# Operator's Guide

# PowerScout™ 3 plus

## Modbus – BACnet
## Power Meter

PowerScout™ 3 Plus
November 8, 2012

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## Contents

# SECTION I:  INTRODUCTION

## Product Description

The PowerScout™ 3 Plus monitors the voltage, current, power, energy and many other electrical parameters on single and three-phase electrical systems. The PowerScout meter uses direct connections to each phase of the voltage, and uses current transformers to monitor each phase of the current. Information on energy use, demand, power factor, line frequency and more are derived from the voltage and current inputs.

The communications interface to the unit is an RS-485 serial connection that uses the BACnet Master Slave Token Passing (MS/TP) protocol or Modbus protocol for sending commands and retrieving data. A separate BACnet client (Data Logger, or Building Management and Control System) is usually connected to the PowerScout for BACnet. A separate remote terminal unit (RTU), Data Logger, or Building Management and Control System is usually connected to the PowerScout for Modbus mode. This separate unit provides data recording and trend logging plus a human interface or display.

Up to 127 PowerScout 3 Plus meters may be connected to a single BACnet client for monitoring and recording power usage at multiple locations within a single site. Up to 254 meters may be connected to Modbus.

## PowerScout™ SAFETY SUMMARY and SPECIFICATIONS

| | | |
|---|---|---|
| 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. | c UL us LISTED 4RH8 E186827 CE | Conforms to UL Std 61010-1<br>Certified to CSA Std C22.2 No. 61010-1 |
| The PowerScout is an Over-Voltage Category III device. | | |

**CAUTION: THIS METER MAY CONTAIN LIFE THREATENING VOLTAGES. QUALIFIED PERSONNEL MUST DISCONNECT ALL HIGH VOLTAGE WIRING BEFORE USING OR SERVICING THE METER.**

### WARNING

Use of this device in a manner for which it is not intended may impair its means of protection.

## SYMBOLS ON EQUIPMENT

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

When connecting the PowerScout to an AC load, follow these steps in sequence to prevent a shock hazard.

1. De-energize the circuit to be monitored.
2. Connect the CTs to the phases being monitored.
3. Connect the voltage leads to the different phases. Use proper safety equipment (gloves and protective clothing) as required for the voltages monitored.

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

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

### SENSOR LIMITATIONS

USE ONLY SHUNTED CURRENT TRANSFORMERS (CTs).
Do not use other CTs. Only use shunted CTs with a 333mV maximum output only. Serious shock hazard and logger damage can occur if unshunted CTs are used. The UL listing covers the use of the following DENT Instruments CTs that are UL Recognized and have been evaluated to IEC 61010-1:
CT-HSC-020-X (20A Mini), CT-HSC-050-X (50A Mini), CT-HMC-0100-X (100A Midi), and the CT-HMC-0200-X (200A Midi). The use of any other CT will invalidate the UL Listing of the ELITEpro SP."

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

**CAUTION:** THE POWERSCOUT™ SHOULD ONLY BE WIRED BY QUALIFIED PERSONNEL. HAZARDOUS VOLTAGES EXIST. EXTERNAL WIRING MUST HAVE A MINIMUM RATING OF 600V CAT III SUCH as THHN OR AS REQUIRED BY NEC or LOCAL ELECTRICAL CODES.

No accessories are approved for use with the PowerScout 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. Phone: 541.388.4774 Email: techhelp@DENTinstruments.com

## PowerScout™ RÉSUMÉ DE SÉCURITÉ ET SPÉCIFICATIONS

| | | |
|---|---|---|
| Cette information de sécurité est destinée à être utilisée à la fois par l'opérateur de l'enregistreur et le personnel de service. DENT Instruments, Inc n'assume aucune responsabilité pour l'utilisateur qui ne respecte pas les directives en matière de sécurité. | c UL us LISTED 4RH8 E186827 CE | Conforme à UL Std 61010-1<br>Certifié CSA Std C22.2 No. 61010-1 |
| Le PowerScout est un appareil de surtension de catégorie III. | | |

**ATTENTION: CE METER PEUT CONTENIR DE HAUTES TENSIONS QUI PEUVENT ÊTRE DANGEREUSES. UN PERSONNEL QUALIFIÉ DOIT DÉBRANCHER TOUS LES CÂBLES À HAUTE TENSION AVANT D’UTILISER OU DE RÉPARER DU METER.**

### ATTENTION

L'utilisation de cet appareil d'une manière pour laquelle il n'est pas destiné peut annuler ses moyens de protection.

## SYMBOLES DES EQUIPEMENTS

Signifie prudence. Voir le manuel pour une description de la signification.

En faisant la connexion du PowerScout à une prise de courant alternatif, suivez ces étapes en ordre pour empêcher un risque de choc.
1. Décharger le circuit à contrôler.
2. Connectez le TC aux phases à surveiller.
3. Connectez les fils de tension à des phases différentes. Utiliser des équipements de sécurité (gants et des vêtements de protection) qui sont nécessaires pour les tensions surveillées.

**INDIQUE HAUTE TENSION. RISQUE DE CHOC ÉLECTRIQUE. HAUTES TENSIONS PEUVENT ÊTRE PRÉSENTES QUI METTENT LA VIE EN DANGER. PERSONNEL QUALIFIÉ UNIQUEMENT.**

**NE PAS DEPASSER 600V.** Ce compteur peut contrôler les charges jusqu'à 600V. Le dépassement de cette tension peut causer des dommages à l'appareil et du danger pour l'utilisateur. Utiliser toujours le potentiel transformateur (PT) pour des charges de plus de 600V. Le PowerScout est un appareil à 600 V de surtension de catégorie III.

### LIMITATIONS DE DÉTECTEUR

**UTILISEZ SEULEMENT TRANSFORMATEURS DE COURANT (TC) SHUNTÉE.**

**N’utilisez pas d'autres TC. Utilisez seulement des TC shuntée avec une puissance maximale 333mV. Un sérieux risque de décharge électrique et des dommages à l'enregistreur peut se produire si des TC pas shuntée sont utilisés. Utiliser seulement les CTs des DENT Instruments suivants qui sont énumérés jusqu'au 600V/CATIII.**
CT-HSC-020-U,CT-HSC-050-U,CT-HMC-0100-U,CT-HMC-0200-U

L'équipement protégé en double isolation (IEC 536 Classe II).

**ATTENTION:** LE POWERSCOUT ™ NE DOIT ÊTRE BRANCHÉ QUE PAR UN PERSONNEL QUALIFIÉ. TENSIONS DANGEREUSES SONT PRÉSENTES.

Pas d'accessoires approuvés pour une utilisation avec le PowerScout sauf ceux spécifiés par DENT Instruments dans ses documentations sur les produits et également sur les prix. Si le compteur semble endommagé ou défectueux, tout d'abord déconnecter le pouvoir de l'appareil. Alors s'il vous plaît appelez 541.388.4774 ou contacter par courriel l'assistance technique (techhelp@DENTinstruments.com), pour obtenir de l'aide. Alors s'il vous plaît appelez 541.388.4774 ou contacter par courriel l'assistance technique (techhelp@DENTinstruments.com), pour obtenir de l'aide.

## PowerScout 3 Plus™ Technical Specifications

| Specification | Description |
|---|---|
| Service Types | Single Phase, Three Phase-Four Wire (WYE), Three Phase-Three Wire (Delta) |
| 3 Voltage Channels | 80-346 Volts AC Line-to-Neutral, 600V Line-to-Line, CAT III |
| Current Channels | 3 channels 0-5,000+ Amps depending on current transducer |
| Maximum Current Input | 175% of current transducer rating |
| Measurement Type | True RMS using high-speed digital signal processing (DSP) |
| Line Frequency | 50/60/400Hz |
| Waveform Sampling | 12 kHz |
| Parameter Update Rate | 500 milliseconds |
| Measurements | Volts, Amps, kW, kWh, kVAR, kVARh, kVA, kVAh, Apparent Power Factor (aPF), Displacement Power Factor (dPF). All parameters for each phase and for system total. |
| Accuracy | Better than 1% (<0.5% typical) for V, A, kW, kVAR, kVA, PF |
| Resolution | 0.01 Amp, 0.1 Volt, 0.01 watt, 0.01 VAR, 0.01 VA, 0.01 Power Factor depending on scalar setting |
| LEDs | Bi-color LEDs (red and green): 1 LED to indicate communication, 3 LEDs for correct phasing (PhaseChek: Green when voltage and current on the on the same phase; Red when incorrectly wired.), 2 Digital Channel indicators |
| Pulse Output | Open Collector, 75mA max current, 40V max open voltage |
| **Communication** | |
| Direct | User Selectable Modbus or BACnet Master Slave Token Passing protocol (MS/TP) over RS-485 |
| Max Communication Length | 1200 meters with Data Range of 100K bits/second or less |
| Communication Rate (baud) | 9600 (Modbus Default), 19200, 38400, 57600, 76800 (BACnet default), 115200 |
| Data Bits | 8 |
| Parity | None, Even, Odd |
| Stop Bit | 2, 1, 0 |
| Data Formats | Modbus Protocol OR<br>BACnet Master Slave / Token Passing (MS/TP) protocol |
| Power | From L1 Phase to L2 Phase. 80-600VAC CAT III 50/60Hz 70mA Max. Non-user replaceable .5 Amp internal fuse protection |
| **Mechanical** | |
| Operating Temperature | -7 to + 60 °C (-20 to 140 °F) |
| Humidity | 5% to 95% non-condensing |
| Enclosure | ABS plastic, 94-V0 flammability rating |
| Weight | 357 g (12.6 ounces), exclusive of CTs |
| Dimensions | 21.8 x 5.8 x 4.0 cm (8.6” x 5.8” x 1.6”) |
| **ViewPoint™ Minimum System Requirements** | |
| Operating System | Windows® 8, Windows® 7 (32 or 64 bit), Vista (32 or 64 bit), or XP |
| Communications Port | One USB port or serial port |
| Hard Drive | 50 MB minimum available |
| Processor | Pentium Class 1 GHz or more recommended |

# SECTION II: BACnet METERS

## SECTION II.A: Quick Start Guide - BACnet

This section details the quick start setup for a PowerScout 3 Plus connected to a third party BACnet client. As BACnet clients differ in user interfaces this section is generic to all third party BACnet clients.

> High voltage MAY BE PRESENT. Risk of electric shock. Life threatening voltages may be present. Qualified personnel only.
>
> Haute tension peut être présente. Risque de choc électrique. Tensions dangereuses peuvent être présentes. Personnel qualifié uniquement.

1. Connect the PowerScout 3 Plus to the BACnet MS/TP client with three-conductor wire (positive (+), negative (-), and System Common (S) ).
2. Set the rotary switches to the desired BACnet MS/TP master address (1-127 decimal).
3. Verify that the PowerScout 3 Plus can be discovered through the BACnet client.
4. Securely mount the PowerScout 3 Plus using the two mounting tabs at each end of the case.
5. Mount each current transformer (CT) on the wire to be monitored. Next, connect the CT leads to the terminal block on the PowerScout. Verify the CTs are correctly oriented on the wires with the orientation pointed toward the load (away from the breaker). Note that:
   The CT on the L1 voltage phase wire is connected to the PowerScout's CT 1 input
   The CT on the L2 voltage phase is connected to the CT 2 input
   The CT on the L3 voltage phase is connected to the CT 3 input
   - Refer to the end of *Section II.B: Field Installation* to review common wiring diagrams.
6. Connect the voltage leads on the PowerScout 3 Plus to the appropriate voltage phases. Connect the neutral wire to the neutral bus or to ground if using a three-phase Delta service. The PowerScout 3 Plus is powered from L1 and L2 voltage connections.
7. Verify the PhaseChek™ LEDs are all flashing green.
8. On the BACnet client, write the desired **CT Type** (MilliVolt = 1, Rogowski = 2) to the present value of **object identifier 12130** and **CT Value** (in Amps) to the present value of **object identifier 12010.**
9. Clear the stored accumulated and demand data by writing to **object identifier 10140 "Clear Accumulated Values"** present value 1234.0
10. View the current values of voltage **(object instances 3000 to 4000),** current **(object instances 4000-5000)** and power **(object instances 1000 to 2000)** and verify that the readings are correct.

## PowerScout 3 Plus Diagram


Figure II-1: PowerScout 3 Plus Layout – US voltage wire colors shown

# SECTION II.B: Field Installation – BACnet

**WARNING! REMOVE THE METER FROM ALL SOURCES OF VOLTAGE BEFORE MOUNTING.**

## Mounting the PowerScout™ 3 Plus

The PowerScout 3 must be installed in an approved electrical panel or enclosure using proper installation practices according to the local electrical codes.

- To mount the PowerScout 3 Plus use the two tabs provided at each end of the case. Securely mount the PowerScout near a dedicated circuit disconnect breaker.

## Connecting the PowerScout 3 Plus

The PowerScout 3 Plus has the following connections:

- A three-wire connector for the RS-485 BACnet/ModBus link.
- Four voltage wire leads for connecting to voltage sources (L1, L2, L3, and Neutral). The PowerScout 3 Plus is self-powered from L1 and L2.
- Up to three current transducers (CTs).

### Completing the Wiring Connections – RS-485, Voltage Leads and CTs

1. Connect the RS-485 adapter to the computer using the USB cable by inserting each white ferrule into the appropriate opening on the PowerScout 3 Plus. The red wire inserts in (+), the black wire in (-) and the green wire in (S).
2. Connect the CTs on the PowerScout 3 Plus connections labeled CT 1, CT 2 and CT 3. Place the CTs on the phase wires of the load to be monitored and corresponding to the phase of the voltage leads. The CT labeled CT 1 must be placed on L1 phase voltage wire, CT 2 must be on the L2 voltage and CT 3 on the L3 voltage. Refer to *PhaseChek*™ in Section III for information about the CT LEDs and verifying the CT installation.
3. Connect the PowerScout's 14 AWG THHN (or equivalent) wires, after a building-installed, dedicated circuit disconnect breaker, as close as possible to the breaker. Mark the breaker as the disconnect for the PowerScout 3 Plus. Refer to the wiring diagrams in this chapter for specifics of the wiring connections.
   Follow local electrical codes during this installation.

***Note**: The PowerScout 3 Plus has an internal, non-user replaceable .5 Amp internal fuse protection.*

## Powering the PowerScout 3 Plus

The PowerScout 3 Plus is self-powered from the L1 and L2 lines. When 80 – 600VAC or DC is placed across the L1 and L2 wires, the three phasing LEDs begin to flash in sequence.

## PowerScout 3 Plus Single-Phase Connections

The PowerScout 3 Plus can be used to monitor single-phase loads. There are several guidelines to keep in mind about this type of connection:

1. The PowerScout 3 Plus is powered from a potential between L1 and L2. This can be phase-to-phase (230V) or phase-to-neutral (115V). With a single-phase 230V panel, the L1 and L2 voltage leads are connected between the L1 and L2 voltage sources. With a 115V circuit, the L1 voltage lead is connected to the L1 "hot lead," and the L2 voltage lead is connected to neutral.
2. Each CT must be paired with the correct voltage source. The current and voltage need to be in-phase for accurate measurements. For instance, CT 1 would monitor branch circuit supplied by voltage source L1, and so on.
3. The neutral must be connected because the PowerScout 3 Plus uses line-to-neutral measurements for all calculations.

On the US version of the PowerScout 3 Plus, the voltage leads are color coded: Black/L1, Red/L2, Blue/L3, and White/neutral. On international PowerScout 3 Plus instruments, the voltage leads are black and labeled L1, L2, L3, and N.

### A Typical 230V Single-Phase Panel Setup

Connect the Black L1 voltage lead to Voltage L1, Red L2 voltage lead to L2 voltage, White Neutral voltage lead to neutral. CT1 would monitor L1 loads and CT2 would monitor L2 loads. Based on the above guidelines, CT3 can be used if the Blue L3 voltage lead is connected to either L1 or L2. As long as voltage lead L3 and CT3 are in-phase, the PowerScout 3 Plus will provide correct kW readings. If the Blue L3 voltage lead was connected to L2 voltage source, then CT3 could monitor any L2 branch circuit. Or, if the Blue L3 voltage lead was connected to L1 voltage source, then CT3 could monitor any L1 branch circuit.

### A Typical 115V Single-Phase Panel Setup

Connect the Black L1 voltage lead to Voltage L1 (hot), Red L2 voltage lead to Neutral, and White N voltage lead to neutral. CT1 would monitor the L1 load. CT3 can be used if the Blue L3 voltage Lead is connected to L1. CT3 could then monitor any L1 branch circuit.

### System Values

System values are the sum of L1 + L2 + L3 measurements. System values may not be meaningful since two different devices or loads can be monitored by a single PowerScout 3 Plus element.

When paired with the right voltage phase, each CT provides individual kW/kWh readings for that CT channel.

## PhaseChek™

PhaseChek[1] is a unique feature of the PowerScout 3 Plus  that simplifies installation by ensuring proper CT-to-phase installation and avoiding faulty data collection. The PowerScout 3 Plus automatically adjusts for CT orientation—reducing set-up time and nearly eliminating installation errors.

### Verifying the PowerScout Setup Using the LEDs

The PowerScout 3 Plus has three bi-color PhaseChek LEDs. These LEDs provide the following information:

- All LEDs are green — the system power factor is greater than 0.55 and the CTs are properly placed on the corresponding voltage phases.
- Any one LED is red — there is a phasing connection error.
- Two LEDs are red and one is green — two CTs are reversed.
- All three LEDs are red —all CTs are incorrectly connected.

> ***Note**: If the total system power factor is less than 0.55, the LEDs will be red even if connected properly. This situation is rare but could occur if, for example, the load to be monitored is a lightly loaded electric motor where it is common for the power factor to be less than 0.55 and the corresponding LEDs will be red.*

The following table describes the PhaseChek error conditions and the appropriate correction.

| L1 | L2 | L3 | Error Description | Correction |
|---|---|---|---|---|
| 🟢 | 🟢 | 🟢 | Setup is correct and the system power factor is greater than 0.55.<br>-or-<br>All CTs are disconnected. | Connect the CTs. |
| 🔴 | 🔴 | 🔴 | All CTs are incorrectly connected,<br>-or-<br>The system power factor is less than 0.55. | Rotate the CT connections by one position by move CT 1 to CT 2, CT 2 to CT3 and CT3 to CT1, until all LEDs are green.<br><br>The system power factor is less than 0.55 but the CTs are connected properly indicating a light load. |
| 🟢 | 🔴 | 🔴 | CT 2 and CT 3 are reversed. | Switch the position of the CTs flashing red. |
| 🔴 | 🔴 | 🟢 | CT 1 and CT 2 are reversed. | Switch the position of the CTs flashing red. |
| 🔴 | 🟢 | 🟢 | CT 1 is swapped with either CT 2 or CT 3. | Switch CT 1 with CT 2.<br>-or-<br>Switch CT 1 with CT 3. |
| 🟢 | 🔴 | 🟢 | CT 2 is swapped with either CT 1 or CT 3. | Switch CT 2 with CT 1.<br>-or-<br>Switch CT 2 with CT 3. |

[1] Patent No. 7,612,552. U.S. Patent and Trademark Office.

| L1 | L2 | L3 | Error Description | Correction |
|---|---|---|---|---|
| 🟢 | 🟢 | 🔴 | CT 3 is swapped with either CT 1 or CT 2. | Switch CT 3 with CT 1.<br>-or-<br>Switch CT 3 with CT 2. |
| 🔴 | 🟢 | 🔴 | CT 1 and CT 3 are reversed. | Switch the position of the CTs flashing red. |

**Table II-2: PhaseChek LED Error Resolution**

## Setting the Network Address Switches

There are two rotary network address switches on the PowerScout 3 Plus, labeled Upper and Lower. These two switches are used to select the BACnet MAC address the computer or BACnet client uses to communicate with the PowerScout.

The rotary switches are 16-position, hexadecimal switches. The default factory setting is hex 01. The BACnet MAC address is a hexadecimal (hex) value, represented by the digits 0 through 9 and letters A through F. For example, a network address of 100 in decimal is converted to 64 hexadecimal and set on the PowerScout 3 Plus by:

1. Upper switch – select 6
2. Lower switch – select 4

In some cases the hex value may need to be converted to decimal when entered into the RTU or data logger. See the Appendix for a hexadecimal conversion table.

| Hexadecimal Address | Address Availability |
|---|---|
| 00 | Reserved for resetting the PowerScout 3 Plus to Modbus mode with 9600 baud, 8 bit, 1 stop bit and no parity. |
| 01-7F | Available (01 is the factory default setting). |
| 80-FE | Reserved for BACnet slave devices |
| FF | Reserved for network wide broadcast. The rotary switches can be used to configure the communication protocol to BACnet 2004 or Modbus as well as changing the baud rate if unsure of the current settings. |

**Table II-3: BACnet Hexadecimal Address Availability**

## Establishing Communication (BACnet)

The PowerScout 3 Plus communicates with the BACnet client using the BACnet MS/TP protocol on a RS-485 hardware interface. To establish communication, the Modbus settings must meet the following requirements:

1. The BACnet address on the PowerScout 3 Plus and in the BACnet client must be set to the same value.
2. The PowerScout 3 Plus meter’s default serial parameters are:

| Parameter | Setting |
|---|---|
| Baud | 76800 |
| Data bits | 8 |
| Parity | None |
| Stop Bit | 1 |

**Table II-4: Communication Settings**

The supported baud rates include 9600, 19200, 38400, 57600, 76800, 115200.

3. The baud rate on the BACnet client must match the PowerScout 3 Plus.

## PowerScout 3 Plus Wiring Diagrams

The PowerScout 3 can be wired using any one of the following five common wiring setups. These diagrams will assist you in properly connecting your PowerScout 3 Plus for the setup desired. ALL WIRE COLORS ARE U.S. STANDARD.

⚠ **WARNING! DO NOT EXCEED 600Vac PHASE TO PHASE CAT III.**

When complete, close the enclosure cover, if equipped.

⚠ **Attention: NE PAS DEPASSER UNE PHASE A 600VAC CAT III.**

Une fois terminé, fermer le covercle, s'il y en a un.

⚠ **CAUTION:** THE POWERSCOUT™ 3 Plus SHOULD ONLY BE WIRED BY QUALIFIED PERSONNEL. HAZARDOUS VOLTAGES EXIST.

⚠ **ATTENTION:** LE POWERSCOUT ™ 3 PLUS NE DOIT ETRE BRANCHE QUE PAR UN PERSONNEL QUALIFIE. TENSIONS DANGEREUSES SONT PRÉSENTES.

**DANGER! THE UNENCLOSED POWERSCOUT BOARD REQUIRES EXTRA CAUTION WHEN CONNECTING. LIFE THREATENING VOLTAGES EXCEEDING 600 VOLTS MAY EXIST ON THE BOARD. <u>THE RISK OF SERIOUS INJURY OR DEATH SHOULD NOT BE UNDERESTIMATED</u>.**

**DANGER! LA PLAQUETTE DE CIRCUITS IMPRIMES SANS COUVERCLE EXIGE UN REDOUBLEMENT DE PRUDENCE QUAND ON FAIT LA CONNEXION. LES TENSIONS DEPASSANT 600 VOLTS PEUVENT EXISTER SUR LA PLAQUETTE ET PEUVENT METTRE LA VIE EN DANGER. <u>LE RISQUE DE BLESSURES GRAVES OU DE MORT NE DOIT PAS ETRE SOUS-ESTIME</u>.**

**Figure IV-1: Single Phase, Two Wire**


N = white

L1 = black

L2 = red

L3 = blue

**Figure IV-2: Single Phase, Three Wire**

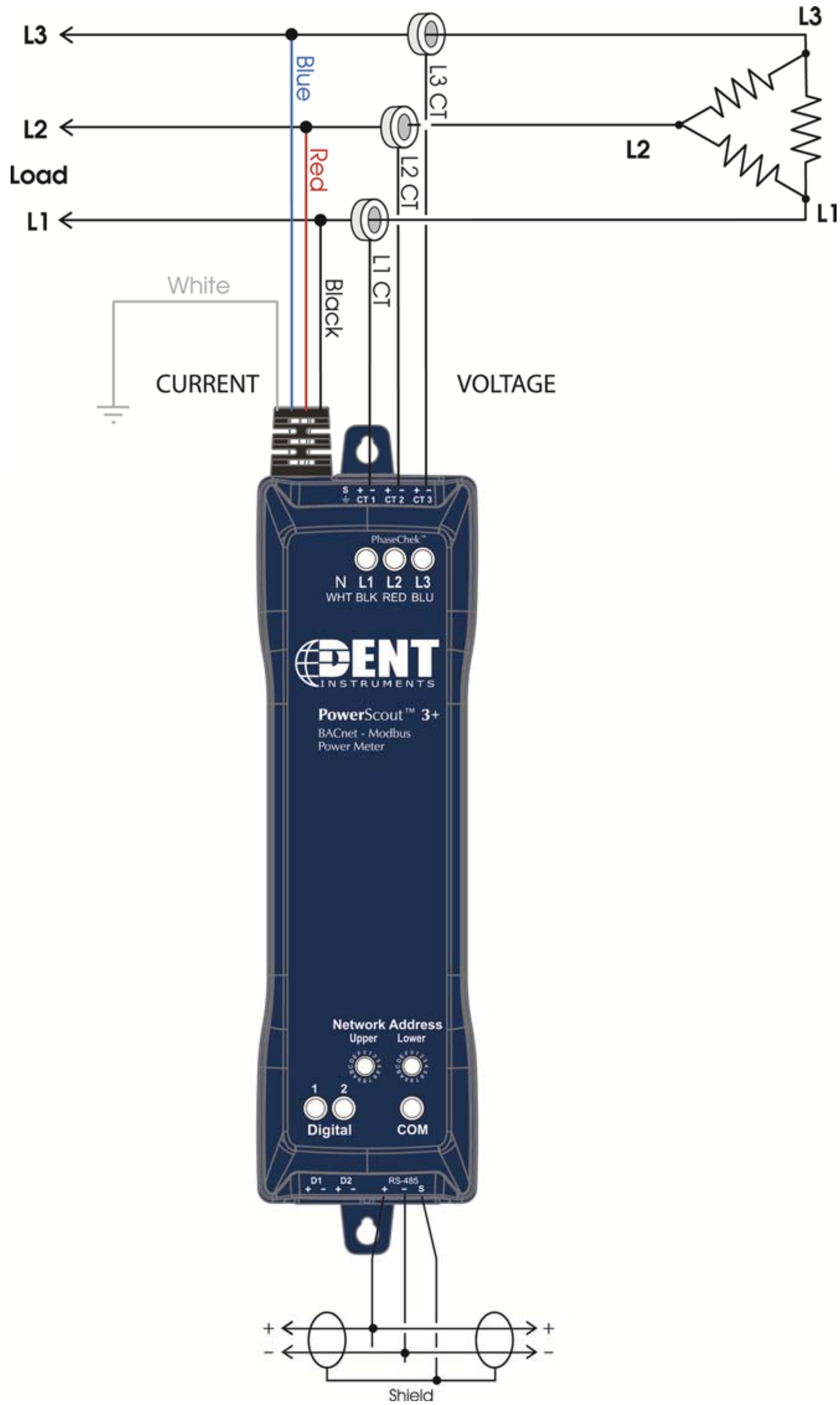

N = white

L1 = black

L2 = red

L3 = blue

**Figure IV-3: Three Phase, Three Wire Delta**



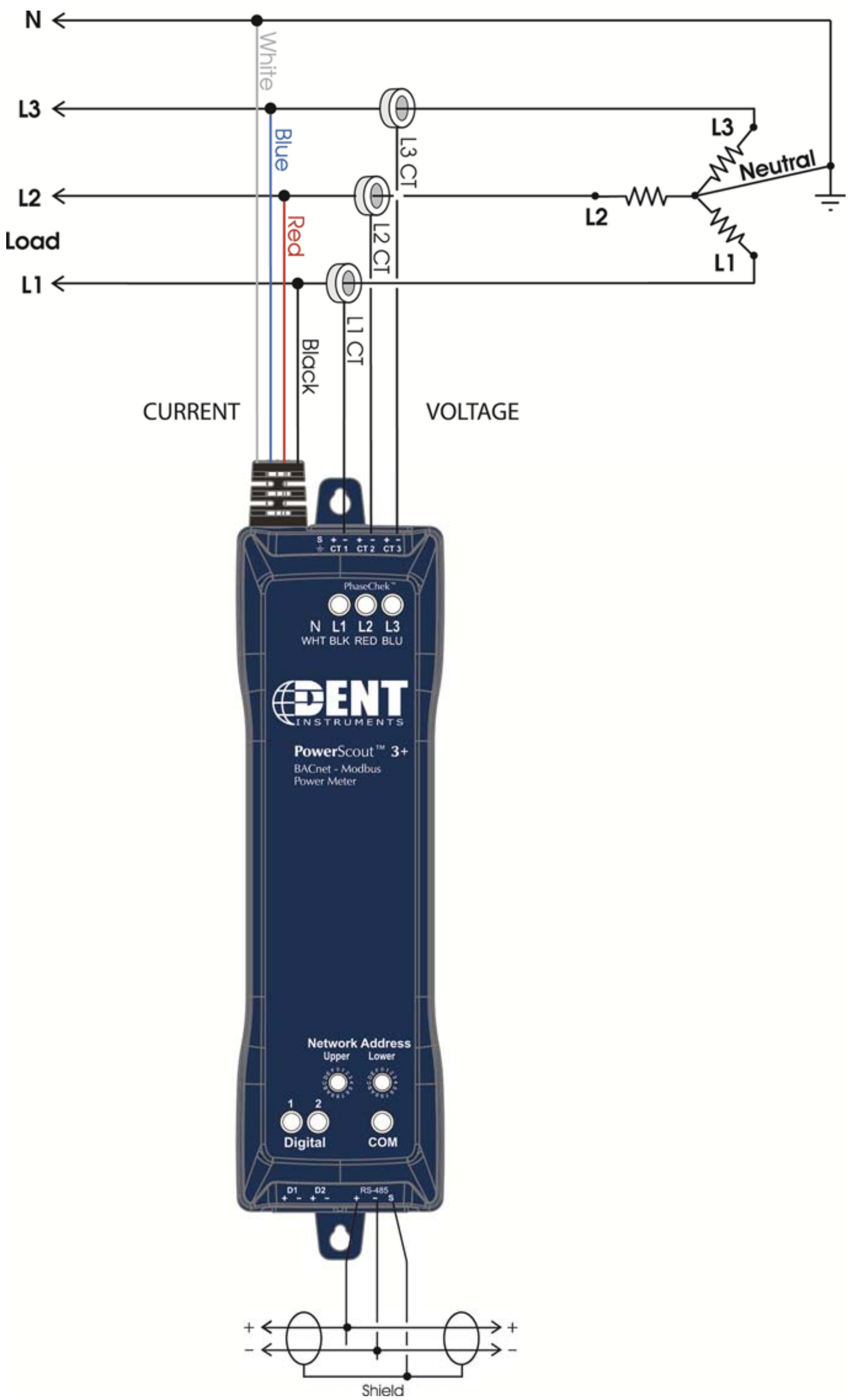

N = white

L1 = black

L2 = red

L3 = blue

**Figure IV-4: Three Phase, Four Wire Wye**



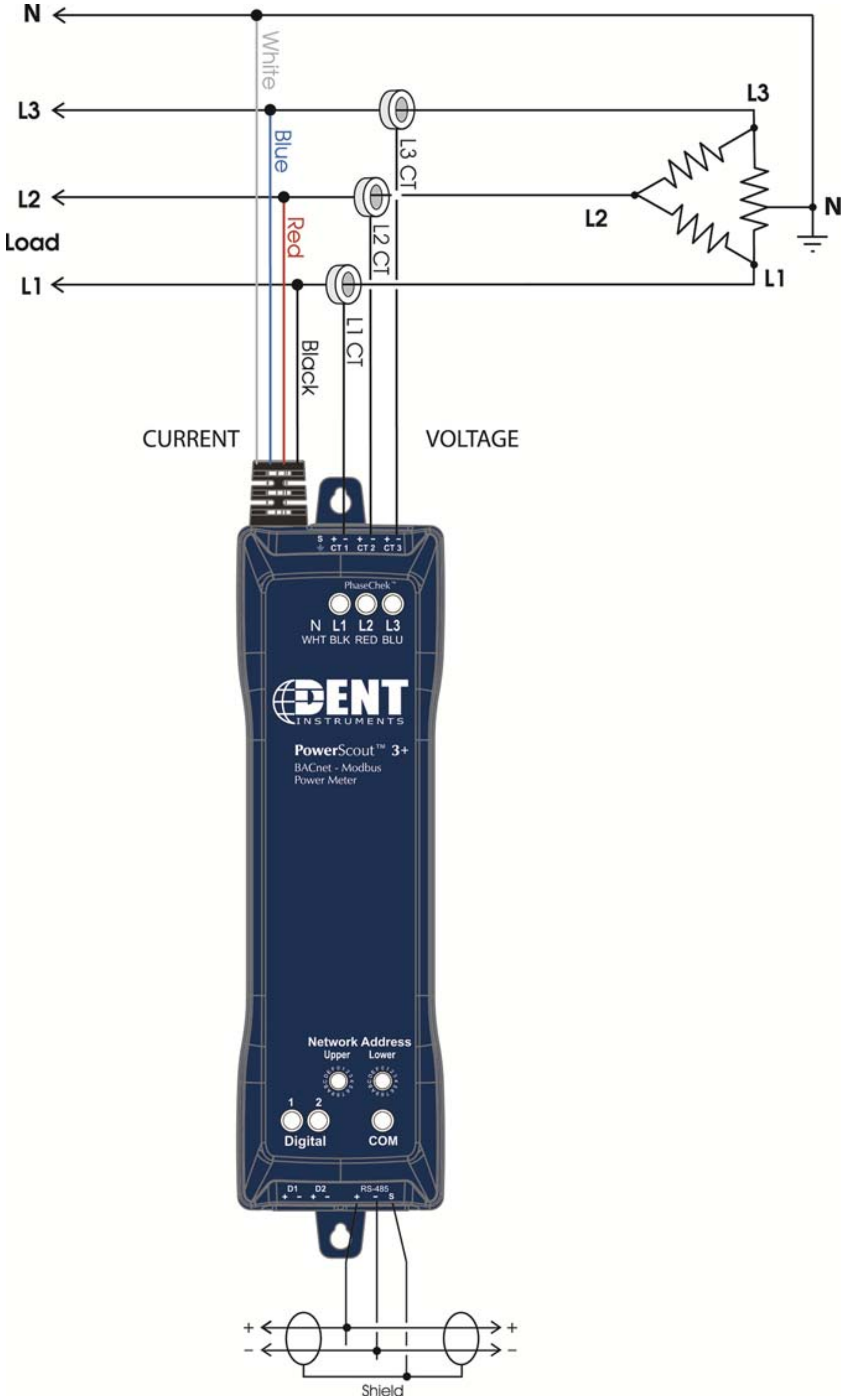

N = white

L1 = black

L2 = red

L3 = blue

**Figure IV-5: Three Phase, Four Wire Delta**




N = white

L1 = black

L2 = red

L3 = blue

## SECTION II.C: Other Functions - BACnet

## Resetting BACnet objects

Many of the PowerScout™ 3 Plus objects are real-time values such as instantaneous watts or power factor. However, some objects are accumulated values such as kWh, kVARh, kVAh and various Peak Demand (kW) values. To reset all these registers at once:

Write to **object identifier 10140 “Clear Accumulated Values”** current value 1234.0

The tables in Section II.D Appendix A list all of the objects available on the PowerScout 3 Plus.

## Digital Output Port Function

The PowerScout 3 Plus has two configurable output ports. The ports can be used to output kWh, kVARh, or kVAh pulses to external devices, or to toggle on and off to control a remote device or relay.

### Pulse Output

Pulse output is used to generate pulses for external devices such as data loggers that can accept pulses but do not have BACnet capability. The PowerScout 3 Plus can generate pulses based on accumulated value(s) such as system kWh, system kVARh, and system kVAh. When a pulse is generated by the PowerScout 3 Plus, the orange and green LEDs both will briefly flash, otherwise they will remain dark.

The pulse output is scaled by the same data scalar register (44602) as are the Modbus registers. For example, when the data scalar is set to 3, each pulse will represent .1 kWh, .1kVAh and .1kVARh.

For system pulse output:

kWh pulse output – write 44001 into the pulse output configuration object.

kVAh pulse output – write 44011 into the pulse output configuration object.

kVARh pulse output – write 44008 into the pulse output configuration object.

### Output Port Registers

Refer to the following two tables to configure the PowerScout 3's two output ports.

| Object Identifier | Name | Detailed Description |
|---|---|---|
| 13020 | Port 1 output control when used as an on/off - open/closed switch | 0 = output LOW (closed)<br>1 = output HIGH (open) [default]<br>Object 13100 present value must = 0 to use |
| 13100 | Digital Port 1 Configuration<br>Turns pulses on/off | 0 = No pulses, Port may be used as an on/off – open/closed switch<br>44001 = System kWh pulses<br>44008 = System kVAh pulses<br>44011 = System kVARh pulses |
| 13110 | Port 1 pulse output relay type | 0 = normally open (HIGH)<br>1 = normally closed (LOW) |

**Table II-5: Digital Port 1 Pulse Output**

| Object Identifier | Name | Detailed Description |
|---|---|---|
| 13030 | Port 2 output control when used as an on/off - open/closed switch | 0 = output LOW (closed)<br>1 = output HIGH (open) [default]<br>Object 13150 present value must = 0 to use |
| 13150 | Digital Port 2 Configuration<br>Turns pulses on/off | 0 = No pulses, Port may be used as an on/off – open/closed switch<br>44001 = System kWh pulses<br>44008 = System kVAh pulses<br>44011 = System kVARh pulses |
| 13160 | Port 2 pulse output relay type | 0 = normally open (HIGH)<br>1 = normally closed (LOW) |

**Table II-6: Digital Port 2 Pulse Output**

## Connecting to a BACnet MS/TP Network

This section describes setting up a BACnet MS/TP network with multiple PowerScout 3 Plus instruments using the BACnet MS/TP serial communication protocol. A network can support up to 127 PowerScout 3 Plus instruments.

### BACnet MS/TP Communication Protocol

BACnet is a standard communications protocol that allows for communication between a BACnet client and multiple devices connected to the same network. RS-485 is the protocol standard used by the PowerScout 3 Plus as the hardware's serial interface while BACnet is the communication protocol.

### Daisy Chain Layout for RS-485 Network

When multiple devices are connected the devices need to be connected in a daisy chain. A daisy chain means that all plus (+) connections are chained together and all minus (-) connections are chained together across the network.

A BACnet MS/TP network containing multiple devices requires a unique address for each device. This allows the master device to identify and communicate with each slave. The BACnet MS/TP network administrator must assign a unique network address to each PowerScout 3 Plus.

Other network layouts are not recommended when using the RS-485 standard.

### Networking Using the BACnet MS/TP Option

1. Install the BACnet MS/TP cable.
2. Set a unique BACnet MS/TP MAC address for each device using the table in Appendix A. Locate the number of the slave device in the "Decimal" column. Move right to the "Hex" column to find the converted address value of this device. For example, for device 1, the upper BACnet MAC address switch is set to 0, the lower BACnet MAC address switch is set to 1.

## Updating Firmware

The PowerScout 3 Plus must be in Modbus mode when updating firmware. For more information, see *BACnet Appendix B—Switching Between BACnet* and *Modbus Mode and Modbus Appendix B—Installing Firmware Updates for the PowerScout 3 Plus*.

## SECTION II.D: Appendices – BACnet

### BACnet Appendix A – PowerScout 3 Plus BACnet Object Tables

| Object Identifier | Name | Description |
|---|---|---|
| 1000 | kW Demand System Maximum | System Maximum Demand (peak demand) (Unsigned/Absolute) |
| 1010 | kW Demand System Now | Average Power (kW) for most recent demand window (Unsigned/Absolute) |
| 1020 | kW Demand System Minimum | Min Average power window (kW) (Unsigned/Absolute) |
| 1030 | kW System | System true Power (kW). Unsigned absolute value of (kW L1) + (kW L2) + (kW L3) |
| 1031 | kW System Net | System Power (kW) Signed net value of (kW L1) + (kW L2) + (kW L3) |
| 1060 | kW System Average | Equals kWh System / (Time Since Reset /3600 seconds/Hr) (resettable) |
| 1080 | kW System Average Positive | Equals kWh System Positive / (Time Since Reset /3600 seconds/Hr) (resettable) (Signed Net) |
| 1090 | kW System Average Negative | Equals kWh System Negative / (Time Since Reset /3600 seconds/Hr) (resettable) (Signed Net) |
| 1100 | kW System Maximum | System Highest Instantaneous Draw Since Reset (kW) |
| 1110 | kW System Maximum Positive | System Highest Instantaneous Positive Draw Since Reset (kW) |
| 1120 | kW System Maximum Negative | System Highest Instantaneous Negative Draw Since Reset (kW) |
| 1130 | kW System Minimum | System Lowest Instantaneous Draw Since Reset (kW, resettable) |
| 1140 | kW System Minimum Positive | System Lowest Instantaneous Positive Draw Since Reset (kW, resettable) |
| 1150 | kW System Minimum Negative | System Lowest Instantaneous Negative Draw Since Reset (kW, resettable) |
| 1160 | kW L1 | Individual Phase True Power (kW) (Signed) |
| 1190 | kW L2 | " |
| 1220 | kW L3 | " |
| 2000 | kWh System Total | System True Energy (kWh) (Unsigned/Absolute) |
| 2010 | kWh System Total Positive | System True Energy (kWh) (Signed Net) |
| 2020 | kWh System Total Negative | " |
| 2040 | kWh L1 Positive | Individual Phase True Energy (kWh) (Signed) |
| 2050 | kWh L1 Negative | " |
| 2070 | kWh L2 Positive | " |
| 2080 | kWh L2 Negative | " |
| 2100 | kWh L3 Positive | " |
| 2110 | kWh L3 Negative | " |
| 3000 | Volts Line to Line Average | Voltage Line to line Average |
| 3010 | Volts Line to Neutral Average | Voltage Line to neutral Average |
| 3020 | Volts L1 to L2 | Individual Phase to Phase Voltages |
| 3030 | Volts L2 to L3 | " |
| 3040 | Volts L1 to L3 | " |
| 3050 | Volts L1 to Neutral | Individual Phase to Neutral Voltages (V) |

| Object Identifier | Name | Description |
|---|---|---|
| 3060 | Volts L2 to Neutral | “ |
| 3070 | Volts L3 to Neutral | “ |
| 4010 | Amps System Average | Average of all phases. |
| 4020 | Amps L1 | Individual Phase Currents (A) |
| 4030 | Amps L2 | “ |
| 4040 | Amps L3 | “ |
| 5000 | kVAR System | System Total Reactive Power (kVAR). Unsigned absolute value of (kVAR L1) + (kVAR L2) + (kVAR L3) |
| 5001 | kVAR System Net | System Total Reactive Power (kVAR). Signed net value of (kVAR L1) + (kVAR L2) + (kVAR L3) |
| 5030 | kVAR L1 | Individual Phase Reactive Energy LSW (kVARh) (signed) |
| 5060 | kVAR L2 | “ |
| 5090 | kVAR L3 | “ |
| 5120 | kVAR Demand System Max | System Maximum Instantaneous kVAR Demand (kVA, resettable). It displays the default value after a CAM until 1 demand window elapses. After a power cycle or CPU reset the value is not reset but it does not update again until 1 demand window elapses. (Unsigned/Absolute) |
| 5130 | kVAR Demand System Now | Average kVAR demand for most recent window (resettable). Displays the default value after a CAM or reset, or power cycle. Updates every min thereafter. True demand value takes a demand period to get to actual value. (Unsigned/Absolute) |
| 6010 | kVARh System | System Total Reactive Energy (Unsigned/Absolute) |
| 6020 | kVARh Sys Positive | System Total Reactive Energy (Signed Net) |
| 6030 | kVARh Sys Negative | “ |
| 6050 | kVARh L1 Positive | Individual Phase Reactive Energy (kVARh) (Signed) |
| 6060 | kVARh L1 Negative | “ |
| 6080 | kVARh L2 Positive | “ |
| 6090 | kVARh L2 Negative | “ |
| 6110 | kVARh L3 Positive | “ |
| 6120 | kVARh L3 Negative | “ |
| 7000 | kVAh System Total | System Total Apparent Energy (Unsigned/Absolute) |
| 7020 | kVAh L1 Positive | Individual Phase Apparent Energy LSW (kVAh) (Signed) |
| 7030 | kVAh L1 Negative | “ |
| 7050 | kVAh L2 Positive | “ |
| 7060 | kVAh L2 Negative | “ |
| 7080 | kVAh L3 Positive | “ |
| 7090 | kVAh L3 Negative | “ |
| 8000 | kVA System | System Total Apparent Power (kVA). Unsigned absolute value of (kVA L1) + (kVA L2) + (kVA L3) |
| 8001 | kVA System Net | System Net Apparent Power (kVA). Signed net value of (kVA L1) + (kVA L2) + (kVA L3) |
| 8010 | kVA L1 | Individual Phase Apparent Powers (kVA) (signed) |
| 8020 | kVA L2 | “ |
| 8030 | kVA L3 | “ |

| Object Identifier | Name | Description |
|---|---|---|
| 8040 | kVA Demand System Max | System Maximum Instantaneous kVA Demand (kVA, resettable). It displays the default value after a CAM until 1 demand window elapses. After a power cycle or CPU reset the value is not reset but it does not update again until 1 demand window elapses. (Unsigned/Absolute) |
| 8050 | kVA Demand System Now | Average kVA for most recent demand window (resettable). Displays the default value after a CAM or reset, or power cycle. Updates every min thereafter. True demand value takes a demand period to get to actual value. (Unsigned/Absolute) |
| 9000 | Displacement PF System | System Total Power Factor (PF) (Signed) |
| 9030 | Apparent PF System | System Total Power Factor (PF) (Signed) |
| 9060 | Displacement PF L1 | Individual Phase displacement Power Factor (PF) |
| 9090 | Displacement PF L2 | “ |
| 9120 | Displacement PF L3 | “ |
| 9150 | Apparent PF L1 | Individual Phase apparent Power Factors (PF) |
| 9180 | Apparent PF L2 | “ |
| 9210 | Apparent PF L3 | “ |
| 10000 | Measured Line Frequency | Line Frequency (Hz) |
| 10010 | Time Since Reset | Seconds since accumulator registers were reset. |
| 10020 | Data acquisition tick | A 1 millisecond counter that is used as a “heartbeat” to verify communications. |
| 10140 | Clear Accumulated Measurements | Writing 1234.0 to the present value will reset all the accumulator objects (kWh, kVAh, kVARh) |
| 10150 | PowerScout Element ID | Used to determine which element is being read & total number of elements available. Element index multiplied by 256 + number of elements. |
| 10190 | Communications protocol | Used to change between BACnet 2004 and Modbus communications protocols. |
| 10200 | Maximum number of MSTP masters | Maximum number of MS/TP masters on the bus (1-127). If network congestion / slowness is occurring reduce this to the highest numbered MAC address |
| 10210 | Maximum Info Frames | Value of max info frames specifies the maximum number of information frames that the node may send before it passes the token. |
| 12000 | CT Phase Shift | CT phase shift (degrees) |
| 12010 | CT Value | CT Value |
| 12030 | Pulse Scalar | Changes the scaling of the output pulses |
| 12040 | Demand Window | Demand window size in minutes; default is 15 min |
| 12050 | Volts Multiplier | Multiply volts values by this scalar. For use with stepdown transformer. Affects all parameters that use volts. |
| 12060 | Amps Multiplier | Multiply amps values by this scalar. For use with stepdown transformer. Affects all parameters that use amps. |

| Object Identifier | Name | Description |
|---|---|---|
| 12070 | Com Settings | Baud: 900=9600, 1900=19200, 3800=38400, 5700=57600, 7600=76800, 11500=115200<br>Parity: Add 00 = NO, Add 10 = ODD, Add 20 = EVEN<br>Stop bit: Add 0 = 1 (UART does not permit 0 stop bits), Add 1 = 1, Add 2 = 2<br>e.g., 901 = 9600 baud, no parity, 1 stop bit |
| 12080 | Service Type | A value of 1 configures the meter for Delta. A value of 0 configures the meter for Wye. |
| 12090 | Line Frequency | Line frequency setting for metering. 50 = 50 Hz, 60 = 60 Hz, 400 = 400 Hz |
| 12100 | Snap mV Threshold | Snap to 0 threshold for millivolt CTs. BACnet value is percentage of CT rating. |
| 12110 | Snap Rogowski Threshold | Snap to 0 threshold for Rogowski CTs. BACnet value is percentage of Rogowski 3000A rating. |
| 12120 | Snap Volt Threshold | Snap to 0 threshold for volts. e.g. 10 is = 10 volts snap |
| 12130 | CT Type | 1 = MilliVolt, 2 = Rogowski |
| 13020 | Output Port 1 Control | 0 = output LOW (closed)<br>1 = output HIGH (open) (present value is set to default (1) |
| 13030 | Output Port 2 Control | 0 = output LOW (closed)<br>1 = output HIGH (open) (present value is set to default (1) |
| 13100 | Pulse Output 1 Conf. | 0 = No pulse output (kWh = 44001, kVARh=44011 or kVAh=44008) |
| 13110 | Pulse Output 1 Relay Type | 0 = normally open (HIGH)<br>1 = normally closed (LOW) |
| 13150 | Pulse Output 2 Conf. | 0 = no pulse output (kWh, kVARh or<br>kVAh = Register number) |
| 13160 | Pulse Output 2 Relay Type | 0 = normally open (HIGH)<br>1 = normally closed (LOW) |

## Configuration Objects (12000-13000)

| Object Identifier | Name | Description |
|---|---|---|
| 12000 | CT Phase Shift | CT phase shift (degrees) |
| 12010 | CT Value | CT Value |
| 12030 | Pulse Scalar | Changes the scaling of the output pulses |
| 12040 | Demand Window | Demand window size in minutes; default is 15 min |
| 12050 | Volts Multiplier | Multiply volts values by this scalar. For use with stepdown transformer. Affects all parameters that use volts. |
| 12060 | Amps Multiplier | Multiply amps values by this scalar. For use with stepdown transformer. Affects all parameters that use amps. |
| 12070 | Com Settings | Baud: 900=9600, 1900=19200, 3800=38400, 5700=57600, 7600=76800, 11500=115200<br>Parity: Add 00 = NO, Add 10 = ODD, Add 20 = EVEN<br>Stop bit: Add 0 = 1 (UART does not permit 0 stop bits), Add 1 = 1, Add 2 = 2 |

| Object Identifier | Name | Description |
|---|---|---|
| | | E.g., 901 = 9600 baud, no parity, 1 stop bit |
| 12080 | Service Type | A value of 1 configures the meter for Delta. A value of 0 configures the meter for Wye. |
| 12090 | Line Frequency | Line frequency setting for metering. 50 = 50 Hz, 60 = 60 Hz, 400 = 400 Hz |
| 12100 | Snap mV Threshold | Snap to 0 threshold for millivolt CTs. BACnet value is percentage of CT rating. |
| 12110 | Snap Rogowski Threshold | Snap to 0 threshold for Rogowski CTs. BACnet value is percentage of Rogowski 3000A rating. |
| 12120 | Snap Volt Threshold | Snap to 0 threshold for volts. e.g. 10 is = 10 volts snap |
| 12130 | CT Type | 1=MilliVolt, 2=Rogowski |

### Writable Registers

| Object Identifier | Name | Description |
|---|---|---|
| 10140 | Clear Accumulated Measurements | Writing 1234.0 to the present value will reset all the accumulator objects (kWh, kVAh, kVARh) |
| 10190 | Communications protocol | Used to change between BACnet 2004 and Modbus communications protocols. |
| 10200 | Maximum number of MSTP masters | Maximum number of MS/TP masters on the bus (1-127). If network congestion / slowness is occurring reduce this to the highest numbered MAC address |
| 10210 | Maximum Info Frames | Value of max info frames specifies the maximum number of information frames that the node may send before it passes the token. |

### Non-Writable Registers

| Object Identifier | Name | Description |
|---|---|---|
| 10150 | PowerScout Element ID | Used for ViewPoint to determine which element is being read & total number of elements available. Element index multiplied by 256 + number of elements. |
| 10030 | Hardware ID | Hardware revisions. |
| 10040 | Features | New features. |

### Positive Power/Energy Accumulator Objects

| Object Identifier | Name | Description |
|---|---|---|
| 2010 | kWh System Total Positive | System True Energy (kWh) Positive |
| 1110 | kW System Maximum Positive | System Highest Instantaneous Positive Draw Since Reset (kW) |

| Object Identifier | Name | Description |
|---|---|---|
| 1140 | kW System Minimum Positive | System Lowest Instantaneous Positive Draw Since Reset (kW, resettable) |
| 2040 | kWh L1 Positive | Individual Phase True Energy (kWh) |
| 2070 | kWh L2 Positive | " |
| 2100 | kWh L3 Positive | " |
| 6010 | kVARh System | System Total Reactive Energy |
| 6050 | kVARh L1 Positive | Individual Phase Reactive Energy (kVAR) |
| 6080 | kVARh L2 Positive | " |
| 6110 | kVARh L3 Positive | " |
| 7020 | kVAh L1 Positive | Individual Phase Apparent Energy LSW (kVAh) |
| 7050 | kVAh L2 Positive | " |
| 7080 | kVAh L3 Positive | " |
| 1080 | kW System Average Positive | Equals kWh System Positive / (Time Since Reset /3600 seconds/Hr) (resettable) |

## Negative Power/Energy Accumulator Objects

| Object Identifier | Name | Detailed Description |
|---|---|---|
| 2020 | kWh System Total Negative | System True Energy (kWh) Negative |
| 1120 | kW System Maximum Negative | System Highest Instantaneous Negative Draw Since Reset (kW) |
| 1150 | kW System Minimum Negative | System Lowest Instantaneous Negative Draw Since Reset (kW, resettable) |
| 2050 | kWh L1 Negative | Individual Phase True Energy (kWh) |
| 2080 | kWh L2 Negative | " |
| 2110 | kWh L3 Negative | " |
| 6030 | kVARh Sys Negative | System Total Reactive Energy |
| 6060 | kVARh L1 Negative | Individual Phase Reactive Energy (kVARh) |
| 6090 | kVARh L2 Negative | " |
| 6110 | kVARh L3 Negative | " |
| 7030 | kVAh L1 Negative | Individual Phase Apparent Energy LSW (kVAh) |
| 7060 | kVAh L2 Negative | " |
| 7090 | kVAh L3 Negative | " |
| 1090 | Negative kW System Average | Equals kWh System Negative / (Time Since Reset /3600 seconds/Hr) (resettable) |

## BACnet Appendix B – Switching between BACnet and Modbus Mode

### Changing Communication Mode Between Modbus and BACnet Using ViewPoint

Using ViewPoint is the preferred way to change communications modes between Modbus and BACnet.

Note that the baud rate and serial settings may need to change between Modbus and BACnet.

If communication fails, see the section *Changing Baud Rate or Communication Mode using address switches (between Modbus and BACnet)* below.

### Changing the PowerScout 3 Plus from Modbus to BACnet mode:

1. Connect to the PowerScout 3 Plus using ViewPoint™.
2. Go to the Read/Write Registers tab in ViewPoint™.
3. Enter 44612 into the "Set Modbus Register" field.
4. In the "To Value:" field enter either 1833 to change to BACnet 2004 mode. Click on the "Set Modbus Register" button.
5. The status should say "Writing Register…"
6. Eventually the status should report "Communications Error"
7. At this point the PowerScout 3 Plus should be in BACnet mode. Connect using a BACnet client.

### If the PowerScout 3 Plus is in BACnet mode:

Note that the user interface will differ on BACnet clients and may require other actions to write the present value property in the BACnet object.

Also note that the baud rate and serial settings may need to change between BACnet and Modbus.

If communication fails, see the section *Changing Baud Rate or Communication Mode using address switches (between Modbus and BACnet)* on the next page.

1. Connect to the PowerScout 3 using a BACnet client (RTU).
2. For object identifier 10190 (Communications protocol), write to the present value attribute: 375 (177 hex) to change to Modbus mode; 1833 (729 hex) to change to BACnet 2004 mode.
3. If changing to Modbus mode: This will cause a loss of communication between the BACnet client and the PowerScout 3 Plus. Connect using Viewpoint.

**Changing Baud Rate or Communication Mode using address switches (between Modbus and BACnet)**

Note that this is only required if *Changing Communication Mode using software (between Modbus and BACnet)* fails and the PowerScout 3 Plus needs to be returned to a particular communications protocol and baud rate.

1. Power down the PowerScout 3 Plus (disconnect all voltage leads).
2. Set the rotary “Network Address” switches to “F” & “F”.
3. Power up the PowerScout 3 Plus (connect the black & red voltage leads to power).
4. Set Switch 1 “Network Address Lower” to one of the following:

| Network Address Switch 1 “Lower” | Communication Mode | Digital 1 LED | Digital 2 LED |
|---|---|---|---|
| 1 | Modbus* | Red On | Off |
| 2 | BACnet 2004 | Off | Red On |

*Factory Default

5. Next Set Switch 2 (‘Network Address Upper’) to one of the following Baud Rates:

| Network Address Switch 2 “Upper” | Baud Rate | PhaseChek™ LED L1 | PhaseChek™ LED L2 | PhaseChek™ LED L3 |
|---|---|---|---|---|
| 1 | 9600 | Off | Off | Green |
| 2 | 19200 | Off | Green | Off |
| 3 | 38400 | Off | Green | Green |
| 4 | 57600 | Green | Off | Off |
| 5 | 76800* | Green | Off | Green |
| 6 | 115200 | Green | Green | Off |

*Factory Default

After powering up the PowerScout 3 Plus, you will have 10 seconds to make changes. However, every time a rotary switch is changed, the 10 second timer resets. After 10 seconds of no switch action, the settings take effect and the switches revert to the Modbus Address selector if in Modbus mode or MAC Address if in BACnet mode.

# SECTION III: MODBUS METERS

## SECTION III.A: Quick Start Guide (Modbus)

| | |
|---|---|
| ⚠ | High voltage MAY BE PRESENT. Risk of electric shock. Life threatening voltages may be present. Qualified personnel only. |
| ⚠ | Haute tension peut être présente. Risque de choc électrique. Tensions dangereuses peuvent être présentes. Personnel qualifié uniquement. |

1. Install the RS-485 driver on the computer using the accompanying CD. Connect the USB cable to the computer's USB port and to the RS-485 adapter.
   - See the section *Installing the RS-485 Adapter* for detailed instructions.

2. Using the CD included with the PowerScout™ 3 Plus, install the ViewPoint™ software onto the computer.
   - See the section *Installing the ViewPoint Software and Communicating with the PowerScout*.

3. Start ViewPoint™ and complete the following on the Communications screen: In the PC COM Port field, select the RS-485 isolated COM Port from the drop-down menu. Set the Modbus address to the desired address. The default Modbus Base Address Switches is set to 01, Data Bits is 8N1 and Baud Rate is 9600.
   - See *Section III.D: Using the ViewPoint Software* for additional information about setting the Modbus address.

   Set the computer aside.

4. Securely mount the PowerScout™ 3 Plus using the two mounting tabs at each end of the case.

5. Mount each current transformer (CT) on the wire to be monitored. Next, connect the CT leads to the terminal block on the PowerScout. Verify the CTs are correctly oriented on the wires with the orientation pointed toward the load (away from the breaker). Note that:
   The CT on the L1 voltage phase wire is connected to the PowerScout's CT 1 input
   The CT on the L2 voltage phase is connected to the CT 2 input
   The CT on the L3 voltage phase is connected to the CT 3 input
   - Refer to the end of *Section III.C: Field Installation* to review common wiring diagrams.

6. Connect the voltage leads on the PowerScout 3 Plus to the appropriate voltage phases. Connect the neutral wire to the neutral bus or to ground if using a three-phase Delta service. The PowerScout is powered from L1 and L2 voltage connections.

7. Verify the PhaseChek™ LEDs are all flashing green.

8. Plug the RS-485 adapter into the PowerScout 3 Plus.

9. In ViewPoint™, on the **Communications** tab, click the **Connect** button to establish communication between the PowerScout 3 Plus and the computer.

10. On the **CT Values** tab configure the **CT Type** an**d CT Amperage Rating.** Clear accumulated and demand data.

11. Select the **Real-time Values** tab for a table of current meter readings and verify the voltage, current and power readings are correct.

12. In ViewPoint, click the **Communications** tab and change communication settings, if necessary, for the RS-485 network.

13. Remove the RS-485 adapter from the PowerScout 3 Plus. Connect the PowerScout 3 Plus to the Modbus network.

14. Configure the RTU/data logging equipment to receive data from the PowerScout 3 Plus.
    - For more information on this step, consult the instruction manual for RTU/data logger.

## PowerScout 3 Plus Diagram

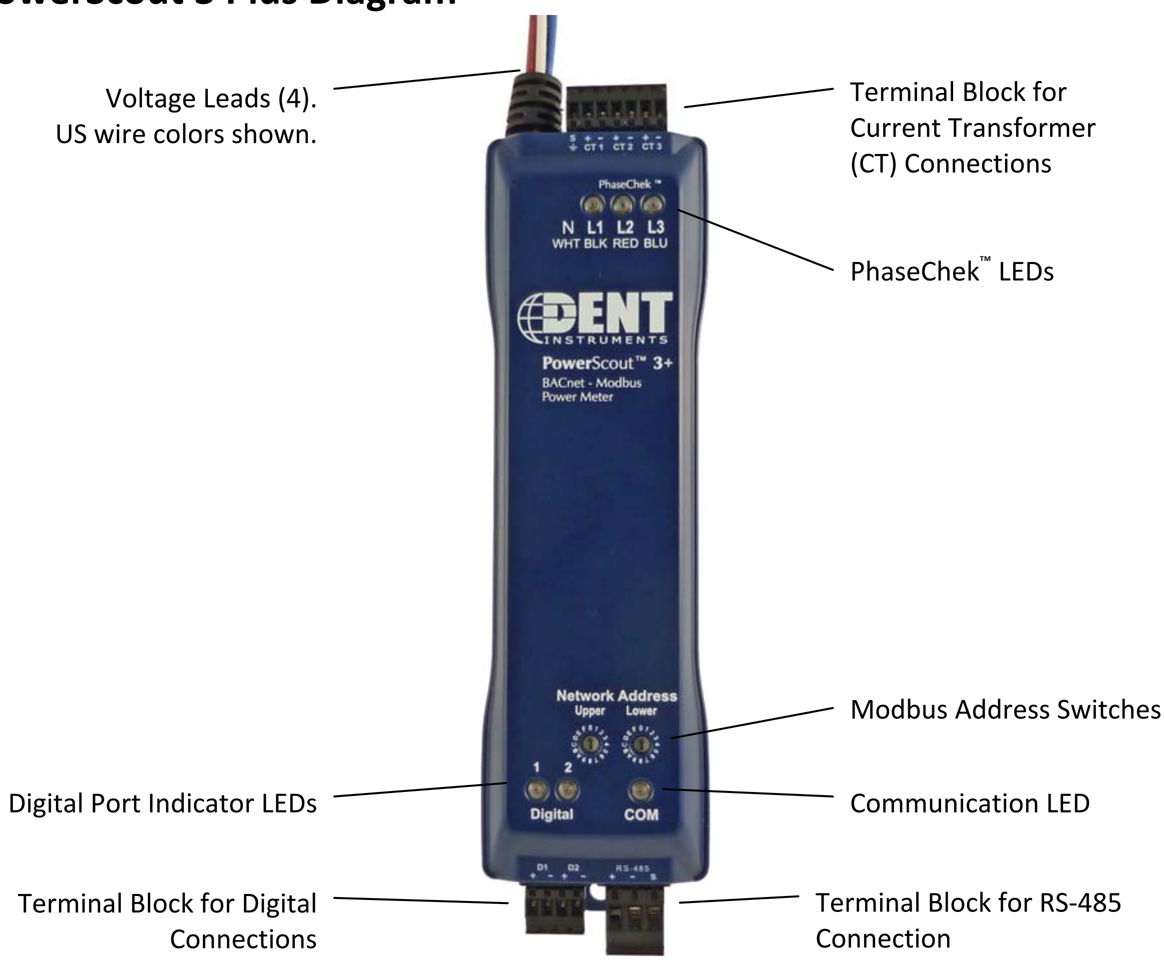



Figure III-1: PowerScout 3 Plus Layout

## SECTION III.B: Before Installation of a Modbus Meter

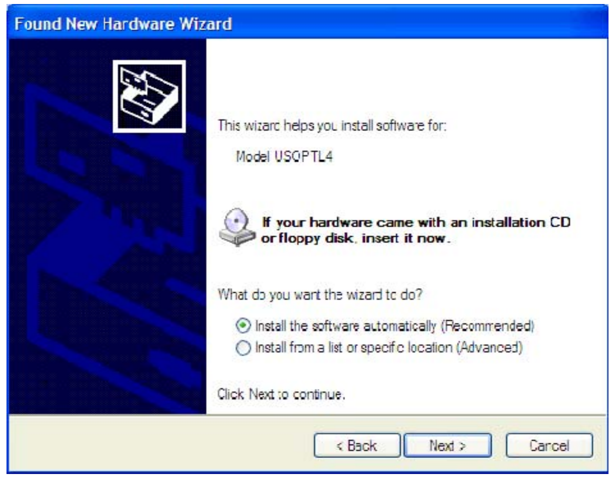
Installation of the RS-485 adapter and the ViewPoint ™ software can be completed and tested with the PowerScout™ 3 Plus prior to the field installation of the meter.

### Installing the RS-485 Adapter to a Computer

1. Insert the CD that came with the USB to RS-485 adapter into your computer.
2. Plug the USB to RS-485 cable into a USB port on the computer with the other end inserted into the adapter. Refer to figure III-3 for the cable location on the adapter.

   The **Found New Hardware Wizard** window appears.
3. The window states "This wizard helps you install software for: Model USOPTL4", and asks "What do you want the wizard to do?"
4. Select **Install the software automatically** and click **Next**.
5. Click **Finish** when the installation is complete.
6. Remove the CD from your computer.
7. Verify that the dip switches on the back of the USB to RS-485 adapter are set to: RS-485, Echo Off, 2 Wire, 2 Wire as shown in Figure III-2.

The adapter is ready to be connected to the PowerScout 3 Plus.



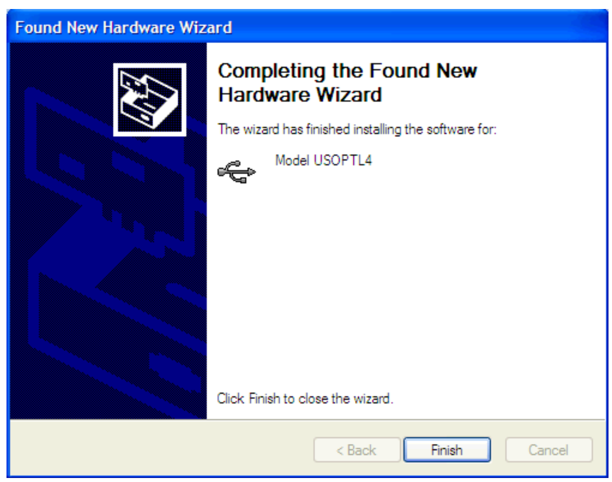





Figure III-2: Dip switches on back of RS-485 Adapter

## Connecting the RS-485 Adapter to the PowerScout 3 Plus

| | |
|---|---|
| ⚠ | High voltage MAY BE PRESENT. Risk of electric shock. Life threatening voltages may be present. Qualified personnel only. |
| ⚠ | Haute tension peut être présente. Risque de choc électrique. Tensions dangereuses peuvent être présentes. Personnel qualifié uniquement. |

To complete the connection between the PowerScout 3 Plus and the computer, the three wires coming from the RS-485 adapter are plugged into the PowerScout 3 Plus.

1. Insert each white ferrule into the appropriate RS-485 connection on the PowerScout. The red wire inserts in (+), the black wire in (-) and the green wire in GND.

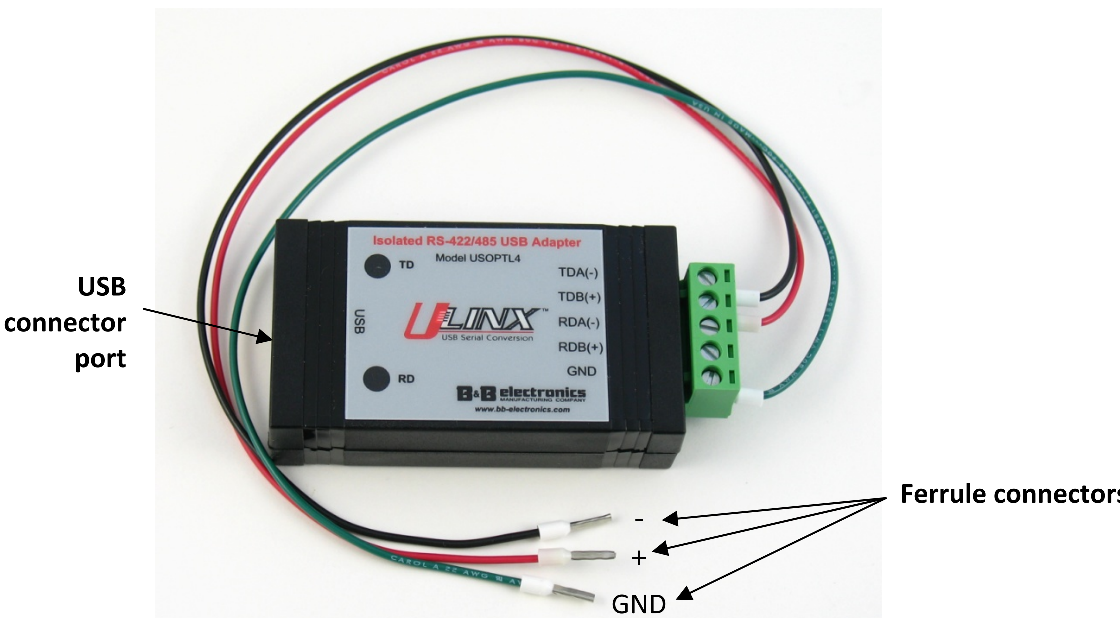



**Figure III-3: RS-485 Adapter**

This completes connecting the PowerScout 3 Plus to the computer using the RS-485 adapter.

## Installing the ViewPoint Software and Communicating with the PowerScout 3 Plus

The ViewPoint software is designed to let you easily configure the PowerScout 3 Plus for different current transformers, check readings and verify correct setup. ViewPoint is compatible with Windows® 7 (32 or 64 bit), Vista (32 or 64 bit), XP or 2000.

1. Insert the ViewPoint CD into the CD-ROM drive.

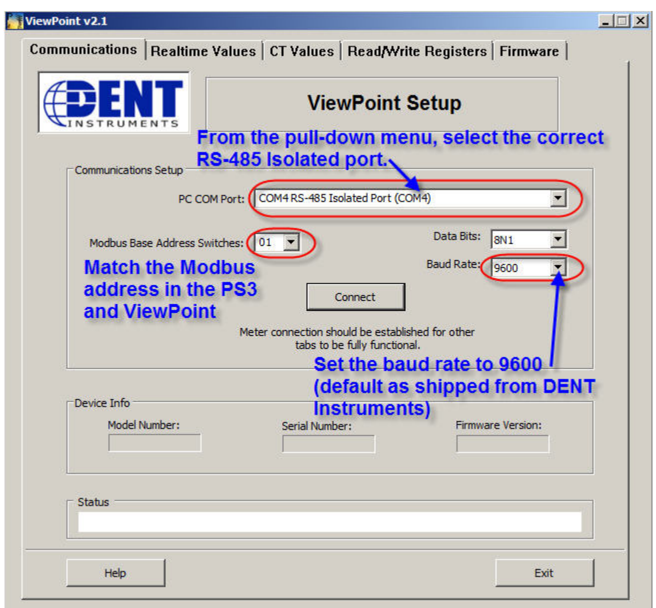
   The installer starts automatically. If it does not, browse to the CD and locate the ViewPointSetup.exe program. Start the installer by double-clicking ViewPointSetup.exe.

2. ViewPoint starts and displays the **Communications** tab that requires two values.
   **PC COM Port**: Using the drop-down menu select **RS-485 isolated COM Port**.
   If ViewPoint was installed first, it needs to be restarted following a RS485 driver installation. If a RS485 port does not appear in the drop-down menu, the RS-485 is not installed correctly.

   **Modbus Base Address Switches**: Contains a hexadecimal value that should match the switches on the PowerScout. This field is pre-configured with the default value of **01**, matching the factory's default switch settings on the PowerScout. If these two values match your current configuration, this completes the Modbus Base Address setting.

   The default settings are used for the two remaining fields: **Data Bits** is 8N1 and the **Baud Rate** is 9600.

> ***NOTE****: The RS-485 driver must be installed on your computer and power applied to the PowerScout.*




3. Next click the **Connect** button to establish a connection between the computer and the PowerScout.

   - When the PowerScout is in the process of connecting to the computer, the COM LED flashes briefly followed by a solid green.

- If the PowerScout 3 Plus cannot connect to the computer, the COM LED flashes red and returns to a solid green. Change the ViewPoint hardware settings and click **Connect** again.

4. ViewPoint fills the **Device Info** fields when the computer communicates with the PowerScout 3 Plus.

This completes the ViewPoint software installation and establishing a connection with the PowerScout 3 Plus. For more information on using ViewPoint, see Section IV: *ViewPoint Software*.

## COM – Communications LED

The PowerScout's COM LED that signals the following communication information.

| COM LED | Description |
|---|---|
| Steady ● | Power is applied to the PowerScout 3 Plus. |
| Flashing ● | PowerScout 3 Plus is communicating. |
| Steady ● | Communications failure. |
| Flashing ● | PowerScout 3 Plus is receiving communication on the bus for a PowerScout 3 Plus at another address. |

**Table III-1: COM LED Descriptions**

### Using ViewPoint

The PowerScout 3 Plus installation can be verified using ViewPoint. Refer to Section V, *Using the ViewPoint Software*, for more information.

# SECTION III.C: Field Installation – Modbus

**WARNING! REMOVE THE METER FROM ALL SOURCES OF VOLTAGE BEFORE MOUNTING.**

## Mounting the PowerScout™ 3 Plus

The PowerScout 3 Plus must be installed in an approved electrical panel or enclosure using proper installation practices according to the local electrical codes.

- To mount the PowerScout 3 Plus use the two tabs provided at each end of the case. Securely mount the PowerScout near a dedicated circuit disconnect breaker.

## Connecting the PowerScout 3 Plus

The PowerScout 3 Plus has the following connections:

- A three-wire connector for the Modbus link.
- Four voltage wire leads for connecting to voltage sources (L1, L2, L3, and Neutral). The PowerScout 3 Plus is self-powered from L1 and L2.
- Up to three current transducers (CTs).

### Completing the Wiring Connections – RS-485, Voltage Leads and CTs

***Note**: The PowerScout 3 Plus has an internal, non-user replaceable .5 Amp internal fuse protection.*

1. Connect the RS-485 adapter to the computer using the USB cable by inserting each white ferrule into the appropriate opening on the PowerScout 3 Plus. The red wire inserts in (+), the black wire in (-) and the green wire in (S).
2. Connect the CTs on the PowerScout 3 Plus connections labeled CT 1, CT 2 and CT 3. Place the CTs on the phase wires of the load to be monitored and corresponding to the phase of the voltage leads. The CT labeled CT 1 must be placed on L1 phase voltage wire, CT 2 must be on the L2 voltage and CT 3 on the L3 voltage. Refer to *PhaseChek*™ in Section III for information about the CT LEDs and verifying the CT installation.
3. Connect the PowerScout's 14 AWG THHN (or equivalent) wires, after a building-installed, dedicated circuit disconnect breaker, as close as possible to the breaker. Mark the breaker as the disconnect for the PowerScout 3 Plus. Refer to the wiring diagrams in this chapter for specifics of the wiring connections.

   Follow local electrical codes during this installation.

## Powering the PowerScout 3 Plus

The PowerScout 3 Plus is self-powered from the L1 and L2 lines. When 80 – 600VAC or DC is placed across the L1 and L2 wires, the three phasing LEDs begin to flash in sequence.

## PowerScout 3 Plus Single-Phase Connections

The PowerScout 3 Plus can be used to monitor single-phase loads. There are several guidelines to keep in mind about this type of connection:

1. The PowerScout 3 Plus is powered from a potential between L1 and L2. This can be phase-to-phase (230V) or phase-to-neutral (115V). With a single-phase 230V panel, the L1 and L2 voltage leads are connected between the L1 and L2 voltage sources. With a 115V circuit, the L1 voltage lead is connected to the L1 "hot lead," and the L2 voltage lead is connected to neutral.
2. Each CT must be paired with the correct voltage source. The current and voltage need to be in-phase for accurate measurements. For instance, CT 1 would monitor branch circuit supplied by voltage source L1, and so on.
3. The neutral must be connected because the PowerScout 3 Plus uses line-to-neutral measurements for all calculations.

On the US version of the PowerScout 3 Plus, the voltage leads are color coded: Black/L1, Red/L2, Blue/L3, and White/neutral. On international PowerScout 3 Plus instruments, the voltage leads are black and labeled L1, L2, L3, and N.

### A Typical 230V Single-Phase Panel Setup

Connect the Black L1 voltage lead to Voltage L1, Red L2 voltage lead to L2 voltage, White Neutral voltage lead to neutral. CT1 would monitor L1 loads and CT2 would monitor L2 loads. Based on the above guidelines, CT3 can be used if the Blue L3 voltage lead is connected to either L1 or L2. As long as voltage lead L3 and CT3 are in-phase, the PowerScout 3 Plus will provide correct kW readings. If the Blue L3 voltage lead was connected to L2 voltage source, then CT3 could monitor any L2 branch circuit. Or, if the Blue L3 voltage lead was connected to L1 voltage source, then CT3 could monitor any L1 branch circuit.

### A Typical 115V Single-Phase Panel Setup

Connect the Black L1 voltage lead to Voltage L1 (hot), Red L2 voltage lead to Neutral, and White N voltage lead to neutral. CT1 would monitor the L1 load. CT3 can be used if the Blue L3 voltage Lead is connected to L1. CT3 could then monitor any L1 branch circuit.

### System Values

System values are the sum of L1 + L2 + L3 measurements. System values may not be meaningful since two different devices or loads can be monitored by a single PowerScout 3 Plus element.

When paired with the right voltage phase, each CT provides individual kW/kWh readings for that CT channel.

## PhaseChek™

PhaseChek[1] is a unique feature of the PowerScout 3 Plus that simplifies installation by ensuring proper CT-to-phase installation and avoiding faulty data collection. The PowerScout 3 Plus automatically adjusts for CT orientation—reducing set-up time and nearly eliminating installation errors.

### Verifying the PowerScout 3 Plus Setup Using the LEDs

The PowerScout 3 Plus has three bi-color PhaseChek LEDs. These LEDs provide the following information:

- All LEDs are green — the system power factor is greater than 0.55 and the CTs are properly placed on the corresponding voltage phases.
- Any one LED is red — there is a phasing connection error.
- Two LEDs are red and one is green — two CTs are reversed.
- All three LEDs are red —all CTs are incorrectly connected.

> ***Note**: If the total system power factor is less than 0.55, the LEDs will be red even if connected properly. This situation is rare but could occur if, for example, the load to be monitored is a lightly loaded electric motor where it is common for the power factor to be less than 0.55 and the corresponding LEDs will be red.*

The following table describes the PhaseChek error conditions and the appropriate correction.

| L1 | L2 | L3 | Error Description | Correction |
|---|---|---|---|---|
| 🟢 | 🟢 | 🟢 | Setup is correct and the system power factor is greater than 0.55.<br>-or-<br>All CTs are disconnected. | Connect the CTs. |
| 🔴 | 🔴 | 🔴 | All CTs are incorrectly connected,<br>-or-<br>The system power factor is less than 0.55. | Rotate the CT connections by one position by move CT 1 to CT 2, CT 2 to CT3 and CT3 to CT1, until all LEDs are green.<br>The system power factor is less than 0.55 but the CTs are connected properly indicating a light load. |
| 🟢 | 🔴 | 🔴 | CT 2 and CT 3 are reversed. | Switch the position of the CTs flashing red. |
| 🔴 | 🔴 | 🟢 | CT 1 and CT 2 are reversed. | Switch the position of the CTs flashing red. |
| 🔴 | 🟢 | 🟢 | CT 1 is swapped with either CT 2 or CT 3. | Switch CT 1 with CT 2.<br>-or-<br>Switch CT 1 with CT 3. |
| 🟢 | 🔴 | 🟢 | CT 2 is swapped with either CT 1 or CT 3. | Switch CT 2 with CT 1.<br>-or-<br>Switch CT 2 with CT 3. |

[1] Patent No. 7,612,552. U.S. Patent and Trademark Office.

| L1 | L2 | L3 | Error Description | Correction |
|---|---|---|---|---|
| ● (green) | ● (green) | ● (red) | CT 3 is swapped with either CT 1 or CT 2. | Switch CT 3 with CT 1.<br>-or-<br>Switch CT 3 with CT 2. |
| ● (red) | ● (green) | ● (red) | CT 1 and CT 3 are reversed. | Switch the position of the CTs flashing red. |

**Table III-2: PhaseChek LED Error Resolution**

## Setting the Network Address Switches

There are two rotary network address switches on the PowerScout 3 Plus, labeled Upper and Lower. These two switches are used to select the Modbus address the client uses to communicate with the PowerScout.

The rotary switches are 16-position, hexadecimal switches. The default factory setting is hex 01. The network address is a hexadecimal (hex) value, represented by the digits 0 through 9 and letters A through F. For example, a Modbus address of 100 in decimal is converted to 64 hexadecimal and set on the PowerScout 3 Plus by:

1. Upper switch – select 6
2. Lower switch – select 4

| Hexadecimal Address | Address Availability |
|---|---|
| 00 | Reserved for resetting the PowerScout 3 Plus to Modbus mode with 9600 baud, 8 bit, 1 stop bit, and no parity. |
| 01-FE | Available (01 is the factory default setting). |
| FF | Reserved for the synchronize command. The rotary switches can be used to configure the communication protocol to BACnet 2004 or Modbus as well as changing the baud rate if unsure of the current settings. |

**Table III-3: Modbus Hexadecimal Address Availability**

### Establishing Communication (Modbus)

The PowerScout 3 Plus communicates with the RTU or data logger using the Modbus data protocol on a RS-485 hardware interface. To establish communication, the Modbus settings must meet the following requirements:

1. The Modbus address on the PowerScout 3 Plus and in the ViewPoint software must be set to the same value. Refer to Section III.D, *Using the ViewPoint Software* to set the Modbus address on the **Communications** tab and establish a connection.

2. The PowerScout's default serial parameters are:

| Parameter | Setting |
|---|---|
| Baud | 9600 |
| Data bits | 8 |
| Parity | None |
| Stop Bit | 1 |

**Table III-4: Communication Settings**

The supported baud rates include 9600, 19200, 38400, 57600 76800, and 115200.

3. The baud rate set in ViewPoint must match the PowerScout's setting. The baud rate can be changed from ViewPoint. If this setting is different, the PowerScout cannot communicate with ViewPoint.

## PowerScout 3 Plus Wiring Diagrams

The PowerScout 3 Plus can be wired using any one of the following five common wiring setups. These diagrams will assist you in properly connecting your PowerScout for the setup desired. ALL WIRE COLORS ARE U.S. STANDARD.

**WARNING! DO NOT EXCEED 600Vac PHASE TO PHASE CAT III.**

When complete, close the enclosure cover, if equipped.

**Attention: NE PAS DEPASSER UNE PHASE A 600VAC CAT III.**

Une fois terminé, fermer le covercle, s'il y en a un.

**CAUTION:** THE POWERSCOUT™ 3 Plus SHOULD ONLY BE WIRED BY QUALIFIED PERSONNEL. HAZARDOUS VOLTAGES EXIST.

**ATTENTION:** LE POWERSCOUT ™ 3 PLUS NE DOIT ETRE BRANCHE QUE PAR UN PERSONNEL QUALIFIE. TENSIONS DANGEREUSES SONT PRÉSENTES.

**DANGER! THE UNENCLOSED POWERSCOUT BOARD REQUIRES EXTRA CAUTION WHEN CONNECTING. LIFE THREATENING VOLTAGES EXCEEDING 600 VOLTS MAY EXIST ON THE BOARD. THE RISK OF SERIOUS INJURY OR DEATH SHOULD NOT BE UNDERESTIMATED.**

**DANGER! LA PLAQUETTE DE CIRCUITS IMPRIMES SANS COUVERCLE EXIGE UN REDOUBLEMENT DE PRUDENCE QUAND ON FAIT LA CONNEXION. LES TENSIONS DEPASSANT 600 VOLTS PEUVENT EXISTER SUR LA PLAQUETTE ET PEUVENT METTRE LA VIE EN DANGER. LE RISQUE DE BLESSURES GRAVES OU DE MORT NE DOIT PAS ETRE SOUS-ESTIME.**

**Figure IV-1: Single Phase, Two Wire**

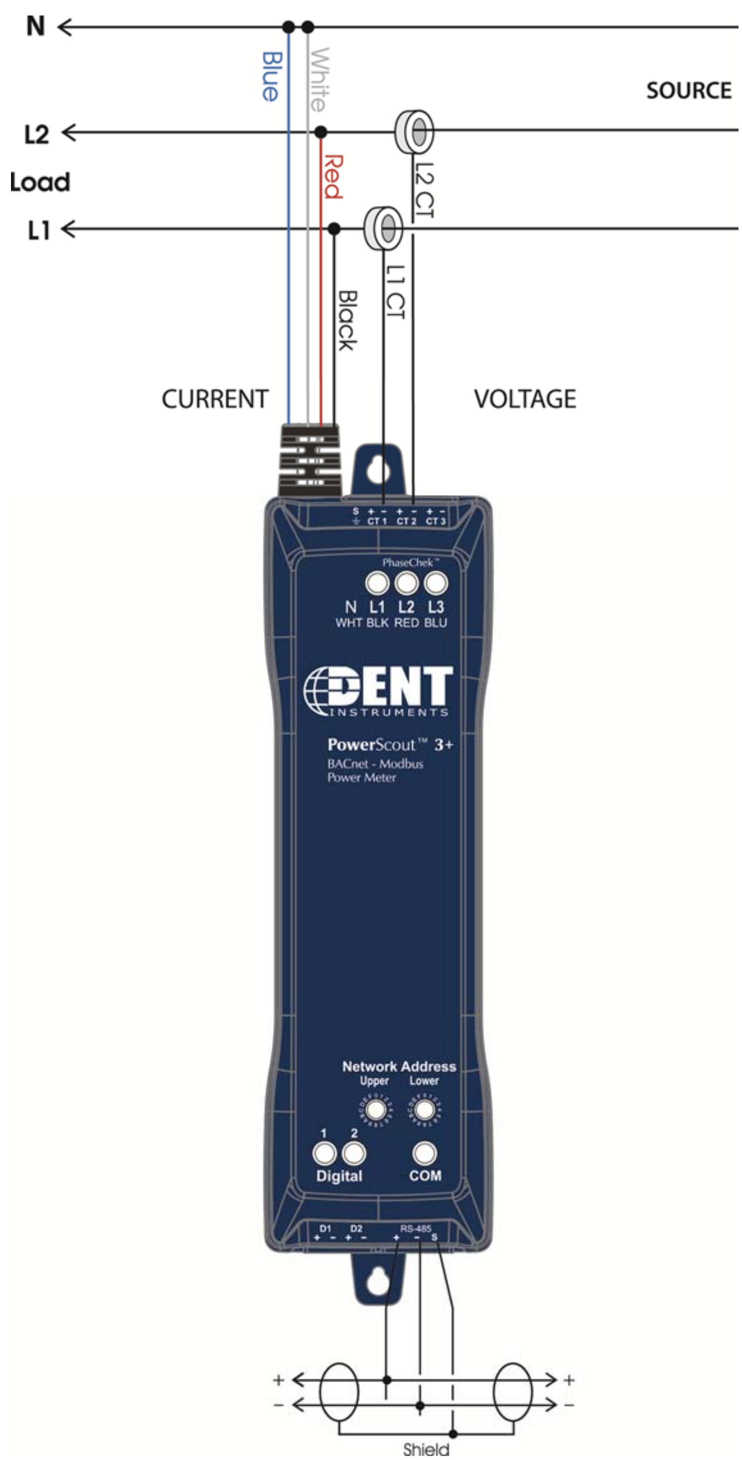

N = white

L1 = black

L2 = red

L3 = blue

**Figure IV-2: Single Phase, Three Wire**



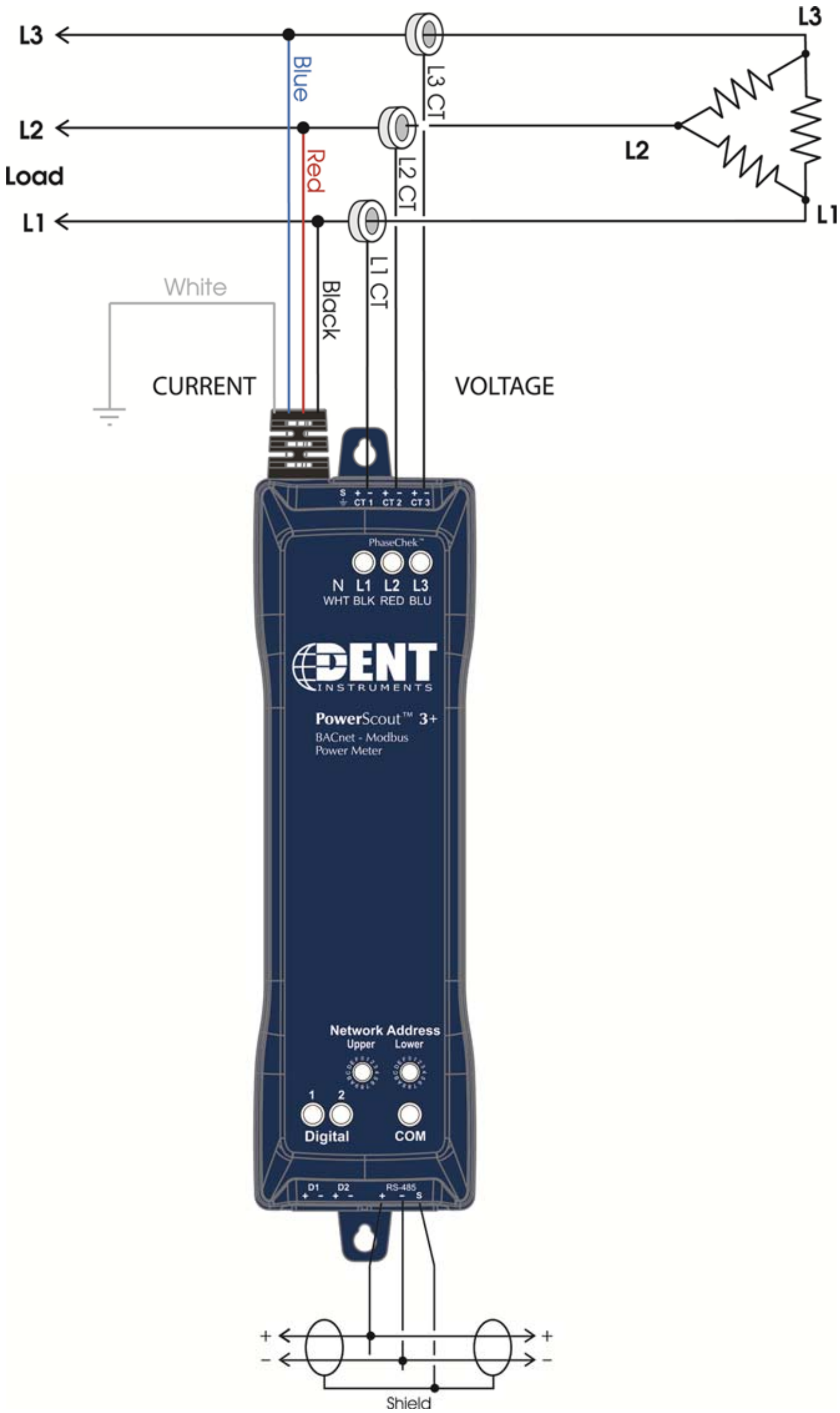

N = white

L1 = black

L2 = red

L3 = blue

**Figure IV-3: Three Phase, Three Wire Delta**



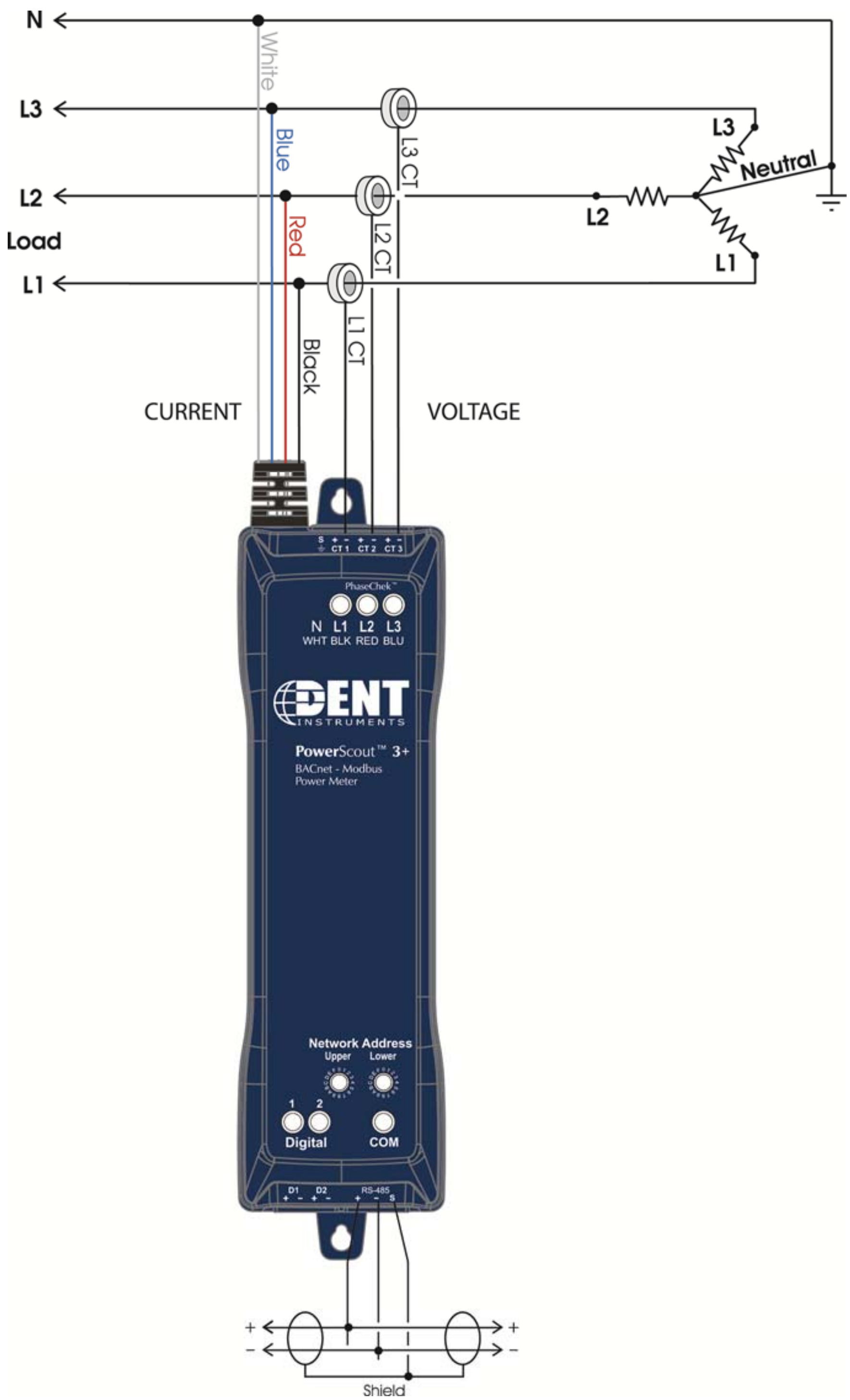

N = white

L1 = black

L2 = red

L3 = blue

**Figure IV-4: Three Phase, Four Wire Wye**



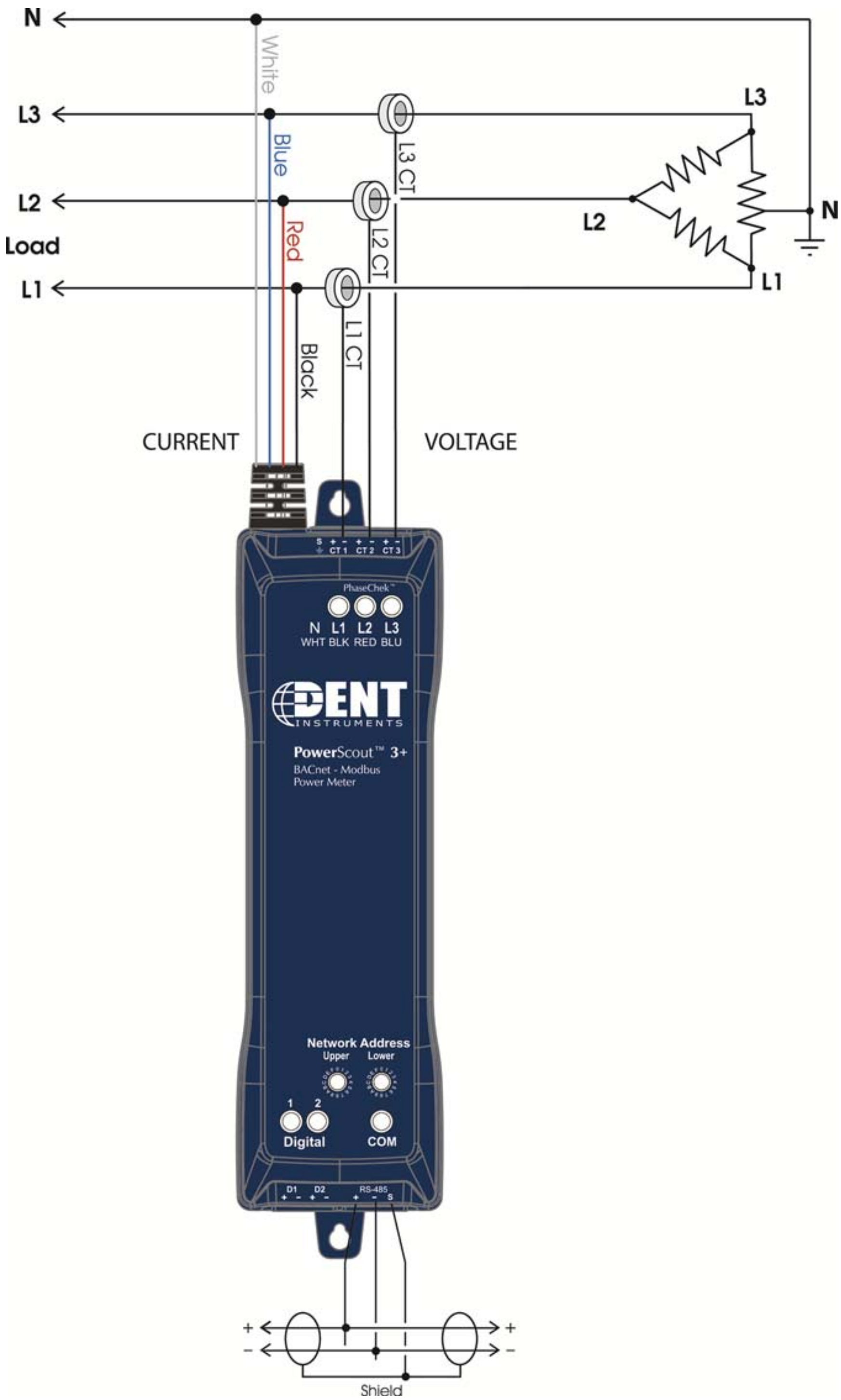

N = white

L1 = black

L2 = red

**L3 = blue**

**Figure IV-5: Three Phase, Four Wire Delta**




N = white

L1 = black

L2 = red

L3 = blue

# SECTION III.D: Using the ViewPoint™ Software (Modbus only)

*For ViewPoint 2.1 and Later*

## Overview of the ViewPoint Screens

ViewPoint has five screens accessed by tabs. Click each tab to display the screen.

### Communications

The **Communications** screen provides the setup parameters that allow ViewPoint to communicate with the PowerScout™ 3 Plus.

**PC COM Port** – Enter the port on the computer connected to the PowerScout 3 Plus. The field populates using the addresses entered to function as a drop-down menu.

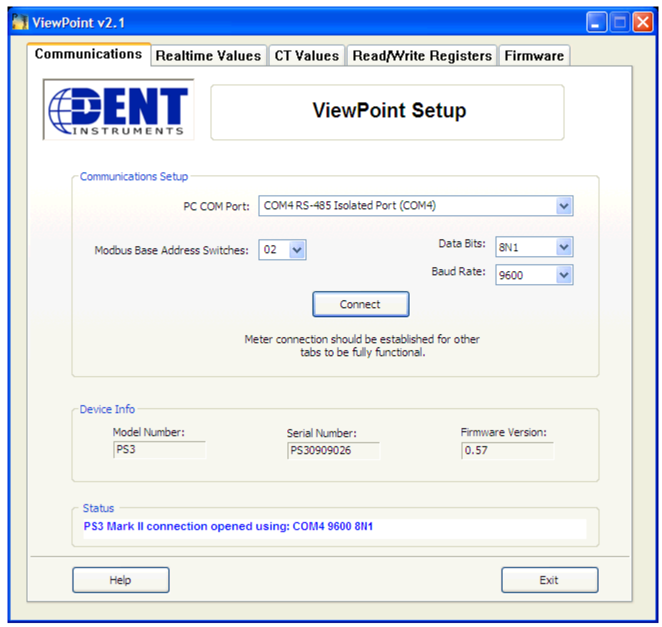
**Modbus Base Address Switches** – Enter the Modbus address set on the PowerScout's upper and lower Modbus address switches. Available are Modbus addresses from 01 (hex 01) to 254 (hex FE). The 00 setting is reserved for factory use.

**Data Bits** – Default setting is 8N1.

**Baud Rate** – Default setting 9600.

Click the **Connect** button to connect ViewPoint with the PowerScout. The **Device Info** section of the screen displays the **Model Number**, **Serial Number** and **Firmware Version** of the PowerScout.

The **Status** window displays communication messages.




### Communication Error

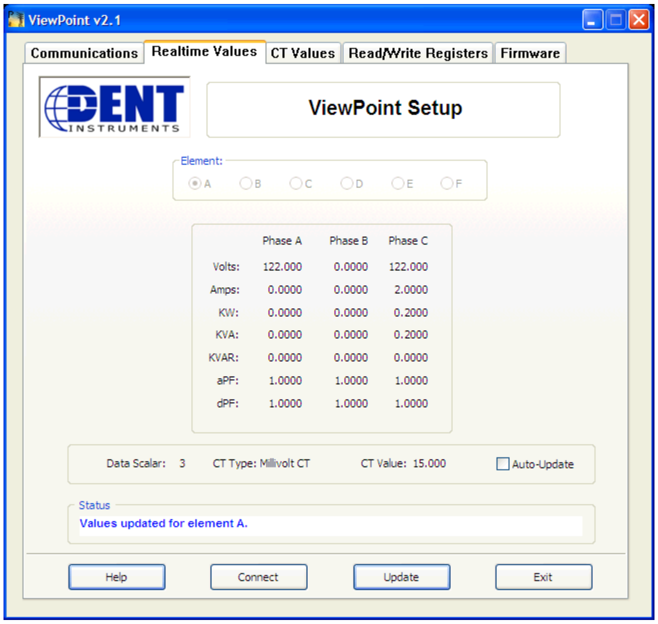
If ViewPoint is unable to communicate with the PowerScout, the **Status** window displays with the message "Error communicating with meter. Check settings and meter switches." To resolve this communications error, try the following:

- No RS-485 option available in the **PC COM Port** drop-down menu - This indicates the PowerScout is not properly connected or the required software driver is not installed.
- **Modbus Base Address Switch** does not match the selected upper and lower switch settings on the PowerScout.
- The selected Baud Rate does not match the PowerScout's baud rate.

For more information, refer to the Appendix *Troubleshooting Communication Issues*.

## Real-time Values

The **Real-time Values** screen displays the current readings for verifying the system is configured properly.




**Element** – The PowerScout 3 Plus is a single meter and cannot be changed from Element A.

The table in the middle section of the screen displays the **Phase A**, **Phase B** and **Phase C** for the real-time values of Volts, Amps, KW and others for Phase A, Phase B and Phase C.

You may view, in real time, values such as **Volts**, **Amps** and **KW**. This screen also displays the current Data Scalar Value, the CT Type connected to the PowerScout 3 Plus and CT Value.

**Data Scalar** – A scalar is used to multiply the raw data value to convert information read from the Modbus registers. Refer to Table III-1 for a list of values. Example: If the scalar value in register 44602 is set to 3 and the total true power for the system (kW) is read from Modbus register 44003 (Offset 4002) and a value of 3465 is returned, the true system kW is:

3465 X 0.1 = 346.5 kW

**CT Type** – Displays the CT selected on the **CT Values** screen. This needs to match the CT connected to the PowerScout.

**CT Amperage Rating** – Displays the amperage rating entered on the **CT Values** screen.

**Auto Update** – Select the checkbox to automatically update approximately every 15 seconds.

**Update** button retrieves the values from the PowerScout 3 Plus.
The **Status** window displays communication messages.

## CT Values

The **CT Values** screen allows the type of current transformer (CT) and the amperage rating to be changed.

**Set** – Select the checkbox to send the settings to the meter.

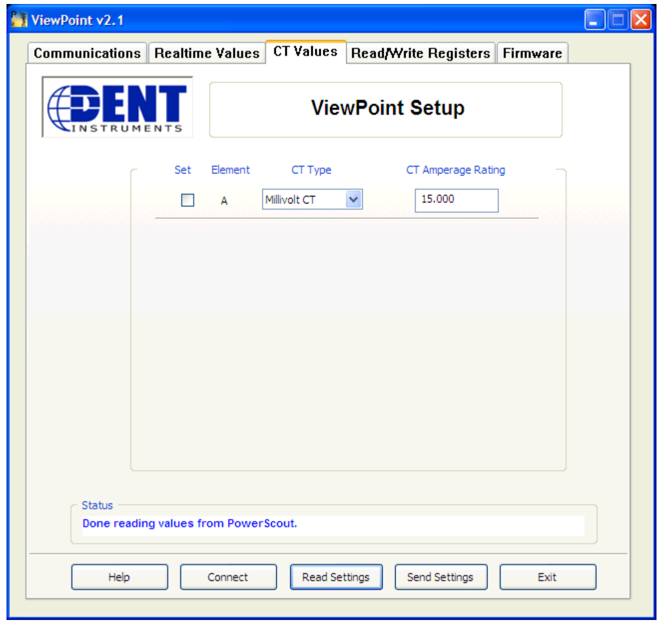
**Element** – Indicator for the meter to send settings to. The PowerScout 3 Plus is a single meter so only Element A is available.

**CT Type** – Use the drop-down menu to select the type of CT attached to the PowerScout.

**CT Amperage Rating** – Enter the amperage rating.

**Read Settings** button – Reads the values from the PowerScout.

**Send Settings** button – Sends the settings specified in ViewPoint to the meter with the Set checkbox selected.



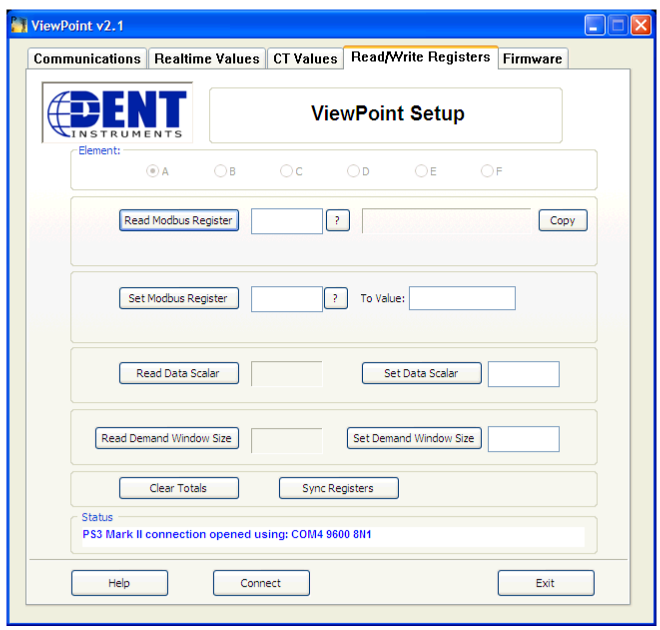

## Read/Write Registers

The **Read/Write Registers** screen provides diagnostic and special configuration options, allowing the changing or viewing of the value of any PowerScout registers. Its use is not required for a basic setup.

**Element** - The PowerScout 3 Plus is a single meter and cannot be changed from Element A.

**Read Modbus Register** - Reads a specified Modbus register by typing the register address in the box and pressing the button. Use the **Copy** button to copy the register address to the box next to the **Set Modbus Register** button. The **?** button provides a list of common registers. Refer to the **Register Picker** menu below.

**Set Modbus Register** – Enter a register address to write to. In the **To Value** box, type the value to write to the register address. The **?** button provides a list of common registers.



**Read Data Scalar** – Retrieves the PowerScout's data scalar setting. For more information about Data Scaling, see *Interpreting the PowerScout Registers—Data Scaling* section of this manual.

**Set Data Scalar** – Sends the data scalar setting to the PowerScout.

**Read Demand Window Size** – Read the demand window size setting on the PowerScout.

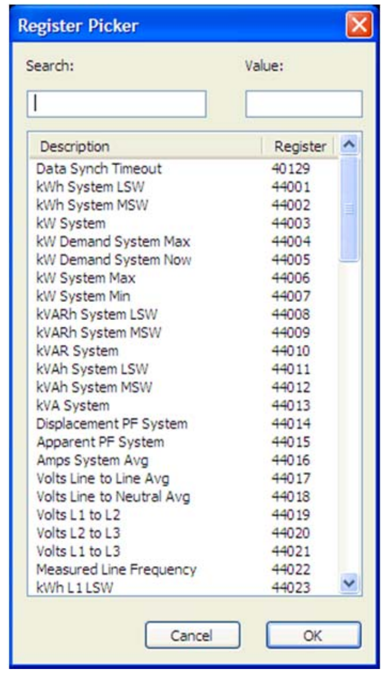
**Set Demand Window Size** – Set the demand window size. The window can be between 1 and 60 minutes.

**Clear Totals** – Clears accumulated data.

**Sync Registers** – Locks all register readings for a maximum of one hour. Data is still continuously collected in the background.

The final section states the status of the logger.

Refer to Appendix E for a list of Modbus registers and their descriptions.




## Firmware

The **Firmware** screen verifies the current firmware version and updates the PowerScout 3 internal firmware.

**Element** - The PowerScout 3 Plus is a single meter and cannot be changed from Element A.

**Firmware Update File** – The file containing the new firmware version can be entered using the box or located with the **Browse** button.

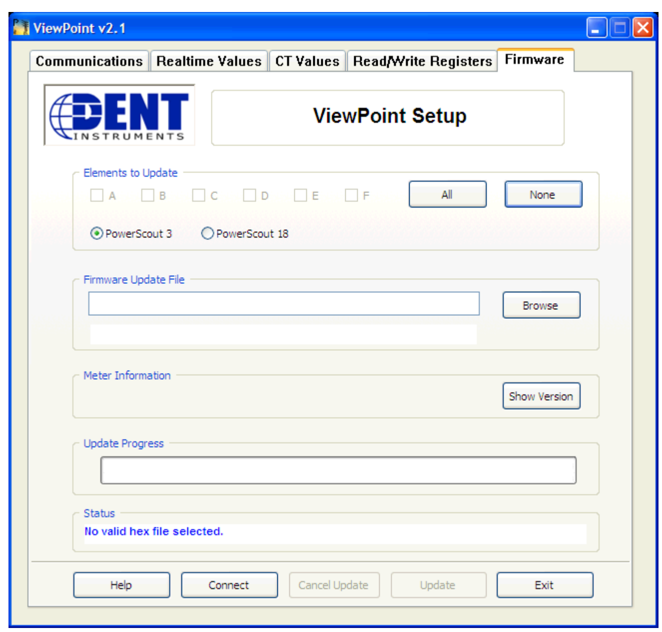
**Meter Information** – To verify the current firmware version of the PowerScout Plus, click the **Show Version** button. The firmware version information displays.

**Update Progress** – Displays the installation progress of the new firmware version.

**Status** - Provides the status of the meter.

**Cancel Update** button – Cancels a firmware update while it is in progress.

**Update** button – Starts the firmware update.



## ViewPoint Buttons

The ViewPoint screens include a row of buttons at the bottom. The available buttons vary depending on the current screen.

**Cancel Update**– Cancels a firmware update while it is in progress.

**Connect** – Establishes a connection between ViewPoint and the PowerScout 3 Plus. If a connection is not established, a message displays in the **Status** window.

**Help** – Displays the help information for the current screen. The help information uses a web browser to display the information for the current screen.

**Exit** – Closes the ViewPoint software.

**Read Settings** – Reads the current values from the PowerScout 3 Plus.

**Send Settings** – Sends new settings set in the ViewPoint screen to the PowerScout 3 Plus.

**Update** – On the **Real-time Values** screen, the **Update** button retrieves the values from the PowerScout 3 Plus. On the **Firmware** screen, the **Update** button starts the installation of the new firmware.

## Communication and Status Messages

Refer to Appendix D, *Troubleshooting Communication Issues*.

## Using ViewPoint to Verify Setup

ViewPoint can be used to verify the connection setup of the PowerScout 3 Plus.

1. Start the ViewPoint software.
2. Select the PowerScout 3 Plus settings on the **Communications** screen and click the **Connect** button. The Status window displays the message "PS3 Mark II connection opened using: COM4 9600 8N1", when communication is established.
3. Click the **Real-time Values** tab and click the **Update** button.

   The table in the middle of the screen updates. The values display for Volts, Amps, KW, etc., and should make sense, meaning the values in the table are relevant for the service being measured. This indicates the PowerScout 3 Plus is verified.

> ***Note**: The status message displays the communication parameters specific to the setup.*

It may also be useful to use a handheld amp meter to test the current and compare its readings to the values provided on the **Real-time Values** screen in ViewPoint.

# SECTION III.E: Other Functions – Modbus

## Resetting Modbus Registers

Many of the PowerScout™ 3 Plus registers are real-time values such as instantaneous watts or power factor. However, some registers are accumulated values such as kWh, kVARh, kVAh and various Peak Demand (kW) values.

Accumulating registers can be reset using the ViewPoint™ **Read/Write Registers** screen.

1. In the data entry box next to the **Set Modbus Register** button, enter or select 44066. This is Modbus register, Reset Acc Measurements.
2. In the **To Value** box type 1234.
3. Click the **Set Modbus Register** button. The accumulating registers are reset to 0.

The tables in Appendix E list all of the data registers available on the PowerScout. Note that following the Modbus protocol, the actual register address requested is offset from the base Modbus register by 40001.

## Data Scaling – Interpreting the PowerScout 3 Plus Registers

The use of Modbus protocols limits the data registers to a maximum of two bytes (16 bits) or a maximum decimal value of 65535. Modbus requires that the data be unsigned (positive) integer values. To overcome these limitations some measured (and stored) values must be *scaled* to fit into the Modbus registers. The raw value read from the Modbus registers is multiplied by a scalar to convert the raw data. The following table lists the data scalars and the respective values for the PowerScout.

| Data Scalar | Scalar Value | | | | | |
|---|---|---|---|---|---|---|
| | kW/kWh Demand | kVAR/kVARh | kVA/kVAh | Power Factor | Amps | Volts |
| 0 | .00001 | .00001 | .00001 | .01 | .01 | .1 |
| 1 | .001 | .001 | .001 | .01 | .1 | .1 |
| 2 | .01 | .01 | .01 | .01 | .1 | .1 |
| 3 | .1 | .1 | .1 | .01 | .1 | .1 |
| 4 | 1 | 1 | 1 | .01 | 1 | 1 |
| 5 | 10 | 10 | 10 | .01 | 1 | 1 |
| ≥6 | 100 | 100 | 100 | .01 | 1 | 1 |

**Table III-5: Data Scalars and Values for Registers 44001 thru 44061**

The data scalar is stored in register 44602.

When selecting a data scalar, the following guidelines need to be considered:

- If the data scalar selected is too low, an incorrect data result is returned from the register.
- If the data scalar selected is too high, the significant digits following the decimal point are removed.

After selecting a data scalar, the formula for calculating the actual value is:

> ***NOTE***: *The register value must be less than 65,535.*

*register value* X *scalar value = actual value*

Or, another way to state this formula is:

*actual value/scalar value = register value*

### Selecting a Scalar

The following table is an example when selecting a data scalar for 3-phase loads based on the CT size or maximum current. These are the minimum recommended scalar settings.

| CT Size or Max. Current | 3-phase Loads | |
|---|---|---|
| | **230 volts** | **460 volts** |
| 50 | Scalar 1 | Scalar 2 |
| 100 | Scalar 2 | Scalar 2 |
| 200 | Scalar 2 | Scalar 2 |
| 400 | Scalar 2 | Scalar 2 |
| 600 | Scalar 2 | Scalar 3 |
| 1000 | Scalar 3 | Scalar 3 |
| 3000 | Scalar 3 | Scalar 3 |

**Table III-6: Data Scalar Selection**

### Examples Using a Data Scalar

The following examples use kW throughout.

For example 1, the following data is used:

Volts x amps = watts        480 volts x 100 amps = 48,000 watts

Watts x 3 = system watts        48,000 watts x 3 = 144,000 watts (144kW)

Check the register's value using the data scalar 2 value of .01:

System kW / scalar value = register value        144kW/.01 = 14,400

Since 14,400 is less than 65,535, using data scalar 2 is a good choice for this example.

For example 2, the following data is used:

480 volts x 1000 amps = 480,000 watts

480,000 watts x 3 = 1,440,000 watts (1,440kW)

Check the register's value using the data scalar 1 value of .001:

1,440kW/.001 = 1,440,000

Since 1,440,000 is greater than 65,535, using data scalar 1 returns an incorrect result. Data scalar 1 is not an appropriate choice.

Reviewing this example using the data scalar 3 value of .1 provides the following result:

1,440kW/.1 = 14,400

Since 14,400 is less than 65,535, using data scalar 3 is a good choice for this example.

### Values Requiring Two Registers

Additionally, some values (e.g., kilowatt hours) may cover a dynamic range that is larger than 65535 and require two Modbus registers. Any parameter in the Modbus Register Assignment tables, in Appendix D, that shows two registers (identified by the terms MSW (Most Significant Word) and LSW (Least Significant Word)) are examples of this wide-ranging parameter.

To interpret the values contained in these registers, the steps are:

1. Multiply the MSW register by 65536.
2. Add the result to the value found in the corresponding LSW register.
3. Multiply the result by the appropriate scalar value from Table IV-1.

> ***TECH TIP****: When reading two register values, ViewPoint automatically calculates the total value.*

For example, assume that System Total True Energy (kWh) is desired and the value of 5013 is read from register 44001 (LSW) and 13 is read from register 44002 (MSW) and that the register 44602 data scalar is set to 3.

To calculate the total kWh recorded:

Multiply the MSW by 65536: 13 X 65536 = 851968

Add the LSW: 851968 + 5013 = 856981

Multiply by the scalar 3 value of 0.1: 856981 X 0.1 = 85698.1 kWh

## Pulse Output Port Function

The PowerScout 3 Plus has two configurable output ports. The ports can be used to output kWh, kVARh, or kVAh pulses to external devices, or to toggle on and off to control a remote device or relay.

### Pulse Output

Pulse output is used to generate pulses for external devices such as data loggers that can accept pulses but do not have Modbus capability. The PowerScout 3 Plus can generate pulses based on accumulated value(s) such as system kWh, system kVARh, and system kVAh. When a pulse is generated by the PowerScout, the orange and LED for that output will briefly flash, otherwise they will remain dark.

The pulse output is scaled by the same data scalar register (44602) as are the Modbus registers. For example, when the data scalar is set to 3, each pulse will represent .1 kWh, .1kVAh and .1kVARh.

For system pulse output:

kWh pulse output – write 44001 into the Digital Port Configuration register.

kVAh pulse output – write 44011 into the Digital Port Configuration register.

kVARh pulse output – write 44008 into the Digital Port Configuration register.

### Output Port Registers

Refer to the following two tables to configure the PowerScout's two digital output ports.

| Modbus Register | Offset | Register Name | Detailed Description |
|---|---|---|---|
| 44402 | 4401 | Port 1 output control when used as an on/off - open/closed switch | 0 = output LOW (closed)<br>1 = output HIGH (open) [default]<br>Register 45110 must = 0 to use |
| 45110 | 5109 | Digital Port 1 Configuration<br>Turns pulses on/off | 0 = No pulses, Port may be used as an on/off – open/closed switch<br>44001 = System kWh pulses<br>44008 = System kVAh pulses<br>44011 = System kVARh pulses |
| 45111 | 5110 | Port 1 pulse output relay type | 0 = normally open (HIGH)<br>1 = normally closed (LOW) |

**Table III-7: Digital Port 1 Pulse Output**

| Modbus Register | Offset | Register Name | Detailed Description |
|---|---|---|---|
| 44403 | 4402 | Port 2 output control when used as an on/off - open/closed switch | 0 = output LOW (closed)<br>1 = output HIGH (open) [default]<br>Register 45210 must = 0 to use |
| 45210 | 5209 | Digital Port 2 Configuration<br>Turns pulses on/off | 0 = No pulses, Port may be used as an on/off – open/closed switch<br>44001 = System kWh pulses<br>44008 = System kVAh pulses<br>44011 = System kVARh pulses |
| 45211 | 5210 | Port 2 pulse output relay type | 0 = normally open (HIGH)<br>1 = normally closed (LOW) |

**Table III-8: Digital Port 2 Pulse Output**

## Lock/Synchronize Function

Multiple PowerScout 3 Plus meters can be installed on a single Modbus network. A snapshot of the power or voltage can be obtained simultaneously for meters on a network. Usually, the RTU reads the values from each meter sequentially, thus readings from meters can vary by several seconds.

The Lock/Synchronize function allows reading from multiple meters at the same time. To use this function, a write command is sent to all meters using a common broadcast Modbus address, FF. All meters on the network receive the command simultaneously. This freezes, or locks the current readings into the Modbus registers. Now the RTU can take read each register, one after another, knowing the retrieved values were recorded just before the lock command was sent by the RTU. The command contains the number of seconds, timeout, needed to read from the meters.

***Note****: During the lock period, no data is lost. The meter continues to gather and record data during the timeout. The values are held in internal memory. At the end of the lock period, these values are moved into the appropriate Modbus register, ensuring no energy measurements are lost during synchronization.*

### Using the Lock/Synchronize Command

1. Send a standard write command for register 40129 (offset 128) with a data value that includes the number of seconds to remain locked, also known as the timeout value. The maximum timeout value is one hour (3600 seconds).
   If the provided timeout value is longer than needed, it can be canceled once all the registers are read.
2. Read all the registers needed for the snapshot.
3. Wait until the number of requested seconds has passed or send another write command to register 40129 (offset 128) with a value of zero which cancels the lock. Now the meters begin updating.

Note: For decimal-based equipment refer to Appendix A for a hexadecimal conversion table.

## Connecting to a Modbus Network

This section describes setting up a Modbus network with multiple PowerScouts using the Modbus serial communication protocol. A network can support up to 254 PowerScout 3 Plus instruments.

### Modbus Communication Protocol

Modbus is a standard communications protocol that allows for communication between a Modbus master and multiple devices connected to the same network. RS-485 is the protocol standard used by the PowerScout 3 Plus as the hardware's serial interface while Modbus is the communication protocol.

### Daisy Chain Layout for RS-485 Network

When multiple devices are connected to a single Modbus master device, the multiple devices need to be connected in a daisy chain. A daisy chain means that all plus (+) connections are chained together and all minus (-) connections are chained together across the network.

A Modbus network containing multiple devices requires a unique address for each device. This allows the master device to identify and communicate with each slave. The Modbus network administrator must assign an unique Modbus address to each PowerScout 3 Plus.

Other network layouts are not recommended when using the RS-485 standard.

### Networking Using the Modbus Option

1. Install the Modbus cable.
2. Set a unique Modbus address for each device using the table in Appendix A. Locate the number of the slave device in the "Decimal" column. Move right to the "Hex" column to find the converted address value of this device. For example, for device 1, the upper Modbus address switch is set to 0, the lower Modbus address switch is set to 1.

## SECTION III.F: Appendices – Modbus

## Modbus Appendix A – VERIS H8035/H8036 Emulation

The PowerScout™ 3 Plus meter can be used as a direct replacement for the Veris, Inc. H8035/H8036 series of networked power meters. This mirroring of the Veris Modbus register assignments makes replacement with a PowerScout 3 Plus simple. However, because the number of parameters that the Veris meters measure is less than half of what the PowerScout 3 Plus can measure, the other Modbus registers described in the table need to be used to utilize the additional capabilities of the PowerScout 3 Plus.

Writing a 1 to register 44526 sets the Slave ID to Veris mode and ViewPoint™ lists the Veris registers in the ViewPoint **Read/Write Registers** tab.

When register 44526 contains a 1 for Veris mode, the Slave ID command format is:

91hFFh(Veris type), Full-Data, Modbus, (CT value) Amp

The following is an example command with CT set for 100A:

91hFFhVeris H8036-0100-2, Full-Data, Modbus, 100 Amp

Example command explanation:

- 91h = version control
- FFh = standard for active

The 91h and FFh are 4 bytes in front of the string that are not displayed in the RTU.

| CT Amperage Rating | Veris Model Number |
|---|---|
| CT ≤ 100A | Veris Type = H8036-0100-2<br>CT Value = 100A |
| 100A < CT ≤ 300A | Veris Type = H8036-0300-2<br>CT Value = 300A |
| 300A < CT ≤ 400A | Veris Type = H8036-0400-3<br>CT Value = 400A |
| 400A < CT ≤ 800A | Veris Type = H8036-0800-3<br>CT Value = 800A |
| 800A < CT ≤ 1600A | Veris Type = H8036-1600-4<br>CT Value = 1600A |
| CT >1600A | Veris Type = H8036-2400-4<br>CT Value = 2400A |

**Table B-1: CT Amp Rating to Veris Models**

| Modbus Register | Offset | ViewPoint Name | Description |
|---|---|---|---|
| 40001 | 0 | kWh System LSW | System True Energy (kWh, Resettable) |
| 40002 | 1 | kWh System MSW | System True Energy (kWh, Resettable) |

| Modbus Register | Offset | ViewPoint Name | Description |
|---|---|---|---|
| 40003 | 2 | kW System | System True Power (kW) |
| 40004 | 3 | kVAR System | System Reactive Power (kVAR) |
| 40005 | 4 | kVA System | System Apparent Power (kVA) |
| 40006 | 5 | Apparent PF System | System Apparent Power Factor (PF) |
| 40007 | 6 | Volts Line to Line Avg | Average Line to Line Voltage |
| 40008 | 7 | Volts Line to Neutral Avg | Average Line to Neutral Voltage |
| 40009 | 8 | Amps System Avg | Average current of all phases |
| 40010 | 9 | kW L1 | Individual Phase True Powers (kW, 3 values) |
| 40011 | 10 | kW L2 | " |
| 40012 | 11 | kW L3 | " |
| 40013 | 12 | Apparent PF L1 | Individual Phase Apparent Power Factors (PF, 3 values) |
| 40014 | 13 | Apparent PF L2 | " |
| 40015 | 14 | Apparent PF L3 | " |
| 40016 | 15 | Volts L1 to L2 | Individual Phase to Phase Voltages (Volts, Delta, 3 values) |
| 40017 | 16 | Volts L2 to L3 | " |
| 40018 | 17 | Volts L1 to L3 | " |
| 40019 | 18 | Volts L1 to Neutral | Individual Phase to Neutral Voltages (Volts, Wye, 3 values) |
| 40020 | 19 | Volts L2 to Neutral | " |
| 40021 | 20 | Volts L3 to Neutral | " |
| 40022 | 21 | Amps L1 | Individual Phase Currents (Amps, 3 values) |
| 40023 | 22 | Amps L2 | " |
| 40024 | 23 | Amps L3 | " |
| 40025 | 24 | kW System Avg | Equals KWH_SYSTEM_L&M ÷ (TimeSinceReset_L&M seconds /3600 seconds/Hr) (resettable) |
| 40026 | 25 | kW Demand System Min | System Minimum Demand (kW, resettable), It displays the default value after a CAM until 1 demand window elapses. After a power cycle or CPU reset the value is not reset but it does not update again until 1 demand window elapses. |
| 40027 | 26 | kW Demand System Max | System Max Demand (kW, resettable). Behaves as 40026. |

**Table B-2: ViewPoint Register Descriptions**

| Address | Units | ≤ 100A | 101 – 400A | 401 – 800A | 801 – 1600A | 1601 – 32,000A |
|---|---|---|---|---|---|---|
| 40001 | kWH LSB | 7.8125exp-3 | 0.03125 | 0.0625 | 0.125 | 0.25 |
| 40002 | kWH MSB | 512 | 2048 | 4096 | 8192 | 16384 |
| 40003 | kW | 0.004 | 0.016 | 0.032 | 0.064 | 0.128 |
| 40004 | kVAR | 0.004 | 0.016 | 0.032 | 0.064 | 0.128 |

| Address | Units | ≤ 100A | 101 – 400A | 401 – 800A | 801 – 1600A | 1601 – 32,000A |
|---|---|---|---|---|---|---|
| 40005 | kVA | 0.004 | 0.016 | 0.032 | 0.064 | 0.128 |
| 40006 | aPF | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 |
| 40007 | VOLTS L-L | 0.03125 | 0.03125 | 0.03125 | 0.03125 | 0.03125 |
| 40008 | VOLTS L-L | 0.015625 | 0.015625 | 0.015625 | 0.015625 | 0.015625 |
| 40009 | AMPS | 3.9063exp-3 | 0.015625 | 0.03125 | 0.0625 | 0.125 |
| 40010 | kW L1 | 0.001 | 0.004 | 0.008 | 0.016 | 0.032 |
| 40011 | kW L2 | 0.001 | 0.004 | 0.008 | 0.016 | 0.032 |
| 40012 | kW L3 | 0.001 | 0.004 | 0.008 | 0.016 | 0.032 |
| 40013 | aPF L1 | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 |
| 40014 | aPF L2 | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 |
| 40015 | aPF L3 | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 | 3.0518exp-5 |
| 40016 | VOLTS L1-L2 | 0.03125 | 0.03125 | 0.03125 | 0.03125 | 0.03125 |
| 40017 | VOLTS L2-L3 | 0.03125 | 0.03125 | 0.03125 | 0.03125 | 0.03125 |
| 40018 | VOLTS L3-L1 | 0.03125 | 0.03125 | 0.03125 | 0.03125 | 0.03125 |
| 40019 | VOLTS L1-N | 0.015625 | 0.015625 | 0.015625 | 0.015625 | 0.015625 |
| 40020 | VOLTS L2- N | 0.015625 | 0.015625 | 0.015625 | 0.015625 | 0.015625 |
| 40021 | VOLTS L3- N | 0.015625 | 0.015625 | 0.015625 | 0.015625 | 0.015625 |
| 40022 | AMPS L1 | 3.9063exp-3 | 0.015625 | 0.03125 | 0.0625 | 0.125 |
| 40023 | AMPS L2 | 3.9063exp-3 | 0.015625 | 0.03125 | 0.0625 | 0.125 |
| 40024 | AMPS L3 | 3.9063exp-3 | 0.015625 | 0.03125 | 0.0625 | 0.125 |
| 40025 | kW | 0.004 | 0.016 | 0.032 | 0.064 | 0.128 |
| 40026 | kW | 0.004 | 0.016 | 0.032 | 0.064 | 0.128 |
| 40027 | kW | 0.004 | 0.016 | 0.032 | 0.064 | 0.128 |

**Table B-3: Veris Multipliers for Integer Registers 40001-40027**

Per the Veris implementation, to obtain true engineering units, the values returned from the registers in Table B-2 must be multiplied by the scaling values listed in Table B-3.

For example, if the PowerScout 3 Plus has 100A CTs connected to it, the system reactive power (kVAR) is calculated by:

- Read register 40004
- Multiply the value returned from register 40004 by 0.004

## Modbus Appendix B – Installing Firmware Updates for the PowerScout™ 3 Plus

PowerScout 3 Plus firmware updates are available from DENT Instruments, typically contained in a zip file that can be downloaded, unzipped and installed using ViewPoint ™. The PowerScout 3 Plus requires ViewPoint 2.1 or later.

> ***NOTE**: The PowerScout 3 Plus must be in Modbus mode before firmware can be updated.*

Contact DENT Instruments to obtain access to a firmware update at:

Phone: 541-388-4774 or 1-800-388-0770

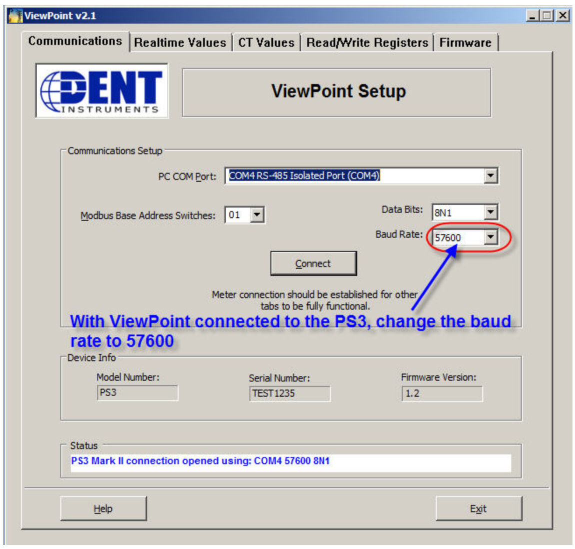
Email: info@DENTinstruments.com

A username and password obtained from DENT Instruments is required to download firmware.

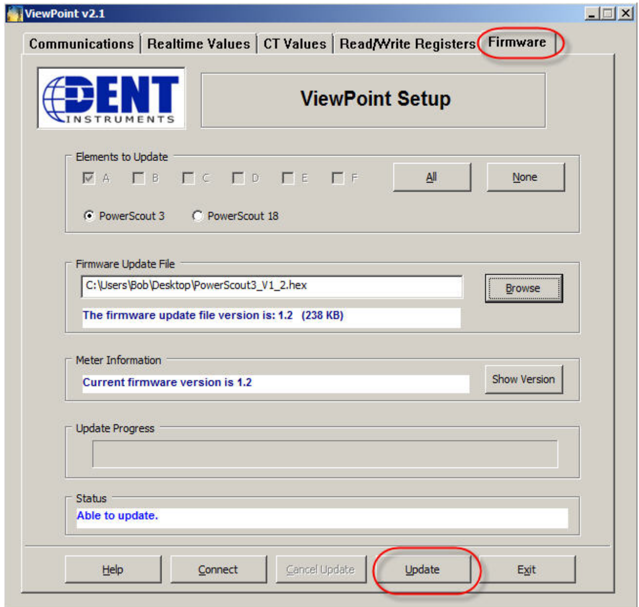
### Downloading and Installing Firmware

1. Download the zip file containing the firmware. Extract the zip file to a folder on the computer.
2. Connect the computer to the PowerScout 3 Plus. Refer to Section III, *Installing the ViewPoint Software and Communicating with the PowerScout* for additional information.
   If connectivity fails with the 9600 baud rate, refer to the *Troubleshooting* section at the end of this appendix.
3. Select the baud rate for loading the firmware to the PowerScout 3 Plus.
   A baud rate of 9600 downloads the firmware to the PowerScout 3 Plus in approximately six minutes. A faster baud rate can be selected to reduce the time by approximately 2.5 minutes.

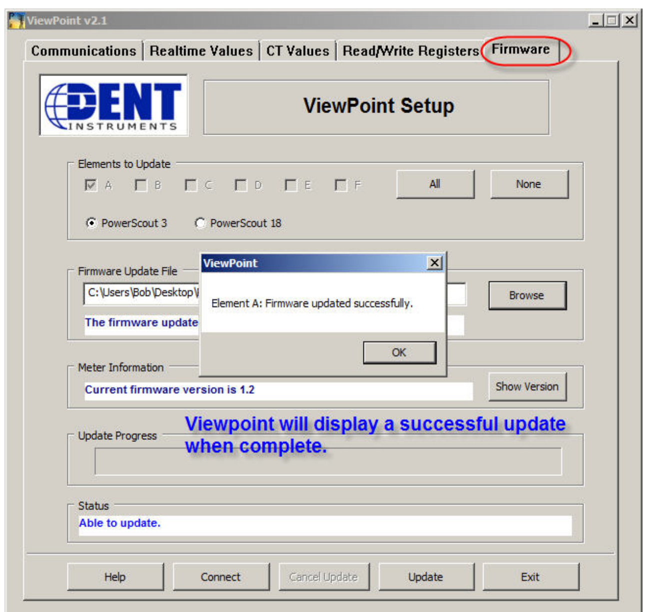
   Change the baud rate using the **Communications** tab. Select the desired baud rate. The baud rate is synchronized between ViewPoint and the PowerScout 3 Plus by clicking the **Connect** button.



4. Select the **Firmware** tab in ViewPoint. Click **Browse** to locate the extracted firmware files. Click **Update** to start the firmware update.




5. When the update completes, ViewPoint displays a message window confirming a successful update.




6. If the baud rate was changed for the firmware update, restore the baud rate to its original setting.

**OPTIONAL:** When the firmware update completes and if the digital connections are not in use counting generating output pulses, the Digital LEDs turns on. This behavior is due to the new control feature for the Digital channels in this firmware version. Having the Digital LEDs on for unused Digital channels does not affect meter operation. To turn off the LEDs, complete the following steps:

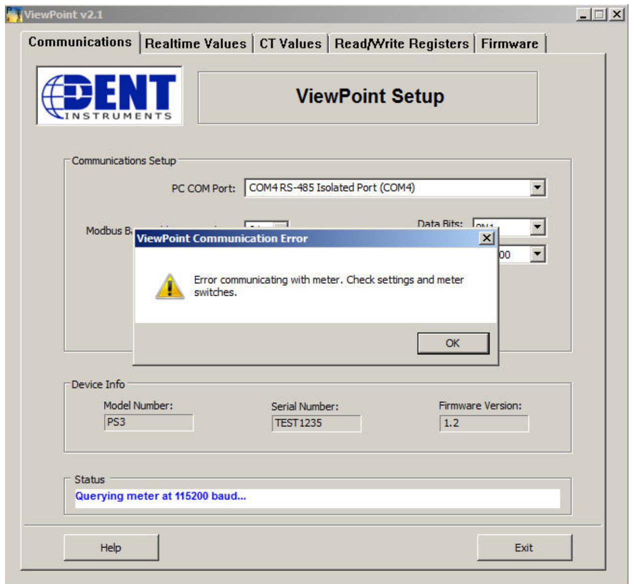
Set the control output to disable the LED:

- Set register 44402 = 1 (for I/O 1), 44403 = 1 (for I/O 2).
- Wait 60 seconds before power cycling the PowerScout 3 Plus, to save the settings.

This completes the firmware update for the PowerScout 3 Plus.

## Modbus Appendix C – Troubleshooting Communication Issues

The following headings provide possible solutions for communication errors.




### Baud Rate Communications Error

When the baud rate on the ViewPoint **Communications** screen and the PowerScout 3 Plus do not match, communication fails. To correct a baud rate communications error, use the following steps:

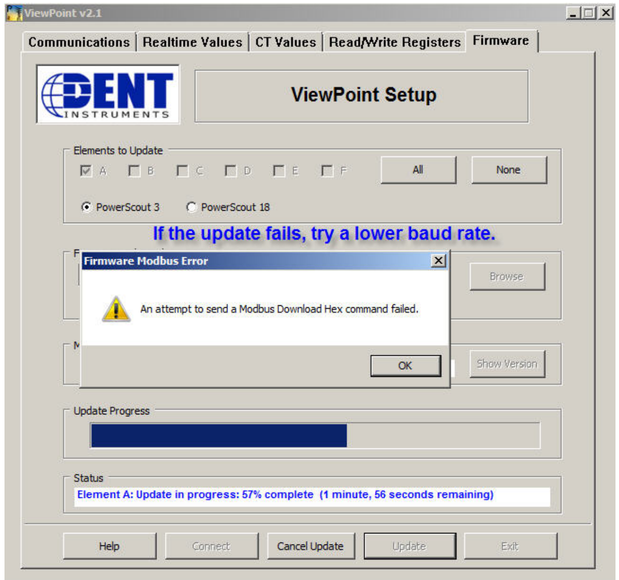
1. In ViewPoint, set the **Modbus Base Address Switches** field to 00.
2. On the PowerScout 3, set both the upper and lower Modbus address switches to 0.
3. Press the **Connect** button. With both settings at 00, ViewPoint and the PowerScout 3 Plus will communicate at a 9600 baud rate regardless of a baud rate mismatch. Communications is established.
4. Next, select the desired baud rate in ViewPoint from the **Baud Rate** drop-down menu. This synchronizes the baud rates between ViewPoint and the PowerScout 3 Plus.
5. Click **Connect** to reconfirm communications.

### Port Error

If the **PC COM Port** drop-down menu does not contain a RS-485 port, the RS-485 adapter driver is not installed or the device is not connected to the computer's USB port. Check that the adapter is connected to a live USB port or move the USB cable to another USB port.

## Firmware Update Fails

When the firmware update fails, select a slower baud rate and retry the update.




## Other Communication Failures

The following items can also cause a communication failure.

- Check for wiring and cabling issues with the RS-485 adapter. Check for polarity, frayed wires, and/or pinched insulation.
- Verify that the dip switches on the back of the USB to RS-485 adapter are set to the following:


- Reboot the computer. Click **Connect** on the Communications tab to reestablish communications.

## Modbus Appendix D – PowerScout 3 Plus Modbus Register Assignment Tables

### Modbus Register Assignments

Offset refers to a base of 40001.

| Modbus | Offset | Register | Description |
|---|---|---|---|
| 44001 | 4000 | kWh System LSW | System Total Net True Energy LSW (kWh) |
| 44002 | 4001 | kWh System MSW | System Total Net True Energy MSW (kWh) |
| 44003 | 4002 | kW System | System Total True Power (kW) |
| 44004 | 4003 | kW Demand System Max | System Maximum Demand (peak demand). |
| 44005 | 4004 | kW Demand System Now | Average Power (kW) for most recent demand window |
| 44006 | 4005 | kW System Max | System Maximum Instantaneous kW<br>(Highest 500mS kW) |
| 44007 | 4006 | kW System Min | System Minimum Instantaneous kW<br>(Lowest 500mS kW) |
| 44008 | 4007 | kVARh System LSW | System Total Net Reactive Energy LSW (kVARh) |
| 44009 | 4008 | kVARh System MSW | System Total Net Reactive Energy MSW (kVARh) |
| 44010 | 4009 | kVAR System | System Total Reactive Power (kVAR) |
| 44011 | 4010 | kVAh System LSW | System Total Apparent Energy LSW (kVAh) |
| 44012 | 4011 | kVAh System MSW | System Total Apparent Energy MSW (kVAh) |
| 44013 | 4012 | kVA System | System Total Apparent Power (kVA) |
| 44014 | 4013 | Displacement PF System | System Total Power Factor (PF) |
| 44015 | 4014 | Apparent PF System | System Total Power Factor (PF) |
| 44016 | 4015 | Amps System Avg | Average of all phases. |
| 44017 | 4016 | Volts Line to Line Avg | Voltage Line to line (Volts) Average. |
| 44018 | 4017 | Volts Line to Neutral Avg | Voltage Line to neutral (volts) Average. |
| 44019 | 4018 | Volts L1 to L2 | Individual Phase to Phase Voltages |
| 44020 | 4019 | Volts L2 to L3 | “ |
| 44021 | 4020 | Volts L1 to L3 | “ |
| 44022 | 4021 | Line Frequency | Line Frequency (Hz) |
| 44023 | 4022 | kWh L1 LSW | Individual Phase True Energy LSW (kWh) |
| 44024 | 4023 | kWh L1 MSW | Individual Phase True Energy MSW (kWh) |
| 44025 | 4024 | kWh L2 LSW | “ |
| 44026 | 4025 | kWh L2 MSW | “ |
| 44027 | 4026 | kWh L3 LSW | “ |
| 44028 | 4027 | kWh L3 MSW | “ |
| 44029 | 4028 | kW L1 | Individual Phase True Powers (kW) |
| 44030 | 4029 | kW L2 | “ |
| 44031 | 4030 | kW L3 | “ |
| 44032 | 4031 | kVARh L1 LSW | Individual Phase Reactive Energy LSW (kVARh) |
| 44033 | 4032 | kVARh L1 MSW | Individual Phase Reactive Energy MSW (kVARh) |
| 44034 | 4033 | kVARh L2 LSW | “ |
| 44035 | 4034 | kVARh L2 MSW | “ |
| 44036 | 4035 | kVARh L3 LSW | “ |
| 44037 | 4036 | kVARh L3 MSW | “ |
| 44038 | 4037 | kVAR L1 | Individual Phase Reactive Powers (kVAR) |
| 44039 | 4038 | kVAR L2 | “ |
| 44040 | 4039 | kVAR L3 | “ |

| Modbus | Offset | Register | Description |
|---|---|---|---|
| 44041 | 4040 | kVAh L1 LSW | Individual Phase Apparent Energy LSW (kVAh) |
| 44042 | 4041 | kVAh L1 MSW | Individual Phase Apparent Energy MSW (kVAh) |
| 44043 | 4042 | kVAh L2 LSW | “ |
| 44044 | 4043 | kVAh L2 MSW | “ |
| 44045 | 4044 | kVAh L3 LSW | “ |
| 44046 | 4045 | kVAh L3 MSW | “ |
| 44047 | 4046 | kVA L1 | Individual Phase Apparent Powers (kVA) |
| 44048 | 4047 | kVA L2 | “ |
| 44049 | 4048 | kVA L3 | “ |
| 44050 | 4049 | Displacement PF L1 | Individual Phase displacement Power Factor (PF) |
| 44051 | 4050 | Displacement PF L2 | “ |
| 44052 | 4051 | Displacement PF L3 | “ |
| 44053 | 4052 | Apparent PF L1 | Individual Phase apparent Power Factors (PF) |
| 44054 | 4053 | Apparent PF L2 | “ |
| 44055 | 4054 | Apparent PF L3 | “ |
| 44056 | 4055 | Amps L1 | Individual Phase Currents (A) |
| 44057 | 4056 | Amps L2 | “ |
| 44058 | 4057 | Amps L3 | “ |
| 44059 | 4058 | Volts L1 to Neutral | Individual Phase to Neutral Voltages (V) |
| 44060 | 4059 | Volts L2 to Neutral | “ |
| 44061 | 4060 | Volts L3 to Neutral | “ |
| 44062 | 4061 | Time Since Reset LSW | Seconds since KWH register was reset. LSW |
| 44063 | 4062 | Time Since Reset HSW | Seconds since KWH register was reset. MSW |
| 44080 | 4079 | kW System Average | Equals KWH_SYSTEM_L&M ÷ (TimeSinceReset_L&M seconds /3600 seconds/Hr) (resettable) |
| 44081 | 4080 | kW Demand System Min | Min Average power window (kW) |
| 44082 | 4081 | kVA Demand System Max | System Maximum Instantaneous kVA Demand (kVA, resettable). It displays the default value after a CAM until 1 demand window elapses. After a power cycle or CPU reset the value is not reset but it does not update again until 1 demand window elapses. |
| 44083 | 4082 | kVA Demand System Now | System Average kVA Demand For the most recent (current) Demand Window.(resettable) Displays the default value after a CAM or reset, or power cycle. Updates every min thereafter. True demand value takes a demand period to get to actual value. Similar to 44005 |
| 44084 | 4083 | kVAR Demand System Max | System Maximum kVAR Demand (kVAR, resettable). It displays the default value after a CAM until 1 demand window elapses. After a power cycle or CPU reset the value is not reset but it does not update again until 1 demand window elapses. |
| 44600 | 4599 | CT Integer | CT Integer Value |
| 44601 | 4600 | CT Decimal | CT Decimal Value x 1000 |
| 44602 | 4601 | Data Scalar | A Value of 0-6 that changes the scaling of certain registers |
| 44603 | 4602 | Demand Window Size | Demand window size in minutes; default is 15 min |

## Configuration Registers

| Modbus | Offset | Register | Description |
|---|---|---|---|
| 44525 | 4524 | CT Type | 1=mV, 2=Rogowski (RoCoil) |
| 44526 | 4525 | Slave ID | !1=DENT, 1=Veris; Sets SLAVE_ID to Veris or DENT |
| 44599 | 4598 | CT Phase Shift | CT Phase Shift X 100 +/- |
| 44604 | 4603 | Volts Multiplier | Multiply volts values by this scalar. Use with Step-down Transformer. Affects all parameters that use volts (i.e., kW) |
| 44605 | 4604 | Amps Multiplier | Multiply amps value by this scalar. For use with x:5A CTs and single let monitoring of a three phase load. Affects all parameters that use amps (i.e, kW) |
| 44606 | 4605 | Communication Setting | Baud: 900=9600, 1900=19200, 3800=38400, 5700=57600, 7600 =76800, 11500=115200<br>Parity: Add 00 = NO, Add 10 = ODD, Add 20 = EVEN<br>Stop bit: Add 0 = 1 (UART does not permit 0 stop bits), Add 1 = 1, Add 2 = 2<br>E.g., 901 = 9600 baud, no parity, 1 stop bit |
| 44607 | 4606 | Service Type | A value of 0x0001 configures the PowerScout for DELTA<br>A value of 0x0000 configures the PowerScout for WYE |
| 44609 | 4608 | Set Line Frequency | Line frequency setting for metering: 50=50 Hz, 60=60Hz, 400=400 Hz |
| 44612 | 4611 | Communications Settings | Write 1883 to change to BACnet 2004 mode |

## Writable Registers

| Modbus | Offset | Register | Description |
|---|---|---|---|
| 40129 | 128 | Synchronize Register | Multiple PowerScout's synchronization register |
| 44066 | 4065 | Clear Accumulated Measurements | Writing 1234 resets all 'C' registers, accumulated PowerScout data (kWh, kWh, etc) stored in flash to CAM Default value |

## Non-Writable Registers

| Modbus | Offset | Register | Description |
|---|---|---|---|
| 44201 | 4200 | Model Number 1st 2 bytes | Model Name 10 bytes (ASCII Alpha-Numeric) |
| 44202 | 4201 | Model 2 | " |
| 44203 | 4202 | Model 3 | " |
| 44204 | 4203 | Model 4 | " |
| 44205 | 4204 | Model Number last 2 bytes | " |
| 44206 | 4205 | Serial Number 1st 2 bytes | Serial Number 10 bytes (ASCII Alpha-Numeric) |
| 44207 | 4206 | Serial 2 | " |
| 44208 | 4207 | Serial 3 | " |
| 44209 | 4208 | Serial 4 | " |
| 44210 | 4209 | Serial Number last 2 bytes | " |

| Modbus | Offset | Register | Description |
|---|---|---|---|
| 44220 | 4219 | PowerScout Element ID | Used by ViewPoint to determine which element is being read & total number of elements available. Element index multiplied by 256 + number of elements. |
| 44511 | 4510 | Hardware ID | Hardware revisions. |
| 44069 | 4068 | Firmware Major Revision | Major Revision Level (big software releases) |
| 44070 | 4069 | Firmware Minor Revision | Minor Revision Level (small software changes) |

### Positive Power/Energy Measurement Registers

| Modbus | Offset | Register | Description |
|---|---|---|---|
| 46001 | 6000 | Positive kWh System LSW | System Positive True Energy LSW (kWh, resettable) |
| 46002 | 6001 | Positive kWh System MSW | System Positive True Energy MSW (kWh, resettable) |
| 46003 | 6002 | Positive kW System | System Positive Instantaneous Positive True Power (kW) (net sum of all individual kWs, if sum is negative value=0) |
| 46005 | 6004 | kW Demand System Now | Average Power (kW) for most recent demand window |
| 46006 | 6005 | Positive kW System Max | System Highest Instantaneous Positive Draw Since Reset (kW, resettable) |
| 46007 | 6006 | Positive kW System Min | System Lowest Instantaneous Positive Draw Since Reset (kW, resettable) |
| 46008 | 6007 | Positive kVARh System LSW | System Positive Reactive Energy LSW (kVARh, resettable) |
| 46009 | 6008 | Positive kVARh System MSW | System Positive Reactive Energy MSW (kVARh, resettable) |
| 46010 | 6009 | Positive kVAR System | System Instantaneous Positive Reactive Power (kVAR) (net sum of all individual kVARs, if sum is negative value=0) |
| 46014 | 6013 | Positive Displacement PF System | System Positive Displacement Power Factor (dPF); Register is 100x actual value (If the System dPF (44014) is positive, this register will contain that value else it will be zero) |
| 46015 | 6014 | Positive Apparent PF System | System Positive Apparent Power Factor (aPF); Register is 100x actual value (If the System aPF (44015) is positive, this register will contain that value else it will be zero) |
| 46023 | 6022 | Positive kWh L1 LSW | Individual Phase Positive True Energy LSW (kWh, resettable) |
| 46024 | 6023 | Positive kWh L1 MSW | Individual Phase Positive True Energy MSW (kWh, resettable) |
| 46025 | 6024 | Positive kWh L2 LSW | “ |
| 46026 | 6025 | Positive kWh L2 MSW | “ |
| 46027 | 6026 | Positive kWh L3 LSW | “ |
| 46028 | 6027 | Positive kWh L3 MSW | “ |
| 46029 | 6028 | Positive kW L1 | Individual Phase Instantaneous Positive True Powers (kW) |
| 46030 | 6029 | Positive kW L2 | “ |

| Modbus | Offset | Register | Description |
|---|---|---|---|
| 46031 | 6030 | Positive kW L3 | “ |
| 46032 | 6031 | Positive kVARh L1 LSW | Individual Phase Positive Reactive Energy LSW (kVARh, resettable) |
| 46033 | 6032 | Positive kVARh L1 MSW | Individual Phase Positive Reactive Energy MSW (kVARh, resettable) |
| 46034 | 6033 | Positive kVARh L2 LSW | “ |
| 46035 | 6034 | Positive kVARh L2 MSW | “ |
| 46036 | 6035 | Positive kVARh L3 LSW | “ |
| 46037 | 6036 | Positive kVARh L3 MSW | “ |
| 46038 | 6037 | Positive kVAR L1 | Individual Phase Positive Instantaneous Reactive Powers (kVAR) |
| 46039 | 6038 | Positive kVAR L2 | “ |
| 46040 | 6039 | Positive kVAR L3 | “ |
| 46050 | 6049 | Positive Displacement PF L1 | Individual Phase Positive Displacement Power Factors (dPF); Register is 100x actual value (If the Individual dPF (44050) is positive, this register will contain that value else it will be zero) |
| 46051 | 6050 | Positive Displacement PF L2 | “ |
| 46052 | 6051 | Positive Displacement PF L3 | “ |
| 46053 | 6052 | Positive Apparent PF L1 | Individual Phase Positive Apparent Power Factors (aPF); Register is 100x actual value (If the Individual aPF(44053) is positive, this register will contain that value else it will be zero) |
| 46054 | 6053 | Positive Apparent PFL2 | “ |
| 46055 | 6054 | Positive Apparent PF L3 | “ |
| 46080 | 6079 | Positive kW System Average | Equals Positive KWH_SYSTEM_L&M ÷ (TimeSinceReset_L&M seconds /3600 seconds/Hr) (resettable) |
| 46081 | 6080 | Positive kW Demand System Minimum | Min Average power window (kW) |

## Negative Power/Energy Measurement Registers

| Modbus | Offset | Register | Detailed Description |
|---|---|---|---|
| 47001 | 7000 | Negative kWh System LSW | System Negative True Energy LSW (kWh, resettable) |
| 47002 | 7001 | Negative kWh System MSW | System Negative True Energy MSW (kWh, resettable) |
| 47003 | 7002 | Negative kW System | System Negative Instantaneous Negative True Power (kW) (net sum of all individual kWs, if sum is positive value=0) |
| 47005 | 7004 | kW Demand System Now | Average Power (kW) for most recent demand window |
| 47006 | 7005 | Negative kW System Max | System Highest Instantaneous Negative Draw Since Reset (kW, resettable) |
| 47007 | 7006 | Negative kW System Min | System Lowest Instantaneous Negative Draw Since Reset (kW, resettable) |

| Modbus | Offset | Register | Detailed Description |
|---|---|---|---|
| 47008 | 7007 | Negative kVARh System LSW | System Negative Reactive Energy LSW (kVARh, resettable) |
| 47009 | 7008 | Negative kVARh System MSW | System Negative Reactive Energy MSW (kVARh, resettable) |
| 47010 | 7009 | Negative kVAR System | System Instantaneous Negative Reactive Power (kVAR) (net sum of all individual kVARs, if sum is positive value=0) |
| 47014 | 7013 | Negative Displacement PF System | System Negative Displacement Power Factor (dPF); Register is 100x actual value (If the System dPF (44014) is Negative, this register will contain that value else it will be zero) |
| 47015 | 7014 | Negative Apparent PF System | System Negative Apparent Power Factor (aPF); Register is 100x actual value (If the System aPF (44015) is Negative, this register will contain that value else it will be zero) |
| 47023 | 7022 | Negative kWh L1 LSW | Individual Phase Negative True Energy LSW (kWh, resettable) |
| 47024 | 7023 | Negative kWh L1 MSW | Individual Phase Negative True Energy MSW (kWh, resettable) |
| 47025 | 7024 | Negative kWh L2 LSW | " |
| 47026 | 7025 | Negative kWh L2 MSW | " |
| 47027 | 7026 | Negative kWh L3 LSW | " |
| 47028 | 7027 | Negative kWh L3 MSW | " |
| 47029 | 7028 | Negative kW L1 | Individual Phase Instantaneous Negative True Powers (kW) |
| 47030 | 7029 | Negative kW L2 | " |
| 47031 | 7030 | Negative kW L3 | " |
| 47032 | 7031 | Negative kVARh L1 LSW | Individual Phase Negative Reactive Energy LSW (kVARh, resettable) |
| 47033 | 7032 | Negative kVARh L1 MSW | Individual Phase Negative Reactive Energy MSW (kVARh, resettable) |
| 47034 | 7033 | Negative kVARh L2 LSW | " |
| 47035 | 7034 | Negative kVARh L2 MSW | " |
| 47036 | 7035 | Negative kVARh L3 LSW | " |
| 47037 | 7036 | Negative kVARh L3 MSW | " |
| 47038 | 7037 | Negative kVAR L1 | Individual Phase Negative Instantaneous Reactive Powers (kVAR) |
| 47039 | 7038 | Negative kVAR L2 | " |
| 47040 | 7039 | Negative kVAR L3 | " |
| 47050 | 7049 | Negative Displacement PF L1 | Individual Phase Negative Displacement Power Factors (dPF); Register is 100x actual value (If the Individual dPF(44050) is Negative, this register will contain that value else it will be zero) |
| 47051 | 7050 | Negative Displacement PF L2 | " |
| 47052 | 7051 | Negative Displacement PF L3 | " |

| Modbus | Offset | Register | Detailed Description |
|---|---|---|---|
| 47053 | 7052 | Negative Apparent PF L1 | Individual Phase Negative Apparent Power Factors (aPF); Register is 100x actual value (If the Individual aPF (44053) is Negative, this register will contain that value else it will be zero) |
| 47054 | 7053 | Negative Apparent PFL2 | “ |
| 47055 | 7054 | Negative Apparent PF L3 | “ |
| 47080 | 7079 | Negative kW System Average | Equals Negative KWH_SYSTEM_L&M ÷ (TimeSinceReset_L&M seconds /3600 seconds/Hr) (resettable) |
| 46081 | 7080 | Negative kW Demand System Minimum | Min Average power window (kW) |

## Modbus Appendix E – Modbus Commands

The Modbus messaging protocol used for communication follows the Modbus RTU protocol described in this section. Each register read from or written to the PowerScout 3 Plus is a 16-bit unsigned, positive integer value. The PowerScout 3 Plus supports the following commands.

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

**Table F-1: Supported Modbus Commands**

The following guidelines are used for these Modbus commands:

- All values are hexadecimal, spaces are not included.
- The address is the value of the address switch on the PowerScout 3 Plus. This must be different for each PowerScout on a single Modbus network.
- The register’s high-order and low-order bits are the 16-bit value of a single, or first, register to be accessed for a read or write.
- The CRC is the 16-bit CRC value. Note that the CRC's LSB and MSB are reversed in comparison to those for the registers and data.

### Read Holding Registers

This command reads the contents of a contiguous block of holding registers containing data values from the PowerScout 3 Plus. When a read command is received, the PowerScout 3 Plus sends a response that includes the values of the requested registers.

| Command Information | Command Layout | Example Command |
|---|---|---|
| PowerScout address | nn | 37 |
| Command number | 03 | 03 |
| First register to read – high order bits | xx | 00 |
| First register to read – low order bits | xx | 0C |
| Number of registers to read – high order bits | xx | 00 |
| Number of registers to read – low order bits | xx | 01 |
| CRC low order bits | xx | 41 |
| CRC high order bits | xx | 9F |

**Table F-2: Format for Modbus Command 03**

### Example Command

This command reads from a PowerScout 3 Plus with an address switch setting of 37 hex (55 in decimal), reading one byte starting at register offset 0C hex (12 in decimal). Note that offset 12 corresponds to Modbus register 40013. All values are hexadecimal; spaces are not sent.

| Example Request Field Name | Command (Hex) | Response Field Name | Response (Hex) |
|---|---|---|---|
| PowerScout address | 37 | PowerScout address | 37 |
| Command | 03 | Command | 03 |
| Starting register address to read– high order bits | 00 | Byte count | 02 |
| Starting register address to read– low order bits | 0C | Register value –high order bits | 00 |
| Number of registers to read – high order bits | 00 | Register value – low order bits | 00 |
| Number of registers to read – low order bits | 01 | CRC low order bits | 70 |
| CRC low order bits | 41 | CRC high order bits | 40 |
| CRC high order bits | 9F | | |

**Table F-3: Format for Modbus Command 03**

Command: 3703000C0001419F

Response: 37030200007040

The response is from the PowerScout 3 Plus at address 37. Two bytes were read from the requested register, 000C. The value of the registers read was 0000. The CRC value was 4070. The number of registers read must be between 1 and 125 inclusive.

***Note**: The value sent as the register address in the read and write Modbus commands is not the register listed in the table, instead an abbreviated version is sent. The actual register address sent is the Modbus register value minus 40001. For example, the address sent in the command message for register 40025 is actually 0024 (0018 hexadecimal), and the address sent for register 44062 is actually 4061 (0FDD hexadecimal).*

### Write Single Register

This command writes to a single holding register of the PowerScout 3 Plus. The normal response is an echo of the request, returned after the register contents are written.

| Command Information | Command Layout | Example Command |
|---|---|---|
| PowerScout address | nn | 37 |
| Command number | 06 | 06 |
| Register to write – high order bits | xx | 00 |
| Register to write – low order bits | xx | 00 |
| Register value to write – high order bits | xx | 00 |
| Register value to write – low order bits | xx | 00 |
| CRC low order bits | xx | 8C |
| CRC high order bits | xx | 5C |

**Table F-4: Format for Modbus Command 06**

### Example Command

This command writes to a PowerScout 3 Plus with an address switch setting of 37 hex (55 in decimal), writing one byte at register 000C, and writing a value of 00 to clear the KWH registers. The data value of 0 is sent to register 0. Note that offset 0 corresponds to Modbus register 40001. The CRC is 5C8C. All values are hexadecimal; spaces are not sent.

| Example Request Field Name | Command (Hex) | Response Field Name | Response (Hex) |
|---|---|---|---|
| PowerScout address | 37 | PowerScout address | 37 |
| Command number | 06 | Command number | 06 |
| Register to write – high order bits | 00 | Register written to – high order bits | 00 |
| Register to write – low order bits | 00 | Register written to – low order bits | 00 |
| Register value to write – high order bits | 00 | Register value written – high order bits | 00 |
| Register value to write – low order bits | 00 | Register value written – low order bits | 00 |
| CRC low order bits | 8C | CRC low order bits | 8C |
| CRC high order bits | 5C | CRC high order bits | 5C |

**Table F-5: Format for Modbus Command 03**

Command: 3706000000018C5C

Response: 3706000000018C5C

The response is from the PowerScout 3 Plus at address 37. One byte was written to at the requested register, 0000. The value written was 0000. The CRC value was 5C8C. An echo of the original command after the contents are written is a valid response.

### Error Response

If the first register in this write command is not in the valid range of registers, the PowerScout 3 Plus returns an error message.

### Report Slave ID

This command is used to read the description, the current status and other information specific to a remote device. A normal response includes the data contents specific to the device.

| Command Information | Command Layout | Example Command |
|---|---|---|
| PowerScout address | nn | 37 |
| Command number | 11 | 11 |

**Table F-6: Format for Modbus Command 11 (17 in decimal)**

### Example Command

| Example Request Field Name | Command (Hex) | Response Field Name | Response (Hex) |
|---|---|---|---|
| PowerScout address | 37 | PowerScout address | 37 |
| Command number | 11 | Command number | 11 |
| CRC low order bits | D7 | Byte count | |
| CRC high order bits | 8C | Slave ID | |
| | | Run indicator status | |
| | | Additional data | |

**Table F-7: Format for Modbus Command 11 (17 in decimal)**

### Slave ID

The PowerScout 3 Plus uses the following default format for the slave ID:

```
00hFFhDENT Instruments PowerScout 3, Serial Number, FW Rev Major Revision. Minor Revision, Scalar X
```

Example:

```
00hFFhDENT Instruments PowerScout 3, PS3912001, FW Rev 1.0, Scalar 3
```

The 00h is used for version control and the FFh indicates the meter is active. The 00h and FFh are two bytes in front of the string that are not displayed on the RTU.

# SECTION IV: Frequently Asked Questions – FAQs

**What is the maximum distance for BACnet MS/TP or Modbus (RS-485) communication?**
BACnet MS/TP or Modbus (RS-485) can reach a distance up to 1200 meters (4000') with data rates at 100 kbps.

**One (or more) of the PhaseChek™ LEDs is red. What does this mean?**
Any number of red lights indicates the PowerScout™ 3 Plus is wired incorrectly. Review the table in *PhaseChek* in Section III of this manual for a description of the indicator lights.

**How is the PowerScout 3 Plus powered?**
All PowerScout instruments are line-powered. An internal power supply attached between L1 and L2 provides power to the unit.

**Can the PowerScout 3 Plus be used to monitor single-phase loads?**
The PowerScout 3 Plus can be used to monitor single-phase loads. Refer to section II.B or III.C for detailed setup information.

**How many PowerScout 3 Plus instruments can be connected together?**
Up to 127 PowerScout 3 Plus meters can be connected together on a BACnet MS/TP network.
Up to 254 PowerScout 3 Plus meters can be connected together on a Modbus network.

**How is hexadecimal (HEX) to decimal converted?**
Use the Hexadecimal to Decimal conversion table in the Appendix section of this manual.

**What is true RMS?**
RMS stands for "Root-Mean-Square." True RMS is the power from AC voltage/current that will produce the equivalent amount of heat in a resistor as a DC voltage/current, whether sinusoidal or not. For example, if a resistive heating element is rated at 15 kW of heat at 240VAC RMS, then the heat would be the same if we applied 240V of DC instead of AC. A meter without true RMS will incorrectly read distorted waveforms. All DENT Instruments meters measure true RMS.

**How accurate is the PowerScout 3 Plus?**
The PowerScout 3 Plus accuracy is better than 1%.

**What is the lead length for RoCoil CTs?**
The maximum lead length for the RoCoils is 30 meters (100').

**Can a 3-phase balanced load be monitored with one CT?**
This is not the best way to measure a three phase load as it ignores imbalances in voltage and power factor. However, if desired there is an Amp Multiplier Modbus register (44605) that can be set for three which will multiply the current by three and therefore amps, watts, VA, VARs will be 3X greater.

**How can I switch the PowerScout 3 Plus from BACnet to Modbus mode?**
Use the BACnet client (RTU) to write 375 to the present value of object identifier 10190 (Com Interface). See BACnet Appendix B for more details.

**How can I switch the PowerScout 3 Plus from Modbus to BACnet mode?**
Using a PC running ViewPoint™ (or an RTU that can write to Modbus registers), write to register 44612 the value 1833 (to change to BACnet 2004). See also BACnet Appendix B for more details.

**How can I fix BACnet network timing errors / slowness?**
There are two objects that can be changed if network timing or slowness is present. Object identifier 10200 Maximum number of MSTP master should be set to the highest MAC address present on the network. Object identifier 10210

**What is the purpose of setting a scalar value?**
Each Modbus register is only 16 bits wide and is in integer format without any fixed number of decimal points. Simply putting a value directly into one of these registers would limit the smallest number to be 1, and only allow for a maximum value of 65535. To handle larger numbers, or numbers with better resolution, we use a scalar value that is used to apply a factor in multiples of 10 to the 16 bit data register value.

**How do I update the firmware in BACnet mode?**
Currently, the PowerScout 3 Plus must be in Modbus mode in order to use ViewPoint to update the firmware (either through the software switch or the rotary switches).

## Glossary

| | |
|---|---|
| Analog Value | A type of BACnet object that is a floating point number. On the PowerScout, Analog Value objects are used to represent the electrical measurements. |
| BACnet | **B**uilding **A**utomation **C**ontrol **net**works. A communications protocol that allows building automation and control devices and their association properties (objects) to be automatically discovered. |
| Discovery | In BACnet devices and the objects they expose can be found through a discovery process. This means that devices and objects do not need to be manually added if a BACnet client supports discovery. |
| Falling edge | Transition of the input signal from high to low. |
| Hexadecimal | In mathematics and computer science, hexadecimal (or hex) is a numeral system with a radix, or base, of 16. It uses sixteen distinct symbols, most often the symbols 0–9 to represent values zero to nine, and A, B, C, D, E, F (or a through f) to represent values ten to fifteen. |
| LSW | **(Modbus mode only)** Least Significant Word. Unit of data with the low-order bytes at the right. |
| Object | A BACnet object is a standard data structure that on the PowerScout 3 Plus represents electrical measurements. |
| MS/TP | Master-Slave / Token Passing is a model of communication used by BACnet where |

one device (the master node) has unidirectional control of the RS-485 serial bus. The token is passed from master node to master node to allow a master node to send frames over the bus.

| | |
|---|---|
| MSW | **(Modbus mode only)** Most Significant Word. Unit of data with the high-order bytes at the left. |
| PhaseChek™ | PhaseChek™ is a unique feature of the PowerScout™ and greatly simplifies installation and, at a glance, verifies correct CT orientation during installation. The PowerScout automatically adjusts for CT orientation—greatly reducing set-up time and all but eliminating installation errors. It is common for an individual phase power factor to be less than 0.55 and the corresponding LED will be red. |
| Power Factor | The power factor of the AC electric power system is defined as the ratio of the real power flowing to the load to the apparent power, and is a number between 0 and 1 (frequently expressed as a percentage, e.g. 0.5 pf = 50% pf). Real power is the capacity of the circuit for performing work in a particular time. Apparent power is the product of the root mean squared current and root mean squared voltage of the circuit. Due to energy stored in the load and returned to the source, or due to a non-linear load that distorts the wave shape of the current drawn from the source, the apparent power can be greater than the real power. |
| Rising edge | Transition of the input signal from low to high. |
| RMS | Root-Mean-Square. True RMS is the AC voltage/current that produces the equivalent amount of heat in a resistor as a DC voltage/current, whether sinusoidal or not. All DENT Instruments meters measure true RMS. |
| RS-485 | EIA-485 is used as the physical layer underlying many standard and proprietary automation protocols used to implement Industrial Control Systems, including BACnet / Modbus. |
| RTU | A Remote Terminal Unit (RTU) is a microprocessor controlled electronic device which interfaces objects in the physical world to a distributed control system or SCADA system by transmitting telemetry data to the system and/or altering the state of connected objects based on control messages received from the system. |
| SCADA | SCADA stands for Supervisory Control And Data Acquisition. It generally refers to an industrial control system: a computer system monitoring and controlling a process. |
| Service | A BACnet service is a message that the PowerScout must respond to. In BACnet these include WhoIs, I-Am, and ReadProperty. |

## Release Notes

Firmware update 2.53 provides the following enhancements:

- This is the first release of BACnet MS/TP functionality.
- The register 44612 is added to switch between BACnet and Modbus mode.

# SECTION V: General Appendices

## Appendix A – Decimal to Hexadecimal Conversion Table

Decimal values are used for the PowerScout™ addresses. The hex value is the corresponding value set on the upper and lower rotary network address switches on the PowerScout.

- Upper rotary network address switch = high (first) digit
- Lower rotary network address switch = low (second) digit

| Decimal | Hex | Decimal | Hex | Decimal | Hex | Decimal | Hex | Decimal | Hex | Decimal | Hex |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01 | 44 | 2C | 87 | 57 | 130 | 82 | 173 | AD | 216 | D8 |
| 2 | 02 | 45 | 2D | 88 | 58 | 131 | 83 | 174 | AE | 217 | D9 |
| 3 | 03 | 46 | 2E | 89 | 59 | 132 | 84 | 175 | AF | 218 | DA |
| 4 | 04 | 47 | 2F | 90 | 5A | 133 | 85 | 176 | B0 | 219 | DB |
| 5 | 05 | 48 | 30 | 91 | 5B | 134 | 86 | 177 | B1 | 220 | DC |
| 6 | 06 | 49 | 31 | 92 | 5C | 135 | 87 | 178 | B2 | 221 | DD |
| 7 | 07 | 50 | 32 | 93 | 5D | 136 | 88 | 179 | B3 | 222 | DE |
| 8 | 08 | 51 | 33 | 94 | 5E | 137 | 89 | 180 | B4 | 223 | DF |
| 9 | 09 | 52 | 34 | 95 | 5F | 138 | 8A | 181 | B5 | 224 | E0 |
| 10 | 0A | 53 | 35 | 96 | 60 | 139 | 8B | 182 | B6 | 225 | E1 |
| 11 | 0B | 54 | 36 | 97 | 61 | 140 | 8C | 183 | B7 | 226 | E2 |
| 12 | 0C | 55 | 37 | 98 | 62 | 141 | 8D | 184 | B8 | 227 | E3 |
| 13 | 0D | 56 | 38 | 99 | 63 | 142 | 8E | 185 | B9 | 228 | E4 |
| 14 | 0E | 57 | 39 | 100 | 64 | 143 | 8F | 186 | BA | 229 | E5 |
| 15 | 0F | 58 | 3A | 101 | 65 | 144 | 90 | 187 | BB | 230 | E6 |
| 16 | 10 | 59 | 3B | 102 | 66 | 145 | 91 | 188 | BC | 231 | E7 |
| 17 | 11 | 60 | 3C | 103 | 67 | 146 | 92 | 189 | BD | 232 | E8 |
| 18 | 12 | 61 | 3D | 104 | 68 | 147 | 93 | 190 | BE | 233 | E9 |
| 19 | 13 | 62 | 3E | 105 | 69 | 148 | 94 | 191 | BF | 234 | EA |
| 20 | 14 | 63 | 3F | 106 | 6A | 149 | 95 | 192 | C0 | 235 | EB |
| 21 | 15 | 64 | 40 | 107 | 6B | 150 | 96 | 193 | C1 | 236 | EC |
| 22 | 16 | 65 | 41 | 108 | 6C | 151 | 97 | 194 | C2 | 237 | ED |
| 23 | 17 | 66 | 42 | 109 | 6D | 152 | 98 | 195 | C3 | 238 | EE |
| 24 | 18 | 67 | 43 | 110 | 6E | 153 | 99 | 196 | C4 | 239 | EF |
| 25 | 19 | 68 | 44 | 111 | 6F | 154 | 9A | 197 | C5 | 240 | F0 |
| 26 | 1A | 69 | 45 | 112 | 70 | 155 | 9B | 198 | C6 | 241 | F1 |
| 27 | 1B | 70 | 46 | 113 | 71 | 156 | 9C | 199 | C7 | 242 | F2 |
| 28 | 1C | 71 | 47 | 114 | 72 | 157 | 9D | 200 | C8 | 243 | F3 |
| 29 | 1D | 72 | 48 | 115 | 73 | 158 | 9E | 201 | C9 | 244 | F4 |
| 30 | 1E | 73 | 49 | 116 | 74 | 159 | 9F | 202 | CA | 245 | F5 |
| 31 | 1F | 74 | 4A | 117 | 75 | 160 | A0 | 203 | CB | 246 | F6 |
| 32 | 20 | 75 | 4B | 118 | 76 | 161 | A1 | 204 | CC | 247 | F7 |
| 33 | 21 | 76 | 4C | 119 | 77 | 162 | A2 | 205 | CD | 248 | F8 |
| 34 | 22 | 77 | 4D | 120 | 78 | 163 | A3 | 206 | CE | 249 | F9 |
| 35 | 23 | 78 | 4E | 121 | 79 | 164 | A4 | 207 | CF | 250 | FA |
| 36 | 24 | 79 | 4F | 122 | 7A | 165 | A5 | 208 | D0 | 251 | FB |
| 37 | 25 | 80 | 50 | 123 | 7B | 166 | A6 | 209 | D1 | 252 | FC |
| 38 | 26 | 81 | 51 | 124 | 7C | 167 | A7 | 210 | D2 | 253 | FD |

| Decimal | Hex | Decimal | Hex | Decimal | Hex | Decimal | Hex | Decimal | Hex | Decimal | Hex |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 39 | 27 | 82 | 52 | 125 | 7D | 168 | A8 | 211 | D3 | 254 | FE |
| 40 | 28 | 83 | 53 | 126 | 7E | 169 | A9 | 212 | D4 | 255 | --- |
| 41 | 29 | 84 | 54 | 127 | 7F | 170 | AA | 213 | D5 | | |
| 42 | 2A | 85 | 55 | 128 | 80 | 171 | AB | 214 | D6 | | |
| 43 | 2B | 86 | 56 | 129 | 81 | 172 | AC | 215 | D7 | | |

**Table A-1: Decimal to Hexadecimal Conversion Table**

## **Appendix B** – CT Wire Lead Polarity

| CT Type | CT Lead + | CT Lead - |
|---|---|---|
| Rogowski (RōCoil) | White | Brown |
| Split Core mV | White | Black |
| Clamp On mV | Red | Black |

**Table G-1: CT Polarity**

**Note**: The directionality for Rogowski CTs is the arrow points toward the load (e.g. motor).