 Communications Terminal: A, B, S

Terminal Name	Name	Description
A	Data+	Positive RS485 RxD/TxD
B	Data-	Negative RS485 RxD/TxD
S	Shield	Cable Shield

The Acuvim II Series meter supports two protocols: BACnet MS/TP and Modbus RTU. By default, the meter is configured to Modbus RTU communication.



During normal meter operation, caution should be used when handling the following as high voltage may be present:

- Terminal Blocks
- Current/Potential Transformer leads and the related circuits.
- All primary and secondary circuits may contain lethal current and voltage
- Contact with current channels must be avoided.

The meter can be connected to the BACnet network through RS485 interface. Users can configure BACnet settings by following steps below:

1. Press **H** and **V/A** keys simultaneously for about one second and release, the screen will go blank, and the cursor will be flashing. Press either **P** or **E** to move the flashing cursor over to **Setting** and press **V/A** to enter the meter settings. Enter the password for the meter and press **V/A** to enter the Parameter Setting page. Press either **P** or **E** to move the cursor over to **SYS,** and press **V/A** to enter the System Parameter Settings page.

Please refer to Chapter 3 for details on how to use the meter's display.

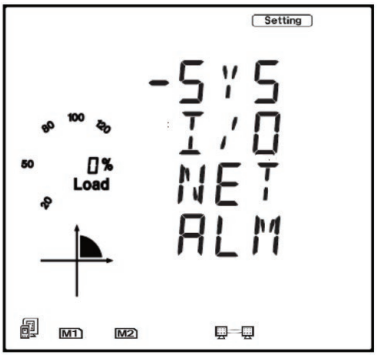


Figure 6-1 Parameter Setting Page

2. Set the BACnet meter address in page ***S01.*** After setting the address, press ***V/A*** to accept.

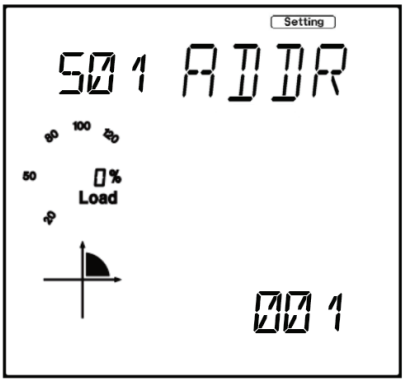


Figure 6-2 System Parameter Setting - S01 Address

3. Set Baud Rate in page ***S02.*** The default setting is 19200, and the meter can support the Baud Rate ranges from 2400 to 115200. After setting the BACnet MS/TP Baud Rate, press ***V/A*** to accept.

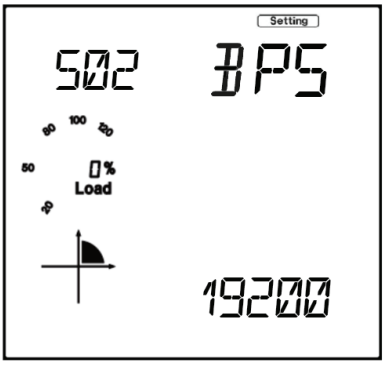


Figure 6-3 System Parameter Setting - S02 Baud Rate

4. Set Protocol 1 to ***BACNET*** in page ***S38,*** and press ***V/A*** to accept.

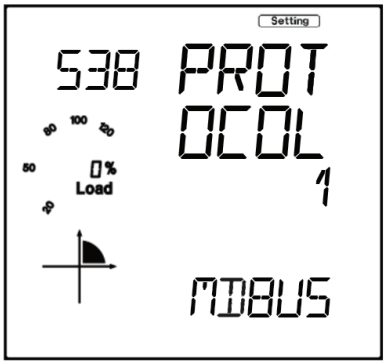


Figure 6-4 System Parameter Setting – S38 Protocol 1

5. Set MS/TP Max Info Frames in page ***S51.*** The BACnet MS/ TP Max Info Frames default value is 10, and the user defined range of Max Info Frames is 1 to 255. After setting the MS/TP Max Info Frames, press ***V/A*** to accept.

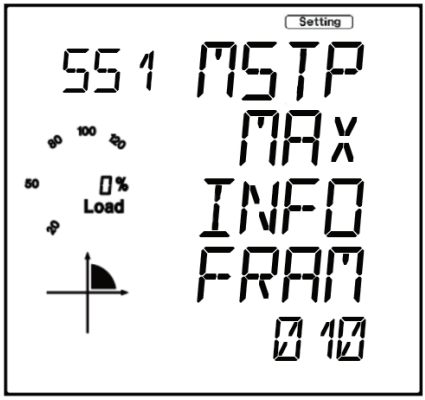


Figure 6-5 System Parameter Setting – S51 MS/TP Max Info Frames

6. Set MS/TP BACnet device ID in page ***S52.*** Set a unique device ID and press ***V/A*** to accept.

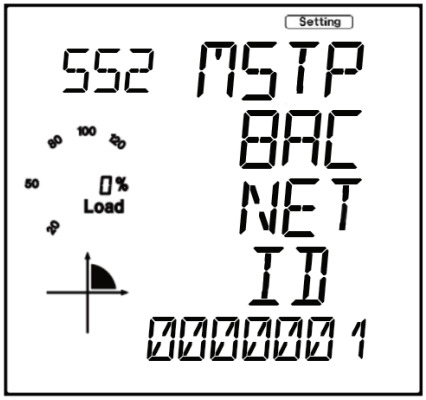


Figure 6-6 System Parameter Setting – S52 MS/TP BACnet ID

NOTE: *Starting from version 6.20, the Acuvim IIV3 -M (DIN-Rail meter without HMI display) type meter communication channel 1 will be exclusively set to Modbus with a fixed baud rate of 9600. This configuration will persist for 60 seconds after each power cycle. All the configuration setting changes will also only take effect after 60 seconds but will be saved immediately. This time limit delay is intentionally designed to provide users an opportunity for situations where the meter may have been incorrectly configured to BACnet. Users can leverage this 60-second window after a power cycle to regain access via Acuview software to rectify the configuration, especially when the external HMI is unavailable.*

6.4.4 BACnet IP Communication

To configure the BACnet IP Communication settings, use the built-in web server included with the AXM-WEB2 module installed to the meter. Ensure the network settings related to the BACnet IP Communication are configured correctly so it can be accessed by a computer within the Local Area Network.

Users can follow the steps below to configure BACnet settings:

1. Open an Internet browser and enter the IP address of the meter.
2. Login with ***Admin*** Access.
3. Click on ***Settings*** located at the top of the window and select ***Communications***.

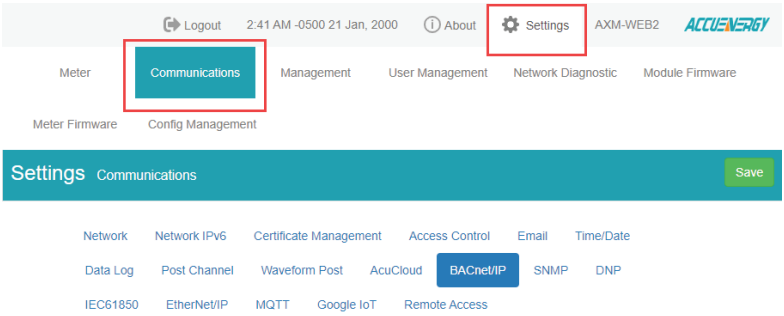


Figure 6-7 Communication Settings

4. Select **BACnet/IP** tab to configure the settings related to BACnet IP protocol.

5. Under **BACnet Enable,** select **Enable** to enable the BACnet protocol.

6. Enter the **BACnet Port** number, the default value is 47808.

7. Enter the **Device Instance** for the device. The instance number of the device must be unique within the BACnet system.

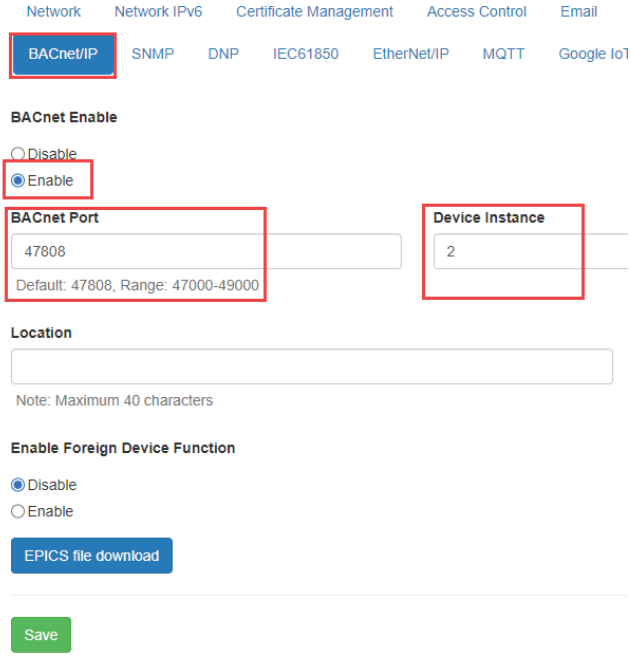


Figure 6-8 BACnet/IP Settings

***NOTE:** To communicate with a BACnet device from other subnet, users can Enable Foreign Device Function and enter BBMD IP, BBMD Port, and Time to Live.*

After Configuring the settings, click on **Save** and reboot the device for the settings to take effect.

6.4.5 Acuvim II Series Power Meter's BACnet Objects

The Acuvim II Series Power Meter supports 71 pre-defined BACnet objects based on the meter's real-time measurement parameters. There is no programming or mapping necessary to use this list of BACnet objects. The object's name easily identifies the type of measurement.

The following objects have the object type as Analog Inputs. The table below lists each of the objects with the instance number and the unit of measurement.

Table 6-85 BACnet Objects

Instance	Object Type	Name	Object Data Type	Units
1	Object Analog Input	Frequency	Float	Hertz (Hz)
2	Object Analog Input	Phase A Voltage	Float	Volts (V)
3	Object Analog Input	Phase B Voltage	Float	Volts (V)
4	Object Analog Input	Phase C Voltage	Float	Volts (V)
5	Object Analog Input	Average Phase Voltage	Float	Volts (V)
6	Object Analog Input	Line Voltage AB	Float	Volts (V)
7	Object Analog Input	Line Voltage BC	Float	Volts (V)
8	Object Analog Input	Line Voltage CA	Float	Volts (V)
9	Object Analog Input	Average Line Voltage	Float	Volts (V)
10	Object Analog Input	Phase A Current	Float	Amperes (A)
11	Object Analog Input	Phase B Current	Float	Amperes (A)
12	Object Analog Input	Phase C Current	Float	Amperes (A)
13	Object Analog Input	Average Current	Float	Amperes (A)
14	Object Analog Input	Neutral Current	Float	Amperes (A)
15	Object Analog Input	Phase A Active Power	Float	Kilowatts (kW)
16	Object Analog Input	Phase B Active Power	Float	Kilowatts (kW)

Instance	Object Type	Name	Object Data Type	Units
17	Object Analog Input	Phase C Active Power	Float	Kilowatts (kW)
18	Object Analog Input	Total Active Power	Float	Kilowatts (kW)
19	Object Analog Input	Phase A Reactive Power	Float	Kilovolt Amperes Reactive (kVAR)
20	Object Analog Input	Phase B Reactive Power	Float	Kilovolt Amperes Reactive (kVAR)
21	Object Analog Input	Phase C Reactive Power	Float	Kilovolt Amperes Reactive (kVAR)
22	Object Analog Input	Total Reactive Power	Float	Kilovolt Amperes Reactive (kVAR)
23	Object Analog Input	Phase A Apparent Power	Float	Kilovolt Amperes (kVA)
24	Object Analog Input	Phase B Apparent Power	Float	Kilovolt Amperes (kVA)
25	Object Analog Input	Phase C Apparent Power	Float	Kilovolt Amperes (kVA)
26	Object Analog Input	Total Apparent Power	Float	Kilovolt Amperes (kVA)
27	Object Analog Input	Phase A Power Factor	Float	-
28	Object Analog Input	Phase B Power Factor	Float	-
29	Object Analog Input	Phase C Power Factor	Float	-
30	Object Analog Input	Total Power Factor	Float	-
31	Object Analog Input	Voltage Unbalance Factor	Float	Percent
32	Object Analog Input	Current Unbalance Factor	Float	Percent
33	Object Analog Input	Load Type	Float	-
34	Object Analog Input	Active Power Demand	Float	Kilowatts (kW)
35	Object Analog Input	Reactive Power Demand	Float	Kilovolt Amperes Reactive (kVAR)
36	Object Analog Input	Apparent Power Demand	Float	Kilovolt Amperes (kVA)
37	Object Analog Input	Phase A Current Demand	Float	Amperes (A)
38	Object Analog Input	Phase B Current Demand	Float	Amperes (A)
39	Object Analog Input	Phase C Current Demand	Float	Amperes (A)
40	Object Analog Input	Import Active Energy	Float	Kilowatt Hours (kWh)
41	Object Analog Input	Export Active Energy	Float	Kilowatt Hours (kWh)
42	Object Analog Input	Import Reactive Energy	Float	Kilovolt Ampere Hours Reactive (kVARh)
43	Object Analog Input	Export Reactive Energy	Float	Kilovolt Ampere Hours Reactive (kVARh)
44	Object Analog Input	Energy Total	Float	Kilowatt Hours (kWh)
45	Object Analog Input	Energy Net	Float	Kilowatt Hours (kWh)

Instance	Object Type	Name	Object Data Type	Units
46	Object Analog Input	Reactive Energy Total	Float	Kilovolt Ampere Hours Reactive (kVARh)
47	Object Analog Input	Reactive Energy Net	Float	Kilovolt Ampere Hours Reactive (kVARh)
48	Object Analog Input	Apparent Energy	Float	Kilovolt Ampere Hours (kVAh)
49	Object Analog Input	Phase A Import Active Energy	Float	Kilowatt Hours (kWh)
50	Object Analog Input	Phase A Export Active Energy	Float	Kilowatt Hours (kWh)
51	Object Analog Input	Phase B Import Active Energy	Float	Kilowatt Hours (kWh)
52	Object Analog Input	Phase B Export Active Energy	Float	Kilowatt Hours (kWh)
53	Object Analog Input	Phase C Import Active Energy	Float	Kilowatt Hours (kWh)
54	Object Analog Input	Phase C Export Active Energy	Float	Kilowatt Hours (kWh)
55	Object Analog Input	Phase A Import Reactive Energy	Float	Kilovolt Ampere Hours Reactive (kVARh)
56	Object Analog Input	Phase A Export Reactive Energy	Float	Kilovolt Ampere Hours Reactive (kVARh)
57	Object Analog Input	Phase B Import Reactive Energy	Float	Kilovolt Ampere Hours Reactive (kVARh)
58	Object Analog Input	Phase B Export Reactive Energy	Float	Kilovolt Ampere Hours Reactive (kVARh)
59	Object Analog Input	Phase C Import Reactive Energy	Float	Kilovolt Ampere Hours Reactive (kVARh)
60	Object Analog Input	Phase C Export Reactive Energy	Float	Kilovolt Ampere Hours Reactive (kVARh)
61	Object Analog Input	Phase A Apparent Energy	Float	Kilovolt Ampere Hours (kVAh)
62	Object Analog Input	Phase B Apparent Energy	Float	Kilovolt Ampere Hours (kVAh)
63	Object Analog Input	Phase C Apparent Energy	Float	Kilovolt Ampere Hours (kVAh)
64	Object Analog Input	Phase A Voltage THD	Float	Percent
65	Object Analog Input	Phase B Voltage THD	Float	Percent
66	Object Analog Input	Phase C Voltage THD	Float	Percent
67	Object Analog Input	Average Voltage THD	Float	Percent
68	Object Analog Input	Phase A Current THD	Float	Percent
69	Object Analog Input	Phase B Current THD	Float	Percent
70	Object Analog Input	Phase C Current THD	Float	Percent
71	Object Analog Input	Average Current THD	Float	Percent

Appendix

Appendix A Technical Data and Specification

Input Ratings

CURRENT INPUTS *(EACH CHANNEL)*

Nominal Current Options	① 5A, ② 1A, ③ 333mV, ④ 100mV Rogowski Coil, ⑤ 80mA/100mA/200mA
Metering Range	① 0-10A, ② 0-2A, ③ 0-400mV, ④ 0-400mV, ⑤ 0-240mA
Pickup Current	① 5mA, ② 1mA, ③ 0.25mV, ④ 0.25mV, ⑤ 0.15mA
Withstand	20Arms Continuous, 0.1% of Nominal 100Arms for 1 Second, Non-Recurring
Burden	0.05VA (Typical) @ 5A RMS
Accuracy	0.1% at Reading

VOLTAGE INPUTS *(EACH CHANNEL)*

Nominal Full Scale	400Vac L-N, 690Vac L-L (+20%)
Withstand	1500Vac Continuous 2500Vac, 50/60Hz for 1 Minute
Input Impedance	2MΩ per Phase
Metering Frequency	45Hz~65Hz
Pickup Voltage	10Vac
Accuracy	0.1% at Reading

ENERGY ACCURACY

Active	Class 0.1s (According to IEC 62053-22) Class 0.1 (According to ANSI C12.20)
Reactive	Class 0.5S (According to IEC 62053-24)

HARMONIC RESOLUTION

Metered Value	63rd Harmonic

Metering

PARAMETERS		ACCURACY	RESOLUTION	RANGE
Voltage		0.1%	0.1V	10V~1000kV
Current		0.1%	0.1mA	5mA~50000A
Power		0.1%	1W	-9999MW~9999MW
Reactive Power		0.1%	1var	-9999Mvar~9999Mvar
Apparent Power		0.1%	1VA	0~9999MVA
Power Demand		0.1%	1W	-9999MW~9999MW
Reactive Power Demand		0.1%	1var	-9999Mvar~9999Mvar
Apparent Power Demand		0.1%	1VA	0~9999MVA
Power Factor		0.1%	0.001	-1.000~1.000
Frequency		0.001%	0.001Hz	45.00~65.00Hz
Energy	Primary 0.1	0.1%	0.1kWh	0-99999999.9kWh
	Primary 0.001	0.1%	0.001kWh	0-999999.999kWh
	Secondary	0.1%	0.001kWh	0-999999.999kWh
Reactive Energy	Primary 0.1	0.1%	0.1kvarh	0-99999999.9kvarh
	Primary 0.001	0.1%	0.001kvarh	0-999999.999kvarh
	Secondary	0.1%	0.001kvarh	0-999999.999kvarh
Apparent Energy	Primary 0.1	0.1%	0.1kVAh	0-99999999.9kVAh
	Primary 0.001	0.1%	0.001kVAh	0-999999.999kVAh
	Secondary	0.1%	0.001kVAh	0-999999.999kVaAh
Harmonics		1.0%	0.1%	
Phase Angle		2.0%	0.1°	0.0°~359.9°
Unbalance Factor		2.0%	0.1%	0.0%~100.0%
Running Time			0.01h	0~9999999.99h

I/O Options

DIGITAL INPUT	
Input Type	Dry
Input Resistance	100kΩ
Input Voltage Range	20~160 Vac/dc
Input Current (Max)	2mA
Start Voltage	15V

Stop Voltage	5V
Pulse Frequency (Max)	100Hz, 50% Duty Ratio (5ms ON and 5ms OFF)
SOE Resolution	2ms

DIGITAL OUTPUT *(DO) (PHOTO-MOS)*

Voltage Range	0~250Vac/dc
Load Current	100mA (Max)
Output Frequency	25Hz, 50% Duty Ratio (20ms ON, 20ms OFF)
Isolation Voltage	2500Vac

RELAY OUTPUT *(RO) (NO, Form A)*

Switching Voltage (Max)	250Vac, 30Vdc
Load Current	5A(R), 2A(L)
Set Time	10ms (Max)
Contact Resistance	30mΩ (Max)
Isolation Voltage	2500Vac
Mechanical Life	$1.5x10^7$

ANALOG OUTPUT *(AO)*

Output Range	0~5V, 0~20mA; 1~5V, 4~20mA; Optional
Accuracy	0.50%
Temperature Drift	50ppm/°C Typical
Isolation Voltage	500Vdc
Open Circuit Voltage	15V

ANALOG INPUT *(AI)*

Input Range	0~5V, 0~20mA; 1~5V, 4~20mA; Optional
Accuracy	0.20%
Temperature Drift	50ppm/°C Typical
Isolation Voltage	500Vdc

POWER SUPPLY FOR DI *(24 VDC)*

Output Voltage	24Vdc
Output Current	42mA
Load (Max)	21 DIs

Communications

Modbus-RTU or BACnet MS/TP	Modbus-RTU 2-Wire Shielded Twisted Pair Cable Connection 2400~115200 bps
RS485 PORT *(OPTIONAL MODULE)*	Same as the primary RS485 port Baud Rate: 4800~115200 bps
ETHERNET *(OPTIONAL MODULE)*	Ethernet 10M/100M BaseT MODBUS-TCP/IP DNP 3.0 V2 Over IP Level 2 IEC 61850 2nd Edition SNMP V3 BACnet-IP HTTP/HTTPs Webserver HTTP/HTTPs, FTP data post SMTP MQTT MV90 NTP PROFINET

Control Power

Universal	AC or DC

AC/DC CONTROL POWER

Operating Range	100~415Vac, 50/60Hz; 100~300Vdc
Burden	5W
Frequency	50/60Hz
Withstand	3250Vac, 50/60Hz for 1 minute
	Installation Category III (Distribution)

LOW VOLTAGE DC CONTROL POWER *(OPTIONAL)*

Operating Range	20~60Vdc
Burden	5W

Operating Environment

Operating Temperature	-25°C to 70°C -13°F to 158°F
Storage Temperature	-40°C to 85°C -40°F to 176°F
Relative humidity	5% to 95% Non-Condensing

Standard Compliance & Certifications	
Measurement Standard	IEC 62053-22; ANSI C12.20; IEC61557-12
Environmental Standard	IEC60068-2, CE, RoHS
Safety Standard	IEC61010-1, UL 61010-1
EMC Standard	IEC61000-4/-2-3-4-5-6-8-11, CISPR 22, IEC61000-3-2, IEC 61000-6-2/4
Outlines Standard	DIN43700, ANSI C39.1
Protocol Conformance	IEC61850 2nd Edition BTL Listed for B-SA (Acuvim II, IIR, IIW)

Appendix B Ordering Information

Meter Model	- Mounting Option	- Current Input	- Power Supply
Acuvim IIR: Data Logging, TOU	**D**: LCD Display *(Panel Mount Meter/ Transducer)*	**5A**: 5A/1A *(Input Field Selectable)*	**P1V3**: 100~415Vac, 50/60Hz, 100~300Vdc
Acuvim IIW: IIR + Waveform Capture and PQ Event Logging	**M**: DIN-Rail Mount Transducer without Display *(Optional Remote Display Available)*	**mV**: 333mV and Rogowski Coil *(Input Field Selectable)*	**P2V3**: 20~60Vdc
		mA: 80ma/100mA/200mA *(Input Field Selectable)*	
Ordering Example:	**Acuvim IIR-M-mV-P2V3**		
	Acuvim IIW-D-5A-P1V3		

Communication Module *(Optional)*	- Protocols	
AXM	**WEB2-FOLC:**	IEC 61850 2nd Edition, Modbus-TCP, HTTP/HTTPs Webserver, SMTP Email, SNMP, HTTP/HTTPs Push, FTP Post, sFTP Server, BACnet-IP, Datalogging, Wi-Fi, Fiber Optics LC, Ethernet Port, EtherNet/IP, MQTT, PROFINET

Note: 1. Accuenergy suggests using USB-RS485 converter for configuration, and 3 CTs per three phase circuits.
2. All fields must be completed to create a part number.
3. Add "-S" after power supply for anti-tampering seal option.

	WEB2:	IEC 61850 2nd Edition, Modbus-TCP, HTTP/HTTPs Webserver, SMTP Email, SNMP, HTTP/HTTPs Push, FTP Post, sFTP Server, BACnet-IP, Datalogging, Wi-Fi, Dual Ethernet Port, EtherNet/IP, MQTT, PROFINET
	WEB2-D:	IEC 61850 2nd Edition, Modbus-TCP, HTTP/HTTPs Webserver, SMTP Email, SNMP, HTTP/HTTPs Push, FTP Post, sFTP Server, BACnet-IP, Datalogging, Dual Ethernet Port, EtherNet/IP, MQTT, PROFINET
	WEB-PUSH:	Modbus-TCP, HTTP/HTTPs Webserver, SMTP Email, SNMP, HTTP/HTTPs Push, FTP Post, sFTP Server, Datalogging
	RS485:	Modbus -RTU
Ordering Example:		**AXM-WEB2-FOLC**
		AXM-RS485

I/O Module *(Optional)*	**- Logic Module**	**- Input/Output Type**
AXM-IO1	**1**	
	2	
Ordering Example:	**AXM-IO1-1**	
AXM-IO2	**1**	**A**: 4~20mA
AXM-IO3	**2**	**B**: 0~20mA
		C: 1~5V
		D: 0~5V
Ordering Example:	**AXM-IO3-1B**	

Accessories *(Optional)*	
REM-DS2:	Remote Display *(Only for Acuvim II DIN-Rail Mount "M" option)*
AXM-DIN:	DIN Rail Adapter
IP66/NEMA4X:	Environmental Protection Cover
USB-RS485:	USB-to-RS485 Converter
Ordering Example:	**AXM-DIN**

Note: 1. Refer to the Communication table and Digital/Analog I/O table on page 6 from the Acuvim II Datasheet.

2. A maximum of 3 modules may be attached to the meter. If a communication module is used (e.g. AXM-WEB2), it must be installed on the back FIRST before the other I/O modules are attached.

3. No more than 2 of the same I/O modules may be attached to the meter (e.g. two AXM-IO2). The same two I/O modules must have a different logic number.

4. If Acuvim IIW uses DI to trigger a waveform capture, the I/O module logic number must be Module 1.

ACCUENERGY

MAKE ENERGY USAGE SMARTER

ACCUENERGY INC.

440 Comstock Rd
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: November 2026