AcuDC-301 Series
EV Charging Meter
Users Manual

ACCUENERGY

Legal Notice

Please read this manual carefully before installation, operation, and maintenance of the AcuDC-301 series EV Charging meter.

The information contained in this document is believed to be accurate at the time of publication, however, Accuenergy assumes no responsibility for any errors which may appear here and reserves the right to make changes without prior notice as part of continuing improvements. Please ask the local representative for the latest product specifications before ordering.

Safety Notice

ELECTRIC SHOCK DANGER SAFETY WARNING

Please read this document carefully before the installation, operation, and maintenance of the AcuDC-301 meter.

If the equipment is used in a manner not specified by Accuenergy, the protection provided by the equipment may be impaired.

Prior to installation, maintenance or repair, the equipment must be de-energized and grounded. All maintenance work must be performed by a qualified professional who have received formal training and have experience with high voltage and current devices.

Accuenergy is not be responsible or liable for any damages or injuries caused by improper meter installation and/or operation.

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 serves as the designated disconnect device for this equipment.

A SWITCH OR CIRCUIT-BREAKER MUST BE INCLUDED IN THE INSTALLATION.

THE SWITCH MUST BE IN CLOSE PROXIMITY TO THE EQUIPMENT AND WITHIN EASY REACH OF THE OPERATOR. THE SWITCH SHALL BE MARKED AS THE DISCONNECTING DEVICE FOR THE EQUIPMENT.

Important Symbols

The following symbols can be found either in this document or on the AcuDC-301 meter.

	**ELECTRIC HAZARD:** Indicates information about procedures which must be followed to reduce the risk of electric shock and danger to personal health.
	**WARNING ALERT:** Indicates information about a hazardous circumstance which, if not considered, may result in severe injury or death.
	**Double Insulation:** Indicates the device is double insulated and does not require to be connected to an electrical earthing.
ALERT	Indicating the operation may lead to device malfunction or potential data loss.
NOTE	An advance notice to provide additional information before an action is taken by the user.

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Chapter 1: Introduction

1.1 AcuDC-301 Overview

The AcuDC-301 EV Charging meter is specially designed for integration with Electric Vehicle (EV) fast charging stations. With revenue-grade accuracy compliant with MID under EN 50470-4 Class C standards, along with cable loss compensation, the meter ensures precise measurement for billing purposes. The EV Charging meter is rated at 0.2% accuracy on current measurements and 0.1% accuracy for voltage measurements. The electronic seal function in AcuDC-301 secures data integrity and deters tampering making it an ideal solution for accurate energy metering in EV charging infrastructures.

1.2 Key Features

High Accuracy Measurement

AcuDC-301 is compliant with MID under EN 50470-4 Class C, delivering precise measurements for revenue-grade billing applications. Current is measured with the use of shunt sensor at an accuracy level of 0.2% between 3.9A to 650A, as well as direct connection for voltage measurements at 0.1% accuracy from 60V to 1000V, covering the entire range of operation for most DC fast charging stations.

Cable Loss Compensation

Resistance in the cable may lead to energy loss in the form of heat, especially for high-current DC fast chargers. The CLC can adjust for the loss when energy received by the EV is less than the energy produced. The AcuDC-301 cable loss compensation calculates the loss based on real-time current, voltage, and cable resistance to ensure accurate billing data.

Electronic Metrology Seal

The electronic seal function secures important settings configurations and data from unauthorized tampering.

Compact & Flexible

The AcuDC-301 meter is 125mm in length, 69mm in width, and 125mm in height, making it a compact device that can easily fit inside an EV charging station. The meter conforms to a standard 35mm DIN rail mount for a simplified installation process.

1.3 Function List

The AcuDC-301 provides powerful data collection and processing functions. In addition to measuring various standard basic parameters, the AcuDC-301 can perform advanced demand metering, max/min statistic recording, energy accumulation. A complete list of AcuDC-301 functions is shown in Table 1-1.

Table 1-1 AcuDC-301 Function List

Function		Parameter
Real-Time Measuring	Basic	Voltage Measured Voltage Compensated Voltage Current Power Ripple Factor U Ripple Factor I
Real-Time Energy	Energy	Import Energy Export Energy Net Energy Total Energy
	Charge	Import Charge Export Charge Net Charge Total Charge
Max/Min with Timestamps		Max Voltage, Min Voltage Max Current, Min Current Max Power, Min Power Max Ripple Factor U, Min Ripple Factor U Max Ripple Factor I, Min Ripple Factor I
Cable Loss Compensation		Cable loss can be compensated through resistor configuration.
Custom Read	Reading	Users may tailor the data output to meet specific requirements.
Transaction Log		Logs up to 61,440 charging session energy records and supports communicate in signed OCMF format.
Eich Log		Logs up to 6,000 records of metrological audit log records for traceability.
Time	Device Run-Time	Hours
	Device Load-Time	Hours
	Device Clock	Year-Month-Date Hours: Minutes: Seconds, Weekdays

Chapter 2: Hardware Installation

AcuDC-301 EV Charging Meter Safety Considerations Before Installation

The installation must be performed by a qualified professional who has received formal training and has experience with high voltage and current devices. Appropriate safety wear is mandatory to ensure safe installation.

Caution must be taken before working on voltage and current channels, including cables and terminal blocks.

Do not supply input voltage above the rated maximum limit of the meter and devices connected to it. Before energizing the meter, please refer to the meter's label and specifications.

Do not perform high voltage tests or insulation experiments to output, input, or communication terminals.

Use dry cloth to wipe the meter if necessary.

An unsuitable environment may affect the measurement accuracy, system function, cause hardware damage, or even lead to safety hazards.

Before installation, make sure the application meets the requirements from specification, including:

Power Supply	24V
Voltage Input	0-1000VDC
Current Input	0-650A
Transient Voltage	Overvoltage Category II
Altitude	0 to 2000m
Pollution	Degree 2
Operating & Storage Temperature Range	MID: –40°C to 70°C (–40°F to 158°F)
Relative Humidity Range	0% to 95%

2.1 Appearance and Dimensions

The AcuDC-301 has an LCD display located on the front and a DIN rail mounted on the rear. The following figures provide the front view and side view of AcuDC-301.

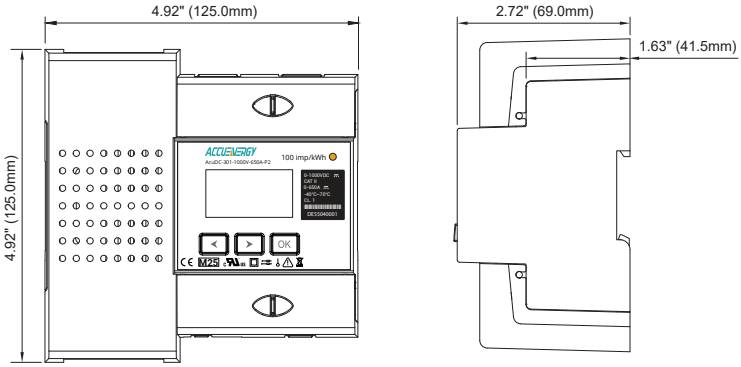


Figure 2-1 AcuDC-301 Front and Side View Diagram

The parts of the AcuDC-301 are listed in the table below and illustrated in Figure 2-2.

Table 2-1 AcuDC-301 Part Name and Description

Part Name	Description
1) Front Casing	Transparent front meter casing with accessible display and controls.
2) Pulse LED Indicator	LED light to indicate energy pulse signal.
3) Current Input Terminal	Built-in shunt used in direct connection.
4) Seal Switch	Enable and disable the seal status.
5) RS485 Terminal	Modbus RS485 communication port.
6) LCD Screen	Backlight screen.
7) Navigation Key	Three keys to navigate through the screen and configure settings.
8) Power Supply Terminal	Control power Input.
9) Voltage Input Terminal	Used for voltage input.
10) DIN Rail	Used on a 35mm DIN rail mount.
11) Ethernet Port	Single RJ45 Ethernet Connector.

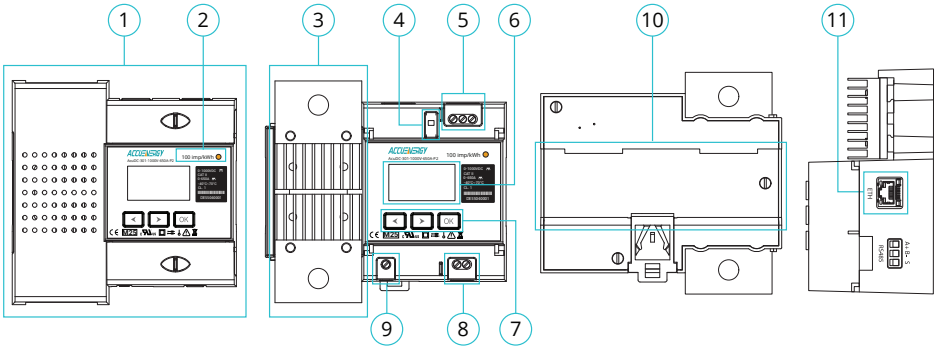


Figure 2-2 AcuDC-301 Part Identification Diagram

2.2 Din Rail Mount Installation

The following instructions describes steps to mount the AcuDC-301 meter onto a standard 35mm (1.38in) DIN rail.

Installation Steps

1. From the back of the AcuDC-301, simultaneously and carefully pull down the clip lock as shown in ① of Figure 2-3.
2. Position the AcuDC-301 so its back is facing the DIN rail. Place the AcuDC-301 two upper mounting brackets over the top of the DIN rail groove. Fit the AcuDC-301 onto the DIN rail as illustrated in ② of Figure 2-3.

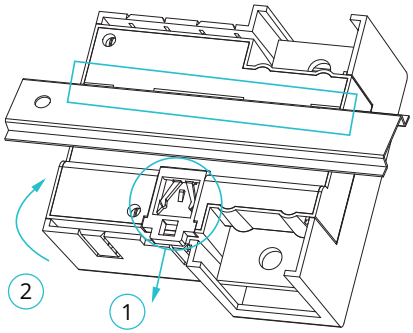


Figure 2-3 AcuDC-301 Installation on DIN Rail

3. Release the clip lock back up ③ to secure the AcuDC-301 onto the DIN rail, as illustrated in Figure 2-4.

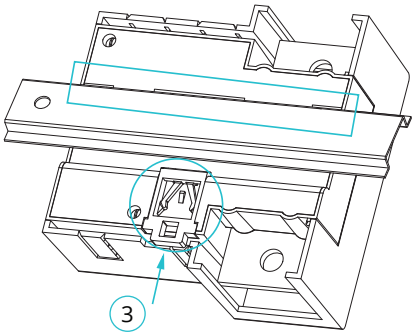


Figure 2-4 Insert Clip Lock to Secure the AcuDC-301

2.3 Wiring Configuration

2.3.1 Power Requirement

Connect the auxiliary power supply of 24VDC from the power adapter to the DC Power Port (+, -). Ensure that a 24V Class 1 power adapter is used for the meter. The maximum current consumption is 0.3A at 12VDC.

NOTE: The 24VDC power supply unit is sold separately. Accuenergy recommends using the AcuLink-RIK-PSU.

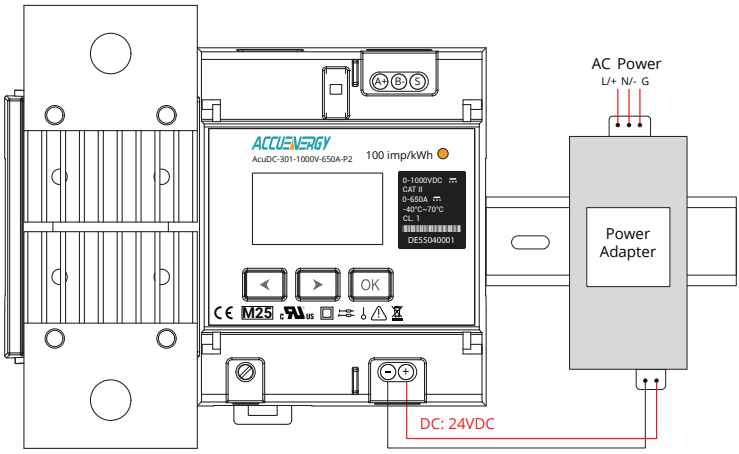


Figure 2-5 AcuDC-301 Power Supply Wiring

2.3.2 Voltage and Current Input Wiring

AcuDC-301 features a built-in shunt for direct DC current measurements up to 650A and voltage signals up to 1000VDC (OVC II).

A fuse (typically 1 A / 1500 VDC) should be used in the voltage input loop for protection.

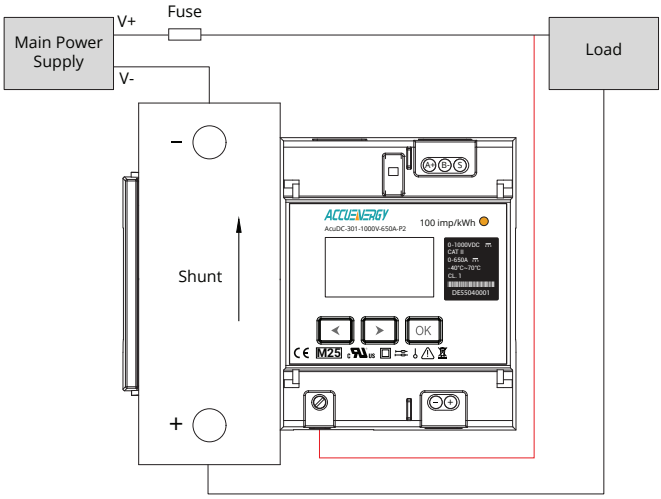


Figure 2-6 AcuDC-301 Voltage and Current Input Wiring

2.3.3 Communication

AcuDC-301 supports an integrated communication interface with RS485 using Modbus RTU and Ethernet connectivity.

2.3.3.1 RS485

AcuDC-301 supports serial RS485 communication via Modbus RTU. The terminals are denoted as A+, B- and S.

- A+ is the positive differential terminal.
- B- is the negative differential terminal.
- S is used for a shield connection.

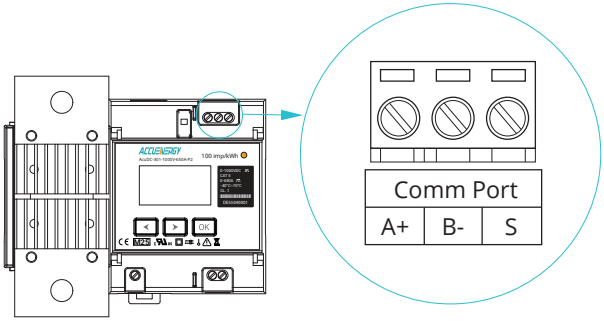


Figure 2-7 Communication Port

The maximum distance of the cable should not exceed 1200m. A shorter cable should be used if more devices are connected to the same communication link or when using a higher baud rate.

In instances where the master device is equipped with an RS232 port, an RS232-to-RS485 converter is required to connect to the AcuDC-301 RS485 interface.

To improve communication quality:

- A high-quality shielded twisted pair cable with a gauge of 22 AWG needs to be used.
- Pay attention to "single-point earthing". This means that there is only one side for the shield to be connected to the ground in a communication link.
- Topology with a "T" type connection should be avoided. No new branches except from the starting point.
- Keep communication cables away from sources of electrical noise to reduce interference.
- When several devices are connected in daisy chain to the same communication line, a termination resistor (typical value 120-300Ω, 0.25W) should be used at the end of the circuit (the last device of the chain) to end the communication line.

2.3.3.2 Ethernet

The AcuDC-301 includes a single RJ45 connector to physically access the Ethernet network. It is recommended to use a CAT 5 cable. The mechanical and electrical characteristics of the connector are consistent with the requirements of IEC 60603-7.

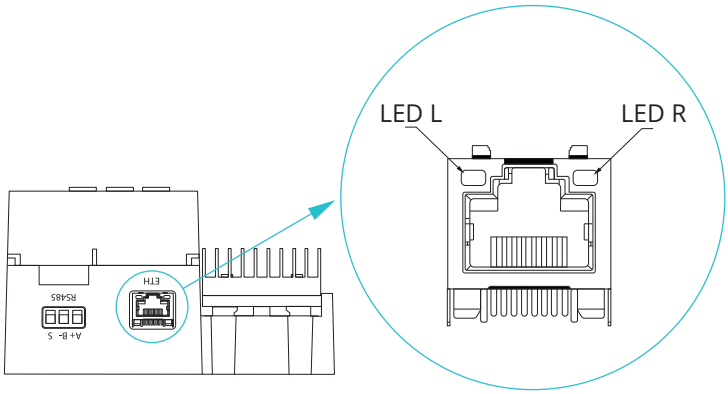


Figure 2-8 AcuDC-301 RJ45 Connector

Table 2-2 Ethernet Pin Index Chart

Pin number	Name	Description
1	TX+	Transmit Data +
2	TX-	Transmit Data -
3	RX+	Receive Data +
4	n/c	Not Connected
5	n/c	Not Connected
6	RX-	Receive Data -
7	n/c	Not Connected
8	n/c	Not Connected

LED_L (Yellow): Displays the speed status. When the LED is on, it indicates a transmission speed of 100Mpbs. When the LED is off, it represents a speed of 10Mbps.

LED_R (Green): Displays the link and activity status. When the LED is on, it indicates the Ethernet port is establishing a connection. A blinking LED indicates there is data transmission activity.

2.3.4 Wiring Recommendation

Use a 3 x 0.5mm (DIN 5264) screwdriver to connect and disconnect the wires. Copper wires with the following specifications shall be used for wiring:

Table 2-3 Wiring Specification Chart

Terminal Name	Functions	Terminal Type	Wire/Terminals/ Accessories Range	Terminal Cross Section	Screw Torque	Temperature Rating
+, -	DC Power Port	Plated Welding Type	22AWG ~ 18AWG	2.5mm²	0.5N.m	105°C
V+	Voltage Input Port	Plated Welding Type	16AWG ~ 14AWG	2.5mm²	0.5N.m	105°C
I+, I-	Current Input Wires	Stripped Wires with Terminal		Min. 380mm²	Users should ensure the shunt is connected.	105°C
	Terminal	Terminals of the Stripped Wires		Min: 1100mm² (Contacted Area)		
	Terminal Fitting	Screw and Gasket	Screw Diameter: 9.4 ~ 10.3mm The inner diameter of the gasket must be larger than 10.5mm & the outer diameter is larger than 30mm.			
RS485 A+, B-, S	RS485 Communication Port	Plated Welding Type	22AWG ~ 18AWG	2.5mm²	0.4N.m	105°C
ETH	Ethernet Communication Port	Standard 10/100 Mbit/s Cable			Not Defined	105°C

Chapter 3: Meter Display Screen & Parameter Settings

This chapter explains how to operate the AcuDC-301 to view real-time metering data and set parameters using the display screen and navigation keys.

3.1 Display Panel and Navigation Keys

The AcuDC-301 features an LCD screen and three navigation keys in the front. From left to right, they are the **Left** < , **Right** > , and **OK** OK keys.

Figure 3-1 AcuDC-301 Front View

3.1.1 Power-Up Sequence

Upon initial power-up, the device will sequentially display the company logo, model number, serial number, boot version, firmware version, checksum and public key to verify the system integrity which is followed by a screen self-test to ensure display is functioning properly. After the sequence, device enters Idle Display Mode, indicating successful initialization.

3.2 Display Modes

After completing the initialization, the AcuDC-301 enters the Idle Mode display. Pressing any key will switch the display to Normal Mode. There are three display modes as described below.

3.2.1 Idle Mode

Idle Mode can be seen after the successful initialization of the AcuDC-301 after it is powered up.

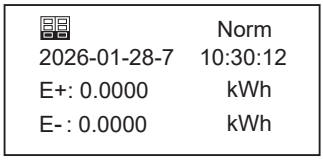


Figure 3-2 Idle Mode Display

The Idle Mode conveniently provides the E+ and E- which indicates the import energy and the export energy for quick assessment.

3.2.2 Normal Mode (HMI)

Pressing any key from the Idle Mode, the display switches to the Normal Mode Display.

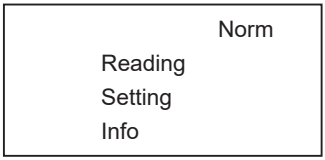


Figure 3-3 Normal Mode Display

In Normal Mode, measured parameters can be viewed in Reading, user configuration can be set up in Settings, and the device information can be accessed in Info. If no key is pressed for 30 seconds, the display will automatically return to Idle Mode.

3.2.3 Charging Mode

When the charging station sends a Start Charging command, the AcuDC-301 enters Charging Mode, and the LCD backlight turns on.

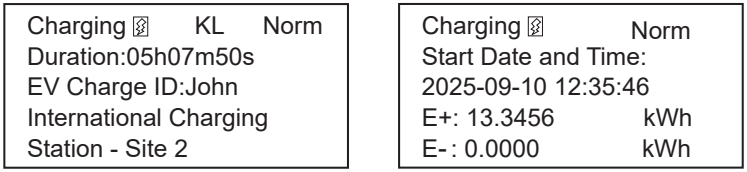


Figure 3-4 Charging Mode Display 1 and 2

During Charging Mode, the AcuDC-301 automatically alternates between the Display 1 and 2 while all keys are automatically disabled. When the charging station sends a Stop Charging command, the device automatically returns to Idle Mode, and the LCD backlight turns off.

NOTE: The status information of AcuDC-301 can be seen on the top section of the screen which provides an indication of system conditions as seen from the table below.

Status	Indication
Fatal Error	Visible only when AcuDC-301 has encountered a critical fault and is non-operational which requires immediate troubleshooting for proper operation.
KL	Displayed only if cable loss compensation state is active
Norm	Operation is under normal conditions
Asb	Operation is in Assembly or debugging mode
Prod	Operation is in Factory Production or testing mode

3.3 Reading Option in Normal Mode

In Normal Mode, real time parameters, user configuration and device can be accessed with the help of navigation keys within the Reading, Setting and Info options respectively as explained in the next section.

In Reading option, real time readings of the system are displayed of the system. For comprehensive information on real time parameters, please refer to chapter 5. Upon pressing OK key, real-time and calculated parameters can be seen in the subscreens as described below.

3.3.1 Voltage Subscreen

The voltage readings will be the first subscreen to appear upon entering the reading menu.

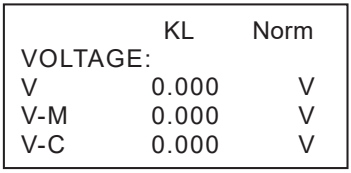


Figure 3-5 Real-Time Voltage Subscreen

The Voltage subscreen displays three parameters: real-time RMS voltage (V), voltage measured (V-M), and voltage compensated (V-C).

V-M and V-C will only be available when cable loss compensation is enabled. V-M is the voltage level measured by the meter without considering the cable losses. V-C is the voltage reading after applying the cable loss compensation algorithm.

3.3.2 Current Subscreen

To access the current readings from the Real-Time screen, press either the **Left** or **Right** key to navigate to the Current subscreen. To return to the previous screen press the **Left** and **Right** keys simultaneously.

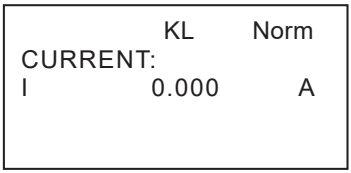


Figure 3-6 Current Subscreen

3.3.3 Power Subscreen

To access the power readings from the Real-Time screen, press either the **Left** or **Right** key to navigate to the Power subscreen. To return to the previous screen press the **Left** and **Right** keys simultaneously.

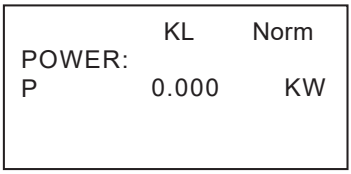


Figure 3-7 Power Subscreen

3.3.4 Import/Export Energy Subscreen

To access the import energy and export energy readings from the Real-Time screen, press either the **Left** or **Right** key to navigate to the Import/Export Energy subscreen. To return to the previous screen press the **Left** and **Right** keys simultaneously.

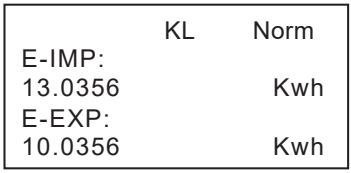


Figure 3-8 Import/Export Energy Subscreen

AcuDC-301 measures import (E-IMP) and export (E-EXP) energy, where import energy refers to the energy consumed (power flowing into the facility from the grid), and export energy refers to the energy generated (power flowing from the facility back to the grid).

3.3.5 Net/Total Energy Subscreen

To access the net energy and total energy readings from the Real-Time screen, press either the **Left** or **Right** key to navigate to the Net/Total Energy subscreen. To return to the previous screen press the **Left** and **Right** keys simultaneously.

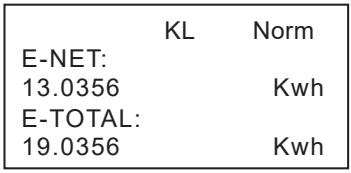


Figure 3-9 Net & Total Energy Subscreen

Net energy (E-NET) is the difference between the energy imported and exported over a specific period, while total energy (E-TOTAL) is the sum of imported and exported energy over a specific period.

3.3.6 Import/Export Charge Subscreen

To access the import/export charge readings from the Real-Time screen, press either the **Left** or **Right** key to navigate to the Import/Export Charge subscreen. To return to the previous screen press the **Left** and **Right** keys simultaneously.

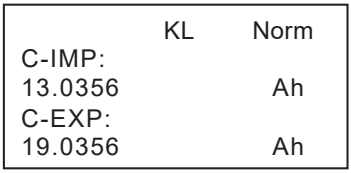


Figure 3-10 Import/Export Charge Subscreen

Import charge (C-IMP) refers to the electric charges while power is flowing to the facility from the grid, and export charge (C-EXP) refers to the electric charges while power is flowing out from the facility back to the grid.

3.3.7 Net/Total Charge Subscreen

To access the net energy and total energy readings from the Real-Time screen, press either the **Left** or **Right** key to navigate to the Net/Total Charge subscreen. To return to the previous screen press the **Left** and **Right** keys simultaneously.

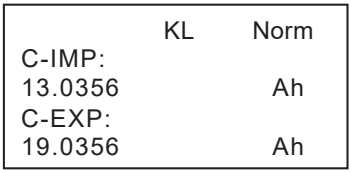


Figure 3-11 Net and Total Charge Subscreen

Net charge (C-NET) is the difference between the electric charges imported and exported over a specific period, while total charge (C-TOTAL) is the sum of imported and exported electric charges over a specific period.

3.4 Setting Option in Normal Mode

In Setting option, user configuration of the meter can be accessed upon pressing the OK key.

Before accessing the Setting screen, the user will be prompted to enter a four-digit password to prevent unauthorized access.

To enter the password, start by pressing the **Left** key to increment the first digit until the correct number is displayed. Press the **Right** key to navigate to the next adjacent digit. Continue until the numbers of all four digits have been selected. Push the **OK** key to confirm the password input.

By default, the AcuDC-301 password is set to **0000.** The following figure shows the password input screen.

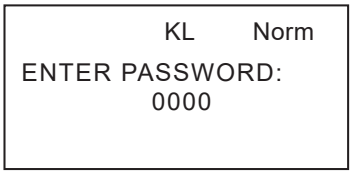


Figure 3-12 Password Input Screen

After entering the Meter Settings screen, the user can use the **Left** and **Right** keys to navigate through different subscreens as described below

3.4.1 Baud Rate

The default baud rate for the AcuDC-301 is 19,200 bits per second. Users can change the baud rate (bps) to one of the following options: 2,400, 4,800, 9,600, 19,200, 38,400, 57,600, 76,800, or 115,200.

The user can press the **OK** key to start changing the baud rate. Use the **Left** and **Right** key to cycle through the baud rate options until the desired number is displayed. Push the **OK** key again to confirm selection.

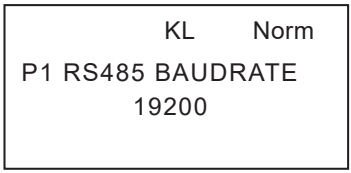


Figure 3-13 RS485 BPS Subscreen

3.4.2 RS485 Parity

The default RS485 parity for the AcuDC-301 is set to None1. Users can change the parity type to one of the following options: None1, None2, Odd, or Even.

The user can press the **OK** key to change the RS485 parity. Use the **Left** and **Right** keys to cycle through parity options. Push the **OK** key to confirm the selection.

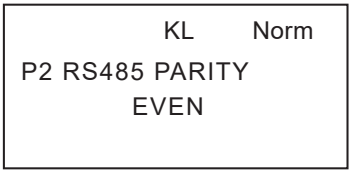


Figure 3-14 RS485 Parity Subscreen

3.4.3 Modbus Slave ID

The Modbus slave ID can be set within the range from 001 to 247. The default slave ID is 001.

Press the **OK** key to change the Modbus slave ID, press the **Left** key to increment the first digit until the correct number is displayed. Press the **Right** key to cycle to the next adjacent digit. Continue until the numbers of all three digits have been selected. Push the **OK** key to confirm the input.

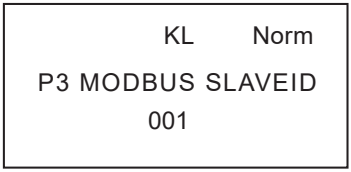


Figure 3-15 Modbus Slave ID Subscreen

3.4.4 Modbus RTU Enable

To toggle the Modbus RTU on or off, the user can press the **OK** key to change the setting. Use the **Left** and **Right** keys to switch between the **Enable** and **Disable** options. Push the **OK** key to confirm selection. By default, the Modbus RTU is enabled.

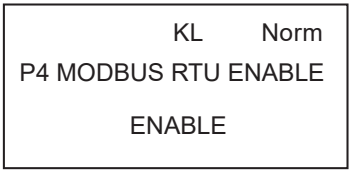


Figure 3-16 Modbus RTU Subscreen

3.4.5 Modbus TCP Enable

To toggle the Modbus TCP on or off, the user can press the **OK** key to change the setting. Use the **Left** and **Right** keys to switch between the **Enable** and **Disable** options. Push the **OK** key to confirm the selection. By default, the Modbus TCP is enabled.

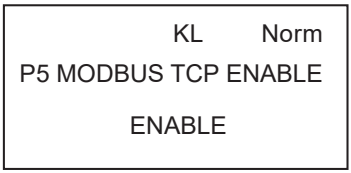


Figure 3-17 Modbus TCP Subscreen

3.4.6 Modbus TCP Port

AcuDC-301 allows users to configure the TCP port number with a range from 00001 to 65534. By default, the port number is 00502.

Press the **OK** key to change the Modbus TCP port, press the **Left** key to increment the first digit until the correct number is displayed. Press the **Right** key to cycle to the next adjacent digit. Continue until the numbers of all five digits have been selected. Push the **OK** key to confirm the input.

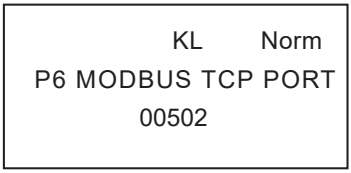


Figure 3-18 Modbus TCP Port Subscreen

3.4.7 DHCP Subscreen

Press the OK key to change the DHCP setting, the user can press the **Left** and **Right** key to switch between the **Auto** and **Manual** options. Push the **OK** key to confirm selection. When set to **Auto,** the meter will automatically assign an IP address. By default, the DHCP is set to **Manual.**

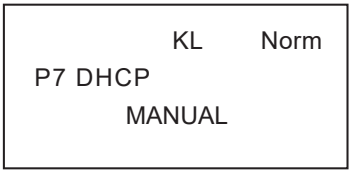


Figure 3-19 DHCP Setting Subscreen

3.4.8 IP Address Subscreen

Push the **OK** key to change the IP address, press the **Left** key to increment the first digit until the correct number is displayed. Press the **Right** key to cycle to the next adjacent digit. Continue until all digits have been selected. Push the OK key to confirm the input. By default, the IP address is set to 192.168.1.254.

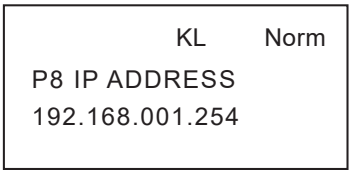


Figure 3-20 IP Address Configuration

3.4.9 Subnet Mask Subscreen

Push the **OK** key to change the Subnet Mask, press the **Left** key to increment the first digit until the correct number is displayed. Press the **Right** key to cycle to the next adjacent digit. Continue until all digits have been selected. Push the OK key to confirm the input. By default, the Subnet Mask is set to 255.255.255.000.

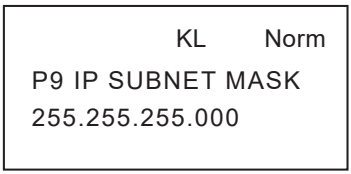


Figure 3-21 Subnet Mask Configuration

3.4.10 Gateway Subscreen

Push the **OK** key to change the Gateway, press the **Left** key to increment the first digit until the correct number is displayed. Press the **Right** key to cycle to the next adjacent digit. Continue until all digits have been selected. Push the OK key to confirm the input. By default, the gateway is set to 192.168.001.001.

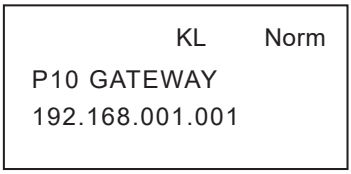


Figure 3-22 Gateway Configuration

3.4.11 Preferred DNS Server (DNS1) Subscreen

Push the **OK** key to change the DNS1, press the **Left** key to increment the first digit until the correct number is displayed. Press the **Right** key to cycle to the next adjacent digit. Continue until all digits have been selected. Push the **OK** key to confirm the input. By default, the DNS1 is set to 008.008.008.008.

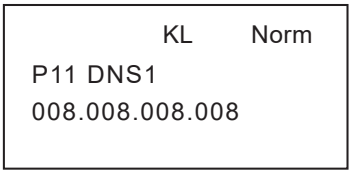


Figure 3-23 DNS 1 Address Configuration

3.4.12 Alternate DNS Server (DNS2) Subscreen

Push the **OK** key to change the DNS2, press the **Left** key to increment the first digit until the correct number is displayed. Press the **Right** key to cycle to the next adjacent digit. Continue until all digits have been selected. Push the **OK** key to confirm the input. By default, the DNS2 is set to 008.008.004.004.

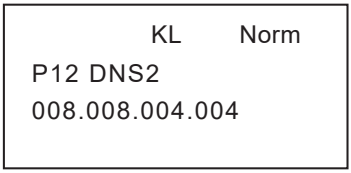


Figure 3-24 DNS 2 Address Configuration

3.4.13 Reset Network Subscreen

The Reset Network setting allows the user to reset the AcuDC-301 DC meter network back to its default setting. The user can press the **Left** and **Right** keys to switch between the **Yes** and **No** options. Select **Yes** to reset the network. Push the **OK** key to confirm selection.

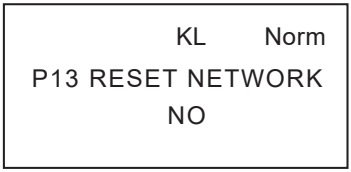


Figure 3-25 Reset Network Subscreen

ALERT: All existing network configurations will be permanently removed from the AcuDC-301 DC meter and reset to default configurations.

3.4.14 Backlit Off Delay

The Backlit Off Delay setting determines how long the display backlight remains on when the meter is inactive before automatically diming the display.

Press the **OK** key to change the Backlit Off Delay, press the **Left** key to increment the first digit until the correct number is displayed. Press the **Right** key to cycle to the next adjacent digit. Continue until the numbers of all three digits have been selected. Push the **OK** key to confirm the input. The backlit off delay range can be set between 000 to 120 minutes. By default, the demand update period is set to 001 minute.

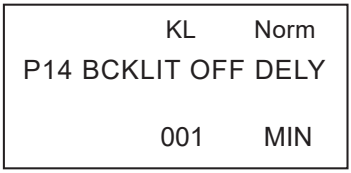


Figure 3-26 Backlight OFF Delay Subscreen

3.5 Information Option in Normal Mode

The Information option displays all the read-only information about the AcuDC-301 meter connected to the system. Upon pressing the OK key, the subscreens seen are described below.

3.5.1 Model and Serial Number Subscreen

When OK is pressed from the Info screen, the model and serial number details can be seen. To return to the previous screen press the Left and Right keys simultaneously.

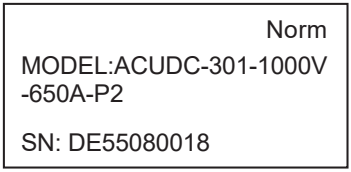


Figure 3-27 Model Info Subscreen

3.5.2 Bootloader and Firmware Version Subscreen

Press either the **Left** or **Right** key from the Model and Serial Number subscreen to navigate to the Bootloader and Firmware Version subscreen. To return to the previous screen press the **Left** and **Right** keys simultaneously.

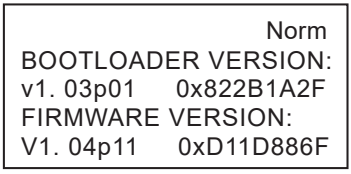


Figure 3-28 Bootloader and Firmware Version Subscreen

3.5.3 Cable loss and Cable Resistance Subscreen

To view the cable loss and cable resistance from the Info screen, press either the **Left** or **Right** key to navigate to this subscreen.

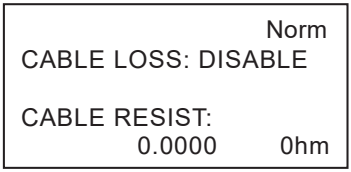


Figure 3-29 Cable Loss and Cable Resistance Subscreen

3.5.4 Public Key Subscreen

To access the Public Key details from the Info screen, press either the **Left** or **Right** key to navigate to the Public Key subscreen. To return to the previous screen press the **Left** and **Right** keys simultaneously.

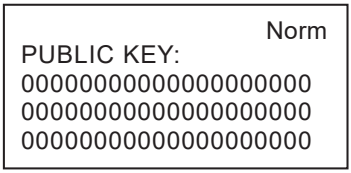


Figure 3-30 Public Key Subscreen

Chapter 4: Advanced Functions and Data Monitoring via Acuview 2

The AcuDC-301 features advanced metering capabilities to measure a multitude of power, energy, and power quality parameters. Some advanced functions are only accessible from the Acuview 2 Meter Data Management Software to access additional information.

4.1 Acuview 2 Initial Setup

The Acuview 2 is a free data management software compatible with Microsoft Windows® operating system to supplement the AcuDC-301 's functionality. It can be used to read and log advanced metering data, as well as configure and view settings at a remote location. This software is free to download at www.accuenergy.com/acuview2.

4.1.1 Launch Acuview 2

With the computer turned on, use your mouse to double-click the Acuview 2 icon on the desktop, or left-click the Start icon from your taskbar to locate and left-click the Acuview 2 icon to launch the Acuview 2 software. The Acuview 2 software will start up and an **Add Connection** window will appear. The **Add Connection** window allows users to either select an existing meter from the list or add a new meter.

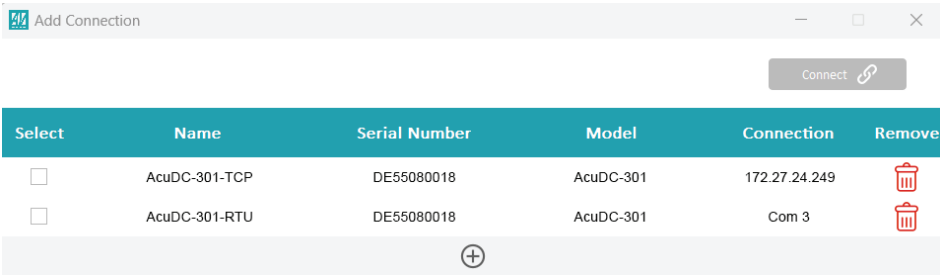


Figure 4-1 Acuview 2 Add Connection

Add a New Meter Connection: Clicking the ⊕ **Add** button allows the **Add Device** panel to appear. The user is required to enter AcuDC-301 information to establish a Modbus RTU or Modbus TCP communication.

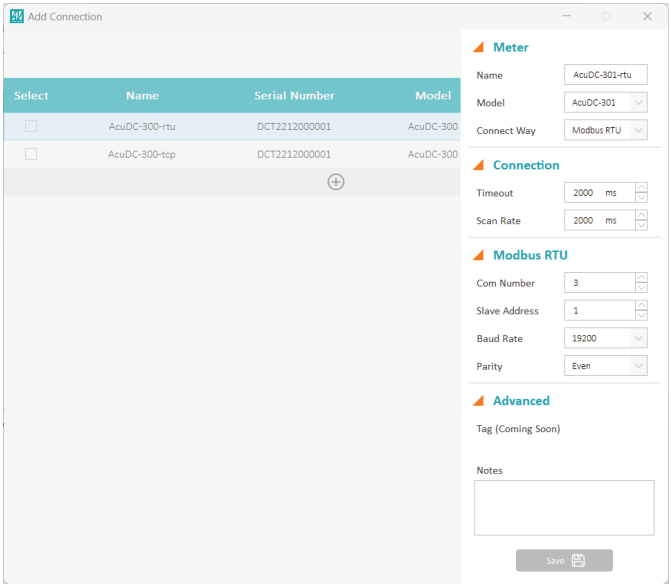


Figure 4-2 Add New AcuDC-301 Panel Using Acuview 2

Name: Customized name for the AcuDC-301 meter.

Model: Select AcuDC-301 as the meter model.

Connect Way: Modbus RTU or Modbus TCP.

Timeout: Specifies when the connection will time out and disconnect if there is no response from the meter after the set time lapses. By default, the timeout is set at 2000 milliseconds (ms).

Scan Rate: Acuview 2 polls from AcuDC-301 every 2000ms by default. The range is between 1000 to 30000ms.

Configure the necessary connection information for either Modbus RTU or Modbus TCP. The connection details are discussed in Chapter 4.1.2 (Modbus RTU) and Chapter 4.1.3 (Modbus TCP). Click the **Save** button after all settings have been completed, and the AcuDC 301 will be successfully added to the list.

4.1.2 Connecting with Modbus RTU

The AcuDC-301 RS485 port can be used to establish a connection to the Acuview 2 through Modbus RTU protocol. This physical communication layer uses a half-duplex, single twisted pair,

RTU protocol. This physical communication layer uses a half-duplex, single twisted pair, two-wire transmission where data travels in one direction at a time. The send (A+) and receive (B-) data signals are shared between the two wires.

Figure 4-3 depicts the wire configuration between the RS485-USB and the AcuDC-301. The AcuDC-301 RS485 port has three terminals, A+ (Positive), B- (Negative), and S (Shield).

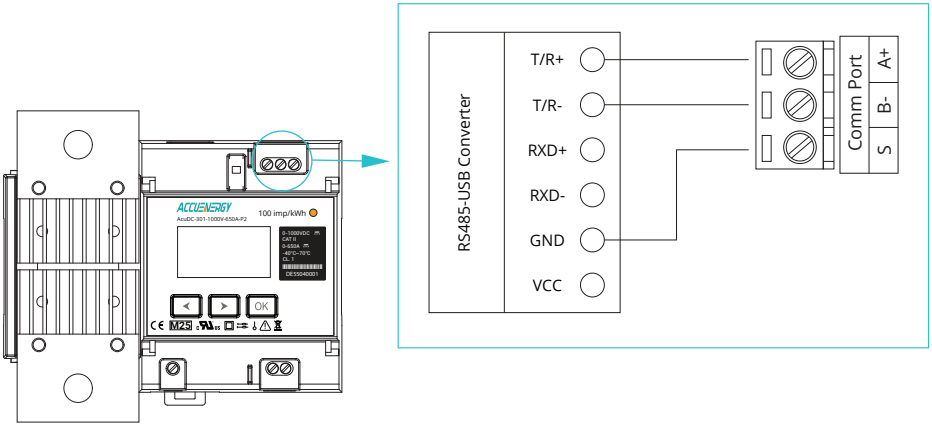


Figure 4-3 RS485-USB Connection to AcuDC-301

After connecting the RS485-to-USB converter to the computer, the COM port must be identified in order to connect to the AcuDC-301.

To assign the COM port,

1. Open the **Device Manager** window on the personal computer.
2. From the list, locate and click **Ports (COM & LPT)** to expand the selection to find the COM port number.

The following figure illustrates that the RS485-to-USB converter has been allocated to COM4.

NOTE: The COM port may be different on each PC. Be sure to identify the correct COM port used by the RS485-to-USB converter.

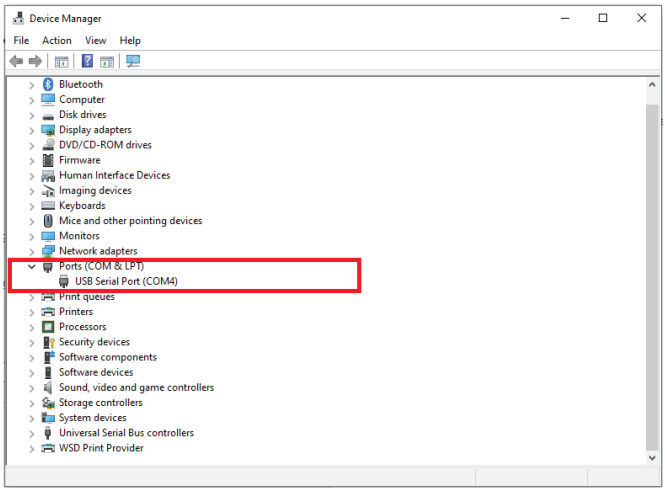


Figure 4-4 COM Port Number Assigned to RS485-to-USB Converter

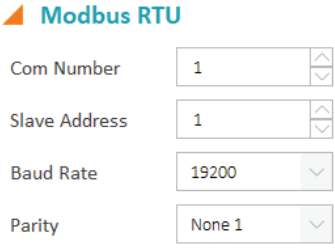


Figure 4-5 Acuview 2 Modbus RTU Connection Setting

Slave Address: Parameter ranges from 1 to 247.

Baud Rate: The rate at which information is transmitted. Select a rate speed from the options of 2,400 bits/s, 4,800 bits/s, 9,600 bits/s, 19,200 bits/s, 38,400 bits/s, 57,600 bits/s, 76,800 bits/s, and 115,200 bits/s.

Parity: Available parameter options for parity are **None1** (no parity, 1 stop bit), **None2 (**no parity, 2 stop bit), **Even**, and **Odd**.

Default Modbus RTU setting:
COM Number: 1
Modbus Slave Address: 1
Baud Rate: 19200
Parity: None1 (no parity, 1 stop bit)

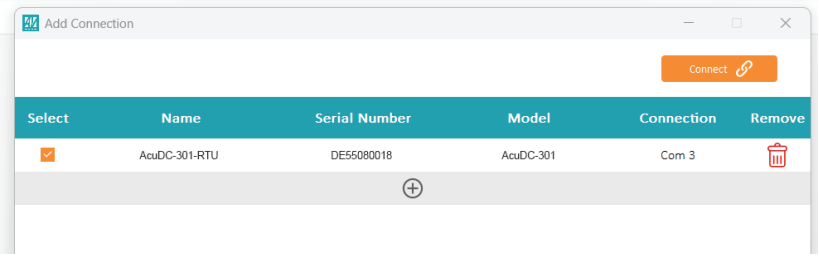


Figure 4-6 Connecting AcuDC-301 to Acuview 2 through Modbus RTU

Once the AcuDC-301 has been successfully added to the Acuview 2, a connection can be established by selecting the AcuDC-301 from the list and clicking on the **Connect** button located in the upper right corner of the window. The AcuDC-301 will automatically connect to the Acuview 2.

4.1.3 Connecting with Modbus TCP

The AcuDC-301 supports connection via Modbus TCP, which utilizes the Ethernet communication interface. To establish a connection using Modbus TCP, ensure that the AcuDC-301 and the computer running Acuview 2 are connected to the same local area network (LAN).

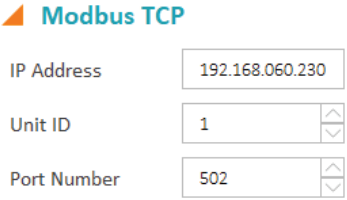


Figure 4-7 Acuview 2 Modbus TCP Connection Setting

Default Modbus TCP settings:
IP Address:192.168.001.254
Unit ID (Slave ID): 1
Port Number: 502

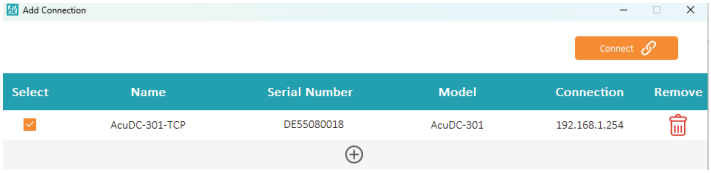


Figure 4-8 Connecting AcuDC-301 to Acuview 2

Once the AcuDC-301 has been successfully added to the Acuview 2, a connection can be established by selecting the AcuDC-301 from the list and clicking on the **Connect** button located in the upper right corner of the window, and the AcuDC-301 will automatically connect to the Acuview 2.

4.2 Basic Measurements

Acuview 2 provides real-time reading data summary at an easy glance and enables exporting and storing of information in files for future tracking and analysis.

4.2.1 Real Time Metering

AcuDC-301 lists standard basic analog measurements in real time from Acuview 2. A full summary of these parameters is listed in the following table.

Table 4-1 AcuDC-301 Basic Analog Measurements

Parameter Type	Parameter Name	Resolution	Accuracy
Basic	Voltage	0.001V	0.1%
	Measured Voltage	0.001V	0.1%
	Compensated Voltage	0.001V	0.1%
	Current	0.001A	0.2%
	Power	0.001kW	0.5%
	Voltage Ripple Factor	0.001%	N/A
	Current Ripple Factor	0.001%	N/A

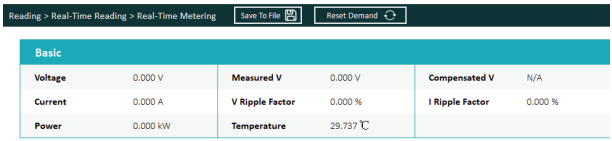


Figure 4-9 Accessing Real-Time Metering Data via Acuview 2

The refresh rate of data on these parameters is 100 milliseconds with easy data export.

4.2.2 High-Speed Metering

The high-speed metering page provides basic measured data with a high refresh rate of 20 milliseconds with easy data export.

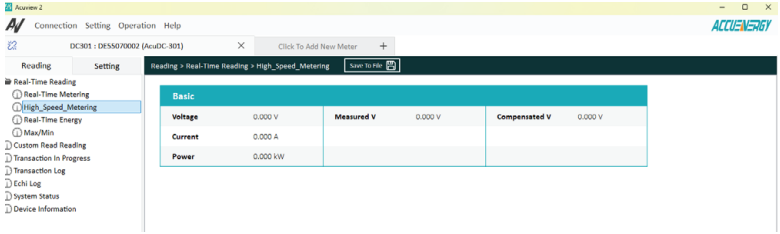


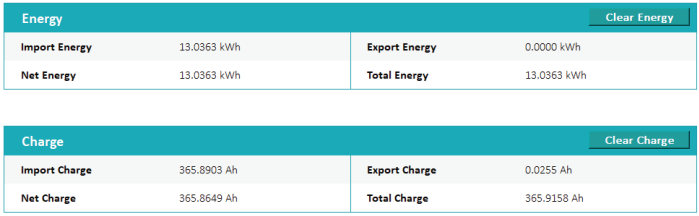
Figure 4-10 High-Speed Metering Data via Acuview 2

4.2.3 Real-Time Energy and Charge

AcuDC-301 supports energy and charge measurements. A full summary of these energy and charge parameters is listed in the following table.

Table 4-3 AcuDC-301 Energy and Charge Measurements

Parameter Type	Parameter Name	Resolution	Accuracy
Energy	Import Energy	0.0001kWh	0.5%
	Export Energy	0.0001kWh	0.5%
	Net Energy	0.0001kWh	0.5%
	Total Energy	0.0001kWh	0.5%
Charge	Import Charge	0.0001Ah	0.5%
	Export Charge	0.0001Ah	0.5%
	Net Charge	0.0001Ah	0.5%
	Total Charge	0.0001Ah	0.5%



Energy			Clear Energy
Import Energy	13.0363 kWh	Export Energy	0.0000 kWh
Net Energy	13.0363 kWh	Total Energy	13.0363 kWh

Charge			Clear Charge
Import Charge	365.8903 Ah	Export Charge	0.0255 Ah
Net Charge	365.8649 Ah	Total Charge	365.9158 Ah

Figure 4-11 Real-Time Energy Readings

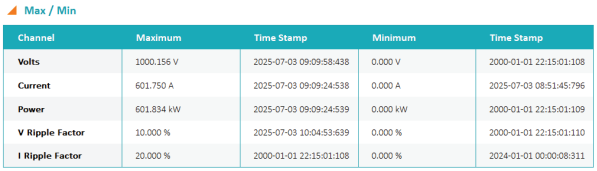
Clear Energy: Reset energy readings to 0.

Clear Charge: Reset charge readings to 0.

NOTE: Modification to Energy and Charge readings is not allowed in the sealed state. Any attempt to modify these readings requires breaking the seal which helps to maintain the integrity of the seal.

4.2.4 Max/Min

AcuDC-301 logs maximum and minimum statistics at a refresh rate of 20 milliseconds for all real-time parameters along with a timestamp indicating when they occurred. All data are stored in non-volatile memory, so all statistical information is preserved when the AcuDC-301 loses power or is powered off.



Max / Min

Channel	Maximum	Time Stamp	Minimum	Time Stamp
Volts	1000.156 V	2025-07-03 09:09:58:438	0.000 V	2000-01-01 22:15:01:108
Current	601.750 A	2025-07-03 09:09:24:538	0.000 A	2025-07-03 08:51:45:796
Power	601.834 kW	2025-07-03 09:09:24:539	0.000 kW	2000-01-01 22:15:01:109
V Ripple Factor	10.000 %	2025-07-03 10:04:53:639	0.000 %	2000-01-01 22:15:01:110
I Ripple Factor	20.000 %	2000-01-01 22:15:01:108	0.000 %	2024-01-01 00:00:08:311

Figure 4-12 Max and Min Readings

Reset Max/Min: Updating the minimum and maximum values with instantaneous readings is permitted and will not affect the legal measurement data.

4.2.5 Custom Read Reading

The Custom Read function allows to select specific parameters for monitoring and retrieval. The values of chosen parameters can be pulled either via Modbus communication or viewed as real-time readings directly in Acuview 2.

Custom Reading

Index	Name	Value
1	Current (float)	0.000 A
2	Power (float)	0.000 kW
3	V Ripple Factor (float)	0.000 %
4	I Ripple Factor (float)	0.000 %
5	Measured V (float)	0.000 V
6	Compensated V (float)	0.000 V
7	Temperature (float)	29.275 ℃

Figure 4-13 Custom Readings

4.2.6 Transaction Log

The AcuDC-301 records transaction logs for charging sessions, including the legally relevant charging data, such as the start and end energy values, timestamps, and signature information. Logs are available and can be retrieved in JSON OCMF format via Modbus TCP or Modbus RTU. With the supported OCMF version is 1.4.1, storage is available for up to 61,440 records.

Transaction logs can be cleared only when the device is not in a sealed state. If the storage is full, an error is reported and the event is recorded in the Eich log, requiring re-verification.

To optimize the time required to retrieve the data, flexible reading data options are available as illustrated in the figure.

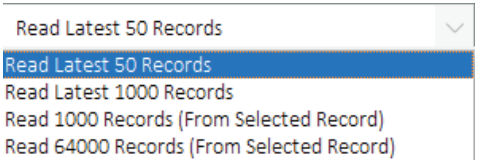


Figure 4-14 Transaction Log Record Retrieval

The value of the field TX in the OCMF file is recorded based on the circumstances under which a transaction ends as indicated in the table below.

Table 4-4 AcuDC-301 Transaction Record

Event	Record
Device Power Loss	P
Transaction aborted Fatal error in the meter (transaction automatically terminated by the meter)	A
Normal termination Charging timeout (transaction automatically terminated by the meter)	E

No.	Log
5	OCMF|{"FV":"1.4","GI":"ACCUENERGY AcuDC300","GS":"DE55070002","GV":"1.0.0","PG":"T5","MV":"Accuenergy","MM":"Acu-DC301-1000-650-...
4	OCMF|{"FV":"1.4","GI":"ACCUENERGY AcuDC300","GS":"DE55070002","GV":"1.0.0","PG":"T4","MV":"Accuenergy","MM":"Acu-DC301-1000-650-...
3	OCMF|{"FV":"1.4","GI":"ACCUENERGY AcuDC300","GS":"DE55070002","GV":"1.0.0","PG":"T3","MV":"Accuenergy","MM":"Acu-DC301-1000-650-...
2	OCMF|{"FV":"1.4","GI":"ACCUENERGY AcuDC300","GS":"DE55070002","GV":"1.0.0","PG":"T2","MV":"Accuenergy","MM":"Acu-DC301-1000-650-...
1	OCMF|{"FV":"1.4","GI":"ACCUENERGY AcuDC300","GS":"DE55070002","GV":"1.0.0","PG":"T1","MV":"Accuenergy","MM":"Acu-DC301-1000-650-...

Figure 4-15 OCMF Transaction End Record

4.2.7 Eich Log

The AcuDC-301 supports Eich Log to record events relevant to legal metrology. Each record contains event details and, when applicable, the old and new values for traceability. The meter stores up to 6,000 Eich Log records, which can only be cleared when the system is not in a sealed state. If the storage is full, the meter reports an error and the event is recorded in the Eich Log requiring re-verification. Eich Log records can be retrieved similarly to Transaction logs.

The Eich Log records include verification failures, system mode changes, seal status changes, full Transaction log or full Eich Log storage, changes to Cable Loss Enable, Cable Loss Resistance, Pulse LED Energy, Charge Point Identification Type, and time synchronization deviations exceeding 300 seconds.

No.	Time Stamp	Event Type	Old Value	New Value
8	2000-01-02 05:06:17.492	Cable Loss Enable Status Chagne	Disable	Enable
7	2000-01-02 01:04:36.781	Cable Loss Enable Status Chagne	Enable	Disable
6	2000-01-01 05:15:25.878	Cable Loss Enable Status Chagne	Disable	Enable
5	2000-01-01 05:15:25.679	Cable Loss Resistanche Change	0.0000	0.0100
4	2000-01-01 01:12:01.538	System Mode Change	Normal Mode	Production Mode
3	2000-01-01 01:12:01.488	Seal Status Change	Sealed	Unsealed
2	2000-01-01 01:11:57.238	System Mode Change	Production Mode	Normal Mode
1	2000-01-01 01:11:57.187	Seal Status Change	Unsealed	Sealed

Figure 4-16 Eich Log Record

4.2.8 System Status

The time and date on AcuDC-301 can be configured on Acuview 2 or by writing to the Modbus register. Refer to Chapter 5 for further details.

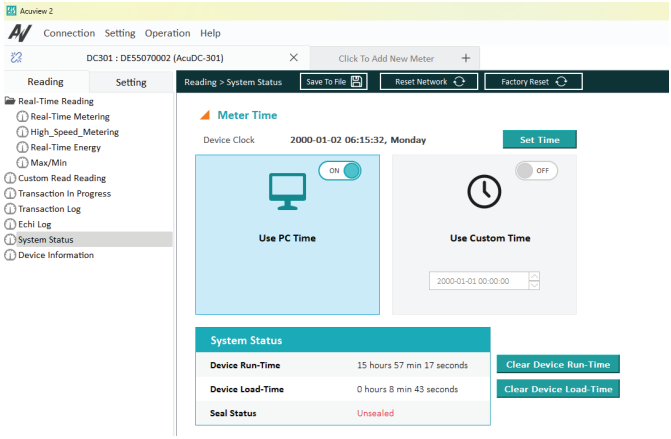


Figure 4-17 AcuDC-301 Time Configuration

Use PC Time: Synchronize it with the internal system clock from the user's PC.

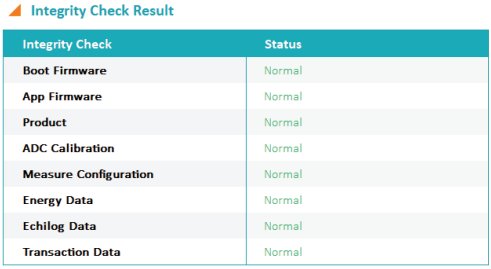
Use Custom Time: Allows the user to manually set the time on AcuDC-301.

Once an option is selected, click the **Set Time** button to confirm the changes.

NOTE: The AcuDC-301 will retain its time settings when powered off for up to three days. After the time has lapsed, it will revert to the default time.

Integrity Check and Fatal Error Status

For safety purposes, the AcuDC-301 is equipped with data integrity checks to prevent data interference, unauthorized modification, or tampering. The results of these checks are displayed on this page. In case of errors, troubleshoots can be performed based on the status indicators, and if necessary, contact the company's maintenance department for resolution.

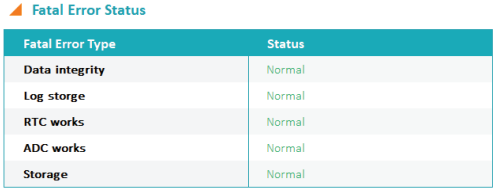


Integrity Check Result

Integrity Check	Status
Boot Firmware	Normal
App Firmware	Normal
Product	Normal
ADC Calibration	Normal
Measure Configuration	Normal
Energy Data	Normal
Echilog Data	Normal
Transaction Data	Normal

Figure 4-18 Integrity Check Result in System Status

Fatal Error Status is very important and must be monitored closely, as the occurrence of a critical error indicates that the device is no longer operating normally and may cause unnecessary issues.



Fatal Error Status

Fatal Error Type	Status
Data integrity	Normal
Log storge	Normal
RTC works	Normal
ADC works	Normal
Storage	Normal

Figure 4-19 Fatal Error Status

4.2.9 Device Information

The AcuDC-301 features an AcuDC-301 information page on Acuview 2. Device Information includes:

- Serial Number
- Firmware Version
- Hardware Version
- Function Model
- Voltage Input
- Current Input
- Power Supply
- Mac Address
- Release Date
- Boot Loader Model

- Boot Loader Version
- Boot Loader Release Date

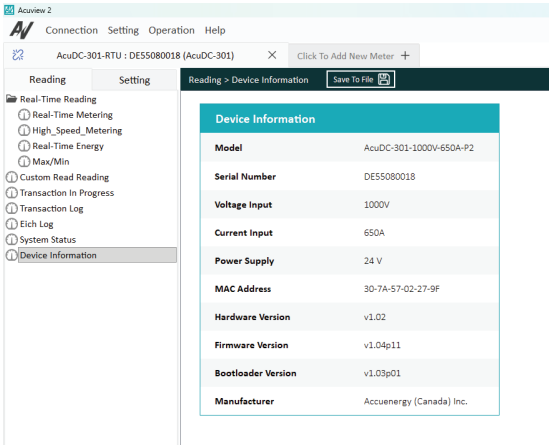


Figure 4-20 Device Information

4.3 Meter Settings

The AcuDC-301 settings can be configured from the AcuDC-301 display screen, Modbus registers or Acuview 2.

To access the AcuDC-301 settings on screen, the user must enter a four-digit password. By default, the meter password is 0000. This password can be changed using the display screen and Acuview 2.

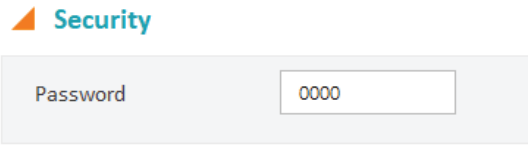


Figure 4-21 Device Password Settings

To apply any changes, users must click the **Update** button at the top of the panel. Click the **Restore** to revert to the default values.

NOTE: Refer to Chapter 3 to find out how to configure the settings from the display screen and Chapter 5 for Modbus registers.

4.3.1 General Settings

In General Settings, communication parameters and system mode settings are configured as depicted in the figure.

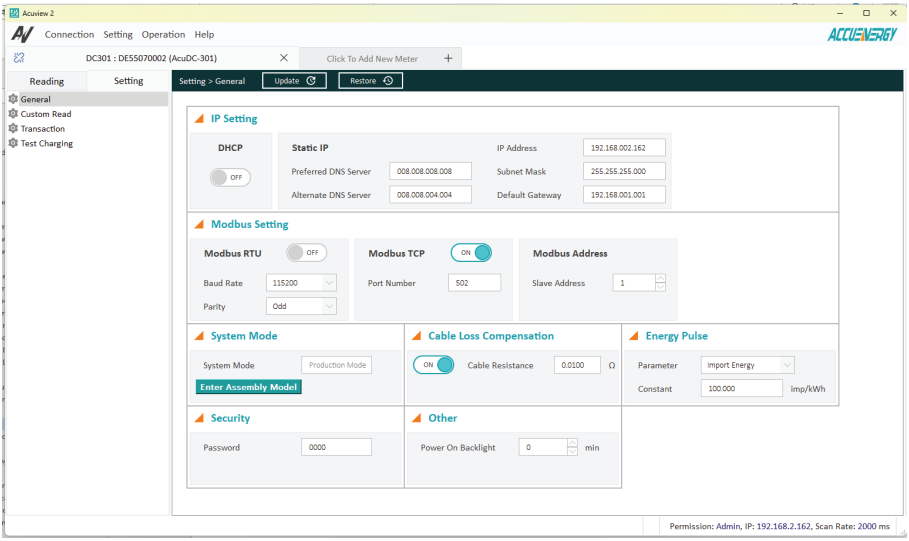


Figure 4-22 General Settings

System Mode

The AcuDC-301 offers three system modes with different permission levels to support configuration, commissioning, and normal operation. These modes help ensure proper system control and maintain measurement integrity.

Production Mode:

Production Mode offers the highest access level and is typically used during manufacturing and commissioning. Configuration changes are allowed only after the seal is broken, according to system requirements.

Assembly Mode:

Assembly Mode is a restricted service mode for controlled configuration and maintenance. For access into the Assembly Mode requires manual user interaction and authentication, such as selecting the mode and entering the required password.

In Assembly Mode, only limited non-critical parameters, such as Cable Loss Compensation Settings, can be modified. Energy-related values and legally relevant measurement data remain

protected and cannot be changed. The meter will automatically exit after a short timeout of 10 seconds to prevent unintended operation. Changes in the configuration made in Assembly Mode may be recorded in the Eich Log, which logs events, to ensure traceability.

Normal Mode:

Normal Mode is the default operating mode and used for standard operation which supports configuration of general system parameters such as communication settings, display options, and time synchronization.

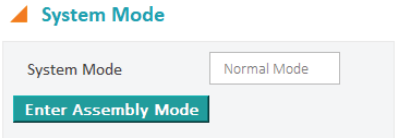


Figure 4-23 General Settings

Modbus Settings

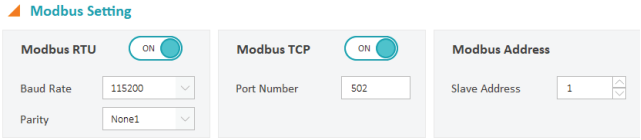


Figure 4-24 Modbus Settings

Protocol: Modbus RTU and/or Modbus TCP.

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 (bits/s). The default value is 19,200, and the range is from 2,400 to 115,200.

Parity: The communication parity by default is set to **None1,** indicating no parity and 1 stop bit.

Port Number: The Modbus port number by default is 502, which can be configured within a range from 1 to 65,534.

Slave Address: With a range from 1 to 247, Slave Address is set as 1 by default. Ensure each Slave device has a unique ID.

NOTE: Resetting to the factory default settings will reset the communication channel. The baud rate for the communication channel will be reset to 19,200 and parity will be set to **None1.** The default slave ID address is 1.

Energy Pulse Settings

The Energy Pulse settings are used to monitor and generate pulse signals related to energy consumption or generation, where an electrical signal is sent from the meter to represent a fixed amount of energy consumed. The more energy is consumed, the more pulses will be sent which are represented by the Pulse LED on the meter display.

Figure 4-25 Energy Pulse Settings

The available choices in Parameters options are None and Energy, where None signifies no pulse output and Energy indicates the output LED pulse signals related to import, export, net, or total energy consumption. The Constant option defines the LED pulse constant measured in impulse per kWh, which is used to convert energy into LED pulse signals.

Cable Loss Compensation Settings

Cable resistance can lead to inaccuracies in energy measurements, as a portion of the energy will be dissipated as heat. For billing applications such as EV charging stations, it is important to ensure the customer is only billed for the amount that is delivered. The AcuDC-301 compensates for cable losses using its resistance, ensuring accurate and reliable measurements.

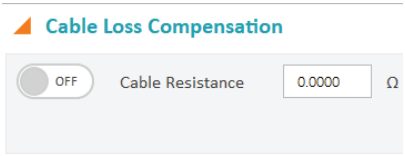


Figure 4-26 Cable Loss Compensation Settings

Cable Resistance: Parameters used in cable loss compensation. The range is from 0Ω to 999.9999Ω.

Other Settings

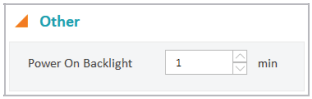


Figure 4-27 Power on Backlight Settings

Backlight: Default setting is 30 minutes, with an adjustable range from 0 to 120 minutes. AcuDC-301 backlight will turn off after the specified time has lapsed. When the value is set to 0, the backlight will remain on indefinitely.

4.3.2 Custom Settings

To accommodate varying operational scenarios, a user-defined data function has been designed, which allows configuration and selection of a subset of data, up to maximum 34 parameters from all the available options, to improve communication efficiency.

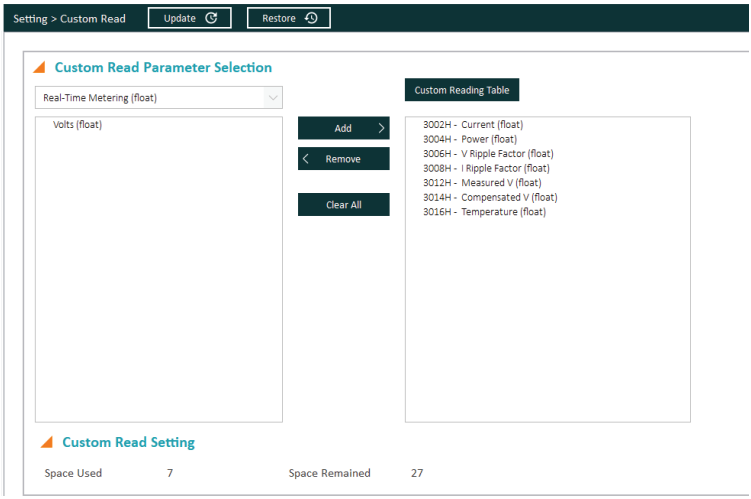


Figure 4-28 Custom Settings

To add custom parameters, select the parameter type from the drop-down menu. Choose one or more items from the left box and click the Add button. To remove parameters, select one or more items from the right box and click the Remove button, or use the Clear All button to remove all parameters from the right box. In the end, click on the Update button to save these configurations.

4.3.3 Transaction

The Transaction function records and manages the charging sessions. Each transaction captures a complete charging event including Energy, Time, and Identification data. Transaction data supports settlement and billing, depending on system configuration and regulatory requirements.

Transactions can be initiated by an external charging station during normal operation or through Test Charging for simulation. In normal operation, the charging station sends the configuration parameters to the meter, then the meter issues a Start Charging command to initiate a charging session.

The meter records transaction data throughout the charging session. Certain transaction information such as the transaction log ID, which is selected by the user, is accessible during operation. After charging is complete, an End Charging command is issued by the meter to terminate the session and generate a Transaction Log.

Time synchronization is essential for transaction processing. It ensures all time stamps in the Transaction Log is accurate and traceable, with the correct time zone offsets applied as needed.

Transaction-related parameters, such as charging timeout and identification settings, must be configured to meet the requirements of the connected charging system. If the configuration parameters change between sessions, update them before each charging session.

The device may automatically terminate a transaction due to charging timeout, fatal error, or power loss. In these cases, the Transaction Log record is generated with the corresponding termination status.

System checks and logging mechanism help maintain the transaction data integrity and traceability. Some transaction processing parameters may be restricted or protected based on the device operating mode and seal status for security. Events related to transaction processing and configuration changes may be recorded in the Eich Log, which logs events, to ensure traceability.

Figure 4-29 Transaction Settings

4.3.4 Test Charging

Test Charging simulates the charging transaction process, including time synchronization and charging station configuration. This function is for testing and validation only and does not represent a legally binding billing transaction.

In Test Charging mode, the software simulates charging station behavior. The charging process begins when configuration parameters are set and a Start Charging command is sent. During the session, the system allows access to selected transaction information, such as the transaction log ID. When charging ends, End Charging command terminates the session and generates a transaction log.

Transaction Log from Test Charging are for testing only and must not be used for billing or legal metrology purposes.

Time synchronization updates the device clock to ensure log timestamps are accurate and meet system requirements, including time zone offsets where applicable.

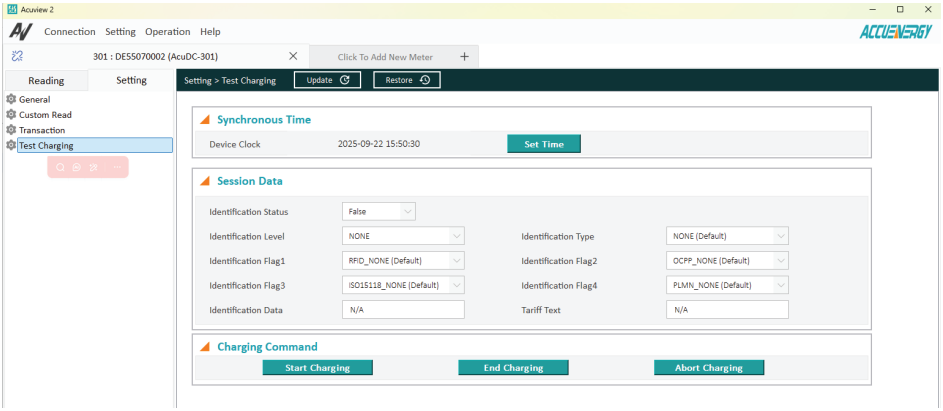


Figure 4-30 Test Charging Settings

NOTE: AcuDC-301 terminates charging in the event of charging timeout, fatal error or power loss and creates a transaction log accordingly. Clicking on End Charging and Abort Charging triggers creation of a transaction log. In these logs, the transaction TX field differs. End Charging is recorded as E and Abort Charging is recorded as A; upon power loss it is recorded as P.

For session data, decisions must be made whether to apply real-time configuration updates or update once, depending on requirements. If data changes for every charging session, the update must be made before each session.

The logical flow chart of a charging session is depicted below.

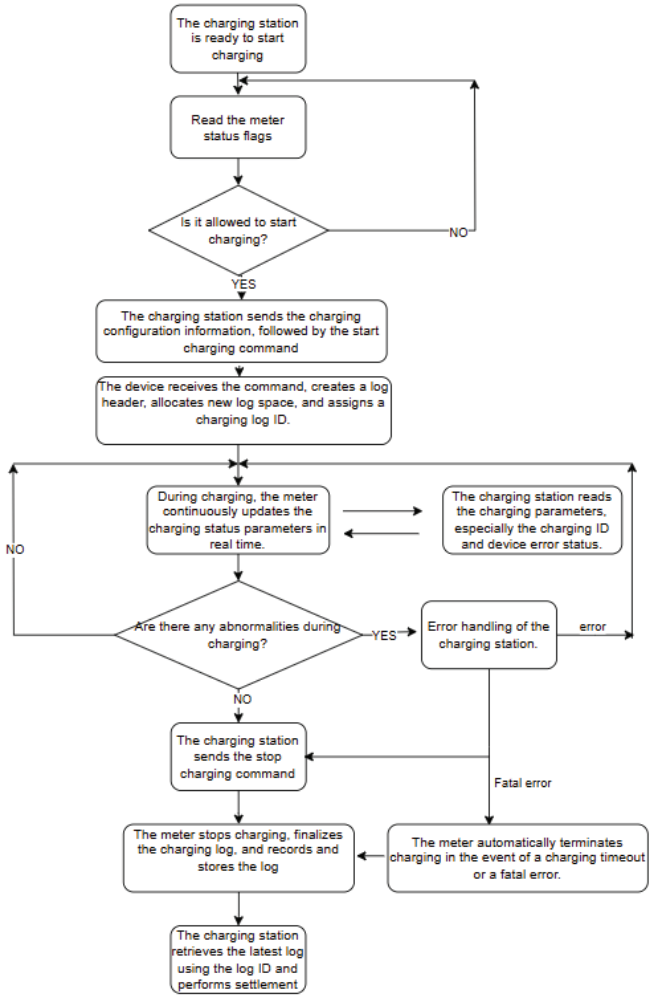


Figure 4-31 A Typical Charging Session

4.3.5 Seal Function

The AcuDC-301 is equipped with a physical seal switch to protect the integrity of measurement data and system configuration. The seal status can be monitored through Acuview 2 or meter's HMI, and the corresponding permissions are controlled based on the seal condition.

When the device is in sealed state, parameters that may affect measurement accuracy, billing, or legally relevant data are restricted from modification. This ensures the integrity and reliability of the recorded data for metering and settlement applications.

Configuration changes are permitted only after the seal is broken. Any modification to parameters that impact measurement behavior is controlled to ensure proper operation.

Firmware updates are not permitted when the device is in sealed state or operating under legally controlled conditions. To perform a firmware update, the device must be unsealed (i.e., after the seal is broken) and placed in a non-operational or service state.

To maintain traceability, changes to certain parameters and system events should be recorded by the device logging mechanism. Meanwhile, any changes to legally relevant parameters are recorded in the Eich Log, which logs events, to ensure traceability.

Figure 4-32 Seal Status Indication

4.4 Firmware Updating

The firmware has a CRC checksum which is verified upon system boot. CRC checksum normally starts only if the checksum is valid.

4.4.1 Preparation

Download the latest version of the AcuDC-301 firmware. The firmware file usually ends with ".MFEA". Firmware update operations and related system events would be recorded in the Eich Log to ensure traceability.

4.4.2 Update the Firmware

1. Click the **Operation** menu tab and select **Firmware Update**.

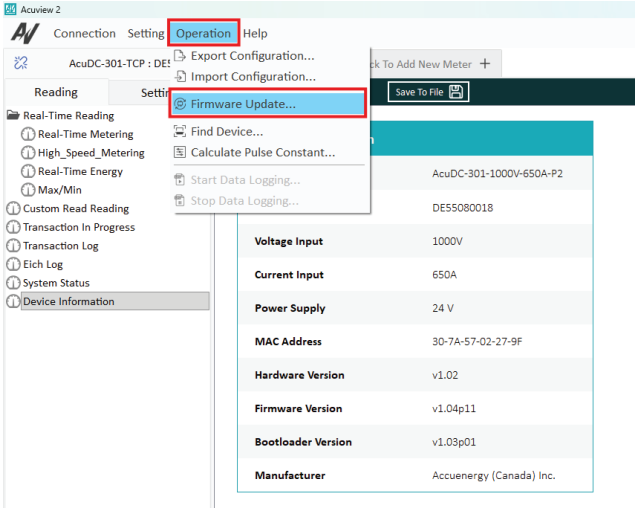


Figure 4-33 Firmware Update Screen

2. Select the firmware file to be updated.

4.4.2.1 Update the Firmware via Modbus RTU

1. Enable **Scan Mode:** In scan mode, the Acuview 2 will scan and display all active serial ports.
2. Select the expected COM port.

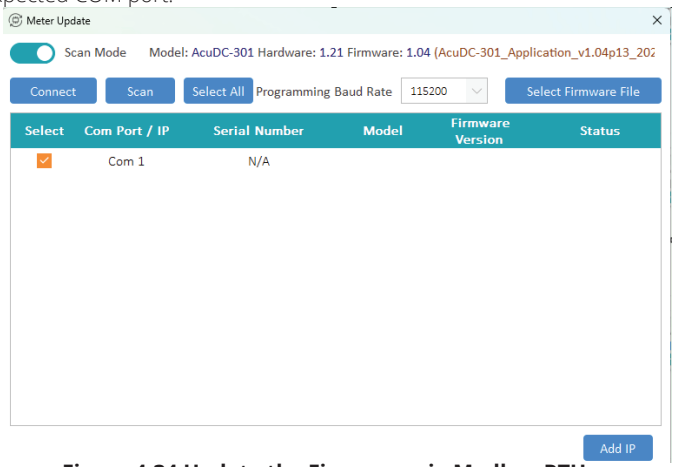


Figure 4-34 Update the Firmware via Modbus RTU

3. Select the COM port and then click **Connect**.
4. In the pop-up menu, configure the slave address, baud rate, and parity according to the Modbus RS485 settings of AcuDC-301, and then click **OK** to confirm.

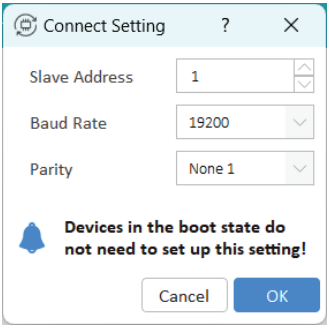


Figure 4-35 Connection Setting Menu

5. If the connection is successfully established, the upgrade will start automatically.

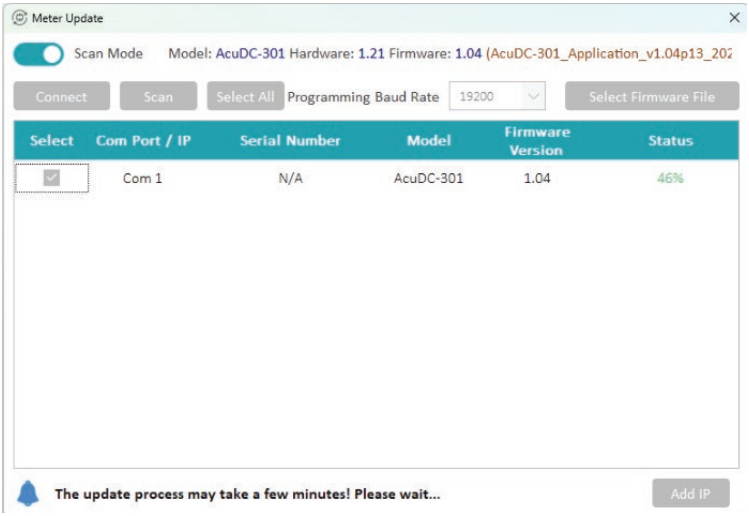


Figure 4-36 Upgrading Screen

4.4.2.2 Update the Firmware via Modbus TCP

1. Disable Scan Mode
2. Select the expected IP

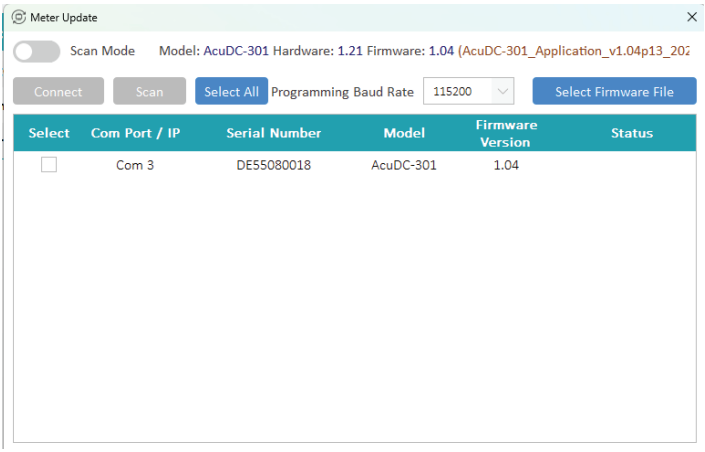


Figure 4-37 Update the Firmware via Modbus TCP

3. Select the device to be updated, then click **Connect**
4. If the connection is successfully established, the upgrade will start automatically.

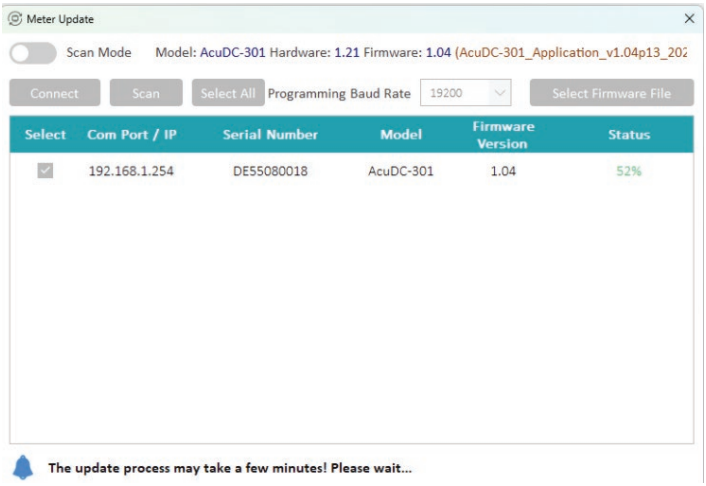


Figure 4-38 Upgrading Screen

5. After the upgrade is complete, AcuDC-301 will restart automatically.

ALERT: Do not disconnect the connection between the computer and AcuDC-301 during the upgrade process. If the upgrade fails, please restart AcuDC-301 and try upgrading again.

Chapter 5: Modbus Communication

The AcuDC-301 built-in Modbus protocol uses register addresses to communicate with other devices on the network.

5.1 Modbus Protocol Introduction

Modbus RTU is a widely used communication protocol which is also used in the AcuDC-301 EV Charging meter. Data format and error checking 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, accompanied by slave devices waiting for a query from the master.

Transmission Mode

Modbus RTU mode of transmission defines the data frame structure and the rules for how data is transmitted. The mode is defined in the following table.

Data Frame

Table 5-1 Data Frame Structure

Address Field	Function Field	Data Field	Error Check Field
8-Bits	8-Bits	Nx8-Bits	16-Bits
Coding System		8-Bit Binary	
Start Bit		1	
Data Bits		8	
Parity		None1, None2, ODD, EVEN	
Stop Bit		1 or 2	
Error Checking		CRC Check	

Address Field

The data frame contains an 8-bit address field to allow a master device to identify slave devices during the communication process. Valid slave device addresses are within the decimal range of 1 to 247. When communication is initiated between a master and a slave device, a unique slave address is sent by the master by placing it in the message address field. The slave responds by sending its own unique address in the address field to allow the master to identify the corresponding slave device.

Function Field

The function field of a message frame contains 8 bits. Valid codes are within the decimal range of 1 to 255. When a message is sent from a master to a slave device, the function code field specifies the type of action to be performed by the slave device.

Table 5-2 Function Field Codes & Action

Code	Meaning	Action
03 (03H)	Read Data	Obtain current binary value from one or more registers.
16 (10H)	Write Multiple-Register	Place specific binary values into a series of consecutive multiple registers.

Data Field

The data field is constructed using multiple sets of two hexadecimal digits within the range of 00 to FF. The data field of messages sent from a master to slave devices contains additional information that the slave must use to take the action defined by the function field. 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 10H), 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 device contains the data requested. If an error occurs, the data field contains an exception code that the master application uses to determine the next action. The data field can be nonexistent (length is 0) 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 upon the reception of the message, and the result is compared to the calculated value it received in the CRC field. If the two values are not equal, an error will be reported.

The CRC process can follow these steps:

1. The CRC calculation begins by initializing a 16-bit register to all 1s. The CRC is then calculated by sequentially applying every 8-bit of the message to the current register, ignoring the start, stop, and the parity bit.
2. The message will be processed one byte (8-bits) at a time, and every byte will perform an exclusive OR (XOR) operation with the current 16-bit register.
3. The result is then shifted towards the least significant bit (LSB), and a 0 will be filled into the most significant bit (MSB) position.
4. If the LSB equals to 1, the 16-bit register will perform an XOR operation with a predefined value. If the LSB equals to 0, no actions will be taken.
5. This shifting and conditional XOR process will be repeated eight times for each byte (8 bits). After the eighth shift, the next byte will perform an XOR operation with the 16-bit register's current value, and the above process will be repeated for another eight times.
6. Every byte in the message will be processed in the same manner. Once all bytes in the massage are processed, the high-byte and the low-byte in the 16-bit register will be swapped, and the remaining value is the CRC score.
7. When the CRC is appended to the message, the low-byte is appended first, followed by the high-byte.

5.2 Communication Format

Table 5-3 Explanation of Frame

Address	Function	Data Start Register HI	Data Start Register LO	Number of Registers HI	Number of Registers LO	CRC 16 HI	CRC 16 LO
06H	03H	00H	00H	00H	21H	84H	65H

5.2.1 Read Data (Function Code 03H)

This function code 03H is used by Modbus to read the contents of a contiguous block of holding registers in the AcuDC-301 EV Charging meter.

Query

This function allows the master device to obtain the measurement results from the AcuDC-301. Table 5-4 is an example of a reading from the measured data.

Example: Reading of two measured data, voltage and current (V, I), from the AcuDC-301.

The data address of the voltage includes 3000H and 3001H. The data address of terminal one current (I1) includes 3002H and 3003H.

Table 5-4 Data Request Table

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7~32
Address Field	Function Field	Data Start Register HI	Data Start Register LO	Number of Registers HI	Number of Registers LO	CRC Error Check Field
01H	03H	30H	00H	00H	04H	00H

Response

The response includes the AcuDC-301 EV Charging meter address, function code, quantity of data bytes, data, and error checking.

Table 5-5 Data Response Table

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11	Byte 12~32
Address Field	Function Field	Byte Count	Data Field 1 HI	Data Field 1 LO	Data Field 2 HI	Data Field 2 LO	Data Field 3 HI	Data Field 3 LO	Data Field 4 HI	Data Field 4 LO	Error Check Field
01H	03H	08H	42H	EFH	F5H	93H	40H	20H	0AH	4BH	00H

(V=42EFF593H (119.98 V), I1=40200A4BH (2.50063A))

5.2.2 Preset/Reset Multi-Register (Function Code 10H)

This function code 10H is used in Modbus to write a block of contiguous registers in the AcuDC-301, such as system parameters setting and so on.

Example: Modbus can be used to change the slave ID (address: 4110H), enable Modbus RTU (4111H), as well as the Value to 50 (0032H) and 1 (0001H) respectively.

Query

Function code 10H allows the user to modify the contents of a multi-register. Some registers of AcuDC-301 can have their contents changed by this message.

Table 5-6 Data Request Table

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Address Field	Function Field	Data Start Register HI	Data Start Register LO	Number of Registers HI	Number of Registers LO	Byte Count	Data Field 1 HI
01H	10H	41H	10H	00H	02H	04H	00H

Byte 9	Byte 10	Byte 11	Byte 12~32
Data Field 1 LO	Data Field 2 HI	Data Field 2 LO	Error Check Field
32H	00H	01H	00H

Response

The normal response to a preset multi-register request includes the AcuDC-301 address, function code, data start register, the number of registers, and error checking.

Table 5-7 Data Response Table

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7~32
Address Field	Function Field	Data Start Register HI	Data Start Register LO	Number of Registers HI	Number of Registers LO	Error Check Field
01H	10H	41H	10H	00H	02H	00H

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