PART OF
BEMSIQ
GROUP

OPERATOR'S GUIDE

FLEX Point™ Software

Commissioning & Integration

Software for:

PowerScout™ FLEX Series: 3 | 12 | 24 | 48

Rev Date: 5/20/26 | © 2026 DENT Instruments, Inc. All rights reserved.

Table of Contents

1. Introduction

1.1. Purpose of this guide

The purpose of this guide is to provide the necessary information to successfully set up and configure your PowerScout™ FLEX meter. This guide primarily provides instructions on utilizing the FLEXPoint™ and FLEXPoint™ GO software applications.

FLEXPoint FLEXPoint GO

Supported Models

This guide covers all available models of the PowerScout™ FLEX meter line. FLEXPoint™ software is only compatible with the PowerScout™ FLEX meter line.

1.2. Communication Interfaces Overview

The PowerScout™ FLEX meter communication interfaces include Ethernet (LAN) or RS-485 serial. BACnet MS/TP and Modbus RTU are the two communication protocols that operate over an RS-485 serial network and BACnet IP and Modbus TCP are supported over Ethernet. A USB port is also provided as the preferred connection for on-site configuration and can be run concurrently with an RTU.

1.3. Additional Resources

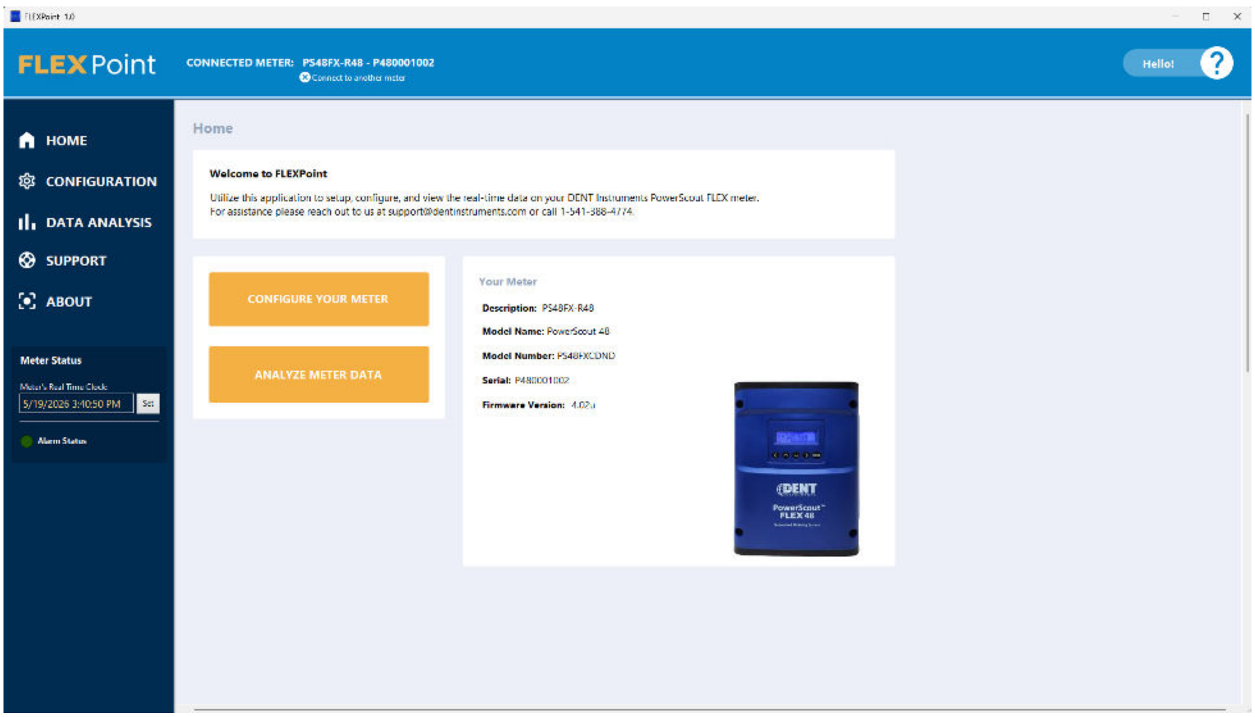
Additional information about the capabilities of FLEXPoint™ software are presented in short videos and can be found at https://www.dentinstruments.com/resources/video

2. FLEXPoint™

2.1. Overview

FLEXPoint

FLEXPoint™ is a Windows application designed to easily configure, manage, and view your PowerScout™ FLEX meter setup and data. The application has been created with user experience in mind and modeled after modern application design best practices and standards.



The application interface is broken down into clear navigable sections to configure your meter, view the real-time data, and get support for your PowerScout™ FLEX meter quickly and easily.

2.2. Basic Workflow

Installation Preparation

Identify and plan your meter installation by identifying loads to be measured, load types, service types, CT types, and communication methods.

Connect to your meter

Install the FLEXPoint™ software and connect to your meter via USB or Ethernet.

Configure Virtual Meters

According to your specific requirements, configure the necessary virtual meters. For detailed instruction, follow the steps outlined in the "Virtual Meter Setup" section below.

Adjust Device Settings

Make any necessary device settings changes. For detailed instruction, follow the steps outlined in the "Device Settings Configuration" section below.

Install Meter (If not yet installed)

As outlined in the installation manual, install the meter in the site location and make all necessary wiring and CT connections as needed for your requirements.

Verify Real Time Data

In the FLEXPoint™ application, navigate to the "Data Analysis" screen to view and validate the real-time data values coming from the meter.

2.3. Software Setup

2.3.1. Installing FLEXPoint™

Download the latest version of the FLEXPoint™ software from https://www.dentinstruments.com/software-downloads/flexpoint-PowerScout-flex-series/

Begin the installation by double-clicking the executable. Follow the on-screen instructions to complete the installation. If desired, you may change the file install location during the installation steps.

The FLEXPoint™ software requires the *National Instruments 2021 LabVIEW* runtime engine to operate. If necessary, the installer will install the necessary runtime files to allow for full functionality.

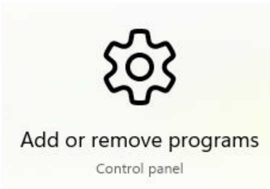
Software Requirements: FLEXPoint™ software is compatible only with PowerScout™ FLEX meters and is supported on Windows 10 and Windows 11.
Note: FLEXPoint™ is not supported on ARM-based processors.

2.3.2. Installation Troubleshooting

Successful installation of FLEXPoint™ application may be prevented by settings specific to your PC for the following reasons:
1) Anti-virus protection software may interfere with the installation of FLEXPoint™. If the installation is not completed for this reason, try temporarily disabling the virus protection software on your PC and re-attempt the installation.
2) Administrative Access. In some cases, user privilege settings may disallow the installation of new applications. This may require logging in as an administrator.

2.3.3. Uninstallation Procedure

To uninstall FLEXPoint™, navigate to the Add/Remove Programs section in the Windows settings, select the FLEXPoint™ application, and then click uninstall.

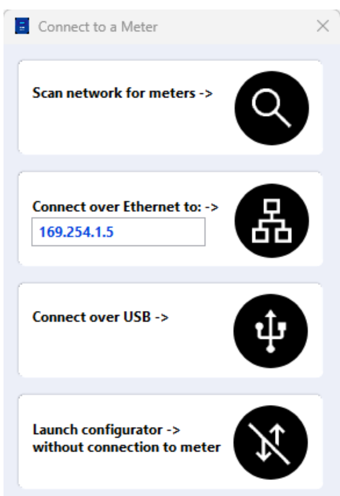


2.4. Connecting to the Meter

2.4.1. FLEXPoint™ Connection Modes

When the FLEXPoint™ application is launched, it will prompt the user to select one of four connectivity options.

- Scan Network for Meters
- Connect over Ethernet to a Predetermined IP address
- Connect over USB cable (A to C)
- Launch without connection (no meter connected)



Note: The USB connection method is recommended for new users who have physical access to the meter and the appropriate USB cable (supplied).

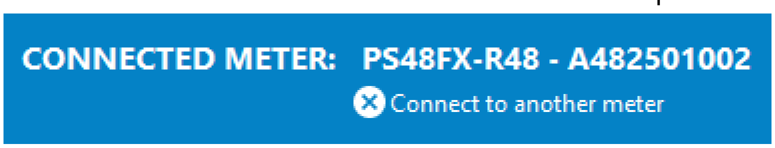
2.4.2. USB

Connect the PowerScout™ FLEX meter to a USB port of your computer to provide both power and communications.

a. If equipped, the LCD user interface is the most visible indication of a running meter.
b. For meters without a display, a green flashing LED on the circuit board indicates that the PowerScout™ FLEX meter has booted and is running.

Launch the application and press the "CONNECT OVER USB" button on the pop-up window.

The meter should be communicating. The FLEXPoint™ application offers visual guides and context help to facilitate meter configuration. By default, PowerScout™ FLEX meters are configured for DHCP Ethernet addressing. A very common configuration sequence is using USB to configure a meter for Ethernet communications at a static IP address and then switching from USB over to Ethernet to locate it. This is facilitated in FLEXPoint™ by pressing the "Connect to Another Meter" icon located in the top bar within the application.



2.4.3. Ethernet

Configuring the PowerScout™ FLEX over Ethernet requires that the meter be powered via a second connection, either USB or line power (L1-L2). The PowerScout™ FLEX does not support Power Over Ethernet (POE). If the meter is already installed within the building's electrical network, closing the AC breaker (or approved disconnect) will turn on the meter through the meter's internal power supply. In the rare case that a computer's USB port cannot provide enough current, an AC / USB charger or a USB battery can be used as a power source while using Ethernet for communications.

Dynamic Host Configuration Protocol (DHCP):

PowerScout™ FLEX meters are shipped in DHCP mode to prevent IP conflicts with other equipment. The meter is expecting to receive an IP address from a DHCP service provided by a router, Layer 3 switch, or a server providing DHCP service. Under this configuration, if the PowerScout™ FLEX meter and the host PC are requesting an IP address from the same DHCP service provider, they will be able to communicate. Upon powering up, the PowerScout™ FLEX meter will indicate the IP address on the LCD user interface (if equipped) or can be found using the Network Scan function.

Direct:

When a PC is directly connected to a PowerScout™ FLEX meter via an ethernet cable, no DHCP service exists. This configuration can be made to work but requires changes to either the meter communication settings or the PC network configuration.

LCD User Interface

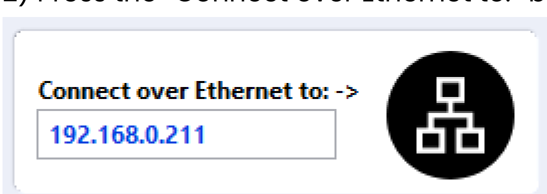
For units equipped with an LCD user interface, navigate to:

Communications > Ethernet Settings > DHCP > OFF

Change the IP address in the meter to match the subnet of your PC's IP address, making the meter IP unique, or note the current address on the meter and prepare to configure your PC's IP settings as shown on the next page.

Once the PC and PowerScout™ FLEX are set to communicate on the same IP subnet:

1) Launch the FLEXPoint™ application and enter the IP address of the meter (shown as the factory default).
2) Press the "Connect over Ethernet to:" button on the pop-up window.

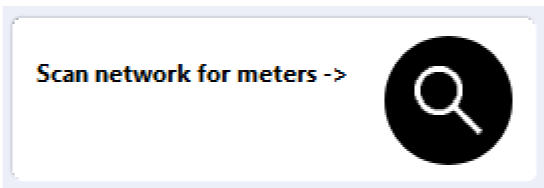


The meter should be communicating.

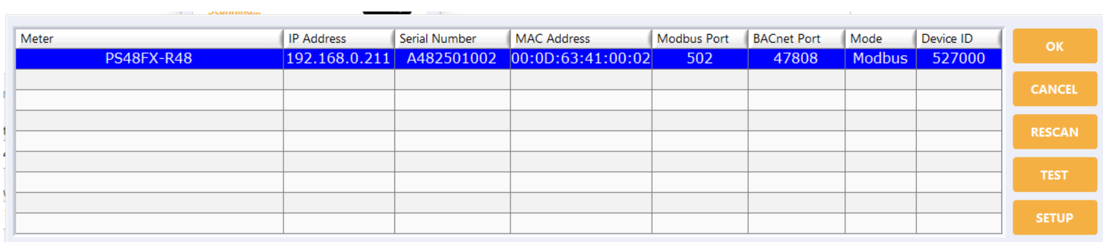
Meters without an LCD User Interface

A PowerScout™ FLEX meter without an LCD user interface has no way to communicate to the user its IP address and is only recommended if the meter has been previously set to a known static address. Setting the IP address must be done ahead of time using another interface such as FLEXPoint™ over USB or via user-supplied applications over RS-485.

2.4.4. Network Scan Tool



Network Scan is a feature for monitoring previously installed and configured PowerScout™ FLEX meters over an Ethernet network. Network Scan will broadcast a User Datagram Protocol (UDP) discovery packet on the same network as the PC running the FLEXPoint™ application. Normally this will be performed on a corporate network running DHCP. Any PowerScout™ FLEX meter that responds will be displayed in a table that includes the system description register, IP address, serial number, and communication configuration.



Highlight the desired meter and select OK, Test, or Setup. Note that the effectiveness of this technique is highly dependent on the configuration of the PC running FLEXPoint™ (which may have more than one network card) and the network configuration. Rescans can be used to make multiple attempts to locate a particular meter on busy networks (UDP has no built-in retry provisions).

2.4.5. Connection Limitations

Each PowerScout™ FLEX meter can support no more than 4 concurrent connections.

2.5. Configuration

2.5.1. Virtual Meter Setup

Virtual meters are the primary advantage of the PowerScout™ FLEX product line. Your PowerScout™ FLEX meter is designed with maximum flexibility in mind. You can configure as many virtual meters as needed for your requirements up to the maximum number of virtual meters supported by your specific model.

By default, your PowerScout™ FLEX meter has no factory virtual meters configured.
To create your first virtual meter, click the "Add Virtual Meter" button.

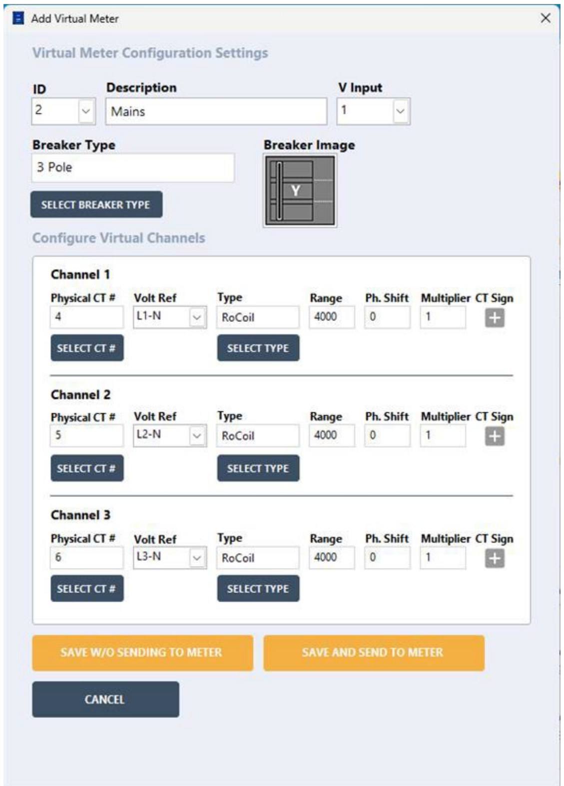
For each virtual meter, you will configure the following options:

- **Description**
- **Voltage Input**
- **Breaker Type**
- **Virtual Channels**

For each virtual channel, you will identify the following configuration options:

- **Physical CT#**
- **Volt Reference**
- **CT Type**
- **Range**
- **Phase Shift**
- **Multiplier**
- **CT Sign**

Configure your virtual meter options according to the physical setup on your electrical loads you intend to monitor.



Follow the steps below for each virtual meter you intend to configure.

1. First, give your virtual meter a description. We recommend a description that will help you clearly identify what loads you are measuring. In the example above, "Mains" is set as the description.

2. If applicable for your meter type, make sure to identify the correct voltage input reference.

3. Select the load circuit breaker type you will be monitoring according to your wired setup.

4. The next step is to configure your virtual current channels associated with this meter.

This is where the flexible capabilities of the PowerScout™ FLEX meter comes in. For each virtual meter you can assign up to 3 virtual current channels as necessary. Each channel can be associated with any physical CT attached to your meter. This capability allows you to maximize your meter's available CT inputs and allows for simple straightforward one-time CT setup.

---

5. Next, choose your voltage reference according to your CT wiring.

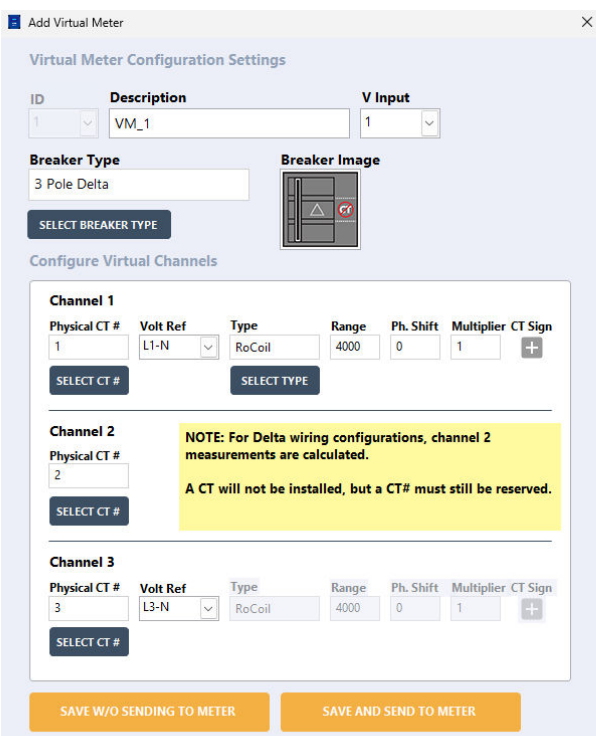
6. And finally, identify your CT details by clicking the "Select Type" button. You can choose your specific CT from the CT picker list. If you need to make any adjustments to the phase shift, multiplier, or CT sign polarity fields, you can do so.

   Most configurations will have the same CT attributes for each virtual current channel, however, if necessary, you can choose to configure a different CT type for each available channel.

Once all your virtual current channels have been configured, save your new virtual meter by clicking the "Save and send to meter" button. This will automatically send your new virtual meter to your PowerScout™ FLEX meter.

NOTE: Delta Load Configuration

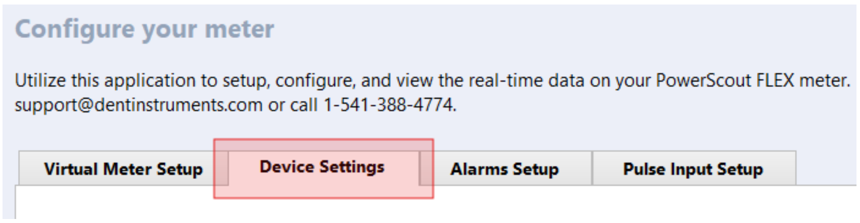
When configuring a virtual meter for a delta load breaker type, it is required to consume a CT input for all 3 channels, even though no physical CT will be connected to channel 2. See the screenshot below as an example:



2.5.2. Device Settings

All device-wide settings can be found within the "Device Settings" tab in the configuration section.

To access the settings, connect to your meter using FLEXPoint™, navigate to the configuration section, then click the "Device Settings" tab.



2.5.3. General Settings

In the device settings tab, scroll to the "General Settings" section.

Within the general settings, you may adjust the following options:

- **System Description**
  The system description can be used to uniquely identify the PowerScout™ FLEX meter.
- **V Input 1 Multiplier**
  Voltage multiplier settings allow potential transformers to be used with the PowerScout™ FLEX meter. This allows for transformer winding ratios or other scaling adjustments to be included in the meter processing to eliminate post process scaling. Adjustments for voltage are global to the meter while CT's can be adjusted on a channel-by-channel basis. The multiplier is a floating-point number and can also be used for post installation calibration if desired.
  Valid range: 0.9 – 10000
- **V Input 2 Multiplier (if applicable)**
- **Power Factor Sign Convention**
  Power Factor is the ratio of a signed number (true power) and an unsigned number (apparent power).

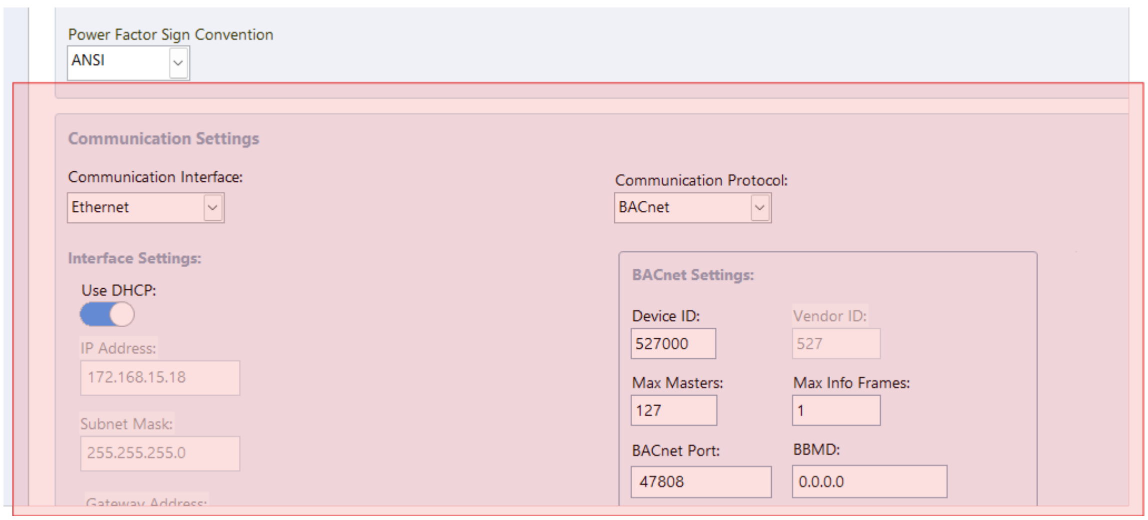
This discrepancy has led to some user confusion. The PowerScout™ FLEX meter allows users to select between two conventions (ANSI & IEEE).

In the IEEE convention, the sign of PF follows the sign of power itself. In the ANSI convention, a "+" PF indicates a lagging current (inductive load) while a "−" PF indicates a leading current (capacitive load).

2.6. Communication Setup

In the device settings tab, scroll to the "Communication Settings" section.

Within the communication settings section, you can choose which communication interface you would like to configure the meter with (Ethernet or RS-485) and additionally, which communication protocol you will be using to communicate with the meter.



2.6.1. Communication Interface Options

Ethernet

For ethernet, you can choose to configure the device for DHCP or enter your network settings manually.

If the PowerScout™ FLEX meter is configured for DHCP when the meter is powered on, or the Ethernet cable is inserted, the meter is assigned an IP address by the DHCP server. This address appears on the meter's LCD user interface or by viewing the communication settings through FLEXPoint™. PowerScout™ FLEX meters are set to use DHCP as a default setting.

When DHCP is turned off, enter the relevant network related settings according to your network configuration. You will need the following:

- IP Address assigned to the meter
- Subnet Mask
- Default Gateway Address

RS-485

For RS-485 serial communication, make sure to select the RS-485 option in the communication interface dropdown.
When selected, the following configuration options are available:

- **Data Bits**
- **Parity**
- **Baud Rate**
- **Slave Address**

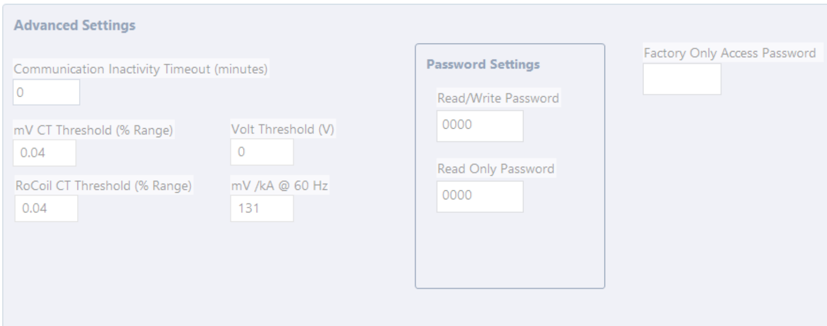
Configure each option as necessary for your serial device.

Communication Protocol Options

- **Modbus**
  No additional protocol settings required when communicating via Modbus.
- **BACnet**
  For BACnet the following configuration options are available:
  - Device ID
  - Vendor ID (optional)
  - Max Masters (optional)
  - Max Info Frames(optional)
  - BACnet Port (optional)
  - BBMD (optional)

Configure each option as necessary for your requirements.

2.7. Advanced Settings



Within the advanced settings you can adjust the following options:

- **Communication Inactivity Timeout**
  Resets the processor if no comms are detected for N minutes (0 is disabled)
- **mV CT Threshold**
  Report 0 rather than values below this % of CT full scale, use with caution
- **RoCoil CT Threshold**
  Report 0 rather than values below this % of 4000A, use with caution
- **Volt Threshold**
  Report 0 rather than values below this absolute voltage, use with caution
- **mV /kA @ 60hz (RoCoil Output)**
  Gain at 60 HZ, use with caution (preset to 131)
- **Password Settings**
  The read only password and read/write password options can be set to restrict access to the meter's LCD screen and web application.

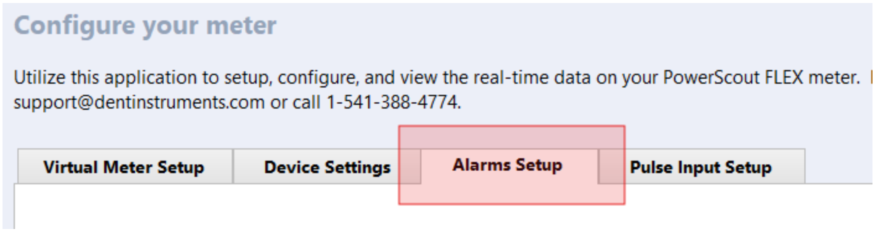
Each password option can be a 4-digit numerical value.

PINs are also accessible as Modbus registers but are encoded so that reading the value of the register through an RTU does not inform a user what the password is. This feature allows DENT Instruments to support retrieval of forgotten PINs if network access is available.

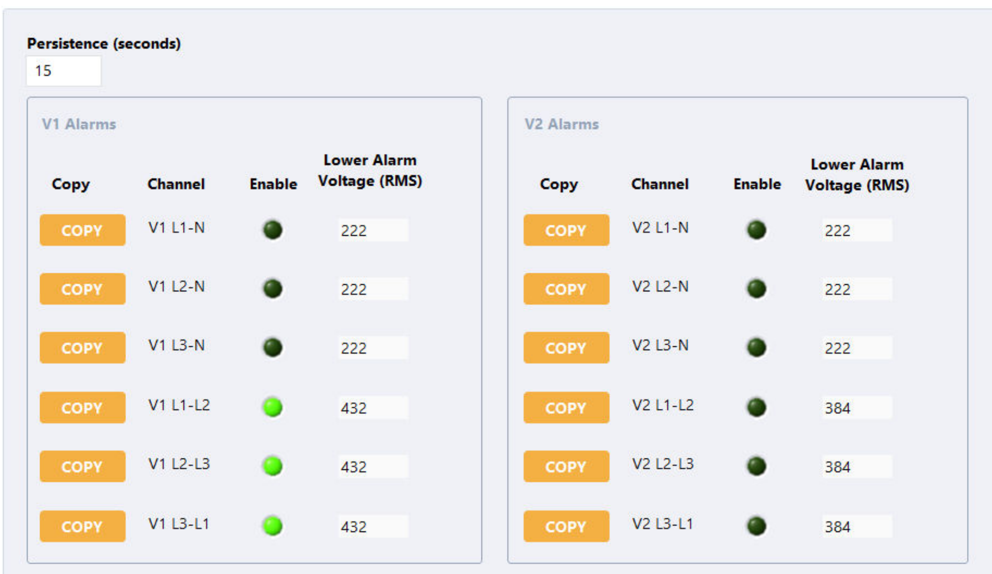
2.7.1. Alarm Configuration

All PowerScout™ FLEX meters can set conditional alarms.

To access the alarm setup screen, connect to your meter using FLEXPoint™, navigate to the configuration section, then click the "Alarms Setup" tab.



Integer Values can be entered for Voltage Input 1 (PS3FX and PS12FX meters) and Voltage Input 2 (PS24FX and PS48FX meters) for L-N and L-L voltage measurements.
Alarms are activated by toggling the "Enable" button for each voltage reference independently and pressing the "Send Alarm Setup to Meter" button.
An example of a 10% drop in a 480 VAC Delta System is shown below. Only Line to Line measurements for Voltage Input 1 are enabled.



Lower Alarm Voltage values can be copied to other voltage references using the "Copy" button, which brings up a dialog and allows the user to choose which references to copy.

The Alarm Persistence field is user-configurable, and the time can be adjusted from 15-60 seconds. The alarm condition must be continually expressed for the persistence time to trigger the alarm. This behavior helps reduce false positives on momentary voltage changes or events that cause the meter to reboot such as changing communication settings.

A triggered alarm will cause the Alarm Status indicator in the left-hand navigation bar to turn red. If an alarm is enabled but not triggered, the indicator will be bright green. If no alarms are enabled, the indicator remains dark.

Host systems are notified of an alarm via a hardware circuit (normally low) that can be wired to an interrupt input. Details about which alarm triggered are determined by reading the status registers under the alarm block 2450 – 2500.
The alarm will be expressed whenever the condition exists and will clear itself if measured values exceed the trigger points. Alarm conditions are evaluated by the meter once per second.

2.8. Real Time Data Analysis

The PowerScout™ FLEX meter provides a plethora of measured and calculated energy related data according to the configured loads. Under the data analysis screen, you can navigate to the following tabbed data sections:

- Power
- Energy
- Energy (Advanced)
- Power Factor
- Demand
- Waveform Capture
- Harmonics
- Phasor Plot

Each tab will dynamically poll the meter and gather the relevant data as configured in the virtual meter setup configuration.

2.8.1. Power

Within the power tab, you can view the RMS measurement of Line to Neutral and Line to Line.

Frequency (Hz): 60.00

Voltage	L1-N	L2-N	L3-N	L-N Average	L1-L2	L2-L3	L3-L1	L-L Average
V Input 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Additionally, for each configured virtual meter, you can view the measured voltage, current, kW, kVA, kVAR, and dPF for each channel and the whole virtual system.

	Mains (ID: 1)			
	V Input 1			
	CT 1	CT 2	CT 3	System
V Reference	L1-N	L2-N	L3-N	L-N Avg
Voltage (V)	0.00	0.00	0.00	0.00
Current (A)	0.01	0.00	0.00	0.00
kW	0.00	0.00	0.00	0.00
kVA	0.00	0.00	0.00	0.00
kVAR	0.00	0.00	0.00	0.00
dPF	1.00	1.00	1.00	1.00

- **Voltage (V)**
  - **Voltage** is the electrical potential difference between two points.
  - Unit: **Volts (V)**
  - In power systems: Determines how strongly current is driven through loads.
- **Current (A)**
  - **Current** is the flow of electric charge through a conductor.
  - Unit: **Amps (A)**
  - In power systems: Current increases as more electrical load is connected.
- **kW (Kilowatts) – Real Power**
  - **kW** is the amount of *real (true) power* being consumed and converted into useful work.
  - Unit: **Kilowatts (kW)**
- **kVA (Kilovolt-Amps) – Apparent Power**
  - **kVA** is the total power supplied to a load, combining both real and reactive components.
  - Unit: **Kilovolt-Amps (kVA)**
  - It represents the total electrical demand placed on the system.
- **kVAR (Kilovolt-Amp Reactive) – Reactive Power**
  - **kVAR** represents the portion of power that oscillates back and forth between the source and reactive elements of a load (inductors and capacitors), sustaining electric and magnetic fields but not performing net useful work.
  - Unit: **Kilovolt-Amp Reactive (kVAR)**
- **dPF (Displacement Power Factor)**
  - **dPF** stands for **Displacement Power Factor**.
  - Describes how well the timing of electrical current lines up with the timing of voltage in an AC system.

2.8.2. Energy

Within the Energy tab, you can view accumulated energy data within each configured virtual meter. Each virtual meter will display kWh, kVAh, and kVARh.

Time since reset: (Days) 25.52

Mains (ID: 1) CLEAR

	CT 1	CT 2	CT 3	System
kWh	0.00	0.00	0.00	0.00
kVAh	0.00	0.00	0.00	0.00
kVARh	0.00	0.00	0.00	0.00

- **kWh (Kilowatt-hour) - Real Energy**
  kWh is the total amount of real (useful) energy consumed over time.

$$kWh = kW \times \text{hours}$$

- **kVAh (Kilovolt-amp hour) - Apparent Energy**
  kVAh is total apparent energy delivered over time.

$$kVAh = kVA \times \text{hours}$$

- **kVARh (Kilovolt-amp reactive hour) - Reactive Energy**
  kVARh is reactive energy over time.

$$kVARh = kVAR \times \text{hours}$$

Each virtual meter's accumulated energy data can be cleared on demand. Additionally, the accumulated entire meter's energy data can be cleared.

2.8.3. Energy (Advanced)

The energy (adv) tab will display cumulative energy flow in all four quadrants of operation, capturing real energy (kWh), apparent energy (kVAh), and reactive energy (kVARh) for both import (energy delivered to the load) and export (energy returned to the source). These measurements support bi-directional power systems such as facilities with on-site generation, energy storage, or regenerative loads. The meter distinguishes between real, apparent, and reactive energy components and tracks reactive energy separately in each quadrant (Q1–Q4), enabling full four-quadrant energy analysis and accurate assessment of load behavior, power factor, and system power flow direction.

Mains (ID: 1) CLEAR

	CT 1	CT 2	CT 3	System
kWh (Import)	0.00	0.00	0.00	0.00
kWh (Export)	0.00	0.00	0.00	0.00
kWh (Net)	0.00	0.00	0.00	0.00
kVAh (Import)	0.00	0.00	0.00	0.00
kVAh (Export)	0.00	0.00	0.00	0.00
kVAh (Net)	0.00	0.00	0.00	0.00
kVARh (Import Q1)	0.00	0.00	0.00	0.00
kVARh (Import Q2)	0.00	0.00	0.00	0.00
kVARh (Export Q3)	0.00	0.00	0.00	0.00
kVARh (Export Q4)	0.00	0.00	0.00	0.00
kVARh (Net)	0.00	0.00	0.00	0.00

kWh (Import)

Total real energy delivered from the source (e.g., utility grid) to the load over time. This represents energy consumed by the facility and typically forms the basis for energy billing.

kWh (Export)

Total real energy delivered from the load back to the source. This occurs when on-site generation (such as solar) exceeds facility demand.

kWh (Net)

The algebraic difference between imported and exported real energy:

- **kWh (Net) = kWh (Import) - kWh (Export)**
  Positive values indicate net consumption; negative values indicate net generation.

kVAh (Import)

Total apparent energy supplied to the load. This includes both real and reactive components and reflects total system loading on conductors, transformers, and switchgear.

kVAh (Export)

Total apparent energy delivered back to the source. This reflects the total exported system load including both real and reactive components.

kVAh (Net)

The algebraic difference between imported and exported apparent energy. This represents the net apparent energy exchange over time.

kVARh (Import Q1)

Reactive energy imported in Quadrant 1:

- Real power (kW) positive
- Reactive power (kVAR) positive

  This typically represents inductive reactive energy absorbed by the load while consuming real power.

kVARh (Import Q2)

Reactive energy imported in Quadrant 2:

- Real power negative
- Reactive power positive

  This represents inductive reactive energy imported while real power is being exported.

kVARh (Export Q3)

Reactive energy exported in Quadrant 3:

- Real power negative
- Reactive power negative

  This represents capacitive reactive energy exported while real power is also exported.

kVARh (Export Q4)

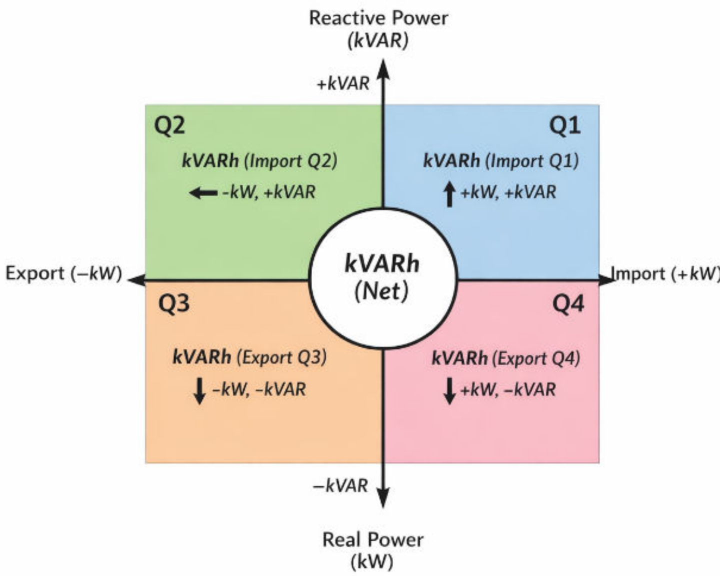
Reactive energy exported in Quadrant 4:

- Real power positive
- Reactive power negative

  This typically represents capacitive reactive energy supplied back to the source while consuming real power.

kVARh (Net)

The algebraic sum of reactive energy across all four quadrants. This indicates the net reactive energy exchange over time and can be used to evaluate overall reactive power behavior and long-term power factor performance.



2.8.4. Power Factor

The meter provides multiple power quality and power factor measurements to fully characterize how efficiently electrical power is being used and how waveform distortion affects system performance. Apparent Power Factor represents overall power utilization efficiency, incorporating both phase shift and harmonic distortion effects. Displacement Power Factor isolates the phase relationship between the fundamental voltage and current waveforms. Distortion Power Factor quantifies the impact of harmonic currents on total RMS current. Phase Angle indicates the angular separation between voltage and current fundamentals, and THD% (Total Harmonic Distortion) measures the degree of waveform distortion caused by harmonics. Together, these values provide a complete assessment of load behavior, power quality, and system efficiency.

	Mains (ID: 1)			
	CT 1	CT 2	CT 3	System
Apparent PF	1.00	1.00	1.00	1.00
Displacement PF	1.00	1.00	1.00	1.00
Distortion PF	1.00	1.00	1.00	1.00
Phase Angle	180.00	180.00	180.00	
THD (%)	0.00	0.00	0.00	0.00

Apparent Power Factor (True Power Factor)

Apparent Power Factor is the ratio of real power to apparent power:

$$\text{Apparent PF} = \frac{kW}{kVA}$$

It reflects the **overall efficiency** of power usage, including both phase displacement and harmonic distortion effects. Values range from 0 to 1 (or -1 to 1 depending on sign convention). This is the most comprehensive measure of power factor and is often used for system performance evaluation and utility compliance.

Displacement Power Factor (dPF)

Displacement Power Factor is defined as:

$$\text{dPF} = \cos(\theta)$$

where θ is the phase angle between the **fundamental voltage and current waveforms**.

It reflects only the effect of phase shift caused by inductive or capacitive loads and assumes sinusoidal waveforms. It does not account for harmonic distortion. A value close to 1 indicates minimal phase shift. dPF is used to determine if power factor correction is required for a load.

Distortion Power Factor

Distortion Power Factor quantifies the reduction in power factor caused by harmonic current distortion:

$$\text{Distortion PF} = \frac{I_1}{I_{RMS}}$$

where:

- I_1 = RMS value of the fundamental current
- I_{RMS} = Total RMS current including harmonics

As harmonic current increases, total RMS current increases and distortion power factor decreases. This value isolates the harmonic contribution to reduced power factor.

Phase Angle (θ)

Phase Angle is the angular difference between the fundamental voltage and current waveforms, measured in degrees.

- Positive angle → current lags voltage (inductive load)
- Negative angle → current leads voltage (capacitive load)
- 0° → purely resistive load

Phase Angle directly determines Displacement Power Factor:

$$\cos(\theta) = \text{dPF}$$

THD (%) — Total Harmonic Distortion

THD% measures the amount of harmonic distortion present in a waveform relative to its fundamental component.
For current:

$$THD_I = \frac{\sqrt{I_2^2 + I_3^2 + I_4^2 + \cdots}}{I_1} \times 100\%$$

For voltage:

$$THD_V = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + \cdots}}{V_1} \times 100\%$$

THD indicates waveform distortion caused by nonlinear loads such as VFDs, rectifiers, LED drivers, and switching power supplies. Higher THD increases RMS current, contributes to heating losses, and lowers overall (apparent) power factor.

2.8.5. Demand

The meter calculates demand values using a sliding **15-minute demand window**, representing the average power over each rolling block (sliding window) 15-minute interval. Demand measurements indicate the rate at which power is being used, rather than total energy consumed. kW demand reflects real power usage, while kVA demand reflects total apparent power loading on the electrical system. “Present” demand represents the current active 15-minute interval, and “Peak” demand records the highest measured 15-minute demand value since the last reset. These values are commonly used for utility billing, capacity planning, and system loading analysis.

Virtual Meter	kW Demand Present	kW Peak Demand	kVA Demand Present	kVA Peak Demand
Mains (ID: 1)	0.000	0.000	0.000	0.000
VM 2 (ID: 2)	0.000	0.000	0.000	0.000

kW Demand Present

The average real power (kW) measured over the current 15-minute demand interval.

- Represents the current rate of real energy consumption.
- Updates every minute during the active demand window.
- Used to monitor real-time loading relative to demand thresholds.

This value reflects actual usable power (kW) being consumed by the facility.

kW Demand Peak

The highest 15-minute average real power (kW) measured since the last demand reset.

- Captures the maximum real power demand event.
- Often used by utilities to determine demand charges.

- Critical for managing peak load costs.

This value indicates the facility's maximum real power requirement during the measurement period.

kVA Demand Present

The average apparent power (kVA) measured over the current 15-minute demand interval.

- Includes both real (kW) and reactive (kVAR) components.
- Represents total system loading on transformers, conductors, and switchgear.
- Reflects infrastructure stress, not just usable power.

This value is important in facilities where power factor impacts system capacity or billing.

kVA Peak Demand

The highest 15-minute average apparent power (kVA) measured since the last reset.

- Indicates the maximum total electrical loading on the system.
- May be used for utility billing where demand charges are based on kVA.
- Important for sizing generators, transformers, and service capacity.

Practical Difference Between kW and kVA Demand

- **kW Demand** → Reflects real power doing useful work.
- **kVA Demand** → Reflects total system loading, including reactive power.

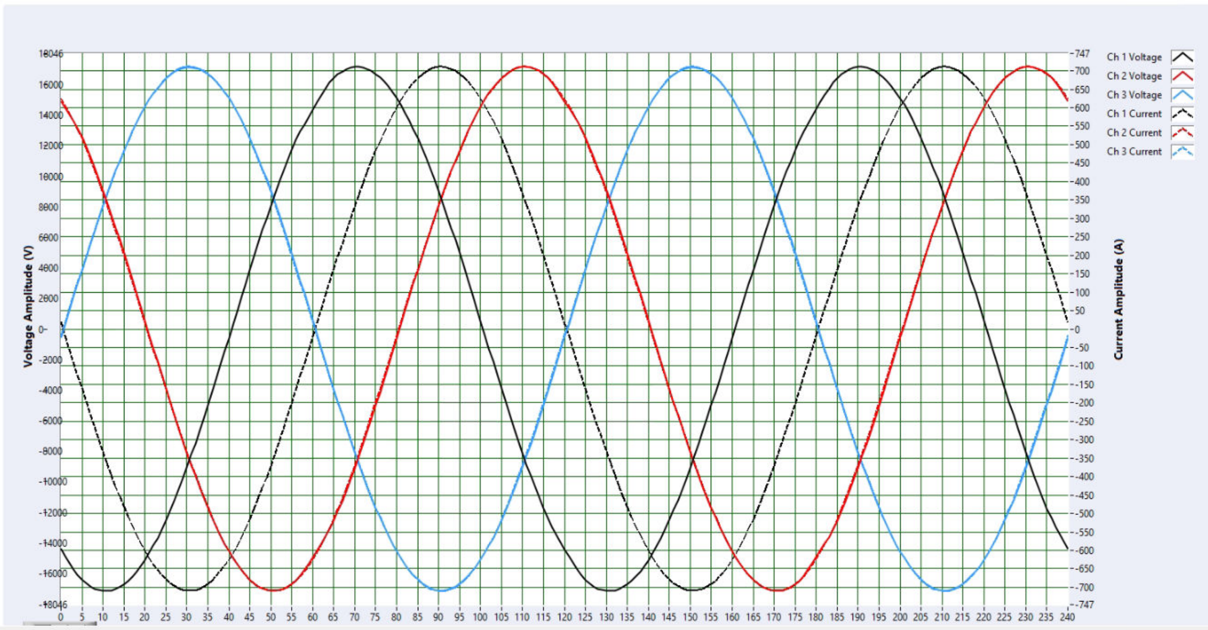
If power factor is less than 1.0:

$$kVA > kW$$

Meaning apparent demand charges or equipment loading may be higher than real demand alone would suggest.

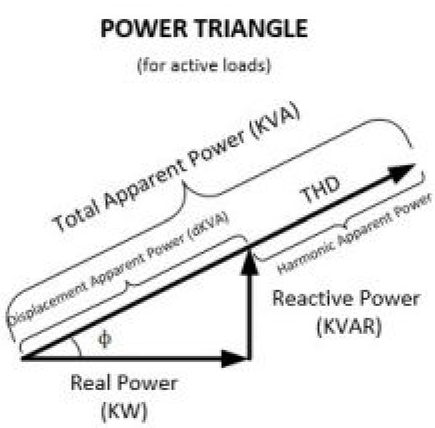
2.8.6. Waveform Capture

Waveform capture data provides high-resolution, time-domain recordings of voltage and current signals. Unlike standard RMS, energy, or demand measurements (which are averaged values), waveform capture preserves the actual instantaneous shape of the electrical waveforms. This data is used to analyze transient events, power quality disturbances, harmonic distortion, and other abnormal system conditions. Waveform capture enables detailed forensic analysis of electrical events that cannot be fully understood through averaged measurements alone.



2.8.7. Harmonics

The PowerScout™ FLEX meter reports overall harmonic content in power (% THD) based on its measurement of Power, Var, and Apparent Power as illustrated in the figure below. This method cannot indicate the harmonic number or distribution but provides the overall harmonic content.



In many circumstances, users are interested in the harmonic content of current. In cases where the voltage is very sinusoidal, the THD measurement is a good estimate of both power and current. However, if the voltage waveform is distorted, the reported THD in power can be misleading. FLEXPoint™ can provide additional analysis of harmonic content in voltage and current by sampling the PowerScout™ FLEX raw data and performing digital signal processing on the signal. Using this method, the individual harmonics levels can be observed. The results are presented in graphical form.

2.8.8. Phasor Plot

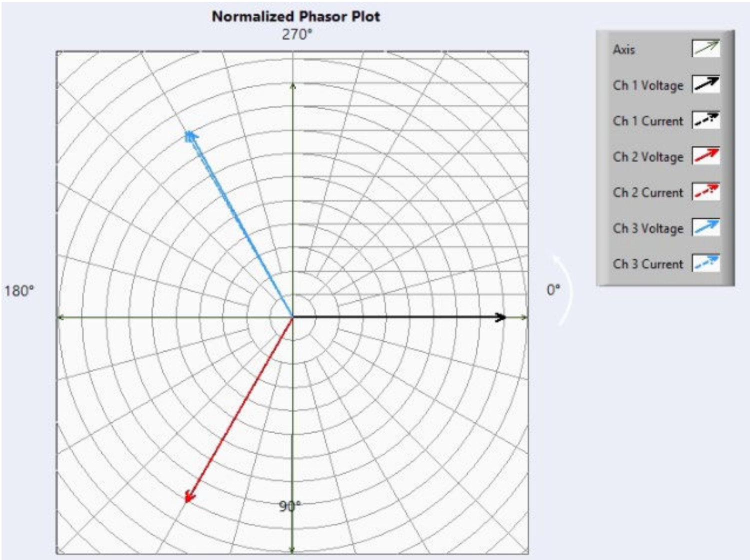
The meter's phasor plot is a graphical representation of the magnitude and phase angle of sinusoidal voltage and current waveforms at the fundamental frequency. While waveform capture shows the instantaneous time-domain shape of voltage and current signals, a phasor plot converts those same waveforms into a frequency-domain vector representation. This makes it easier to visualize phase relationships, magnitude balance, and system conditions in a steady-state AC system.

From captured waveform data, the meter extracts the **fundamental frequency component** (e.g., 50 Hz or 60 Hz) using Fourier analysis. Each fundamental component is then represented as a rotating vector (phasor) with:

- **Length** proportional to RMS magnitude
- **Angle** representing phase position relative to a reference (typically Phase A voltage)

Each phasor (vector) contains two key pieces of information:

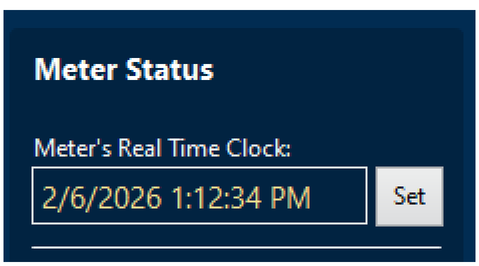
1. **Magnitude**
    - Voltage magnitude (V RMS)
    - Current magnitude (I RMS)
    - Represented by vector length
2. **Phase Angle**
    - Angular displacement relative to a reference waveform
    - Measured in electrical degrees



2.9. Real Time Clock

The PowerScout™ FLEX meter includes a Real Time Clock (RTC). The clock is used only to time stamp Interval Data in the log; it is not used for calculation within the meter. For users of the Interval Data Recording (IDR) function of the meter, it is helpful (but not strictly necessary) to set the real time clock so that data records can be uniquely identified.

The Real Time Clock is visible in the left-hand navigation bar and can be set by clicking the "Set" button.



The clock icon launches the Calendar window and allows the user to set any desired date and time. "Set Time to Now" populates the sets the time and date to match the PC. Press the "OK" button to commit this time to the RTC chip onboard the meter.

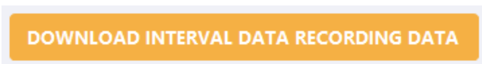
Real Time Clock Power Source

The RTC integrated circuit is a standalone low power circuit within the PowerScout™ FLEX meter. Time is kept in the absence of a connected external power source (AC or USB power) by a super capacitor. The capacitor can keep the RTC running over normal power outages (days to weeks) but is not expected to keep time while the meter is being stored or shipped.

2.10. Interval Data

The PowerScout™ FLEX meter maintains an internal log of the energy data (Net kWh) for each channel in the meter. This log is updated every 15 minutes and is always active. The meter stores 63 days' worth of 15-minute data in its memory. This data can be retrieved by users looking to restore gaps in data collection where RTUs may have been offline or communication has been interrupted.

To access the meter IDR data, navigate to the Device Settings Tab under the configuration screen. Toward the bottom of the tab, click the "Download Interval Data Recording Data" button. You will be prompted to save the file to your local PC.

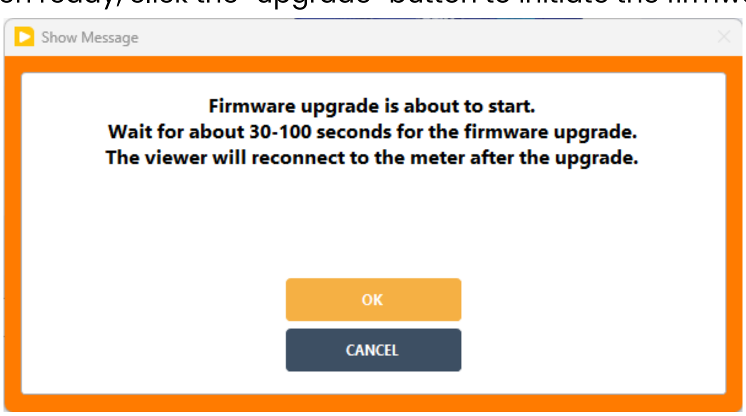


The data log is a Comma Separated Values (CSV) file that can be opened in Excel or another program. The data will be listed in chronological order according to an internal 32-bit sequence counter. The sequence counter can be used to merge separate files together, if necessary.

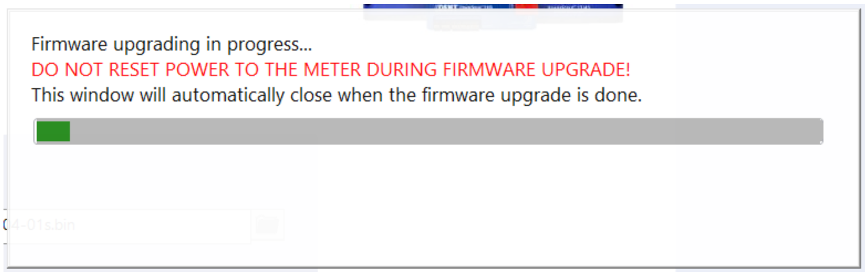
2.11. Firmware Updates

The meter firmware is updated, when necessary, in response to minor bug correction or customer requested features. The firmware update is expected to be downloaded. The basic updating procedure is as follows:

1) Download the latest firmware and FLEXPoint™ software update(from the DENT website).
2) Install the latest version of the FLEXPoint™ software.
3) Locate the appropriate binary file within the Firmware folder
4) In the FLEXPoint™ software, navigate to the "ABOUT" screen, and click the folder icon with the "Firmware Upgrade" section.
5) Locate the appropriate binary file on your computer and click ok.
6) When ready, click the "upgrade" button to initiate the firmware upgrade process.



7) FLEXPoint™ will display an in-progress message during the firmware installation process.



If successful, you will be notified on screen and your meter will reconnect.

2.12. macOS Support

The FLEXPoint™ application is not supported on the macOS platform. To access the meter configuration from a macOS device, utilize the FLEXPoint™ GO web server option as described below.

3. FLEXPoint™ GO – PowerScout™ FLEX Web App

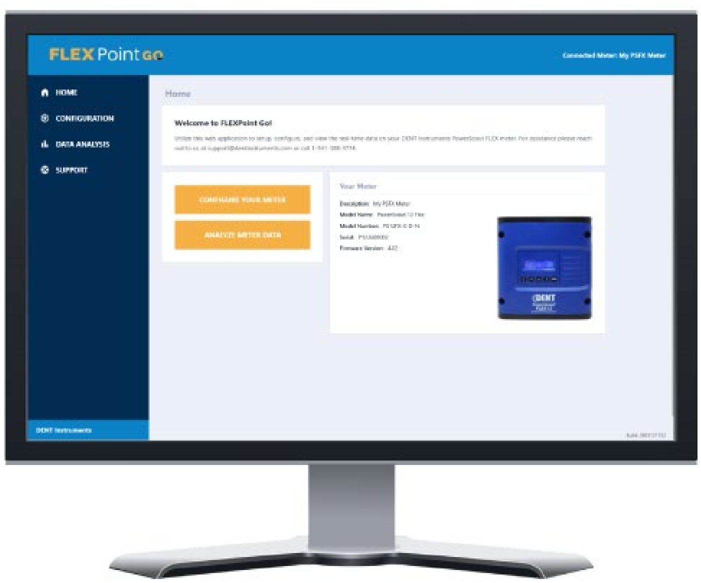
3.1. Overview

FLEX Point GO

In addition to the FLEXPoint™ application, you may configure your meter and view a subset of real-time data from the on-device web server, also known as FLEXPoint™ GO.

With FLEXPoint™ GO you can experience the same modern and user-friendly interface as FLEXPoint™ without needing to install any additional software on your PC.

The web server can be accessed directly within a web browser such as Google Chrome, Mozilla Firefox, or Microsoft Edge. (Note: Internet Explorer is not supported)

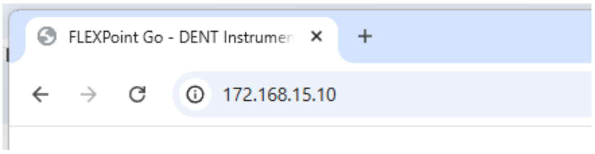


3.2. Ethernet Access

1) Discover the IP address of the meter by one of the following methods (a-c)
   a. Navigate to About Meter on the LCD user interface.
   b. Use a network discovery tool to find the address by connecting and disconnecting the Ethernet cable.
   c. Set the meter to a static address using the serial interface

2) Connect your device to the same subnet as the PowerScout™ FLEX meter

3) Open a web browser
4) Enter the Ethernet address into the web browser



3.3. Authentication

Because the FLEXPoint™ Go Web App can be viewed and controlled by any device with a web browser and communicates in parallel to the host system, the meter can be configured to require a PIN# to restrict access the meter.
Enter the PIN#, if assigned, or leave blank, if unassigned, and press the Login button.

3.4. Capabilities & Limitations

With FLEXPoint™ GO you can experience the same modern and user-friendly interface as FLEXPoint™ without needing to install any additional software on your PC.

The FLEXPoint™ Go Web App works much the same as FLEXPoint™. However, it has no advanced analytics data such as waveform capture, harmonics, or phasor plot data.

Additionally, some advanced device settings require the full FLEXPoint™ application to be installed.

4. Modbus Integration

4.1. Modbus RTU

In a Modbus network, each device must be assigned a unique slave address. Valid Modbus addresses are 1-240.

The slave address of the PowerScout™ FLEX meter needs to be set to match the address expected by the RTU and is normally part of the network specification. The default slave address for for Virtual Meter 1 (VM1) is 1.

For multi-element models, adjacent elements data can be accessed by incrementing the slave address by 1 up to the maximum number of 3 channel elements in the meter.

Note: The PS48 requires 15 addresses beyond VM1, the PS24 requires 7 addresses beyond VM1, and the PS12HD requires 3 addresses beyond VM1.

4.2. Modbus TCP

Modbus Port: The PowerScout™ FLEX meter uses the industry standard Port 502 for Modbus. This port number cannot be changed.

4.3. Register Organization

The PowerScout™ FLEX meter communicates through the reading and writing of registers. Registers are organized into functional groups and are based on the SunSpec Modbus interface model.

- SunSpec Common Registers
- SunSpec TCP Network Stack Registers
- SunSpec Serial Interface Registers
- SunSpec Energy Meter
- DENT Factory Registers
- DENT User Command Registers
- DENT User Configuration Registers
- DENT Metrology Registers
- DENT Waveform Capture Registers

The complete register list is available at: https://www.dentinstruments.com/tech-support-landing-page/powerscout-flex/register-list

4.4. Flattened Register List

PowerScout™ FLEX meters now support a fully flattened register list accessible via a single slave id.
Each virtual meter has a defined block of registers allocated for all of the specific registers associated to that meter.

For full register mappings, visit https://www.dentinstruments.com/tech-support-landing-page/powerscout-flex/register-list

4.5. Modbus Commands

The PowerScout™ FLEX networked power meter family follows the Modbus RTU protocol and supports the following command set.

Supported Modbus Commands		
Command Name	**Command Number**	**Description**
Read Holding Registers	03	Used to read the data values from the PowerScout™ FLEX meter
Write Single Register	06	Used to write a single holding register to a PowerScout™ FLEX meter
Write Multiple Registers	16 (0x10)	Used to write multiple registers (useful but not required for 32-bit values and strings)
Report Slave ID	17 (0x11)	Used to read information from the identified PowerScout™ FLEX meter

4.6. String Handling

Registers that are identified as "strings" are handled uniquely by the PowerScout™ FLEX power meter. Each register in the string block must be written to sequentially, without interruption, either by using a "write multiple" command or by sending single register commands back-to-back. The final character in the string MUST be a NULL character (ASCII 0). The meter will process the entire string only if these two conditions are met, otherwise the data is ignored. This special processing has been implemented to protect partial updates for network settings.

4.7. Floating Point Settings

The PowerScout™ FLEX meter uses 32-bit IEEE 754 formatted floating-point numbers for reporting results and storing scalable user register values such as CT range, CT and PT scaling factors, etc. Because these registers require two 16-bit Modbus addresses to convey, these registers must be accessed as multiple registers or accessed sequentially without interruption. The reason for preventing floating point registers from being updated as single 16-bit registers is that interim values (when the number is half entered) represent valid but unknown numeric values! Requiring both the MSW and LSW registers to be written sequentially prevents meter data from having unknown and potentially very large scaling factors applied to measurement data between register writes.

Selecting the Data Type

It is likely that the RTU program has built-in support for multiple data types including floating point. The PowerScout™ FLEX meter data is stored as MSW, LSW which may take some trial and error to identify in the RTU setup. Float ABCD is an example of how this RTU identifies the matching byte order.

It is anticipated that command-line programmers or script writers may prefer to enter data in hexadecimal format. Non-programmers using Modbus or BACnet utilities (or those using FLEXPoint™) may prefer to use decimal notation. This example works through the details of converting information found in our user documentation (decimal) into a hexadecimal format which should cover the highest level of complexity.

4.8. Soft Reset

Register manipulation of communication protocols or addressing require that the PowerScout™ FLEX performs a "soft reset" to take effect. Register 2100 can receive a user command to facilitate this process. BACnet users write a "1" and Modbus users write "1234" to affect a soft reset. The PowerScout™ FLEX reboot time is approximately 10 seconds.

5. BACnet Integration

5.1. BACnet Overview

Building **A**utomation and **C**ontrol **N**etwork (BACnet) protocol was developed under the auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and is recognized as an American National, European, and ISO global standard. The BACnet default port is 47808 and does not usually need to be changed.

Device Address: DENT meters are Master devices and, as such, must use MS/TP addresses in the range from 0-127. This address must be unique on the network.
Max Masters: The default setting is 127 and does not usually need to be changed.
Max Info Frame: The default setting is 1 and does not usually need to be changed.
The following online BACnet resource is also helpful.
http://www.bacnet.org/

5.2. Device IDs

All device IDs on a BACnet network must be unique. Refer to the section "Serial Protocols" and refer to the Register List for additional information.

5.3. BBMD Setup

Ethernet versions can register as Foreign Devices to a BBMD. BBMD stands for BACnet/IP Broadcast Management Device. The BBMD IP address can be set from FLEXPoint™ or through character string object 2264. A value of 0.0.0.0 disables foreign device registration. This process requires a processor soft reset.

5.4. Segmentation

The PowerScout™ FLEX meter does not support BACnet Segmentation. Segmentation is required when the requested data is longer than the underlying data packet size limitations of the protocol, i.e., the Maximum Transmission Unit (MTU). The MTU for BACnet MS/TP is 480 bytes and for BACnet/IP it is 1476 bytes. This means that some objects with large data arrays will not fit within a packet.

This limitation effectively means that some BACnet client software cannot read the Structured View Object List. In this case the BACnet client structured view mode may need to be disabled, and the standard flat object view will need to be used instead, particularly with BACnet MS/TP.

5.5. Structured View

The PowerScout™ FLEX meter supports the Structured View (SV) object container. If this option is supported in the BACnet exploring tool, objects will be grouped logically into virtual meters which can be named to reflect electrical or physical locations, followed by system objects.

For each virtual meter, Structured View lists the BACnet objects by Object Type and then by numeric number as shown below. In addition, objects for elements are grouped in a “hotel room” scheme.

Some BACnet explorer tools have additional sorting capabilities.

5.6. Object Types

Supported BACnet Object Types		
Object Type	**Abbr**	**Typical Usage**
Analog Input	AI	Meter Readings (floating point numeric inputs)
Analog Value	AV	Analog User Settings (floating point numeric outputs)
Binary Value	BV	User Boolean Settings
Multi State Value	MSV	Enumerated Settings
BitString Value	BSV	Bitfield Status Words and Settings
Positive Integer Value	PIV	Restricted Range User Settings
Character String Value	CSV	User Text string settings

6. Advanced Features

6.1. Pulse Inputs (PS12/PS24/PS48 Only)

PS12 meters are equipped with 4 pulse inputs and PS24/PS48 meters are equipped with 2 pulse inputs. Pulse counting supports accumulation of consumption data from any external meter using a dry contact (Form A Relay) or open collector outputs. The PowerScout™ FLEX pulse inputs are compatible with "low speed" meters. The pulse duration must exceed 50 ms in both the logic low and high state allowing for a maximum input frequency of 10 Hz.
Pulse scaling, resetting and accumulated values are accessed through registers and are "system" in scope. Refer to available documentation for more information.

6.2. CT Multipliers

The PowerScout™ FLEX has registers that allow potential transformers and series current transformers to be used with the PowerScout™ FLEX meter. These registers allow for transformer winding ratios or other scaling adjustments to be included in the meter processing to eliminate post process scaling. Adjustments for voltage are global to the meter while CT's can be adjusted on a channel-by-channel basis. The multiplier is a floating-point number and can also be used for post installation calibration if desired. The default value is 1.0. Values below 0.9 are disallowed.

6.3. Phase Shift Compensation

Most current transformers sold by DENT Instruments have phase shifts from a few tenths of a degree up to a few degrees. For energy meters, this phase shift can produce accuracy errors. However, DENT's FLEXPoint™ software can compensate for CT phase shifts to help maximize reading accuracy. If you are using the desktop version of FLEXPoint™, these values will automatically be populated for you when using the CT Picker. If you are configuring your meter through the FLEXPoint™ GO Web App, use the table located here https://www.dentinstruments.com/current-transformers-list to find the correct phase shift value.

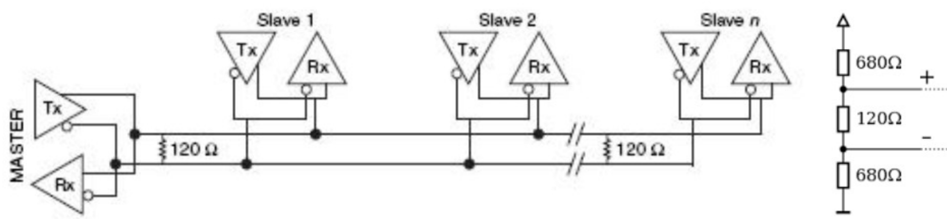
6.3.1. Snap Thresholds

The signal-to-noise ratio of the PowerScout™ FLEX is above 80 dB at full scale (1 part in 10,000). When the signal amplitude becomes so small that it is indistinguishable from noise, it is often better to record 0 than a small, random value. Snap Threshold registers (Advanced Settings section in FLEXPoint™) tell the meter when to record 0 instead of the measurement result. The factory defaults for CTs are expressed in percent and have a default value of 0.04% Full Scale. The voltage thresholds are in absolute value, the recommended minimum voltage is 1.0 volt.

Changing the current Snap Threshold may affect the ANSI C12.20 compliance.

6.4. RS-485 Physical Layer Requirements

The PowerScout™ FLEX meter uses a 2-Wire Half Duplex RS-485 Implementation



- **Termination Resistors**—are NOT included on the PowerScout™ FLEX meter. If the PowerScout™ FLEX meter is at the end of a daisy-chain, then connect a 120-ohm leaded resistor between the + and – terminal at the connector.
- **Bias Resistors**—are NOT included on the PowerScout™ FLEX meter. Bias resistors are needed if the idle conditions of the bus are in an indeterminate logic voltage. Bias resistors are usually located at the master node and are usually 680 ohms for an RS-485 network.
- **Network Topology**—RS-485 is designed to be implemented as a daisy chain (series connections) rather than star or cascade topologies.
- **Signal Names**—Some RS-485 devices use the terminology A/B while others use +/-. Note that A is (-) and B is (+). Many manufacturers incorrectly label the terminals.
- **Bus Loading**—The PowerScout™ FLEX meter is a 1/8th unit load allowing up to 256 like devices in parallel.

7. Security

7.1. Overview

If security levels have been set up in the meter, no data is accessible through the LCD user interface or FLEXPoint™ GO without entering the PIN credentials. Note, however, that protocols such as Modbus do NOT SUPPORT ANY LEVEL of security such that any network traffic acting as a master can retrieve and write data from the registers. Generally, this will require knowledge of the IP address or slave ID and the register list which discourages casual intrusion.

7.2. PIN Types

PowerScout™ FLEX meters have two levels of PIN protection that users can choose to assign for restricting access to meter information. The PIN logic is described in the figure below. The default user entry (on power up or time-out) is 0000 which satisfies both the Read Only and the Read / Write default register settings.

7.3. Read-Only

Configuring the meter for a Read Only user allows data or configuration items to be viewed but not changed. This level of authorization might be appropriate for general end-users, such as building owners, who may not be aware of the details of the installation. It is required to use FLEXPoint™ to configure permissions.

7.4. Read/Write

Read/Write permissions allow users to read and write configuration items. This level of authorization will be required by any technician or user who needs the ability to correct errors in the meter. Permissions cannot be set through the LCD interface or FLEXPoint™ GO.

7.5. Network Security Best Practices

While the PowerScout™ FLEX meter supports industry-standard protocols such as Modbus and BACnet, it is important to understand that **Modbus RTU, Modbus TCP, and BACnet MS/TP/IP do not natively include encryption or authentication mechanisms**. As such, security must be implemented at the network level.

DENT Instruments recommends the following best practices when deploying PowerScout™ FLEX meters in commercial or industrial environments:

Network Segmentation

Place PowerScout™ FLEX meters on a dedicated industrial control network or VLAN separate from:

- Corporate IT networks
- Guest Wi-Fi networks
- Public-facing systems

Segmentation reduces exposure and limits lateral movement in the event of network compromise.

Firewall Configuration

Where Modbus TCP or BACnet/IP is used:

- Restrict inbound traffic to **only trusted master devices (PLC, BMS, SCADA, RTU)**
- Block external WAN access to Port 502 (Modbus TCP) and Port 47808 (BACnet/IP)
- Disable unused protocols when possible

Strong PIN Configuration

PowerScout™ FLEX meters support two PIN levels:

- Read Only
- Read/Write

Best practices include:

- Change default PIN (0000) during commissioning
- Use non-obvious 4-digit combinations
- Limit distribution of Read/Write credentials
- Periodically review access controls

Note: PIN protection does not secure Modbus traffic. It applies only to the LCD interface and FLEXPoint™ GO Web App.

Secure Remote Access

If remote monitoring is required:

- Use VPN tunnels instead of port forwarding
- Use encrypted industrial gateways
- Implement access logging at firewall or router level

Direct port forwarding of Modbus TCP (Port 502) to the public internet is strongly discouraged.

Physical Security

- Install meters inside locked electrical panels or enclosures
- Restrict physical access to RS-485 terminals
- Prevent unauthorized USB access

Physical access may allow configuration changes regardless of network protections.

Firmware Management

To maintain secure operation:

- Keep firmware and FLEXPoint™ software updated
- Use official DENT Firmware Releases only
- Avoid mixing firmware and register lists from different releases

Industrial Cybersecurity Standards

For high-security environments, consider aligning deployment with:

- IEC 62443 (Industrial Automation Security)
- NIST SP 800-82 (Industrial Control System Security)
- Corporate OT cybersecurity policies

Security Responsibility Disclaimer

Because Modbus and BACnet are open industrial protocols without encryption, overall system security depends on proper network design and infrastructure controls implemented by the system integrator or facility IT team.

DENT Instruments provides device-level configuration tools but does not provide network firewall or cybersecurity infrastructure.

8. Troubleshooting

8.1. USB Power

PS12FX, PS24FX, and PS48FX meters draw 500mA from the USB port which may overload "out of spec" USB hosts. If the meter fails to power, or flickers when powering over USB, an alternate configuration for power must be used.

8.2. Ethernet Communication Issues

8.2.1. Meter Not Discoverable via Network Scan

Symptoms:

- Network Scan does not display the meter
- Meter LCD shows IP address but FLEXPoint™ cannot connect
- Intermittent visibility

Possible Causes & Resolutions:

- **Different Subnets**

  Ensure PC and PowerScout™ FLEX are on the same subnet.

- Example:
  - Meter: 192.168.1.50 / 255.255.255.0
  - PC must be 192.168.1.xxx

  If unsure, temporarily configure both to static addresses.

- **Corporate Firewall Restrictions**

Some enterprise networks block UDP broadcast packets required for discovery.

Resolution:

- Attempt manual IP connection.
- Use USB to confirm meter IP.
- Consult IT to allow local subnet broadcast.

- **DHCP Not Present**

If directly connected PC ↔ Meter:

- DHCP will not assign IP automatically.
- Set static IP on both devices.

- **Duplicate IP Address**

  If two devices share the same static IP:
    - Communication may be intermittent or fail.
    - Use Network Scan to confirm serial number.
    - Change one device to a unique IP.

8.2.2. Cannot Connect via Modbus TCP

Check:

- Port 502 is open
- No firewall blocking
- Protocol selected correctly in FLEXPoint™
- Meter configured for Ethernet interface (not RS-485 only)

Use a Modbus client tool to confirm register response.

8.3. RS-485 Communication Issues

If you are receiving no response from the meter (Modbus RTU or BACnet MS/TP), check the following troubleshooting recommendations.

- **Wiring Polarity Reversed**
    - A/B polarity may be mislabeled.
    - Note: A = (-), B = (+) on PowerScout™ FLEX. Swap wires and test.
- **Missing Termination**
    - If meter is end of line:
        - Install 120Ω resistor between A and B.
        - Only two terminations per network.
- **No Bias Resistors**
    - If bus idle state floats:
    - Install bias resistors at master device.
- **Incorrect Baud / Parity**
    - Verify**:**
    - Baud rate matches master
    - Data bits = 8
    - Stop bits = 1 or 2
    - Parity matches configuration
    - Mismatch results in no communication but no physical fault.

- **Duplicate Slave Address**
  - Each Modbus RTU or MS/TP device must have unique address. Duplicate addresses cause unpredictable behavior.
- **Excessive Network Length**
  - Max 1200m at ≤100 kbps
  - Reduce baud rate for long runs.
- **Star Topology**
  - RS-485 must be daisy-chain.
  - Star topology causes reflections and intermittent failures.

9. Appendices

9.1. Technical Specifications

Specification	Description
Service Types	Single Phase, Split Phase, Three Phase-Four Wire (WYE), Three Phase-Three Wire (Delta)
Voltage Channels	90-346 Volts AC Line-to-Neutral, 600V Line-to-Line, CAT III. Two voltage reference inputs (PS48FX and PS24FX only)
Current Channels	3 (PS3 FX) or 12 (PS12 FX) or 24 (PS24 FX) or 48 (PS48 FX) channels, 0.525 VAC max, 333.3 mV CTs, 0-4,000 Amps depending on current transducer
Maximum Current Input	150% of current transducer rating (mV CTs) to maintain accuracy. Measure up to 4000A with RōCoil CTs.
Measurement Type	True RMS using high-speed digital signal processing (DSP) with continuous sampling
Line Frequency	50/60 Hz (45 - 70 Hz measurable range) – measurement taken L1-N
Power	From L1 Phase to L2 Phase. 90-600VAC RMS CAT III 50/60Hz, 500mA AC Max Use of 12-volt auxiliary output requires 100 VAC minimum input voltage.
AC Protection	0.5A Fuse 200kA interrupt capacity
Power Out	PS12FX/PS24FX/PS48FX only: Unregulated 12VDC output, 200 mA, self-resetting fuse
Waveform Sampling	PS3FX/PS12FX/PS24FX 7.2 kHz; PS48FX 3.6 kHz
Parameter Update Rate	1 second
Interval Data Recording	Energy (kWh) values are recorded every 15 minutes for 63 days (downloadable log). Each record is time stamped.
Measurements	Volts, Amps, kW, kVAR, kVA, aPF, dPF, kW demand, kVA demand, Import (Received) kWh, Export (Delivered) kWh, Net kWh, Import (Received) kVAh, Export (Delivered) kVAh, Net kVAh, Import (Received) kVARh, Export (Delivered) kVARh, Net kVARh, THD, Theta, Frequency.

	All parameters for each phase and system total.
Accuracy	0.2% ANSI C12.20-2015 Class 0.2
Resolution	Values reported in IEEE-754 single precision floating point format (32 bit)
Indicators	PS3FX: Standard 2-line display, tri-color backlight (PhaseChek™) PS12FX/PS24FX/PS48FX: Optional 4-line display, tri-color backlight (PhaseChek™)
Alarm Output	User-configurable alarm with open collector output
Pulse Inputs	PS3FX - None PS12FX - 4 inputs PS24FX – 2 inputs PS48FX - 2 inputs 3.3V sourcing voltage (current limited) to user dry contact pulse output Maximum Pulse Rate 10 Hz (50 msec minimum transition time)
Communication	
Hardware	RS-485, Ethernet (IPv4 only), and USB
Supported Protocols	Modbus RTU or BACnet Master Slave Token Passing protocol (MS/TP) Modbus (using SunSpec IEEE-754 single precision floating point model)
Max Communication Length	1200 meters with Data Range of 100K bits/second or less
RS-485 Loading	1/8 unit
Communication Rate (baud)	Modbus: 9600 (Default), 19200, 38400, 57600, 76800, 115200 BACnet: 9600, 19200, 38400, 76800
Data Bits	8
Parity	None, Even, Odd
Stop Bit	2, 1
Termination	None provided
Data Formats	Modbus RTU, BACnet MS/TP, Modbus TCP or BACnet IP

Mechanical	
Wire Connections	12-28 AWG 600 VAC, Voltage connection must be #14 AWG or larger & 600 VAC rated
Mounting	Enclosure or Panel Mount
High Voltage Cover	IP30. Included with all models except PS12FX-P-D-N
Operating Temperature	-20 to + 60⁰ C (-4 to 140⁰ F) (the colder the temperature the more voltage needed to power the board)
Humidity	5% to 95% non-condensing
Enclosure	ABS Plastic, 94-V0 flammability rating Conduit Connections: 1" (PS12FX/PS48FX Wall Mount enclosures) or ½" (PS3FX Wall Mount enclosure)
PS24FX/PS48FX Dimensions	(L) 33.7cm x (W) 25.1cm x (H) 8.0 cm (13.3" x 9.8" x 3.1") (enclosure version) (L) 26.2cm x (W) 24.1cm x (H) 8.0 cm (10.3" x 9.5" x 3.1") (mounting plate version)
PS12FX Dimensions	(L) 24.8cm x (W) 25.1cm x (H) 8.0 cm (9.8" x 9.8" x 3.1") (enclosure version) (L) 17.8cm x (W) 26.3cm x (H) 8.0 cm (7.0" x 10.4" x 3.1") (mounting plate version)
PS3FX Dimensions	(L) 19.1cm x (W) 8.2cm x (H) 3.8cm (7.5" x 3.2" x 1.5") (DIN Rail Version) (L) 25.7cm x (W) 14.0cm x (H) 5.4cm (10.1" x 5.5" x 2.1") (Wall Mount Version)
FLEXPoint™ Software Minimum System Requirements	
Operating System	Windows® 10, Windows® 11 (Does NOT support ARM Processors)
Communications Port	USB or Ethernet connection
FCC Compliance	This device has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful

	interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at user's own expense.
Safety	The following are UL Recognized: • PS3FX-R-D-N • PS12FX-B-y-z • PS12FX-P-y-z • PS24FX-P-y-z • PS48FX-B-y-z • PS48FX-P-y-z The following are UL Listed: • PS12FX-C-y-z • PS48FX-C-y-z • PS24FX-C-D-N • PS3FX-C-D-N Conforms to UL Std 61010-1, 3rd Edition, UL 61010-2-30:2010 Certified to CSA Std C22.2 No. 61010-1, 3rd Edition
CE	LVD (EN61010-1) EMC (EN61326-1) RoHS 2 (EN50581)

9.2. Measurement Parameters

PowerScout™ FLEX meters report measurement parameters at different data scopes depending on how the value is produced and how it is used. Some values apply to the meter as a whole, some apply to a Virtual Meter, and others apply to an individual channel within a Virtual Meter.

Data Scope

System-level parameters apply to the meter as a whole and are not tied to a specific Virtual Meter. Examples may include line frequency, communication settings, meter status, or other global values.

Virtual Meter-level parameters apply to the logical electrical load represented by a Virtual Meter. These values may be calculated from one, two, or three enabled channels within that Virtual Meter. For example, a Virtual Meter-level kW value may represent the sum of the enabled channel kW values for that load.

Channel-level parameters apply to an individual current input assigned to a Virtual Meter. Channel-level values are useful for viewing phase-level or conductor-level measurements, such as current, power, power factor, or energy on a specific channel.

Parameter Types

PowerScout™ FLEX reports both instantaneous values and accumulated values.

Instantaneous parameters represent the measured or calculated condition at the time the value is read. These values update continuously during operation and are commonly used for real-time monitoring, commissioning, and troubleshooting. Examples include voltage, current, kW, kVA, kVAR, power factor, phase angle, frequency, and THD.

Accumulator parameters represent values accumulated over time. These values continue increasing or decreasing as energy flows through the measured load and are commonly used for energy tracking, reporting, billing support, and historical analysis. Examples include kWh, kVAh, kVARh, import energy, export energy, and net energy.

Demand parameters represent average power over a defined time interval rather than a single instantaneous reading or a continuously accumulated total. PowerScout™ FLEX demand values are based on a 15-minute demand interval and may include present demand and peak demand values.

Parameter Table

Term	Unit	Scope	Parameter Type	Definition	Common Use
Voltage	V	System / Channel reference	Instantaneous	Electrical potential difference measured between voltage conductors, such as line-to-neutral or line-to-line.	Verifying service voltage, monitoring voltage stability, identifying under-voltage or phase-loss conditions.
Line-to-Neutral Voltage	V	System	Instantaneous	Voltage measured between a phase conductor and neutral, such as L1-N, L2-N, or L3-N.	Used for Wye and single-phase voltage monitoring.
Line-to-Line Voltage	V	System	Instantaneous	Voltage measured between two phase conductors, such as L1-L2, L2-L3, or L3-L1.	Used for three-phase and Delta system monitoring.
Current	A	Channel	Instantaneous	The flow of electric charge through a conductor, measured for an	Real-time load monitoring and circuit-level

				individual CT input or Virtual Meter channel.	current verification.
Real Power	kW	Virtual Meter / Channel	Instantaneous	The portion of electrical power converted into useful work by the load.	Monitoring active load, demand trends, and consumption behavior.
Apparent Power	kVA	Virtual Meter / Channel	Instantaneous	The total power supplied to a load, combining real and reactive components.	Sizing transformers, generators, conductors, and electrical infrastructure.
Reactive Power	kVAR	Virtual Meter / Channel	Instantaneous	The portion of power that oscillates between the source and reactive load components such as motors, inductors, and capacitors.	Evaluating power factor correction needs and reactive load behavior.
Power Factor	PF	Virtual Meter / Channel	Instantaneous	The ratio of real power to apparent power. Power factor indicates how effectively supplied power is being converted into useful work.	Identifying inefficient loads and possible utility penalty conditions.
Apparent Power Factor	aPF	Virtual Meter / Channel	Instantaneous	Overall power factor including both phase displacement and harmonic distortion effects.	Evaluating total power-use efficiency and power quality.
Displacement Power Factor	dPF	Virtual Meter / Channel	Instantaneous	Power factor based on the phase angle between the fundamental voltage and current waveforms. It does not include	Identifying inductive or capacitive phase shift behavior.

				harmonic distortion effects.	
Distortion Power Factor	—	Virtual Meter / Channel	Instantaneous	The power factor component associated with harmonic current distortion.	Understanding how waveform distortion reduces overall power factor.
Phase Angle / Theta	degrees	Virtual Meter / Channel	Instantaneous	The angular difference between voltage and current waveforms.	Checking load type, CT phasing, and power factor behavior.
Line Frequency	Hz	System	Instantaneous	The measured frequency of the AC electrical system, typically 50 Hz or 60 Hz.	Grid synchronization and frequency stability monitoring.
Total Harmonic Distortion	% THD	Virtual Meter / Channel	Instantaneous	A measure of waveform distortion relative to the fundamental frequency.	Identifying nonlinear loads, harmonic distortion, and power quality issues.
Real Energy	kWh	Virtual Meter / Channel	Accumulator	Accumulated real energy over time. kWh represents useful energy consumed or produced.	Energy consumption tracking, tenant allocation, billing support, and usage analysis.
Apparent Energy	kVAh	Virtual Meter / Channel	Accumulator	Accumulated apparent energy over time, including both real and reactive components.	Evaluating total electrical loading over time.
Reactive Energy	kVARh	Virtual Meter / Channel	Accumulator	Accumulated reactive energy over time.	Long-term power factor analysis and reactive energy tracking.
Import Energy	kWh / kVAh / kVARh	Virtual Meter / Channel	Accumulator	Energy delivered from the source to the load.	Tracking facility consumption from the utility or source.