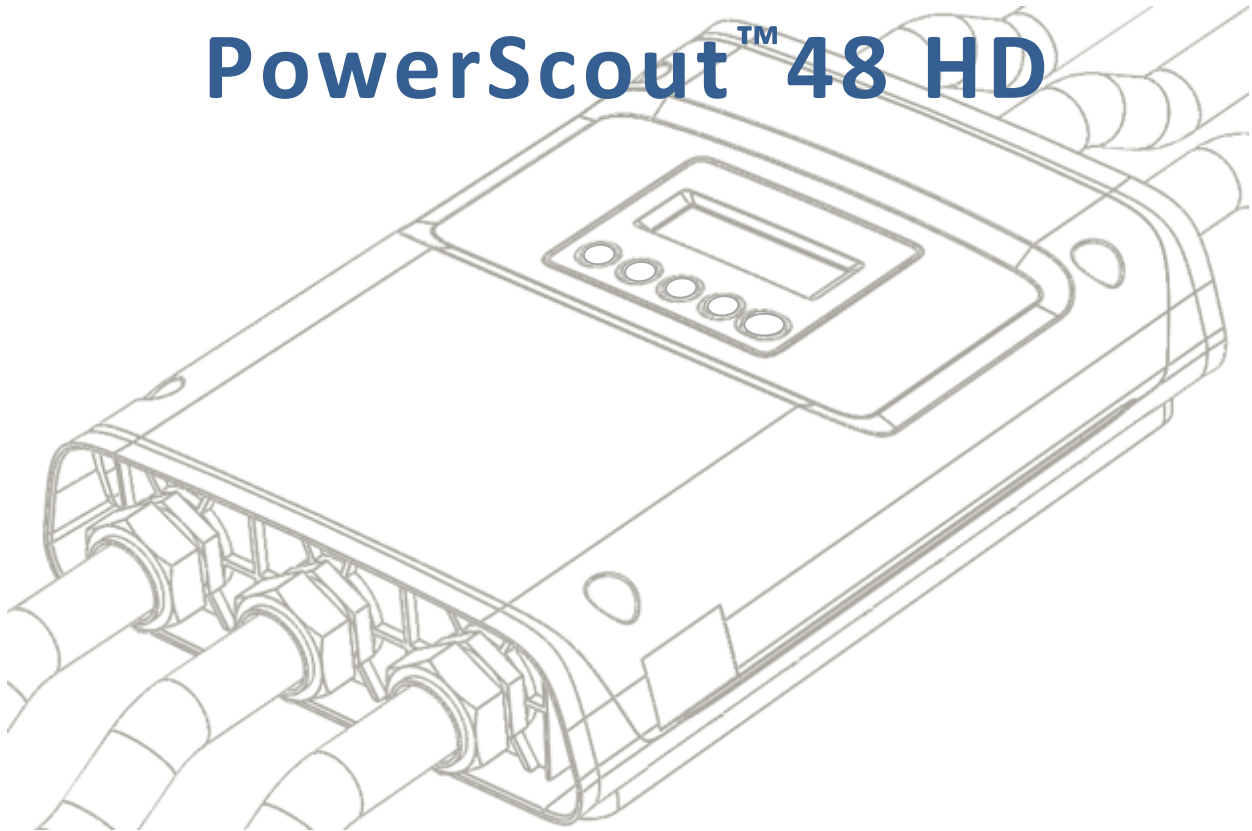


# Operator's Guide

## PowerScout™ 12 HD PowerScout™ 48 HD



## Networked Metering Systems

*and*

## ViewPoint™ HD Software



June 2018

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## INTRODUCTION

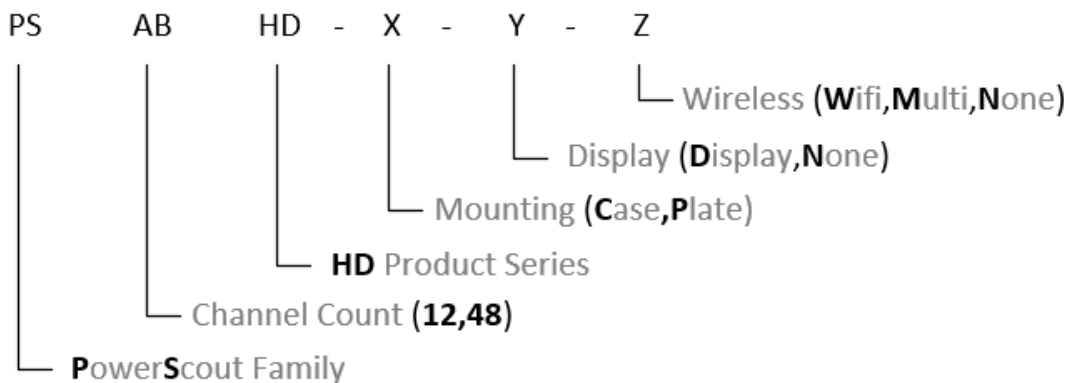
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There are two meters in the PowerScout HD Series: the PowerScout 12 HD (PS12HD) and the PowerScout 48 HD (PS48HD). These meters monitor the voltage, current, power, energy, and many other electrical parameters on single and three-phase electrical systems. A PSHD meter uses direct connections to each phase of the voltage and current transformers to monitor each phase of the current. Information on energy use, demand, power factor, line frequency, and more are derived from these voltage and current inputs.

The PSHD meter is not meant to be a standalone energy recorder; rather it is connected as a slave device to a data logger, Remote Terminal Unit (RTU), or Building Management host network. The PSHD 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.

### Unpacking the Unit

The PSHD can be ordered with optional product features which are identifiable on the part number label.



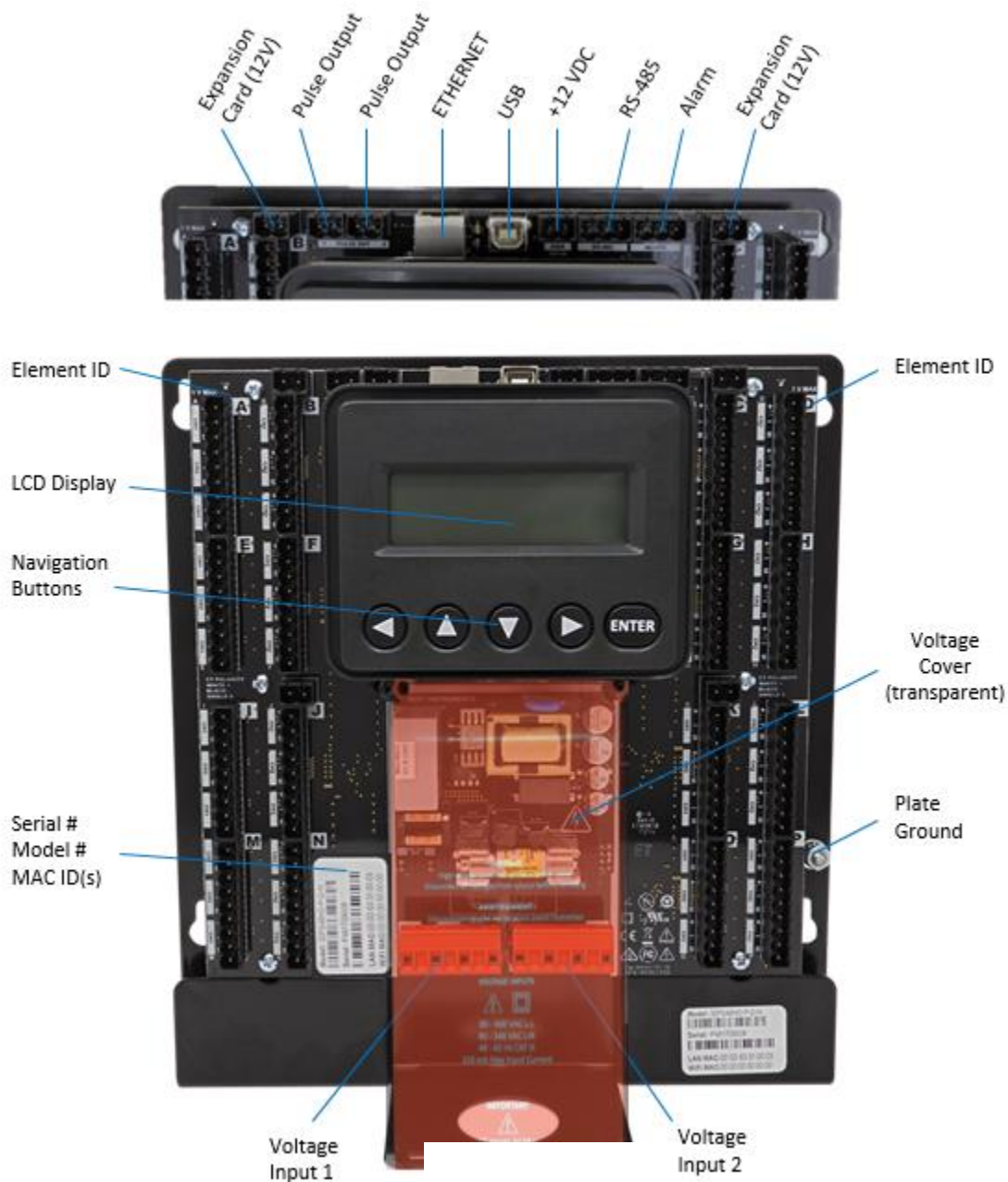
**PowerScout HD Part Numbering Scheme**

Each PSHD meter shipment also includes the following items:

- Meter with Options Installed – Serial Number, MAC ID, and FCC ID indicated on side label.
- Pluggable Connectors
  - PS48 (2 voltage, 50 three-position terminals, 3 two-position terminals)
  - PS12 (1 voltage, 14 three-position terminals, 5 two-position terminals)
- Thumb drive containing ViewPoint HD Software, Register List, Manual, Tutorial Videos
- Certificate of Calibration (COC)
- USB A to B Cable (one per order)

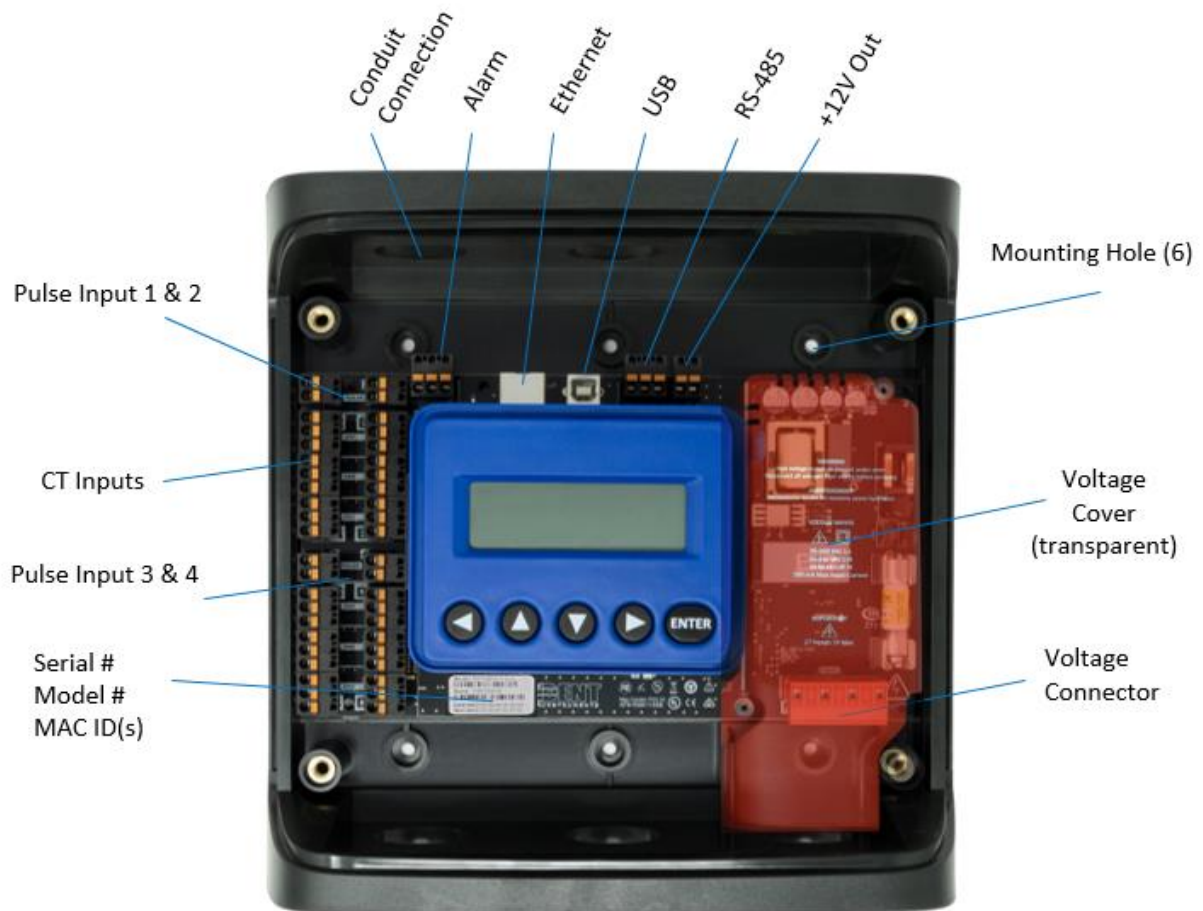
## PSHD Anatomy

All user connections are made on the circuit board. Connectors are identified by function and include polarity markers.



PS48HD (mounting plate version shown)




ALTERNATE PRODUCT CONFIGURATION



PS12HD (Enclosure with cover removed)



## PowerScout HD Meter Safety Summary and Specifications

|  |   |  |
|--|---|--|
| <p>This general safety information is to be used by both the Logger operator and servicing personnel. DENT Instruments, Inc. assumes no liability for user's failure to comply with these safety guidelines.</p> |  <p>PS12HD-B-y-z, PS12HD-P-y-z<br/>PS48HD-B-y-z, PS48HD-P-y-z</p>  <p>PS12HD-C-y-z<br/>PS48HD-C-y-z</p> | <p>The PSHD Family conform to the following:</p>  <p><b>PowerScout HD Series:</b><br/>Conforms to UL Std 61010-1, 3rd Edition<br/>Certified to CSA Std C22.2 No. 61010-1, 3rd Edition</p> |
| <p>PowerScout HD devices need to be installed in a user-supplied UL Listed/ uR Recognized enclosure in order to comply with NEC and local electrical codes.</p>  |   |  |
| <p>The PowerScout HD is an Over-Voltage Category III device. Use approved protection when operating the device.</p>  |   |  |
| <p><b>CAUTION: THIS METER MAY CONTAIN LIFE THREATENING VOLTAGES. QUALIFIED PERSONNEL MUST DISCONNECT ALL HIGH VOLTAGE WIRING BEFORE SERVICING THE METER WITH THE HIGH VOLTAGE TOUCH SAFE COVER REMOVED.</b></p>  |   |  |

## Symbols on Equipment



Denotes caution. See manual for a description of the meanings.



**DENOTES HIGH VOLTAGE. RISK OF ELECTRICAL SHOCK. LIFE THREATENING VOLTAGES MAY BE PRESENT. QUALIFIED PERSONNEL ONLY.**



Equipment protected throughout by double insulation (IEC 536 Class II).

## Symbols in Documentation



Contains additional information pertinent to current subject



**DO NOT EXCEED 346V Line to Neutral or 600 volts Line to Line. This meter is equipped to monitor loads up to 346V L-N. Exceeding this voltage will cause damage to the meter and danger to the user. Always use a Potential Transformer (PT) for voltages in excess of 346V L-N or 600 volts line to line. The PowerScout HD is a 600 Volt Over Voltage Category III device.**

## **MAINTENANCE**

There is no required maintenance with the **PowerScout HD**. Abide by the following items:

**Cleaning:** No cleaning agents, including water, shall be used on the **PowerScout HD**.

No accessories are approved for use with the PowerScout HD meter other than those specified in the DENT Instruments product literature and price sheets.

If the meter appears damaged or defective, first disconnect all power to the meter. Then call or email technical support for assistance.

DENT Instruments, Inc.

Bend, Oregon USA

Phone: 541.388.4774

DENTinstruments.com

Email: [support@DENTinstruments.com](mailto:support@DENTinstruments.com)

## METER SAFETY

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### Building Service Safety Requirements (Load Center, etc.)

Equipment intended for use with field-installed **current transformers that could be installed in panel boards or switchgears** shall observe the following:

Always open or disconnect circuit from power-distribution system (or service) of building before installing or servicing current transformers.

A circuit breaker used as a disconnect must meet the requirements of IEC 60947-1 and IEC 60947-3 (Clause 6.11.4.2)

Current transformers may not be installed in equipment where they exceed 75 percent of the wiring space of any cross-sectional area within the equipment.

Current transformers may not be installed in an area where they block ventilation openings.

Current transformers may not be installed in an area of breaker arc venting.

Not suitable for Class 2 wiring method nor intended for connection to Class 2 equipment.

Secure current transformer and route conductors so that they do not directly contact live terminals or bus.

CTs shall be listed to UL2808



### Meter Installation Safety Requirements

PSHD meters must be installed in accordance with local electrical codes.

Use copper conductors only.

Connection to the mains terminals shall be made with 14 AWG minimum wire gauge.

External secondary inputs and outputs should be connected to devices meeting the requirements of IEC 60950

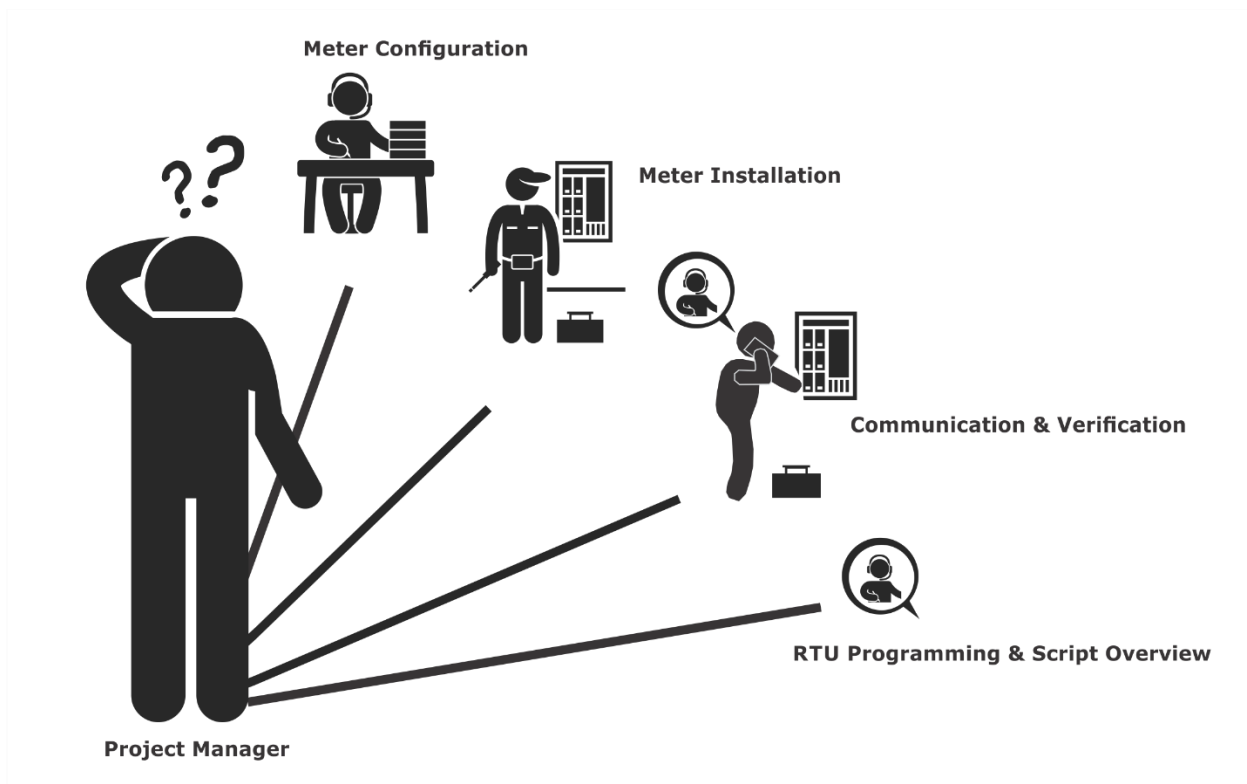
The following additional requirements apply for Recognized board versions of the PSHD meter

- 1) For use only with Listed Energy-monitoring Current Transformers
- 2) Associated leads of the current transformers shall be maintained within the same overall enclosure.
- 3) Unless the current transformers and its leads have been evaluated for REINFORCED INSULATION, the leads must be segregated or insulated from different circuits.
- 4) The current transformers are intended for installation within the same enclosure as the equipment. These may not be installed within switchgears and panel boards” or similar.

## PLANNING FOR FIELD INSTALLATION

### Project Manager Aspects

Meter installation often includes coordination between individuals or groups of people with different responsibilities. Spend a few minutes considering who will be executing each portion of the installation and what tools are needed at each stage. Things to consider include determining how to communicate with the meter, setting address configuration, installing ViewPoint HD, access to PIN numbers, etc. The more tasks completed before installation the fewer tasks will be needed in the field, where most mistakes happen. The following section gives an overview of typical process activities followed by details in the next section.



### CONFIGURATION & DATA VIEWING OPTIONS

The PowerScout HD meter has three methods for configuration and data viewing. The most powerful interface is a Microsoft Windows application (ViewPoint HD) that runs on PCs or Tablets. ViewPoint HD is encouraged for complex installations and is required for configuring advanced functions like alarms. The second interface is the PSHD Web App and is intended for smart phones or tablets that can connect over USB, or Ethernet. The third interface (LCD) is an optional component and is intended for intermittent end-user observation and is restricted in capability. The RTU can also be used for configuration if communication settings are already established. The feature set of each interface is summarized next.

INFORMATION ACCESS BY INTERFACE TYPE

| DENT Interface Options |  |  |   | Customer                         |
|------------------------|--|--|---|----------------------------------|
| Device                 | PC or Laptop Running ViewPoint HD  | Smart Device or Tablet via PSHD Web App          | LCD on Meter (if equipped)  | RTU (Host System) Modbus /BACnet |
| When Used              | Meter Setup<br>Field Visit   | Field Visit                                      | End User  | Building System                  |
| Real Time Values       | All Meter Parameters<br>Waveform Capture<br>Harmonic Analysis<br>All Element View<br>Phasor Plot<br>Alarms | All Meter Parameters<br>Single Element View      | Voltage<br>Current<br>VA<br>VAR<br>kWh<br>Single Element View               | All Meter Parameters             |
| Configuration          | Entire Meter<br>Visual Guides<br>Copy / Paste  | Entire Meter<br><u>Sans Alarms</u><br>Text Based | Communications Only   | Entire Meter<br>Register Based   |
| Security PINs Enforced | Factory Support – Level 3  | Read Only – Level 1*<br>Read / Write – Level 2*  | Read Only – Level 1*<br>Read / Write Level 2*<br>(limited to communication) | Factory Support – Level 3        |

\* If PINs are configured



## Meter Configuration Overview

- Work performed ahead of the installation saves time in the field and results in fewer mistakes!

| Tools   | Typical Work  |
|---|---|
| <ul style="list-style-type: none"> <li>• Desktop or Laptop PC</li> <li>• USB Type AB Cable (preferred) or Ethernet &amp; USB wall charger (&gt; 500 mA)</li> <li>• Thumb Drive (ViewPoint HD Installer) or access to <a href="https://www.dentstruments.com/software-downloads">https://www.dentstruments.com/software-downloads</a></li> <li>• Electrical Schematics of project</li> </ul> | <ul style="list-style-type: none"> <li>• Installation of ViewPoint HD Software</li> <li>• Connect USB/Ethernet cable from PC to meter</li> <li>• Establish communication with meter</li> <li>• Firmware update (if desired)</li> <li>• Configure software for anticipated meter setup</li> <li>• Field wiring documentation</li> <li>• Set alarms</li> <li>• Set security PINs</li> </ul> |



## Meter Installation Overview

- Performed by licensed electrician.

| Tools   | Typical Work  |
|---|---|
| <ul style="list-style-type: none"> <li>• Mounting hardware (customer supplied)</li> <li>• Wiring &amp; supplies, labels, wire ties</li> <li>• Tablet, Smart Device, or Laptop PC</li> <li>• Multi Meter, Current Clamp</li> <li>• Camera</li> </ul> | <ul style="list-style-type: none"> <li>• Mechanical mounting</li> <li>• Electrical installation</li> <li>• Install voltage cover</li> <li>• Apply power to meter</li> <li>• Confirm basic operation of meter</li> </ul> |



## Verification & Communication Overview

- Can be modified with power applied to the meter.

| Tools  | Typical Work  |
|--|---|
| <ul style="list-style-type: none"> <li>• Tablet, Smart Device (Web Page Based), or Laptop PC (ViewPoint HD Software)</li> <li>• On site troubleshooting</li> <li>• Multi Meter, Current Clamp</li> <li>• Camera</li> </ul> | <ul style="list-style-type: none"> <li>• Locate the power meter</li> <li>• Confirm RTU device</li> <li>• Add wire terminations (if required)</li> <li>• Confirm meter communication settings</li> <li>• Meter health metrics (check for setup errors)</li> <li>• Analytics (ViewPoint HD)</li> <li>• Correct instrumentation</li> <li>• Set alarms</li> <li>• Set security PINs</li> <li>• Checklist</li> </ul> |



## RTU Programming and Scripting Overview

| Tools   | Typical Work  |
|---|---|
| <ul style="list-style-type: none"> <li>• Laptop PC (Remote Access to RTU)</li> <li>• Remote troubleshooting</li> <li>• Register List</li> </ul> | <ul style="list-style-type: none"> <li>• Confirm meter communication settings</li> <li>• Confirm communication protocols</li> <li>• Exercise remote connectivity</li> <li>• Run configuration scripting</li> <li>• Set alarms</li> <li>• Set security PINs</li> <li>• Confirm data integrity</li> </ul> |

## METER CONFIGURATION - DETAILS

---



This section is written to support setting up the PSHD in an office environment and configuring the power meter for a pre-determined configuration. In many cases, the setup is standardized for an organization or project. In other cases, the setup can be documented and emailed to an installer. The setup can also be performed on-site and reflect “as-built” configurations.



The PSHD meter cannot be configured using ViewPoint HD over a serial port. RS-485 serial network configurations must be pre-configured or use Modbus / BACnet hosts.

---



This section describes the use of the ViewPoint HD Windows Application. If this interface cannot be used, refer to the section on using the simplified web browser interface. The web browser can be accessed from the USB port to support Mac users.

---

## Install the ViewPoint HD Software

Insert the ViewPoint HD thumb drive into the computer or download from

<https://www.dentstruments.com/software-downloads>

Locate the ViewPoint HD Installer and open this folder.

|  |                   |             |
|--|-------------------|-------------|
|  ViewPoint HD Installer | 4/9/2018 11:50 AM | File folder |
|--|-------------------|-------------|

## TYPICAL INSTALLATION

---

Double-click the “RunMe to Install ViewPoint HD.bat” batch file to install ViewPoint and its support files in Windows default location. This option works for most users.

|   |                   |                    |      |
|---|-------------------|--------------------|------|
|  Install Files                     | 4/6/2018 10:10 AM | File folder        |      |
|  RunMe to Install ViewPoint HD.bat | 4/5/2018 9:49 AM  | Windows Batch File | 1 KB |

---



### CUSTOM INSTALLATION

For users who want to specify the location of the ViewPoint HD software and support files, double-click the folder “Install Files” and run setup.exe. This will prompt the user for additional details.

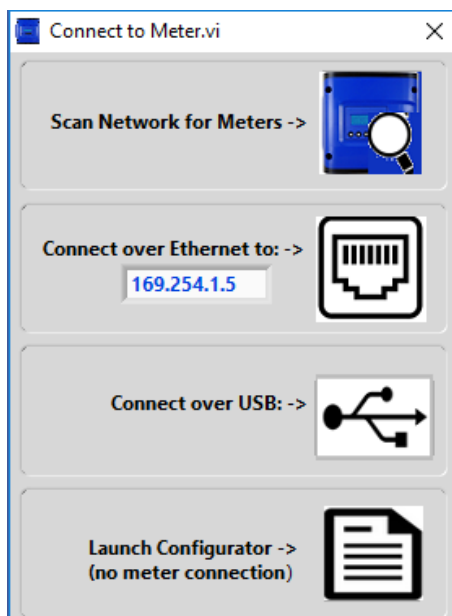
| Name         | Date modified      | Type                  | Size |
|--------------|--------------------|-----------------------|------|
| bin          | 4/20/2018 8:54 AM  | File folder           |      |
| license      | 4/20/2018 8:54 AM  | File folder           |      |
| Local        | 4/20/2018 8:54 AM  | File folder           |      |
| LVRTE        | 4/20/2018 8:54 AM  | File folder           |      |
| supportfiles | 4/20/2018 8:54 AM  | File folder           |      |
| nidist.id    | 4/17/2018 10:51 AM | ID File               |      |
| setup.exe    | 4/17/2018 10:51 AM | Application           | 1,40 |
| setup.ini    | 4/17/2018 10:51 AM | Configuration sett... |      |

### CONNECTION & CONFIGURATION OPTIONS USING VIEWPOINT HD

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

- Connect over USB cable
- Connect over Ethernet to a Predetermined IP address
- Scan Network
- Create Setup file only (no meter connected)

Note: The USB connection method is recommended for new users who have physical access to the meter and a USB A to B cable (supplied). Check out this option first!



ViewPoint HD Connection Options

## USB CONNECTION (POWER & COMMUNICATIONS)

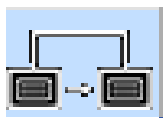
- 1) Connect the PSHD meter to a USB port of your computer to provide both power and communications.
  - a. If equipped, the LCD display is the most visible indication of a running meter.
  - b. For meters without a display, a green flashing LED on the circuit board indicates that the PSHD meter has booted and is running.
  - c. The PSHD meter draws 450mA 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.



**Preferred Connection via USB A to B Cable**

- 2) Launch the ViewPoint HD application and press the “CONNECT OVER USB” button on the pop-up window.

The meter should now be communicating. The ViewPoint HD application offers visual guides and context help to facilitate meter configuration. Please read the ViewPoint HD overview section (below) or watch the tutorial videos for additional information on configuring the meter. By default, PSHD meters are configured for DNS 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 ViewPoint HD by pressing the “Refresh Connectivity” icon located in the upper right hand corner.



## ETHERNET NETWORK CONNECTIONS

Configuring the PSHD over Ethernet requires that the meter be powered used a second connection. The PSHD does not support Power Over Ethernet (POE). If the meter is already installed within the buildings 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 500mA of current, an AC / USB charger or a USB battery can be used as a power source while using Ethernet for communications.



Both the “Network Scan” and “Connect Over Ethernet to IP ...” options require that a valid network connection exists between the PSHD meter and configuration PC. This is a common startup issue!

### DYNAMIC HOST CONFIGURATION PROTOCOL (DHCP):

PSHD 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, as long as the PSHD 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 PSHD meter will indicate the IP address on the LCD display (if equipped) or can be found using the Network Scan function.

### DIRECT:

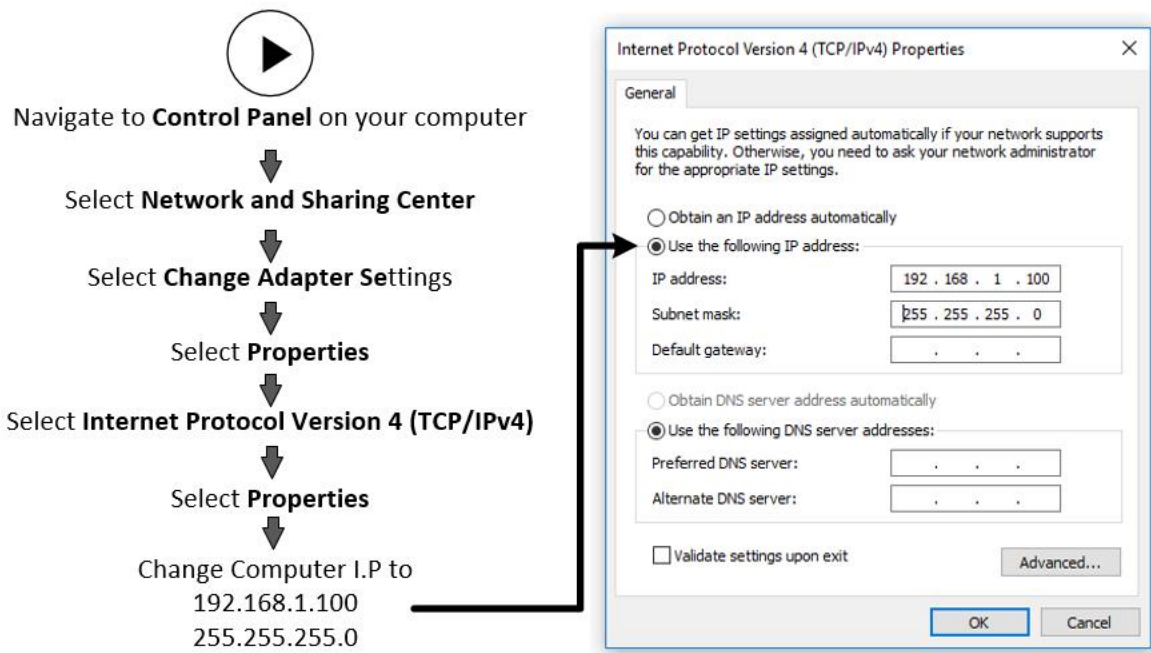
When a PC is directly connected to a PSHD meter via an ethernet cable, no DHCP service exists. This configuration can be made to work, but requires changes to either the meter communication settings or the PC network configuration.

#### LCD Display

For units equipped with an LCD display navigate to

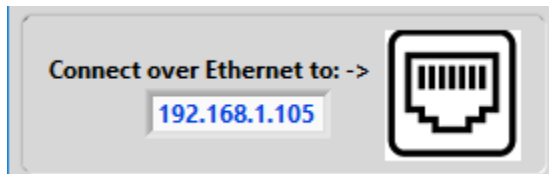
**Communications → Ethernet Settings → DHCP → OFF**

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 below.



Once the PC and PSHD are set to communicate on the same IP subnet:

- 1) Launch the ViewPoint HD 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.



- 3) The meter should now be communicating. ViewPoint HD is an intuitive application; read the ViewPoint HD overview section (below) and/or watch the tutorial videos on the DENT website for additional information on configuring the meter.

**No LCD Display**

A PSHD meter without a display can only communicate directly with a PC over ethernet if the IP address of the meter is set to static. Setting the IP address must be done ahead of time using another interface (such as USB or serial).

### NETWORK SCAN

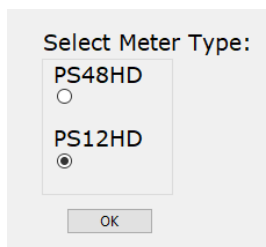
Network Scan is a feature for monitoring previously installed and configured PSHD meters over an Ethernet network. Network Scan will broadcast a UDP discovery packet on the same network as the PC running the ViewPoint HD application. Normally this will be performed on a corporate network running DHCP.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

| Meter                    | IP Address   | Serial Number | MAC Address       | Modbus Port | BACnet Port | Mode   | Device ID |        |
|--------------------------|--------------|---------------|-------------------|-------------|-------------|--------|-----------|--------|
| 72 SS402 Chevelle        | 10.75.75.72  | P129999999    | 00:0D:63:32:99:99 | 502         | 47808       | Modbus | 527000    | OK     |
| Jmonoultramicroscopicsil | 10.75.75.100 | P121812808    | 00:0D:63:32:88:87 | 502         | 47808       | Modbus | 527000    | Cancel |
| 1970 Mach1 428SCJ        | 10.75.75.164 | P481801016    | 00:0D:63:31:00:54 | 502         | 47808       | BACnet | 527070    | Rescan |
| PS12                     | 10.75.75.196 | P121802003    | 00:0D:63:32:00:02 | 502         | 47808       | Modbus | 527000    | Test   |
| PS48HD                   | 10.75.75.229 | P481709015    | 00:0D:63:31:00:0D | 502         | 47808       | BACnet | 527000    | Setup  |
| 69 SS427 Camaro          | 10.75.75.69  | P481802012    | 00:0D:63:31:10:09 | 502         | 47808       | Modbus | 527056    |        |
| PS48HD                   | 10.75.75.177 | P481802011    | 00:0D:63:31:00:01 | 502         | 47808       | Modbus | 527000    |        |
|                          |              |               |                   |             |             |        |           |        |
|                          |              |               |                   |             |             |        |           |        |

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 ViewPoint HD (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).

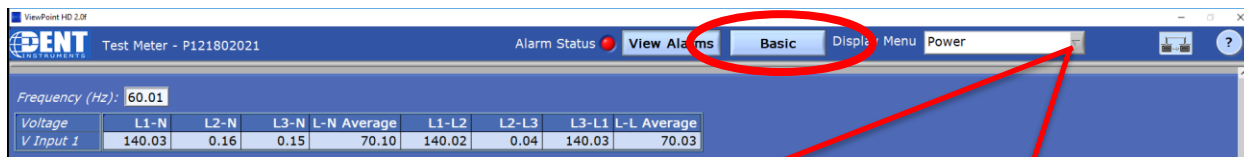
### LAUNCH CONFIGURATOR

The final option in the ViewPoint HD Connect to Meter pop-up window is “Launch Configurator”. This option allows for the creation of a meter setup or alarm table for future use without connecting to a meter. After prompting the user for a meter model (shown below), ViewPoint HD launches under a mode with restricted functionality. This mode operates on files only.



## ViewPoint HD Software Overview




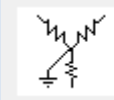
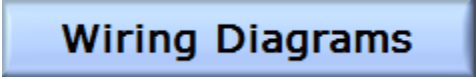
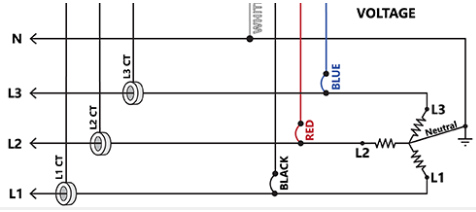
ViewPoint HD is a Windows application and is the most versatile software tool for configuring and verifying a PSHD meter. All functions and menus are accessed under the central drop-down list which has a content **filter** for viewing **basic** metering data or **extended** data that can be helpful in troubleshooting. The information displayed in the drop-down list for each filter setting is summarized below.



| Display Data   |  |
|--|--|
| Basic  | Extended   |
| <p>Monitor</p> <ul style="list-style-type: none"> <li>Power</li> <li>Energy</li> <li>Demand</li> </ul>   | <p>Monitor</p> <ul style="list-style-type: none"> <li>Power</li> <li>Energy</li> <li>Demand</li> <li>Power Factor</li> <li>Waveform Capture</li> <li>Harmonics</li> <li>Phasor Plot</li> </ul> |
| <p>Setup</p> <ul style="list-style-type: none"> <li>Meter Setup</li> <li>Communication Setup</li> <li>Advanced</li> <li>About the Meter</li> </ul> | <p>Setup</p> <ul style="list-style-type: none"> <li>Meter Setup</li> <li>Communication Setup</li> <li>Alarms</li> <li>Advanced</li> <li>About the Meter</li> </ul>                             |

VIEWPOINT HD DOCUMENTATION

ViewPoint HD includes context help and other user-guiding features (shown below) to facilitate rapid and accurate configuration.

| Help Aids  |   |
|--|---|
| <p><b>Information</b></p>  <p><b>Frequency (Hz):</b><br/>           DEFINITIONS:<br/>           Frequency: Line frequency</p> <p>ModBus Address (16 bit) MSW,LSW    <b>BACNet Object</b><br/>           REGISTER / OBJECT ADDRESSES<br/>           Description        <b>MSW, LSW</b><br/>           Frequency            <b>1165, 1166</b></p> | <p>This button toggles the context pop-up window which displays the technical and register description of any screen object you hover over with the mouse. Example shown for Frequency:</p>   |
| <p><b>CT Type</b></p>    | <p>Current Transformer models are selected in the drop-down list and are identified by a combination of CT image and amperage range. The parameters for the selected CT are automatically populated. This information can be edited for custom use.</p> |
| <p><b>Service Type</b></p>  <p><b>4-Wire 3-Phase</b></p>  | <p>Select a service type from the drop-down list. A selection populates the fields with pre-configured service type information. User-selectable fields are shown in white. Greyed out fields indicate restrictions imposed by the meter.</p>           |
| <p><b>Wiring Diagrams</b></p>    | <p>Diagrams of different wiring configurations, such as illustrated here, are available directly within the software for quick reference.</p>   |

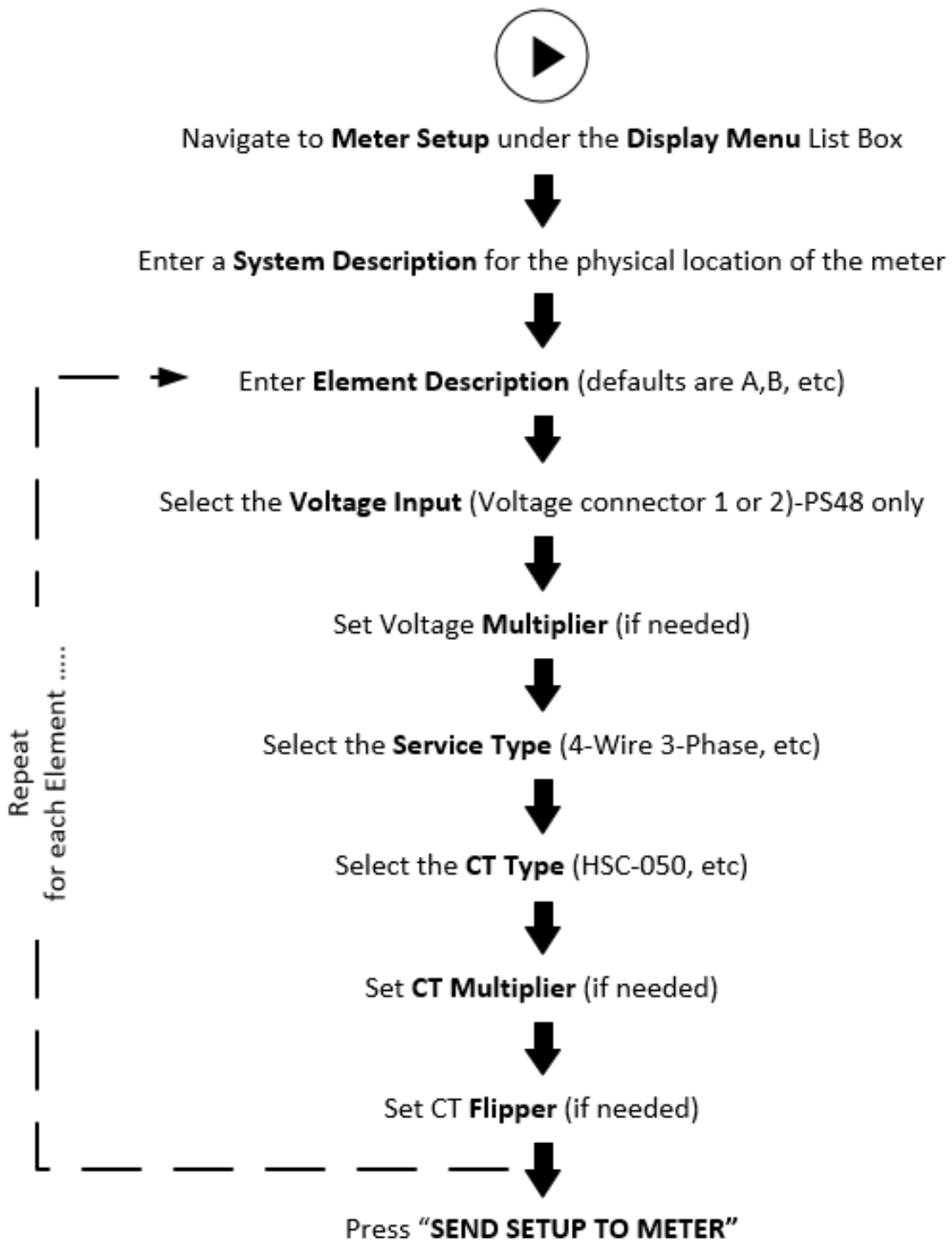
**VIEWPOINT HD DOCUMENTATION—INSTRUCTIONAL VIDEOS**

Additional information about the capabilities of ViewPoint HD software are presented in short videos and can be found at [www.DENTinstruments.com](http://www.DENTinstruments.com) and on the provided thumb drive.

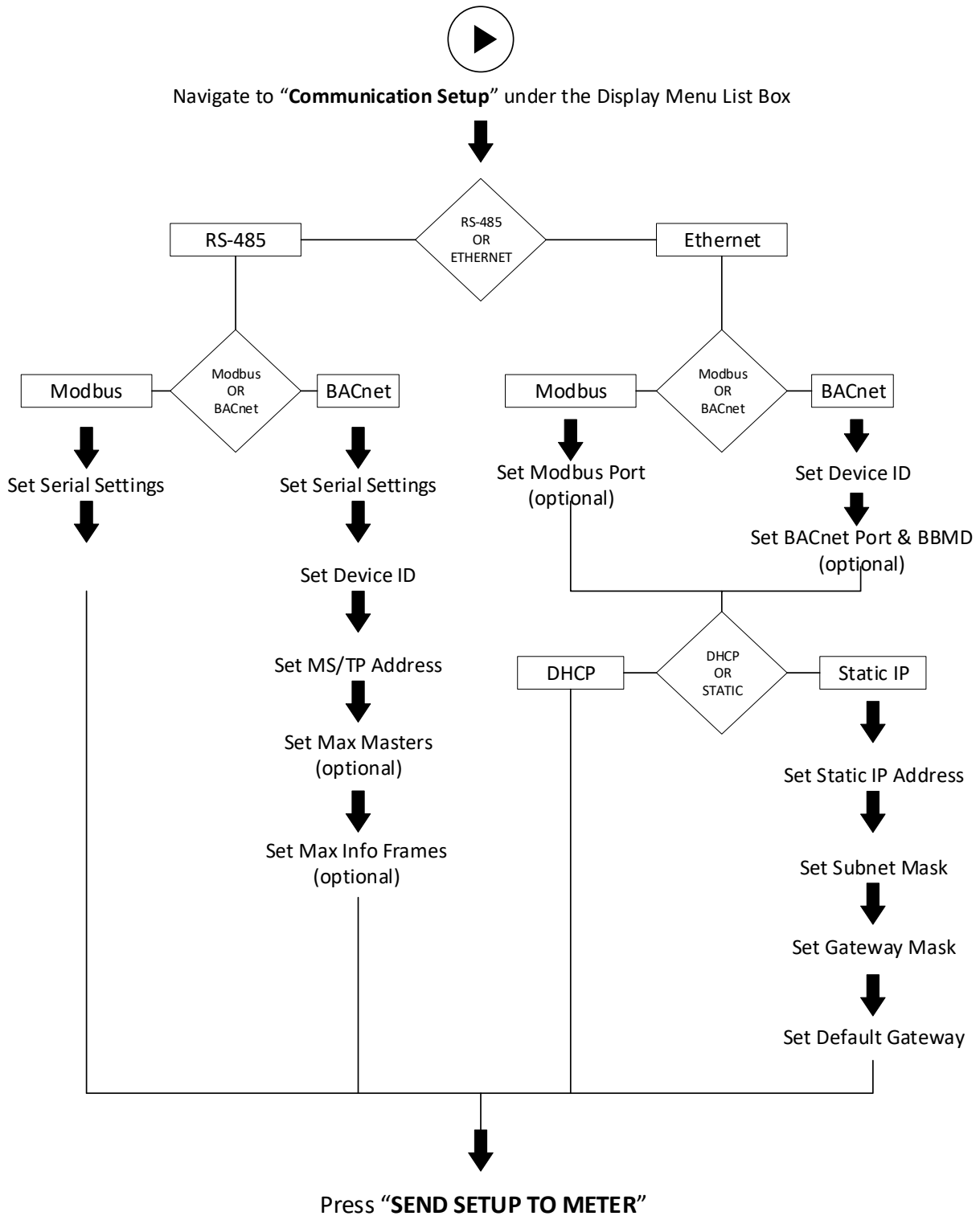
| Video Title                       | Video Hyperlink  |
|-----------------------------------|--|
| <b>Meter Setup—Electrical</b>     | <a href="#">VIDEOS\PSHD Meter Setup\PSHD Meter Setup 8_18_2017.mp4</a>       |
| <b>Waveform Capture &amp; THD</b> | <a href="#">VIDEOS\PSHD Waveform &amp; THD Example\Waveform THD Demo.mp4</a> |
| <b>Phasor Plot</b>                | <a href="#">VIDEOS\PSHD Phasor Plot\Phasor Plot Demo.mp4</a>                 |
| <b>Alarms</b>                     | <a href="#">VIDEOS\PSHD Alarms Demo\Alarms-demo.mp4</a>                      |
| <b>Setting up a PIN</b>           | <a href="#">VIDEOS\PSHD PIN Demo\PIN Demo.mp4</a>                            |
| <b>Excel Register List</b>        | <a href="#">VIDEOS\Register List Demo\Register List.mp4</a>                  |



CONFIGURING ELECTRICAL COMPONENTS USING VIEWPOINT HD



CONFIGURING COMMUNICATIONS USING VIEWPOINT HD



## CONFIGURING ALARMS IN VIEWPOINT HD

The PSHD power meter has the ability to set alarms for over and under conditions for voltage and current on any meter channel.

### Configuration Input Methods

ViewPoint HD uses dynamic entry for the specification of Alarm settings. Whichever text entry field is selected becomes the forcing condition and the other related fields are updated by calculation to reflect a consistent set of conditions. The text entry fields in grey are “configuration aids” and are *NOT* retained by the meter. Only the fields with a black background are stored in the meters memory or in configuration files.

### Nominal Values

Entering alarm thresholds based on “percent of nominal” values is helpful when alarm conditions are desired to be centered around electrical components or industry standard conditions. For example, an over current alarm may be set to 80% of an installed circuit breaker to alert when that breaker exceeds NEC recommendations.

### Absolute Values

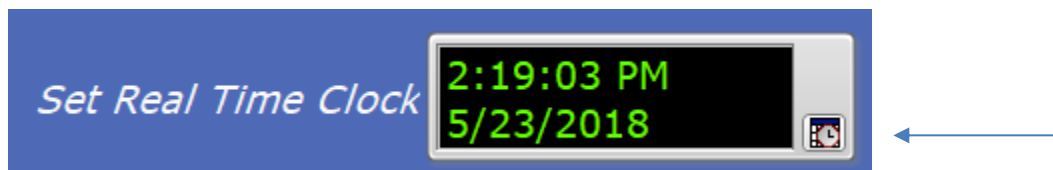
Entering alarms based on absolute value is a matter of entering the triggering values directly in the register fields (black background).

*Voltage Alarms*

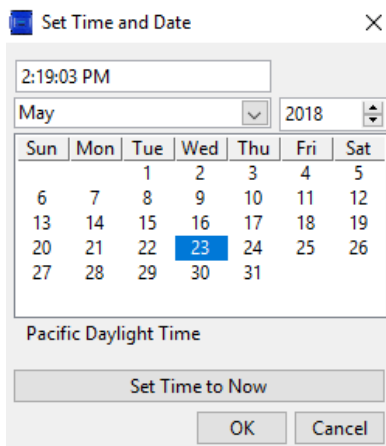
| <i>Persistence (seconds)</i> 15 |                | <i>Lower Limit</i> | <i>Upper Limit</i> | <i>Nominal</i> | <i>Lower Alarm</i>   | <i>Upper Alarm</i>   |
|---------------------------------|----------------|--------------------|--------------------|----------------|----------------------|----------------------|
| <i>Copy</i>                     | <i>Channel</i> | <i>% Service</i>   | <i>% Service</i>   | <i>Service</i> | <i>Voltage (RMS)</i> | <i>Voltage (RMS)</i> |
|                                 |                | <i>Voltage</i>     | <i>Voltage</i>     | <i>Voltage</i> |                      |                      |
| <i>Copy...</i>                  | V1 L1-N        | 80                 | 120                | 277            | 222                  | 332                  |
| <i>Copy...</i>                  | V1 L2-N        | 80                 | 120                | 277            | 222                  | 322                  |
| <i>Copy...</i>                  | V1 L3-N        | 80                 | 120                | 277            | 222                  | 322                  |
| <i>Copy...</i>                  | V1 L1-L2       | 80                 | 120                | 480            | 384                  | 576                  |
| <i>Copy...</i>                  | V1 L2-L3       | 80                 | 120                | 480            | 384                  | 576                  |
| <i>Copy...</i>                  | V1 L3-L1       | 80                 | 120                | 480            | 384                  | 576                  |

### SETTING THE REAL TIME CLOCK

The PSHD meter includes a Real Time Clock. The clock is used only to time stamp Interval Data in the log, it is not used for calculation within the meter. For those customers using the 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 time can be set using ViewPoint HD, under the Advanced Tab, by clicking on the small time icon in the bottom right corner of the clock.



The clock icon launches the Window Calendar and allows the user to any desired date and time. “Set Time to Now” populates the current time. 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 stand alone low power circuit within the PSHD 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.



Users desiring to use the Interval Data Recording capability of the PSHD meter will want to have a procedure that ensures the Real Time Clock is set as part of the commissioning process.

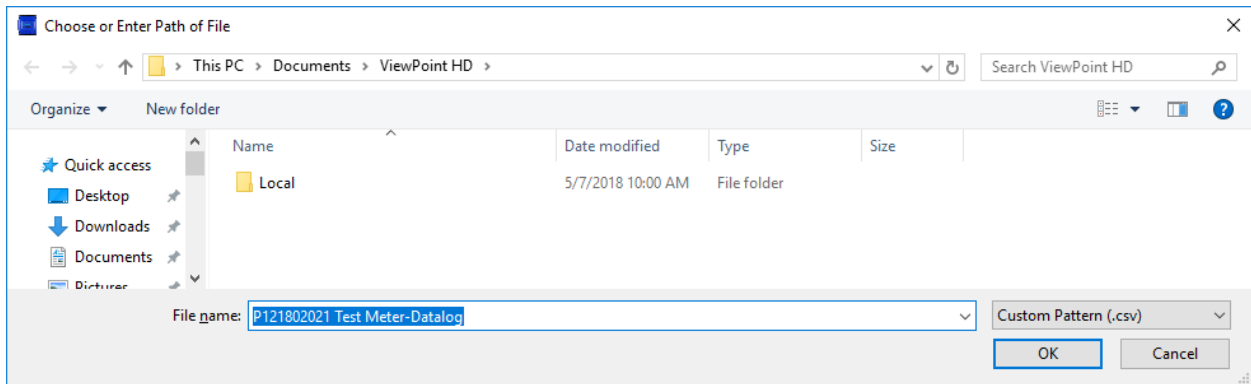
**RETRIEVING INTERVAL DATA**

The PSHD 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. The Interval Data Recording (IDR) is assessed through ViewPoint HD in the Advanced menu.

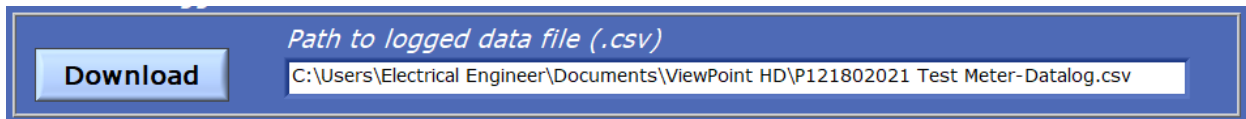
Click the “Download” button.



By default, the name of the data file will include the Serial Number of the Meter and the System Description followed by – Datalog (see below)



After pressing “OK” the entire data path will be displayed



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 (example below).

| Sequence Number | Time Stamp      | A1 kWh  | A2 kWh  | A3 kWh  | A System | B1 kWh ... |
|-----------------|-----------------|---------|---------|---------|----------|------------|
| 123456          | 5/15/2018 12:00 | 1.11E+5 | 2.22E+5 | 3.33E+5 | 6.66E+5  | 0          |
| 123457          | 5/15/2018 12:15 | 1.12E+5 | 2.23E+5 | 3.34E+5 | 6.69E+5  | 0          |

## PSHD Web App Overview

The PSHD power meter hosts a Web Application that can be accessed by any smart device running a web browser. The PSHD Web App can be accessed by using the **USB or Ethernet port**.



Mac users can configure the meter using the PSHD Web App Interface by installing a driver which is included in the Media Distribution materials or on the DENT web site.

### CONNECT TO WEB APP USING USB

- 1) Connect your smart device to the meter
- 2) Open a Web Browser
- 3) Enter <http://169.254.1.5> (this is the static address of the USB port)

### CONNECT TO WEB APP USING ETHERNET

- 1) Discover the IP address of the meter by one of the following methods (a-c)
  - a. Navigate to About Meter on the LCD menu.
  - 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 smart device to the same subnet as the PSHD meter
- 3) Open a Web Browser
- 4) Enter the PSHD's Ethernet address into the web browser

## AUTHENTICATION

Because the PSHD Web App can be viewed and controlled by any smart device, and communicates in parallel to the host system, the PSHD 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.

The screenshot shows the login interface of the PSHD Web App. At the top, it says "Welcome to Power Meter Web App". Below that, it prompts the user to "Please enter Password to login if configured." There is a "DENT Instruments" logo on the left. A message states "If Read Only Password is not setup, click Login for Read Access." To the right, there is a "Password:" label followed by a text input field and a "LOGIN" button.

Organizationally, the PSHD Web App works much the same as ViewPoint HD, although it has no analytics and operates on a single element at a time.

## Macintosh Users

ViewPoint HD is a Windows application and does not run on MAC OS. MAC users can, however, make use of the PSHD Web App interface through the USB port by installing a CDC-EEM driver. This driver is available in the Media Distribution materials or can be downloaded from the DENT Instruments web site.

| Name | Date modified     | Type        | Size |
|------|-------------------|-------------|------|
| MAC  | 5/15/2018 9:13 AM | File folder |      |

| Name                        | Date modified     | Type          | Size     |
|-----------------------------|-------------------|---------------|----------|
| dentinstruments-2.0.3a1.dmg | 5/14/2018 9:44 AM | DMG File      | 2,048 KB |
| Read Me MAC.txt             | 5/15/2018 9:19 AM | Text Document | 1 KB     |

- 1) Users must have OS version of 10.11.1 or higher
- 2) Drag the file dentinstruments-2.03a1.dmg onto the desktop
- 3) Double-click the dmg file to initiate the MAC installer
- 4) Follow the installation prompts
- 5) Reboot the MAC after the installation process is complete.
- 6) Connect the PSHD meter to the MAC with USB cable.
- 7) Open Safari browser and type IP address 169.254.1.5 to access the PSHD Web App
- 8) If no login credentials are setup, click on login button with blank for password
- 9) The PSHD Web App checks for login credentials and, if passed, opens Real Time Web Page

## METER INSTALLATION - DETAILS



This section is intended to support the physical installation of the meter and provide guidance on connecting the current transformers (CTs) correctly within the electrical load center and to the PSHD meter.

### Meter Mounting Configurations

DENT PowerScout HD meters are sold in several form factors. Enclosures are designed to be wall mounted and connected to electrical conduit. Plate mounted versions are ready to be mounted inside a customer supplied NEMA enclosure. Raw PCBA's (available by special order only) need to be mounted on customer-provided stand offs (0.5" in length or longer) and mounted in a NEMA-rated enclosure. Care should be taken not to flex the circuit board during mounting.

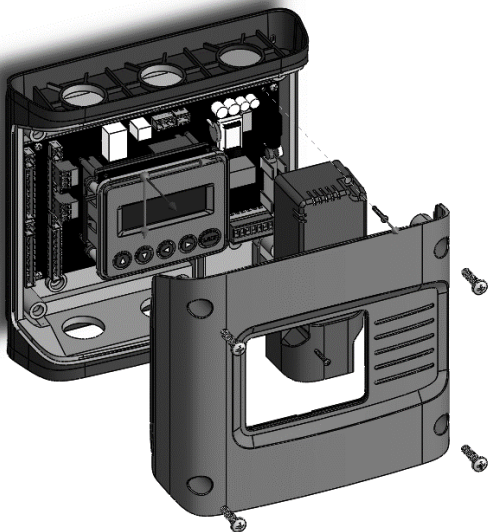
| Mounting Options | PS48 HD   | PS12 HD   |
|------------------|---|---|
| Enclosure        |  |  |
| OEM Plate        |  |   |
| RAW PCBA         | Special Order   | Special Order   |



### INSTALLATION SEQUENCE

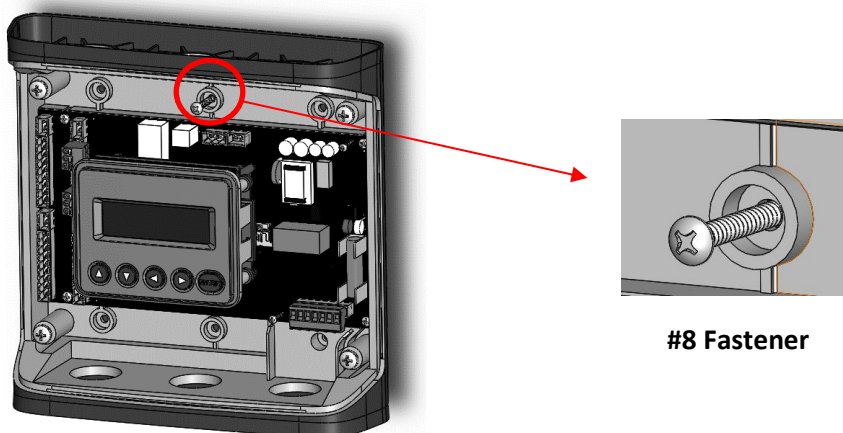
The following section illustrates the PS12HD model. The PS48HD components are slightly different, but follow the same procedure.

**STEP 1)** Remove top cover screws (4x) and high voltage cover screws (2x) – provided



**STEP 2)** Locate, mark, and drill wall mounting points (2x–6x—customer supplied)

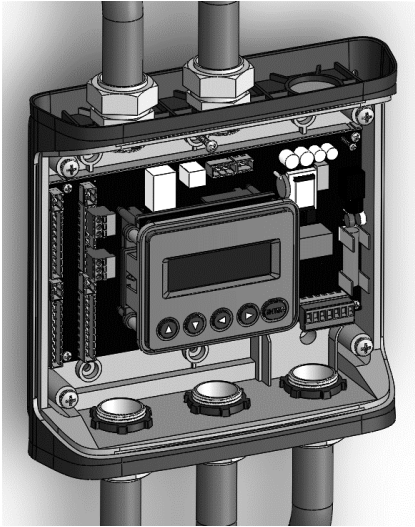
The plastic enclosure itself can be used as a template for marking the drill locations on the wall.



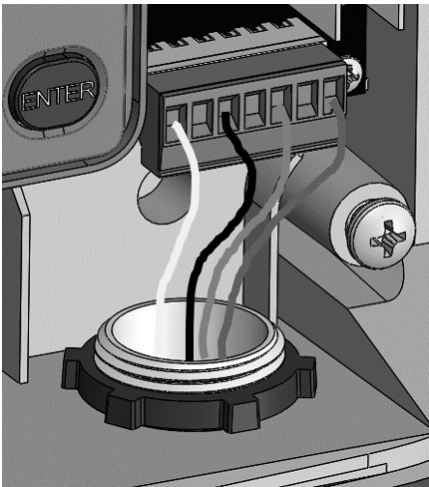
#8 Fastener

If the meter is not available for use as a drill template, a drawing indicating the spacing between mounting holes can be found in the appendix. The centerline holes are intended for fastening to wall studs. If hollow wall fasteners are used, the outer 4 mounting points are recommended.

**STEP 3)** Mount conduit fittings, conduits, and blanking plugs

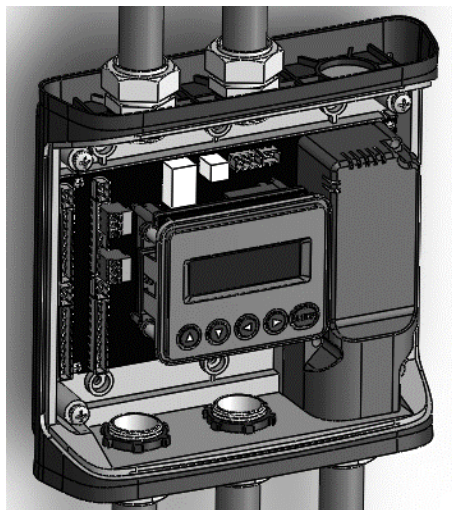


**STEP 4)** Connect voltage leads



**DO NOT ENERGIZE METER WITH VOLTAGE COVER REMOVED**

**STEP 5) Attach high voltage cover**

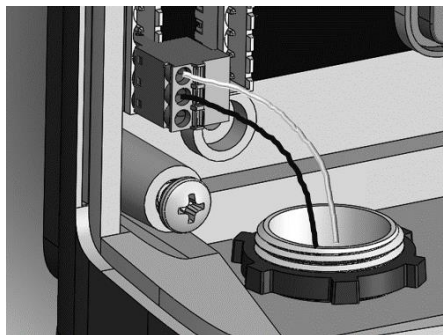


**IP30**



**TOUCH SAFE (with internal cover installed)**

**STEP 6) Connect CT and Communications Wiring**




**CONNECTING VOLTAGE**

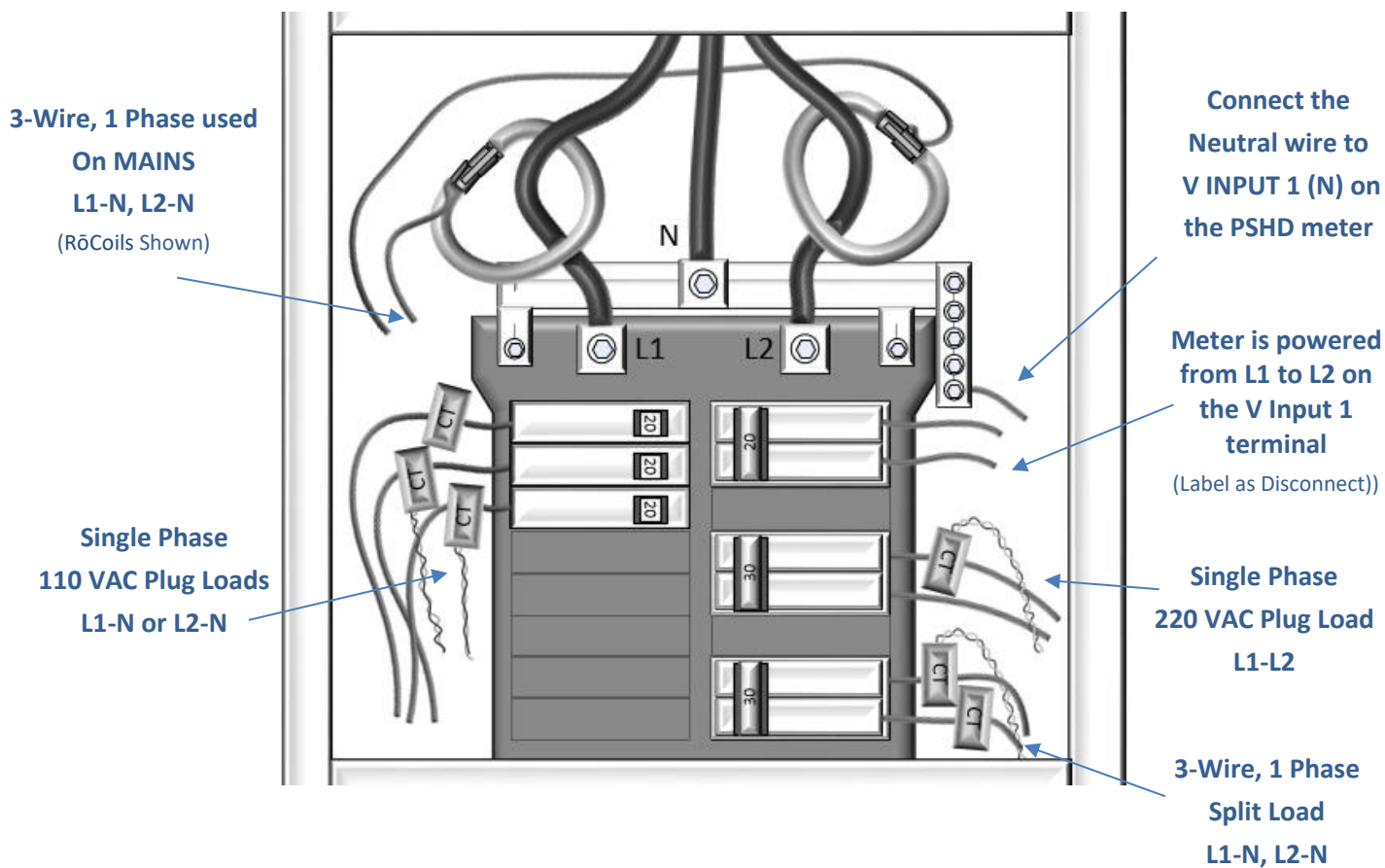
Connect the voltage leads (L1, L2, L3, and N, as necessary) to the meter through a dedicated disconnect or circuit breaker. A voltage lead of **14 AWG THHN Minimum 600VAC rating** (or equivalent) is required.



**IMPORTANT:** Verify the circuit breaker is marked as the disconnect breaker for the meter.

## Wiring the PSHD Meter in a 3-wire, Split $\phi$ Service Panel

 High voltage MAY BE PRESENT. Risk of electric shock. Life threatening voltages may be present. Qualified personnel only.



Illustrating the intended wiring configuration for each of the Service Types available in the Service drop-down list under “Meter Setup”

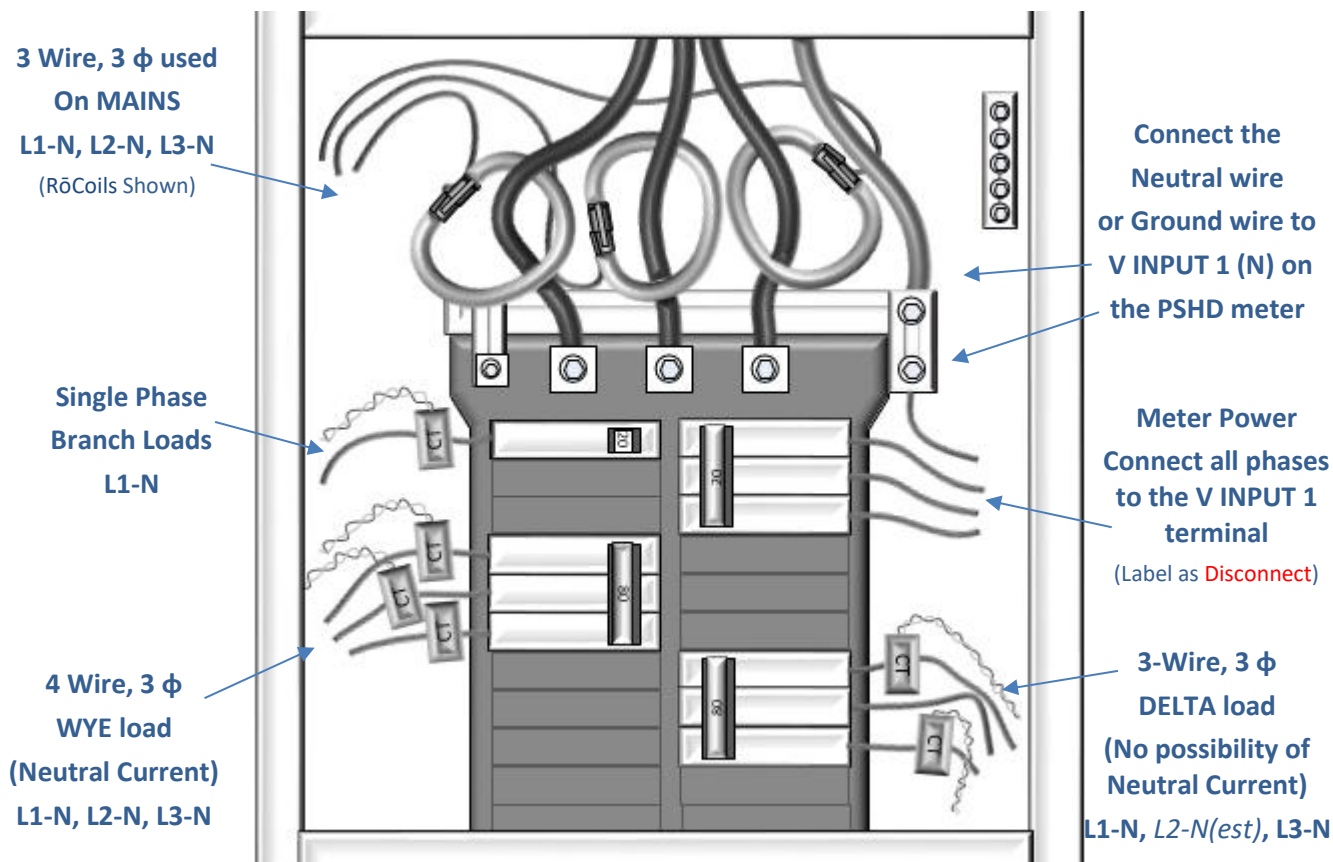
**EXAMPLE LOADS:**

**Single Phase L1-N or L2-N 110 VAC:** Lighting, Appliance, Living Zone

**Single Phase L1-L2 220 VAC:** Water Heater, Clothes Dryer, Equipment with no neutral wire.

**Split Phase L1-L2 220 VAC:** Service Entrance, Equipment with neutral wire.

## Wiring the PSHD Meter in a 4-wire, 3 $\phi$ Service Panel



Illustrating the intended wiring configuration for each of the Service Types available in the Service drop-down list under “Meter Setup”



**Note:** The PSHD Meter Series uses the “Neutral” Terminal as a voltage reference. For systems without a neutral conductor, DENT Instruments suggests connecting a ground wire to this terminal. If the neutral terminal is left open, L-L measurements will be accurate, but L-N measurements may not be symmetric. If a ground wire is connected to the Neutral terminal, <2 mA will flow into the ground wire.

## Current Transformer Basics

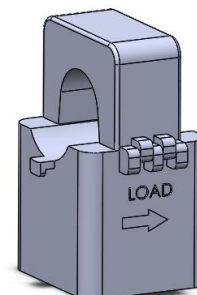
### Ensure CTs meet the following criteria:

- 600 VAC UL Rated
- UL2808 Listed
- 1/3 (333 mV) output voltage
- Appropriate range for the circuit (5-120% of CT Rating Recommended)
- Read the label



### Ensure CT orientation & placement:

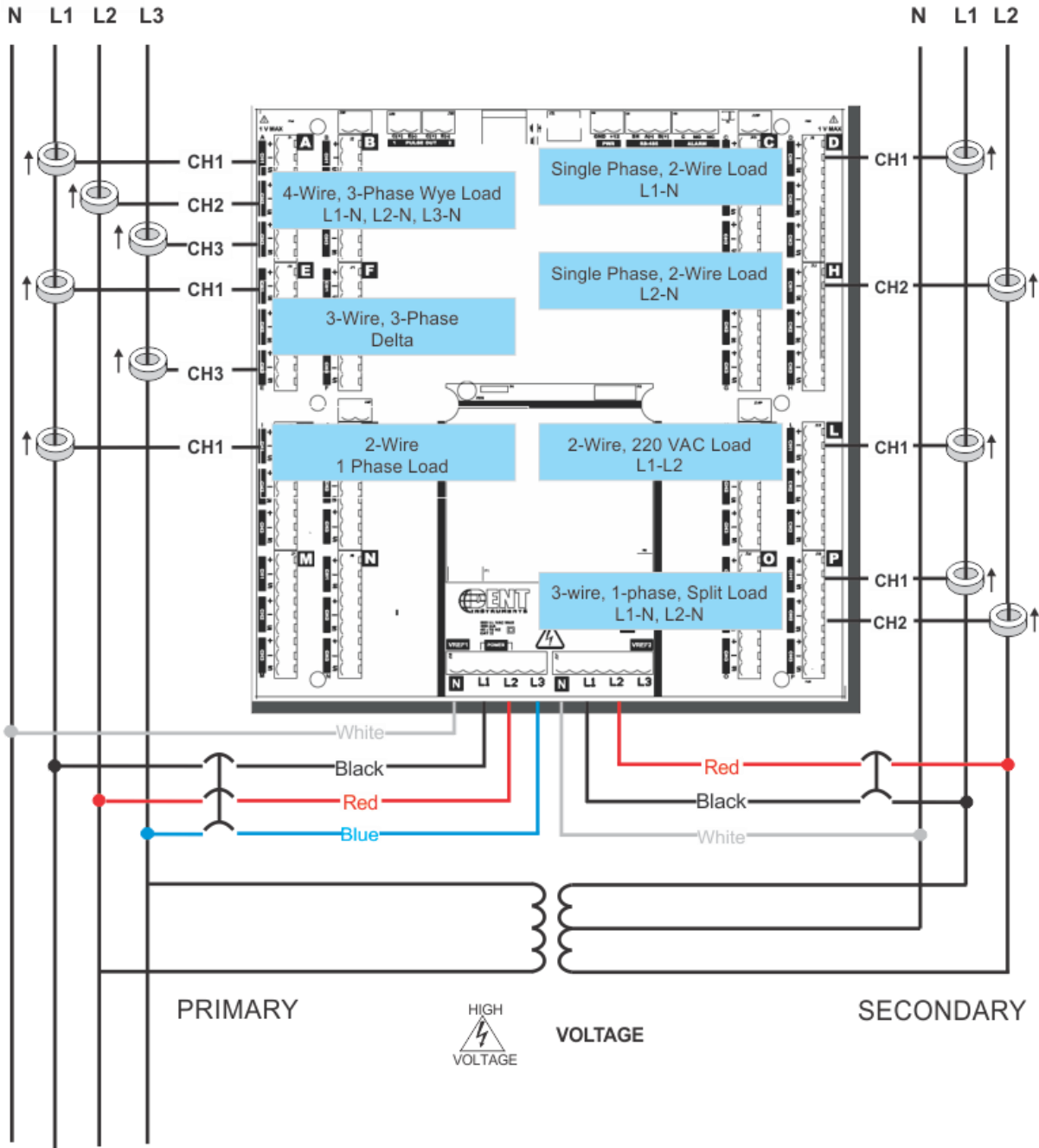
- Arrow points toward load (or as instructed by CT label)
- Arrow points away from Panel (or as instructed by CT label)
- Placed on First Conductor of voltage Reference (L1-L2) circuits are placed on L1
- Observe wiring color and polarity
- Use the Shield wire if provided (connect to PCB terminal marked S)



| Wiring Guide for CT Types  |   |
|--|---|
| Split, Hinged, & Solid Core CTs  | RōCoil CTs  |
|  |   |
| <p><b>White: Positive</b><br/> <b>Black: Negative</b><br/>                     (no shield)</p> | <p><b>White: Positive</b><br/> <b>Brown: Negative</b><br/> <b>Bare Wire: Shield</b></p> |

### Wiring the CTs to the PSHD Meter

The image below is the counterpart to the service panel illustration and indicates how to connect CTs to the PSHD meter for each service type. For service types that are not specifically listed, it is recommended to choose “single phase” service and configure each channel individually. Three phase loads are illustrated on the left and split phase loads on the right as an example only. Elements are fully interchangeable on the meter.



## COMMUNICATION & VERIFICATION - DETAILS



This section is intended to support the commissioning of the PSHD meter by an instrumentation technician. In many cases, the electrical installation is conducted ahead of the availability of the RTU or was performed by a different installer. Often the technician is working in concert with a remote programmer who is confirming the connectivity with a remote host system. A Digital Multimeter (DMM) can be used to confirm measurements at the board terminals, if necessary.



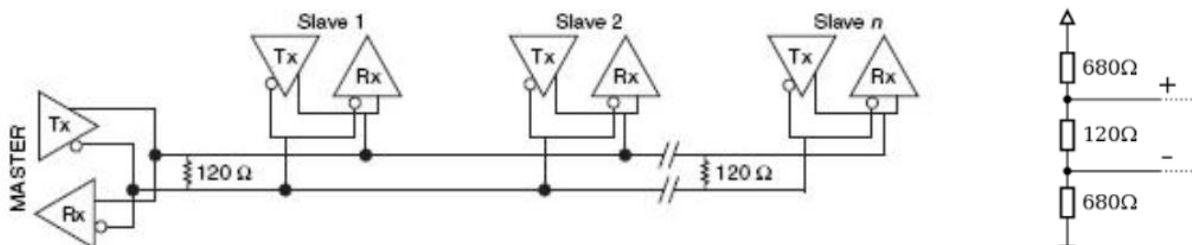
**It is assumed that the meter is now powered up from the line voltage. It is safe to touch the meter (including the user buttons) with the top cover removed ONLY IF THE INTERNAL HIGH VOLTAGE COVER IS INSTALLED.**



Communications settings and real-time data values can be confirmed quickly using the LCD interface if equipped. When significant setup modifications are anticipated, a computer interface is recommended.

### Physical Connections on an RS-485 Multidrop Network

The PSHD meter uses a 2-Wire Half Duplex RS-485 Implementation.



**2-Wire Multidrop Network using Terminating Resistors**

- **Termination Resistors**—are NOT included on the PSHD meter. If the PSHD 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 PSHD meter. Bias resistors are needed if the idle conditions of the bus are in an indeterminant logic voltage. Bias resistors are usually located at the master node and are usually 680 ohms for a 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 PSHD meter is a 1/8<sup>th</sup> unit load allowing up to 256 like devices in parallel.

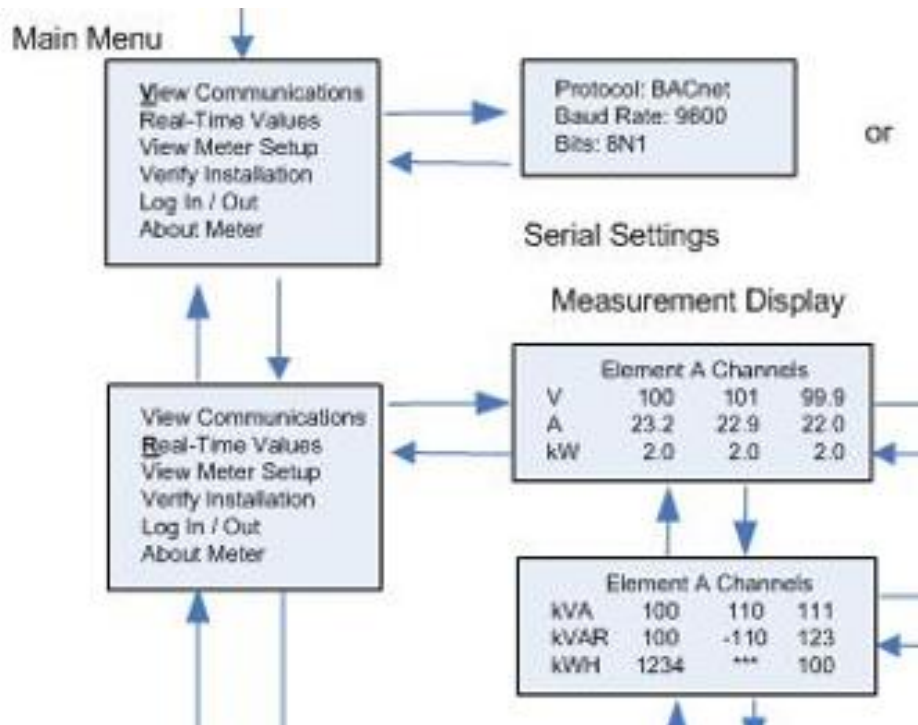


## Communication Verification



Verification includes confirmation of BOTH the physical interface settings (Serial or Ethernet) and the protocol (Modbus or BACnet) settings.

The LCD User Interface can be used to quickly confirm the settings required for each combination of interface and protocol. The interface is intuitive and groups together commonly associated registers. The complete interface is presented in Appendix A as a navigational map. Arrows indicate how to move from one menu display to the next. A **Reverse Contrast** entry in the documentation indicates the active menu item in a list which corresponds to a blinking character in the physical LCD. The ENTER button is used to select a property and up / down buttons are used to select among the values supported by the meter. Note that changes to the meter configuration are limited to the communication interface using the LCD. If additional changes (such as CT type) are required, they must be made using a software interface.



Example LCD Navigation

### VIEWPOINT HD / PSHD WEB APP

If your PSHD model does not include the LCD User Interface, or if you prefer to verify the installation using software, then verification is facilitated through the ViewPoint HD PC application or the PSHD Web App which shares a common design. Refer to the section on Configuration Details for an overview and list of instructional videos for ViewPoint HD or the PSHD Web App.

## Physical Interface Verification

### SERIAL SETUP VERIFICATION

In a multidrop serial network, the host data format settings are typically known or specified and the slave is adjusted to match. In some cases (long wiring runs, etc.), it may be necessary to experiment in determining the fastest allowable baud rate for a given wiring configuration by changing BOTH the host and slave devices. Configurations other than 8N1 are rare and it is advised to use this configuration for Data Bits, Parity, and Number of Stop bits, if possible.

### LAN ETHERNET NETWORK VERIFICATION

The PSHD meter communicates using IEEE 802.3 Ethernet connectivity running at a 10/100 Mbps. Verification of the meter settings over Ethernet includes ensuring that the IP address of the meter is within a range that allows communication with a host (if static) or is set for DHCP, allowing the meter to be assigned an address by a DHCP server as described below.

### DHCP

If the PSHD 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 LCD or can be found through connection with ViewPoint HD or the PSHD Web App. The IP address assigned to the meter should be regarded as a **temporary address** as the address may change between power cycles making it difficult for the host system to know how to find the meter on the network. One common approach is to set the PSHD for DHCP so that the address can be assigned by a DHCP server and then change that IP address to static once the connection is made. PSHD meters are set to use DHCP as a default setting to facilitate this approach.

### STATIC IP

If the PSHD meter is set to a static IP then its address should be assigned by an IT department to avoid multiple devices on the same network. This scheme is usually used when an RTU is expecting to find the meter at a specific IP address.

## Protocol Verification

The network protocol is typically specified as part of the installation. 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 the protocols over Ethernet. Each combination of interface and protocol require specific registers settings described below. The scope of this section is to use either the LCD interface or software tools to quickly confirm or change settings to match an existing specification. Further information and optimization tips are covered in the section on RTU programming.

## Modbus Settings

### MODBUS RTU SETTINGS

**Device Address:** In a Modbus network each device must be assigned a **unique slave address**. Valid Modbus addresses are 1-240 (keeping in mind the PS48HD requires 15 addresses beyond Element A or the PS12HD requires 4 address beyond Element A). The slave address of the power meter sets the register address for **ELEMENT A**. Adjacent elements B, C, D, etc. are accessed by incrementing the slave address by 1. The slave address of the PSHD meter needs to be set to match the address expected by the RTU and is normally part of the network specification. The default address for element A is 1.

### MODBUS TCP SETTINGS

**Modbus Port:** The PSHD meter uses the industry standard Port 502 for Modbus. This port number can be changed, although this is considered an advanced setting and should be left at 502 unless this generates a conflict on the host system. The port number can only be changed through the ViewPoint HD software interface.

## BACnet Settings

**BACnet Device ID:** In a BACnet network, each device must be assigned a **unique Device ID and is common to BACnet MS/TP and BACnet IP protocols**. Besides the standard ability to change this from a BACnet explorer tool it may be changed via ViewPoint HD, PSHD Web App, or LCD.

### BACNET MSTP

**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.

### BACNET IP

**BACnet Port:** The BACnet default port is 47808 and does not usually need to be changed

**BBMD:** The BACnet/IP Broadcast Management Device is set to 0.0.0.0 at default and can be changed through a software tool to allow discovery across networks.

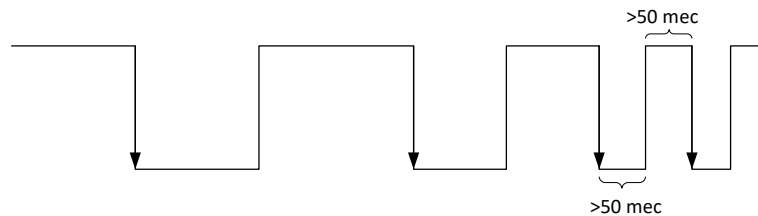
## Pulse Outputs

Early PS48HD meters (Hardware revision H running firmware version 1.012) were equipped with 2 pulse outputs. Customer feedback indicated that inputs would be more useful than outputs. In response to this, the pulse direction was reversed on the PS12HD and is planned to be reversed on PS48HD meters starting with hardware revision I. While this transition is taking place, the terminals identified as Pulse Outputs (image right) are non-operational on PS48HD meters running firmware version 1.018 and higher.



## Pulse Inputs

PS12HD meters are equipped with 4 pulse inputs and PS48HD meters (hardware version I) 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 PSHD pulse inputs are compatible with “low speed” meters. The pulse duration must exceed 50mS 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 the register list, ViewPoint HD, or videos for more information.

## ALARM (SPDT)

The PSHD meter supports user-configurable alarms for over-current, under-current, over-voltage, and under-voltage. ViewPoint HD helps users set these values by allowing for values to be entered using direct entry mode or specifying the limits as a percentage of nominal.

Alarm persistence settings are used to allow for temporary conditions, such as a motor starting, that are beyond trigger limits. For example, in the case of meter upset from ESD events, short persistence settings may lead to false alarm triggers. When any alarm condition has been satisfied throughout the persistence interval, the PSHD trips the MASTER ALARM relay, which is an electromechanical relay on the PCB.

Once tripped, the relay can only be reset by clearing the alarm through Modbus register/ BACnet object 2451”

The Master Alarm relay can be hard wired to an interrupt or polling circuit in a host system allowing for a more rapid response than the data polling frequency, if desired. The status of each alarm is determined by reading status registers.

Refer to the register list, ViewPoint HD, or instructional videos for more information.



**Note: The Master Alarm relay is intended for low voltage DC connections.  
The user must protect the switch from over-current conditions when closed.**

## 12 Volt Auxiliary Power

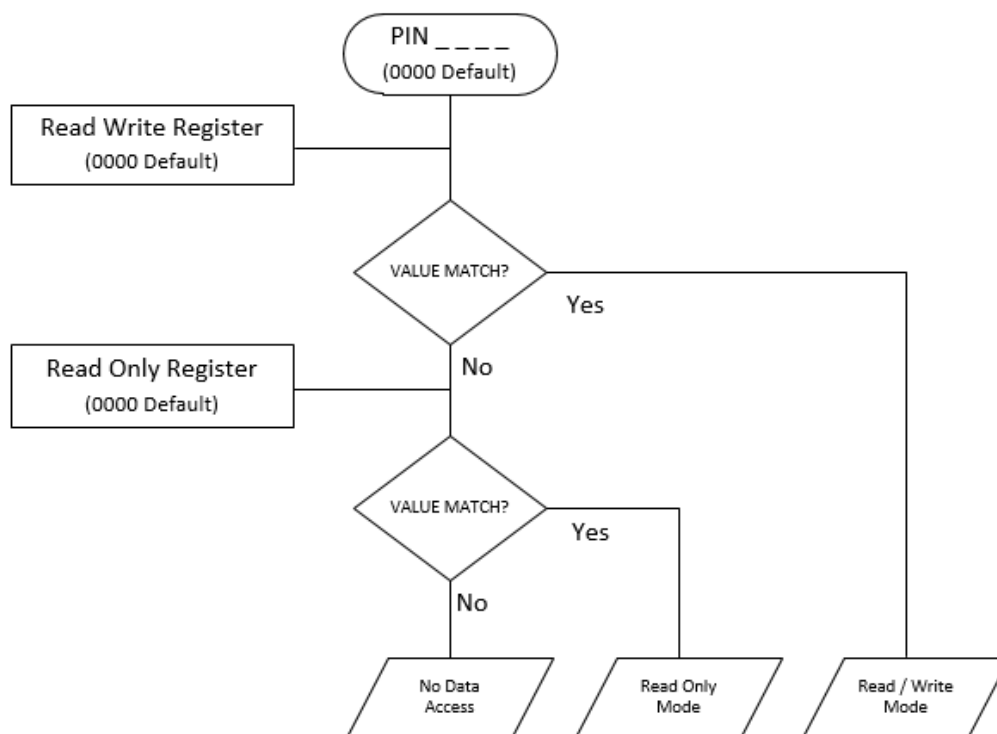
The PSHD meter provides an auxiliary 12 volt output that is derived from an auxiliary winding on the PSHD's line-connected power supply. The 12 volt supply voltage is unregulated but protected by a self-resetting fuse. The purpose of the supply is to power external radio equipment or provide supply voltage for analog sensors, such as 4-20 mA current loop devices. If full-rated current is drawn from this terminal, the minimum operating voltage of the L1-L2 power supply is 100 VAC.

## Access Restriction Limitations

If security levels have been set up in the meter, no data is accessible through the LCD user interface or PSHD Web App 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.

## Security PIN Protection

PSHD 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.



## USING THE PERMISSION REGISTERS

The PSHD meter uses both a “Read Only” register and a “Read / Write” register to compare against user entries from the LCD keypad or PSHD Web App form entry. Both internal permission registers have a default value of [0000]. A consequence of this is that both PIN registers need to be configured (i.e. changed from defaults) to implement a read only PIN, otherwise the situation may occur where a user intends to restrict access to “Read Only” by setting only this PIN unaware of the fact that the default PIN still matches the criteria for “Read / Write” which will accidentally promote the user. ViewPoint HD and the PSHD Web App disallow this condition, but remote programmers using direct register access may create this condition.

### READ ONLY PERMISSION REGISTER

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 recommended to use ViewPoint HD to configure permissions, although it is also possible to set up a Read Only PIN using the PSHD Web App if a Read/ Write PIN has already been entered (either through the LCD or the PSHD Web App itself).

### READ/WRITE PERMISSION REGISTER

Read/Write permissions allow users to read and write configuration items and to reset the PINs. This level of authorization will be required by any technician or user who needs the ability to correct setup errors in the meter. The default PINs [0000] allow new users to reset the Read / Write PIN from either the PSHD Web App or ViewPoint HD. Permissions cannot be set through the LCD interface.

### READING PINs OVER MODBUS OR BACNET

ViewPoint HD can be used to directly report the Read Only and Read/ Write PINs under the Advanced Tab (passwords). The value reported by ViewPoint HD is the value as entered in the web page or LCD interface.

PINs are also accessible as 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 looking up forgotten PINs, if network access is available.

### VIEWPOINT HD – UNRESTRICTED ACCESS

The ViewPoint HD software tool can be used to read & write configuration information to the meter without entering credentials.



ViewPoint HD is the preferred tool for setting up access restrictions because it allows users to test the function of the PINs without locking themselves out from the ability to change the PIN, a frustrating catch 22!

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## Verification of Installation

Once the PSHD meter is configured and communicating with the RTU, it is a good idea to perform some simple checks to ensure that all the CTs are on the correct voltage phases and that the CTs are facing the correct direction. The following are recommendations that work for typical installations. Special circuit conditions, like unloaded motors, may indicate an installation error when none exists. A Digital Multimeter (DMM) can be used to confirm these cases.

### INSTALLATION PHASE VERIFICATION

The PSHD meter includes a PhaseChek™ algorithm that identifies any element that the meter suspects may be incorrectly phased (i.e., the CT is associated with the wrong voltage source or is physically on the wrong wire) based on power factors below 0.55. This feature is accessed using the LCD interface by navigating to “VERIFY INSTALLATION” and pressing the ENTER button. The LCD display will list the elements having at least one channel with a low power factor.

#### CHECK ELEMENTS

A EF

Use the navigation buttons to highlight a specific element and hit enter or just hit enter and move from element to element using the ← / → keys. Within each element (identified on the top line of the display) the status of each channel is identified as good (PF > 0.55) or bad (PF < 0.55).

#### ELEMENT F

CH1 Good

CH2 Bad

CH3 Bad

Two “Bad” channels are often an indication that two CTs are inadvertently swapped. When the power factor for all enabled channels is greater than 0.55, the meter reports:

#### CHECK ELEMENTS

ALL CHANNELS GOOD



PhaseChek™ is only applied for elements that are enabled. VIEW METER SETUP on the LCD screen can be used to ensure that all intended elements are active. PhaseChek™ is advisory only. It is possible that the power factor for a particular load is truly less than 0.55, as may be observed in a free running motor.

The ViewPoint HD and the PSHD Web App run **PhaseChek™** continuously on all enabled elements and report low power factor in the real time values table by turning the text **RED** or by using a red indicator.

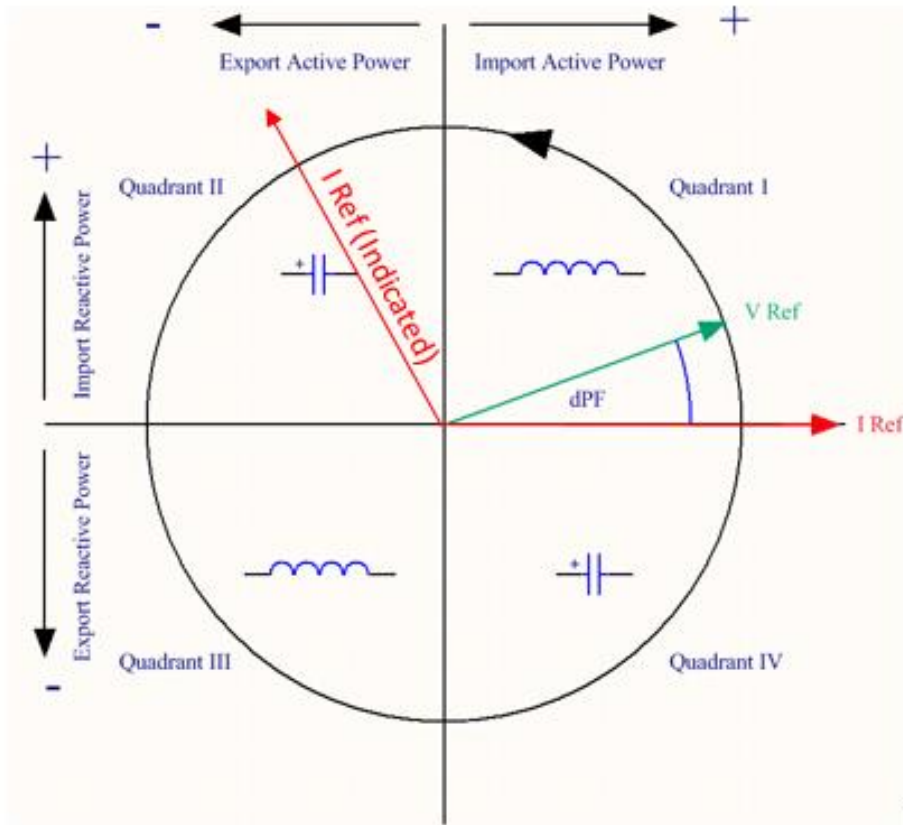


## PHASE CHECKING BY PHASOR PLOT

When a CT is installed on the incorrect phase, the indicated current vector is pointing either 180 degrees away (a split phase system) or 120 degrees away (a three-phase system) from the true displacement angle. In the latter case, this usually causes a significant decrease in the reported power factor, even if the CT is also on backwards. When the absolute displacement power factor of a load is below 0.55 (an angle greater than 57 degrees between voltage and current), the PSHD meter will flag it as a phasing error. ViewPoint HD has a PhasorPlot feature that can be used to study the voltage and current vectors of a given meter element.

### Check for Low Power Factor

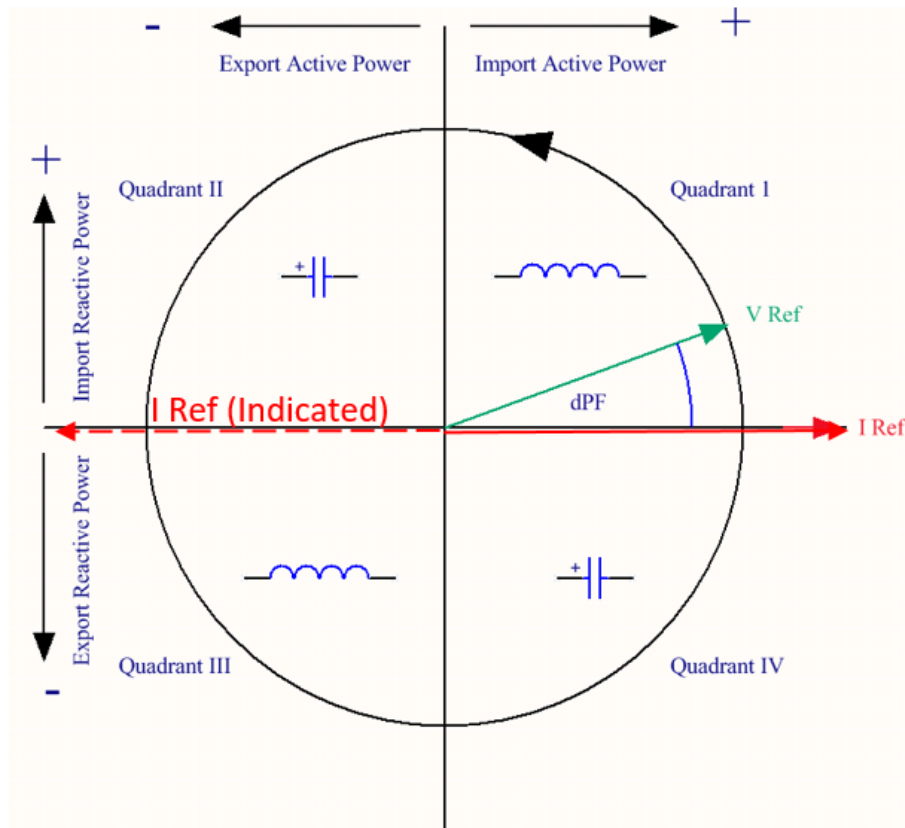
- **ViewPoint HD:** Real Time Values > (All power factors < 0.55 are shown in **RED**)
- **PSHD Web App:** Real Time Values > (All power factors < 0.55 are shown in **RED**)
- **LCD:** Verify Installation > (LCD will list all elements having a PF < 0.55)



Electrical Power Quadrants with Incorrect CT Phase shown

## CT Orientation Check

The PSHD meter reports power and energy in each electrical quadrant under a different register. When CTs are installed backwards, the indicated current vector is oriented 180 degrees away from the true displacement angle. In accordance with standard definitions, the Wattage and VARs of the effected channel report with a sign opposite from what is expected. Often this means that the import registers will be reading zero while the export registers are showing a value. Note that backward CTs have no impact on the amplitude of the Power Factor. A moderate power factor (>0.7) in concert with a negative power is a clue that the CT is on backwards, but is on the correct phase.



Electrical Power Quadrants with Reversed CT shown

Check that the wattage has the correct sign (Designated + for loads)

- **ViewPoint HD:** Real Time Values > (Confirm Sign of Power For All Elements)
- **PSHD Web App:** Real Time Values > (Confirm Sign of Power For All Elements)
- **LCD:** Real Time Values > (Confirm Sign of Power for Each Element)



If a CT is discovered to be on backwards after the installation is complete, the direction of the CT can be reversed through a user configuration register designed for this purpose, called the “**Flipper**,” located at 2226, 2234, and 2235 or use ViewPoint HD’s meter setup.

## Power Factor Convention

Power Factor is the ratio of a signed number (true power) and an unsigned number (apparent power). This discrepancy has led to some customer confusion. The PSHD 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). The sign relationships are shown below for these conventions in each electrical quadrant.

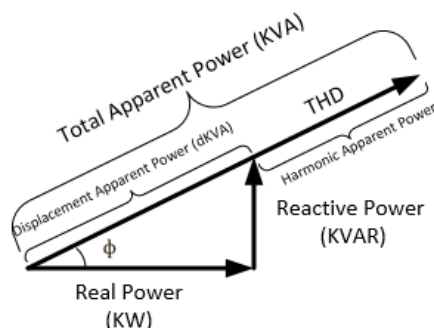
| P.F. | Q1 | Q2 | Q3 | Q4 |
|------|----|----|----|----|
| ANSI | +  | -  | +  | -  |
| IEEE | +  | -  | -  | +  |

## Total Harmonic Distortion

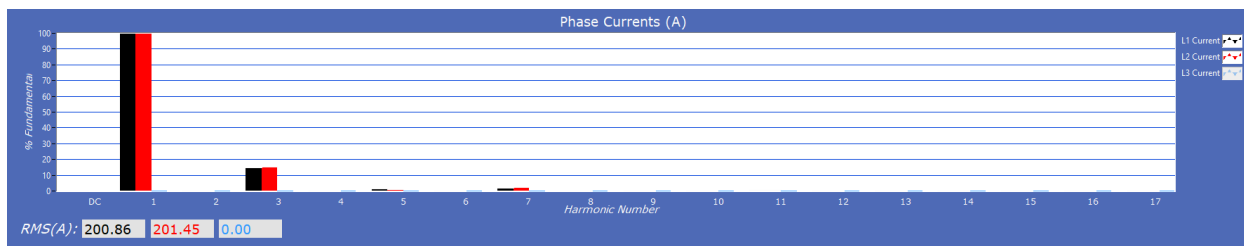
The PSHD meter reports overall harmonic content in power (% THD) based on its measurement of Power, Var and Apparent Power as illustrated in the figure below. This method cannot indicate the harmonic number or distribution but provides the overall harmonic content.

### POWER TRIANGLE

(for active loads)



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. ViewPoint HD can provide additional analysis of harmonic content in voltage and current by sampling the PSHD 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.



## Pre-Processing Aids

The PSHD has several registers that can aid in pre-processing or post-processing data that otherwise may need secondary operations.

### SNAP THRESHOLDS

The signal to noise ratio of the PSHD 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* tab in ViewPoint HD) tell the meter when to record 0 instead of the measurement result. The factory defaults for CT's 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

### MULTIPLIERS

The PSHD has registers that allow potential transformers and series current transformers to be used with the PSHD 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. Default values are 1.0

### CT PHASE SHIFTS

Current transformers like all other transformers experience a small magnetizing current that is out of phase with the measurement current. Phase shift registers are available on a per channel basis and allow corrections of +/- 3 degrees. Viewpoint HD loads the default phase shift for the CT types available in the picker list. If no phase shift information is available then enter the accuracy class in degrees (i.e. 1% = 1.0 degree).

### DEMAND

PSHD meters keep track of electrical demand using a 15 minute sliding window. The *Peak Demand* and *Present Demand* registers contain the highest average power consumption in any 15 minute interval and the average power consumption in the last 15 minute interval respectively. The Clear Peak Demand register is used to reset the peak demand detector.

## RTU PROGRAMMING AND SCRIPTING - DETAILS



This section is intended for the programmer of the RTU or host system and includes details about meter and element addressing, register locations, data formats and protocol examples.

### Register Organization

The PSHD meter communicates through the reading and writing of registers. Registers are organized into functional groups and are compliant with 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 set is included as an Excel file on the supplied thumb drive or at:

[HTTPS://WWW.DENTINSTRUMENTS.COM/TECHNICAL-DOCUMENTS/POWERSCOUT](https://www.dentinstruments.com/technical-documents/powerscout)

### ELEMENT VS SYSTEM SCOPE

#### Element

The term “element” is used in two contexts. Physically the term Element is used to describe groups of three channel sections identified by alphabetic letter on the silk screen of the PCBA (ie A,B,C,D). In a three phase power system these correspond to electric circuits. Logically the term Element describes the scope of a data item, register or point (Modbus register or BACnet object). Each Element based point is accessed by choosing the appropriate Modbus address, BACnet object range, or BACnet structured view. Elements in turn have points that refer to individual channels or to SUMS or AVERAGES of those channels. Registers that contain data inclusive of more than one channel are identified as being either SUMS or AVERAGES of the enabled channels within an element. In a BACnet structured view an Element represents a level of organization for related points.

#### Channel

Channels are identified on the circuit board as CH1, CH2, or CH3 and represent physical CT inputs. In three phase system configurations, these correspond to a current load on a corresponding line voltage. In single phase configurations, they are just used to identify a CT location. Registers providing data for an individual channel are also described as elements in their scope as a unique value exists for each Slave Address or BACnet object instance.

**System**

The term “**System**” refers to registers defining the characteristics of the entire circuit board. System registers report the same value independent of the slave address. Under BACnet structured view the system points are grouped together.

**CONFIGURING ELEMENT AND CHANNEL REGISTER FOR SERVICE TYPES**

The ViewPoint HD software enforces all element configurations to form a valid electrical system. Configurations performed by remote systems may produce unexpected results if configurations are internally inconsistent. The following tables document how to configure element and channel registers for each service type. Every register should be explicitly written.

Red Text indicates Required Values, Purple Text indicates Suggested Defaults, if this data is not known.

**Modbus Absolute Address/BACnet Object Assignments for Setting up Service Types**

| REGISTER TEMPLATE |          |         |           |             |               |         |
|-------------------|----------|---------|-----------|-------------|---------------|---------|
| Service Type      | 2207     |         |           |             |               |         |
| V_Input           | 2217     |         |           |             |               |         |
| Description       | 2617     |         |           |             |               |         |
| Channels          | Volt Ref | CT Type | Range     | Phase Shift | CT Multiplier | CT Sign |
| CH1               | 2220     | 2223    | 2224,2225 | 2224,2225   | 2221,2222     | 2226    |
| CH2               | 2229     | 2232    | 2227,2228 | 2233,2234   | 2230,2231     | 2235    |
| CH3               | 2238     | 2241    | 2236,2237 | 2242,2243   | 2239,2240     | 2244    |

**Configurations**

| 4 Wire 3 φ (Wye) |            |                      |          |                |               |         |
|------------------|------------|----------------------|----------|----------------|---------------|---------|
| Service Type     | 1          |                      |          |                |               |         |
| V_Input          | 1 or 2     |                      |          |                |               |         |
| Description      | 31 Char    |                      |          |                |               |         |
| Channels         | Volt Ref   | CT Type              | Range    | Phase Shift    | CT Multiplier | CT Sign |
| CH1              | L1 – N [1] | mV [1] or RōCoil [2] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |
| CH2              | L2 – N [2] | mV [1] or RōCoil [2] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |
| CH3              | L3 – N [3] | mV [1] or RōCoil [2] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |

| 3 Wire 3 φ (Delta) |            |                      |          |                |               |         |
|--------------------|------------|----------------------|----------|----------------|---------------|---------|
| Service Type       | 2          |                      |          |                |               |         |
| V_Input            | 1 or 2     |                      |          |                |               |         |
| Description        | 31 Char    |                      |          |                |               |         |
| Channels           | Volt Ref   | CT Type              | Range    | Phase Shift    | CT Multiplier | CT Sign |
| CH1                | L1 – N [1] | mV [1] or RōCoil [2] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |

|     |            |                      |           |           |           |        |
|-----|------------|----------------------|-----------|-----------|-----------|--------|
| CH2 | L2 – N [2] | mV [1] or RōCoil [2] | Same as 1 | Same as 1 | Same as 1 | 0 or 1 |
| CH3 | L3 – N [3] | mV [1] or RōCoil [2] | Same as 1 | Same as 1 | Same as 1 | 0 or 1 |

Even though CH2 is calculated internally, it is recommended that the CT settings reflect those from CH1, rather than being left at factory default, to facilitate configuration validation from the RTU.

| 2 Wire 1ϕ (Plug Load) |         |
|-----------------------|---------|
| Service Type          | 3       |
| V_Input               | 1 or 2  |
| Description           | 31 Char |

| Channels | Volt Ref  | CT Type              | Range    | Phase Shift    | CT Multiplier | CT Sign |
|----------|-----------|----------------------|----------|----------------|---------------|---------|
| CH1      | ANY [1-6] | mV [1] or RōCoil [2] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |
| CH2      | ANY [1-6] | mV [1] or RōCoil [2] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |
| CH3      | ANY [1-6] | mV [1] or RōCoil [2] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |

Any channel that needs to be turned OFF should set the CT Type to OFF.

| 3 Wire 1 ϕ (Split Phase) |         |
|--------------------------|---------|
| Service Type             | 4       |
| V_Input                  | 1 or 2  |
| Description              | 31 Char |

| Channels | Volt Ref   | CT Type              | Range    | Phase Shift    | CT Multiplier | CT Sign |
|----------|------------|----------------------|----------|----------------|---------------|---------|
| CH1      | L1 – N [1] | mV [1] or RōCoil [2] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |
| CH2      | L2 – N [2] | mV [1] or RōCoil [2] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |
| CH3      | L3 – N [3] | OFF [0]              | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |

Even though CH3 is not used for computation it is recommended that the CT settings reflect those from CH1 rather than being left at factory default to facilitate configuration validation from the RTU.

| Disabled (OFF) |         |
|----------------|---------|
| Service Type   | 5       |
| V_Input        | 1 or 2  |
| Description    | 31 Char |

| Channels | Volt Ref   | CT Type | Range    | Phase Shift    | CT Multiplier | CT Sign |
|----------|------------|---------|----------|----------------|---------------|---------|
| CH1      | L1 – N [1] | OFF [0] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |
| CH2      | L2 – N [2] | OFF [0] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |
| CH3      | L3 – N [3] | OFF [0] | Any > 0A | -3.0° to +3.0° | Any > 0 [1]   | 0 or 1  |

Even though disabled channels are not used in calculations and report 0.0 they still contain configuration information. It is suggested that they be set to a known value rather than left at defaults to facilitate configuration validation by the RTU.

## CONFIGURING SYSTEM REGISTERS

### Modbus Absolute Address/BACnet Object Assignment

| REGISTER TEMPLATE  |           |
|--------------------|-----------|
| Description        | 2601      |
| PF Sign Convention | 2248      |
| V1 Multiplier      | 2203,2204 |
| V2 Multiplier      | 2205,2206 |

### Configurations

|        |
|--------|
| System |
|--------|

|                    |                     |
|--------------------|---------------------|
| Description        | 31 Char             |
| PF Sign Convention | ANSI [1] or IEEE[2] |
| V1 Multiplier      | Any > 0 [1]         |
| V2 Multiplier      | Any > 0 [1]         |

## Modbus Protocol Commands

If configured for Modbus, the PSHD networked power meter family follows the Modbus RTU protocol and supports the following command set.

| Supported Modbus Commands |                      |   |
|---------------------------|----------------------|---|
| Command Name              | Command Number (Hex) | Description   |
| Read Holding Registers    | 03                   | Used to read the data values from the PSHD meter        |
| Write Single Register     | 06                   | Used to write a single holding register to a PSHD meter |
| Report Slave ID           | 11                   | Used to read information from the identified PSHD meter |

### SLAVE ADDRESS

For Modbus/TCP the base slave address (or “unit address” as the Modbus TCP spec. calls it) is fixed at 1.

Refer to the section “Serial Protocols” for additional information on setting the Slave Address and finding the address of a specific meter element.

### MODBUS STRING ENTRY

Registers that are identified as “strings” are handled uniquely by the PSHD 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 NUL 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.

### COMMANDS REQUIRING A PROCESSOR RESET

Register manipulation of communication protocols or addressing require that the PSHD perform a “soft reset” in order 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 effect a soft reset. The PSHD reboot time is approximately 10 seconds.

See the Modbus examples document on the DENT Instruments web site or included with your electronic documentation for additional support on programming Modbus. The following online resources are also helpful.

[http://Modbus.org/docs/PI\\_MBUS\\_300.pdf](http://Modbus.org/docs/PI_MBUS_300.pdf)

<http://www.Modbustools.com/Modbus.html>

<http://www.simplyModbus.ca/TCP.htm>



## BACnet

**Building Automation and Control Network (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.

**BACnet Device ID.** 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

### Serial



The PSHD Serial version supports writable max\_master, MS/TP address, max\_info\_frames properties in the device object for MS/TP networks. For best network performance, the max\_master should be set to the highest MS/TP MAC address on the network. The MS/TP address (object 1069) must be unique on the MS/TP network. The max\_info\_frames does not need to be changed in most installations.

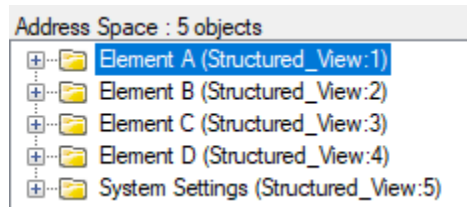
### Ethernet



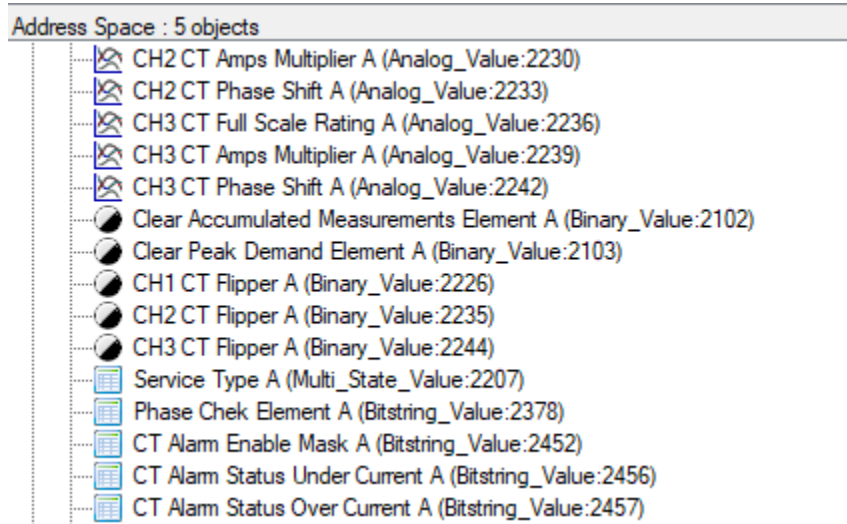
Ethernet versions can register as Foreign Devices to a BBMD. **BBMD** stand for *BACnet/IP Broadcast Management Device*. The BBMD IP address can be set from ViewpointHD or through character string object 2264. A value of 0.0.0.0 disables foreign device registration. This process requires a processor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

## BACNET STRUCTURED VIEW

The PSHD meter supports the Structured View (SV) object container. If this option is supported in the BACnet exploring tool, objects will be grouped logically into elements which can be named to reflect electrical or physical locations, followed by system objects, as shown below for a PS12 having elements A-D.



Within each element, 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. That is Element A (and system objects) have a range from 0-9999, Element B 10000-19999, Element C 20000-29999, to Element P on the PS48HD 150000-159999. Some BACnet explorer tools have additional sorting capabilities.



| PSHD 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                             |

The following online BACnet resources are also helpful.

<http://www.bacnet.org/>

## APPENDIX A—PSHD LCD MENU NAVIGATION

### ABOUT METER

The complete LCD navigation map is shown in diagram form in the next few pages. The “About Meter” menu is the most commonly accessed item which requires 5 down presses or 1 up (rolling menu) to access.

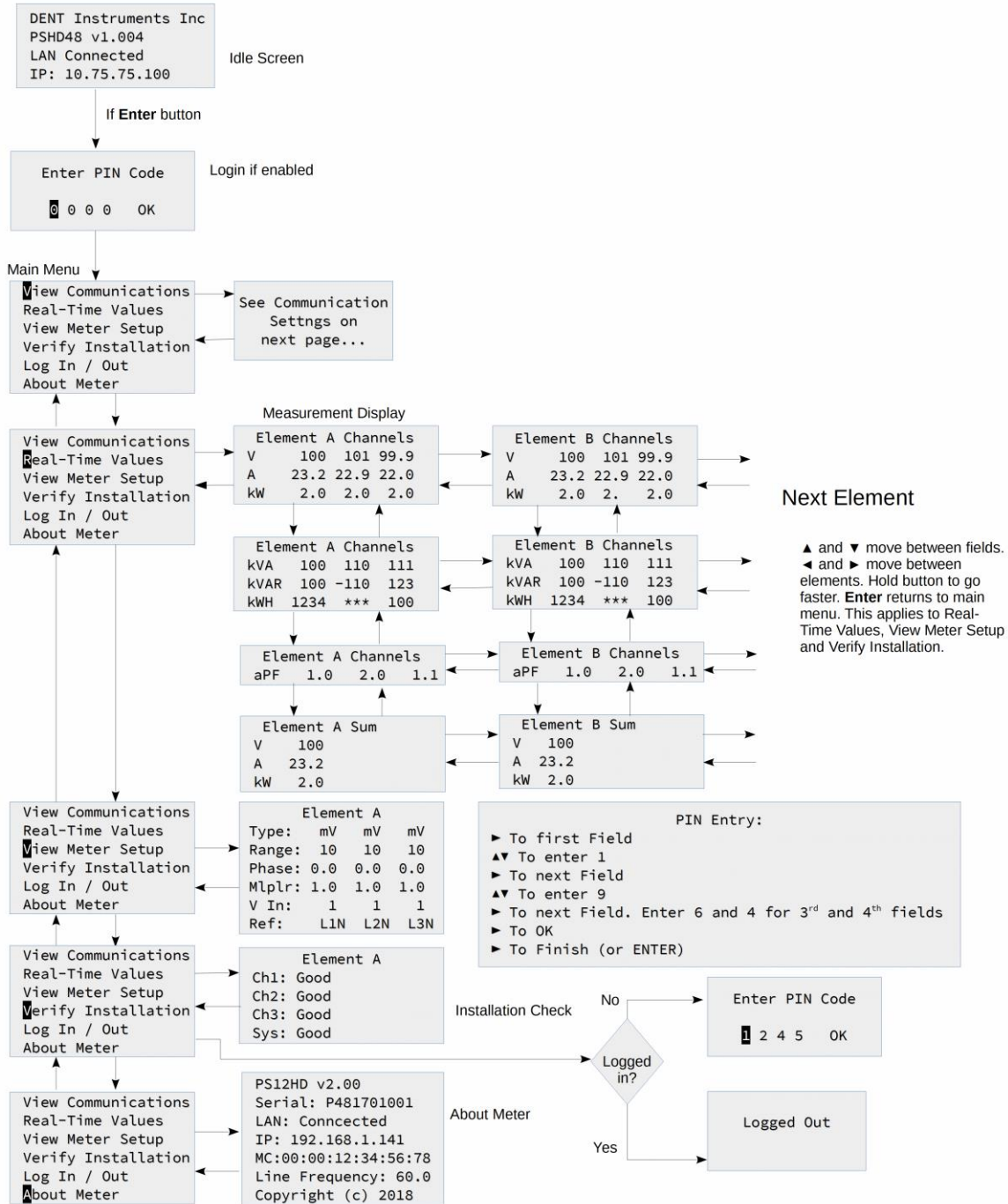
```

View Communications
Real-Time Values
View Meter Setup
Verify Installation
Log In / Out
About Meter
  
```

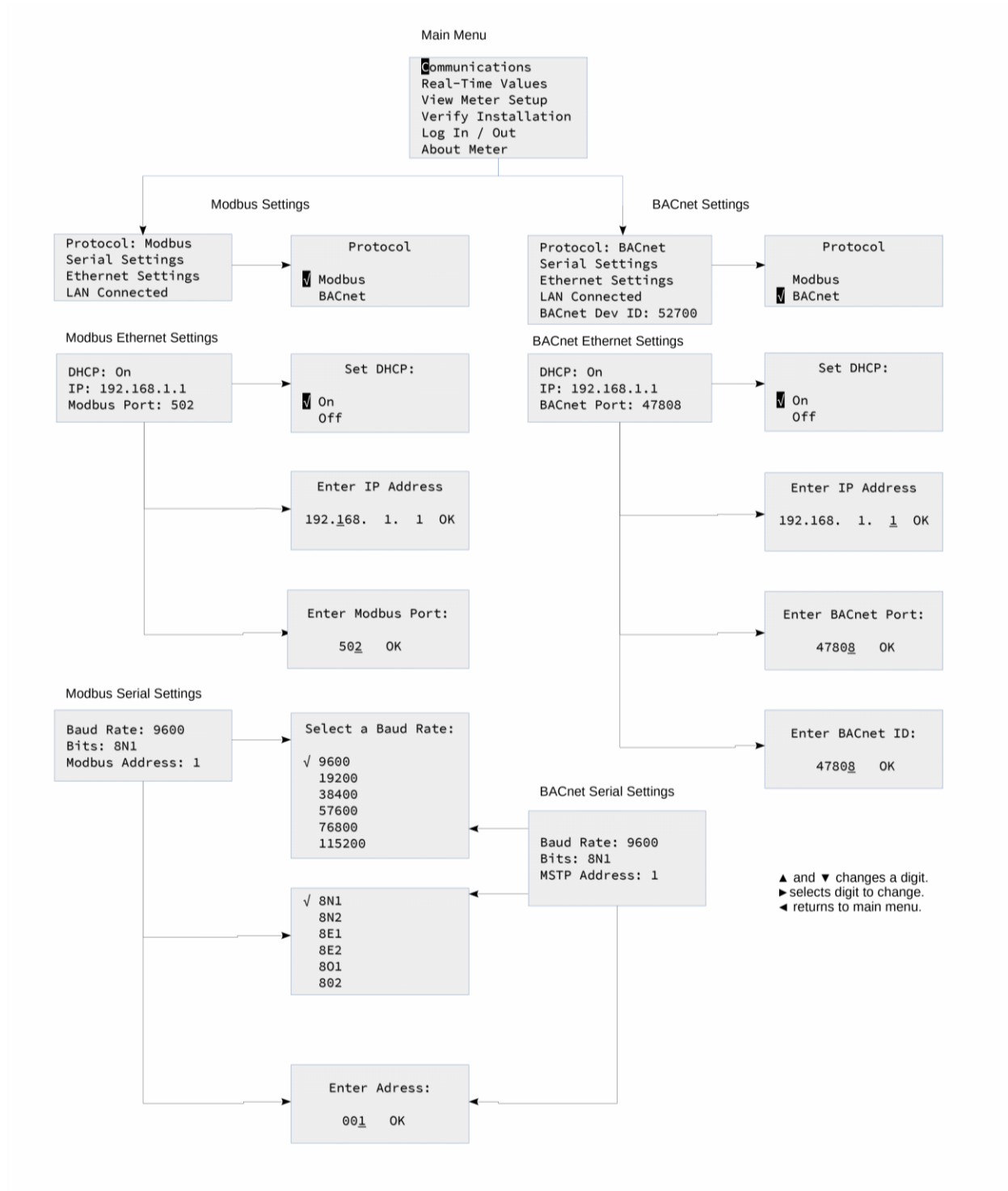
The “About Meter” menu contains the following items which are displayed 4 lines at a time and accessed by using the ^ v keys on the front display.

|                      |                             |
|----------------------|-----------------------------|
| PS12HD v2.00         | Model and version           |
| Serial: P121501001   | Serial number               |
| LAN: Connected       | State of LAN connection     |
| IP: 10.1.1.1         | Current IP address          |
| MC 00:0D:63:00:00:00 | MAC Address                 |
| Line Frequency: 60.0 | Current line frequency      |
| DENT Instruments     | Manufacturer name           |
| Copyright (c) 2018   | Copyright notice            |
| Protocol: Modbus     | Communication protocol      |
| Modbus Address: 1    | Modbus address              |
| Modbus Port: 502     | Modbus port                 |
| MSTP Address: 1      | MSTP address                |
| Baud Rate: 9600      | RS485 baud rate             |
| DHCP: ON             | Current DHCP Setting        |
| BACnet Port: 47808   | BACnet Port                 |
| BACnet DevID: 527000 | BACnet Device ID            |
| Pulse In 1: 0.0      | Channel 1 pulse accumulator |
| Pulse In 2: 0.0      | Channel 2 pulse accumulator |
| Pulse In 3: 0.0      | Channel 3 pulse accumulator |
| Pulse In 4: 0.0      | Channel 4 pulse accumulator |
| System Descriptor:   | System description          |
| PS12HD               | set by user                 |
| UTC Date / Time:     | Current time in UTC (GMT)   |
| 2018-04-24 10:04:08  |                             |

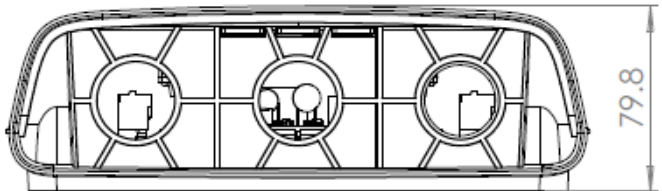
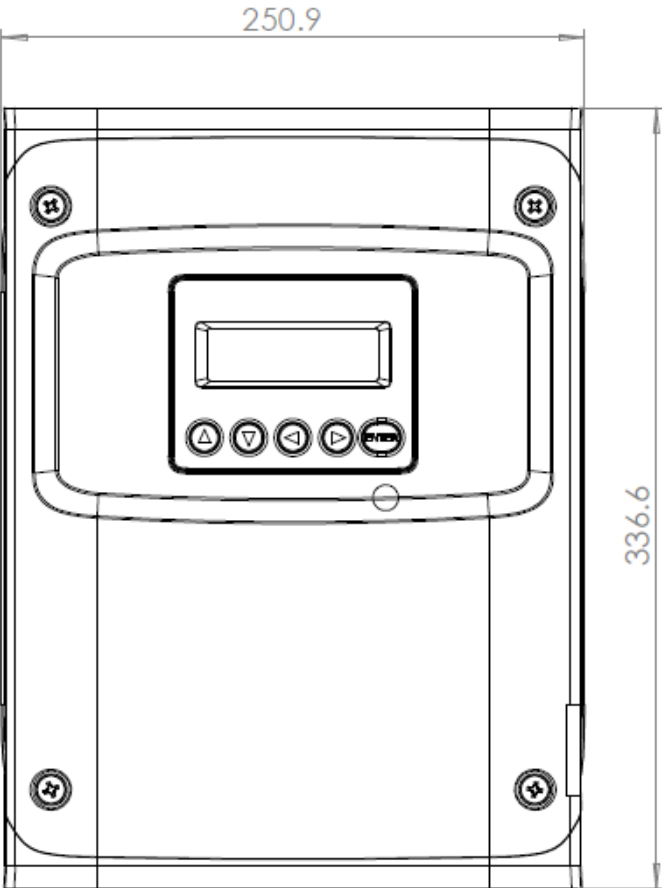
## MENU NAVIGATION



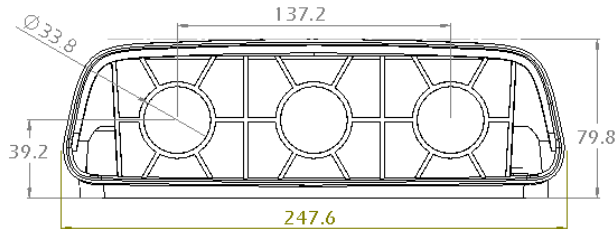
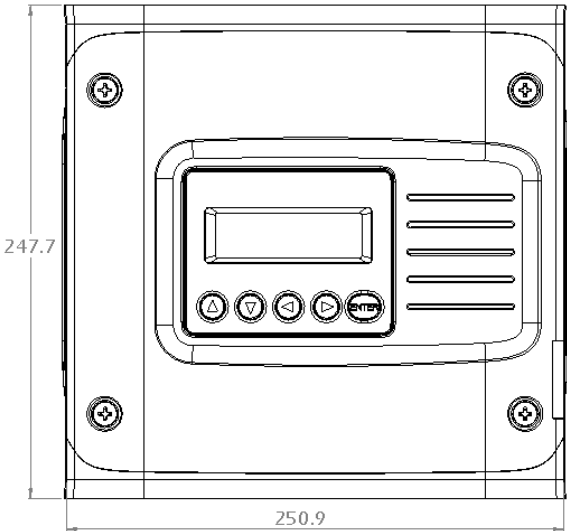
COMMUNICATION NAVIGATION



# APPENDIX B—ENCLOSURE DIMENSIONS



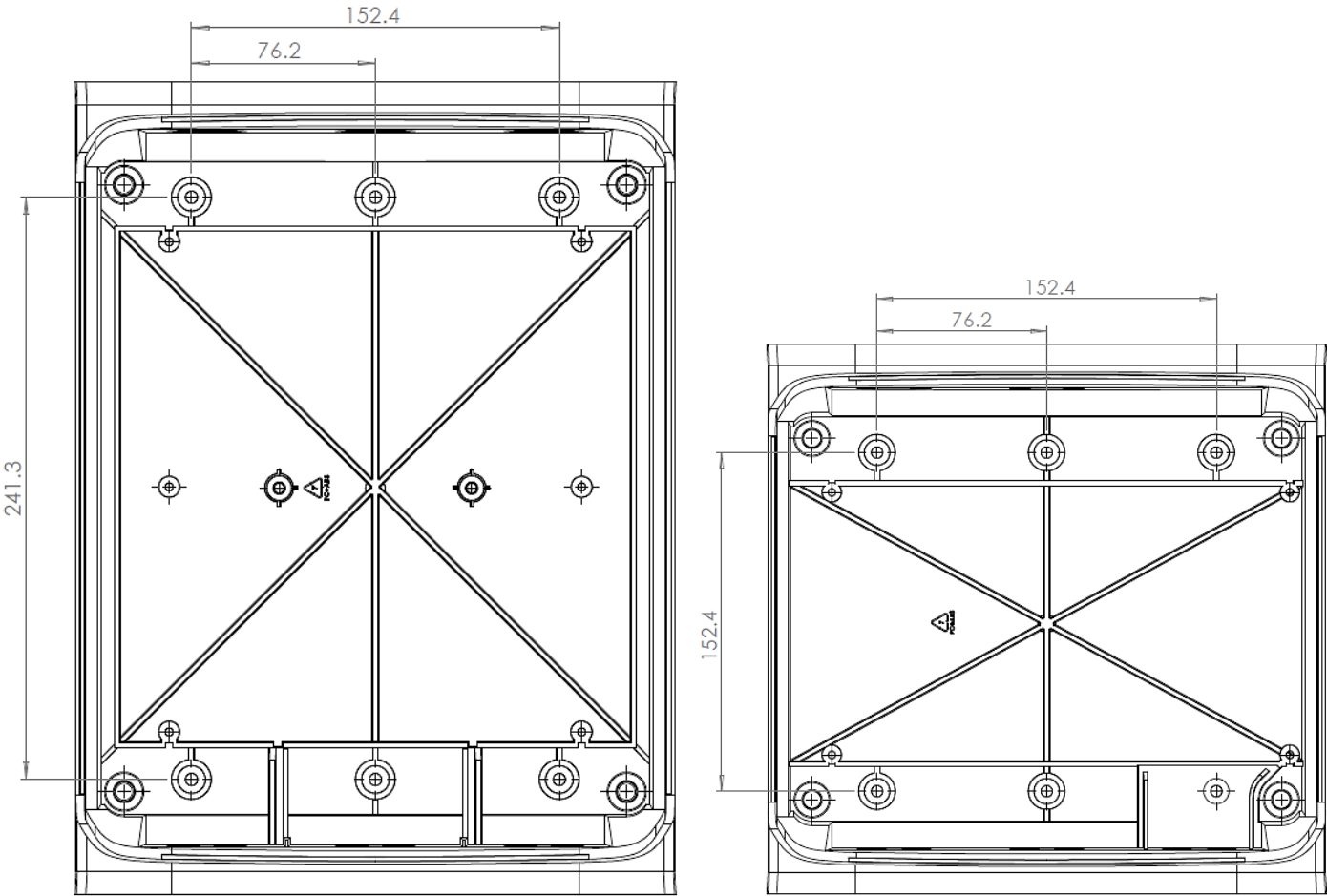
PS48HD Enclosure Dimensions



PS12HD Enclosure Dimensions

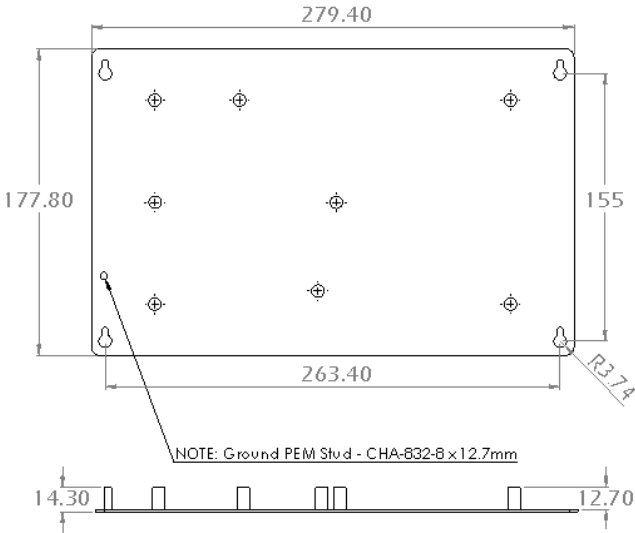
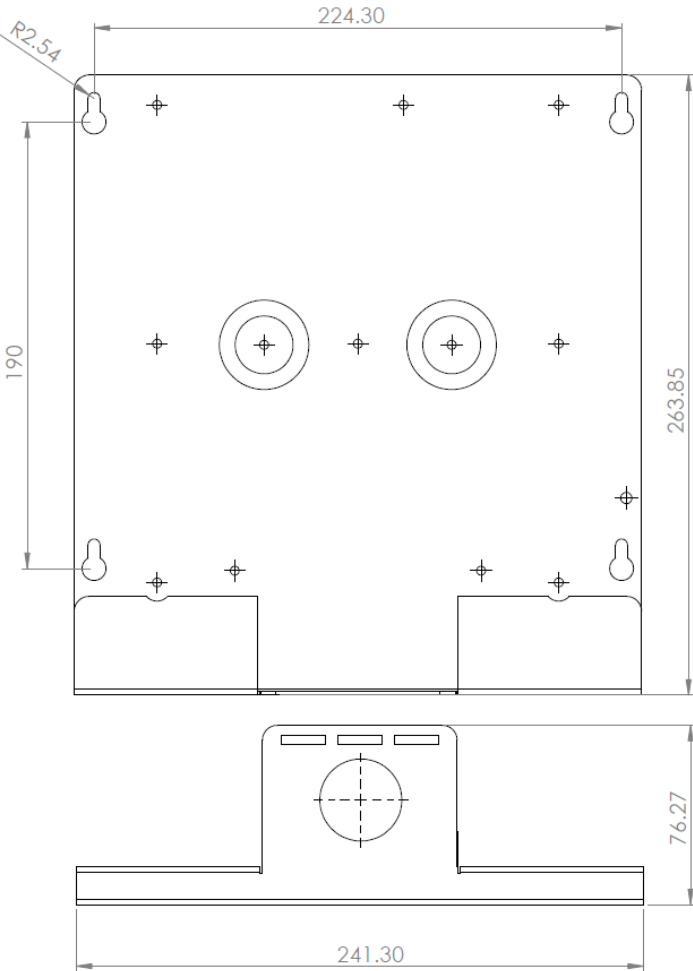
# APPENDIX C—MOUNTING TEMPLATES

## Enclosure Internal Mounting Hole Locations



PS48HD and PS12HD Enclosure Drill Templates

### Sheet Metal Plate Mounting Hole Locations



PS48HD and PS12HD Mounting Plate Drill Templates



## APPENDIX D—PSHD 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.<br>Two voltage reference inputs (PS48HD only)   |
| Current Channels        | 12 (PS12HD) or 48 (PS48HD) channels, 0.525 VAC max, 333 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 measureable range) – measurement taken L1-N   |
| Power                   | From L1 Phase to L2 Phase. 90-600VAC RMS CAT III 50/60Hz, 500mA AC Max<br>Use of 12 volt auxiliary output requires 100 VAC minimum input voltage.  |
| AC Protection           | 0.5A Fuse 200kA interrupt capacity   |
| Power Out               | Unregulated 12VDC output, 200 mA, self-resetting fuse  |
| Waveform Sampling       | 1.8 kHz (PS48HD), 3.6 HZ (PS12HD)  |
| Parameter Update Rate   | 1 second   |
| Interval Data Recording | Energy (kWh) values are recorded every 15 minutes for 63 days (downloadable log)<br>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 C12.20-2010 Class 0.2  |
| Resolution              | Values reported in IEEE-754 single precision floating point format (32 bit)  |
| Indicators              | Optional 4-line display, tri-color backlight (PhaseChek™)  |
| Alarm Output            | Over/Under Voltage & Current (SPDT Relay - 30 VDC)   |
| Pulse Inputs            | PS12HD – 4 inputs<br>PS48HD – 2 inputs **<br>3.3V sourcing voltage (current limited) to customer dry contact pulse output<br>Maximum Pulse Rate 10 HZ (50 msec minimum transition time)<br>** Available Q4 2018  |

### Communication

| Specification                                    | Description   |
|--|---|
| <b>Hardware</b>                                  | RS-485, Ethernet, & USB (for configuration only)  |
| <b>Supported Protocols</b>                       | Modbus RTU or BACnet Master Slave Token Passing protocol (MS/TP)<br>Modbus (using SunSpec IEEE-754 single precision floating point model)   |
| <b>Max Communication Length</b>                  | 1200 meters with Data Range of 100K bits/second or less   |
| <b>RS-485 Loading</b>                            | 1/8 unit  |
| <b>Communication Rate (baud)</b>                 | 9600 (Default), 19200, 38400, 57600, 76800, 115200  |
| <b>Data Bits</b>                                 | 8   |
| <b>Parity</b>                                    | None, Even, Odd   |
| <b>Stop Bit</b>                                  | 2, 1  |
| <b>Termination</b>                               | None provided   |
| <b>Data Formats</b>                              | Modbus RTU, BACnet MS/TP, Modbus TCP or BACnet IP   |
| <b>Mechanical</b>                                |   |
| <b>Wire Connections</b>                          | 12-22 AWG 600 VAC, Voltage connection must be #14 AWG or larger & 600 VAC rated   |
| <b>Mounting</b>                                  | Enclosure or Panel Mount  |
| <b>High Voltage Cover</b>                        | IP30. Available with PS48/PS12 Enclosure and PS48 Plate models  |
| <b>Operating Temperature</b>                     | -20 to + 60° C (-4 to 140° F) (the colder the temperature the more voltage needed to power the board)   |
| <b>Humidity</b>                                  | 5% to 95% non-condensing  |
| <b>Enclosure</b>                                 | ABS Plastic, 94-V0 flammability rating, connections sized for 1-inch EMT conduit  |
| <b>PS48 Dimensions</b>                           | (L) 33.7cm x (W) 25.1cm x (H) 8.0 cm (13.3" x 9.8" x 3.1") (enclosure version)<br>(L) 26.2cm x (W) 24.1cm x (H) 8.0 cm (10.3" x 9.5" x 3.1") (mounting plate version)   |
| <b>PS12 Dimensions</b>                           | (L) 24.8cm x (W) 25.1cm x (H) 8.0 cm (9.8" x 9.8" x 3.1") (enclosure version)<br>(L) 17.8cm x (W) 26.3cm x (H) 8.0 cm (7.0" x 10.4" x 3.1") (mounting plate version)  |
| <b>PCBA Dimensions</b>                           | (L) 21.6cm x (W) 21.6cm x (H) 6.4 cm (8.5" x 8.5" x 2.5")   |
| <b>ViewPoint™ HD Minimum System Requirements</b> |   |
| <b>Operating System</b>                          | Windows® 7, Windows® 8, Windows® 10   |
| <b>Communications Port</b>                       | USB or Ethernet connectivity  |
| <b>Safety</b>                                    |   |
| <b>FCC Compliance</b>                            | 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 |

| Specification                 | Description   |
|-------------------------------|---|
|                               | 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. |
| <b>Serial/Ethernet Meters</b> | The following are UL Recognized:<br><b>PS12HD-B-y-z, PS12HD-P-y-z, PS48HD-B-y-z, PS48HD-P-y-z</b><br>The following are UL Listed: <b>PS12HD-C-y-z , PS48HD-C-y-z</b><br>Conforms to UL Std 61010-1, 3rd Edition, UL 61010-2-30:2010<br>Certified to CSA Std C22.2 No. 61010-1, 3rd Edition  |