

PowerWave 2™ Bus System 250-800A

Branch Circuit Monitoring System Setup and Operation



**Ctrl Nr: PM375107
Revision: 002**

Thank you for your recent purchase of a PowerWave 2™ Bus System from Power Distribution, Inc. For safety reasons as well as to ensure optimal performance of your PowerWave 2™ Bus System, please carefully read the instructions before trying to install, operate, service, or maintain the system.

For any questions regarding the installation, operation, service, or maintenance of your PowerWave 2™ Bus System, please contact us:

Power Distribution, Inc. | 4200 Oakleys Court | Richmond, VA 23223
+1.800.225.4838 | +1.804.737.9880 | pdiservice@pdicorp.com

**PowerWave 2™ Bus System
250-800A
Branch Circuit Monitoring System
Setup and Operation
Control Number: PM375107 Rev 002**

© 2017 by Power Distribution, Inc. All rights reserved.

Release date: November 2017

PDI, JCOMM, Quad-Wye, ToughRail Technology, and WaveStar are registered trademarks of Power Distribution Inc. All other trademarks are held by their respective owners.

Power Distribution, Inc. (PDI)

Power Distribution, Inc. (PDI) designs, manufactures, and services mission critical power distribution, static switching, and power monitoring equipment for corporate data centers, alternative energy, industrial and commercial customers around the world. For over 30 years, PDI has served the data center and alternative energy markets providing flexible solutions with the widest range of products in the industry.

Contents

Safety	6
1 BCMS Options	7
2 Customer Network Connections	9
2.1 Comm Box Customer Connections	9
2.2 Making a Modbus RTU Connection	9
2.3 Daisy-chaining Power Feeds	11
2.3.1 Daisy-chaining Power Feeds using Modbus RTU	11
2.3.2 Daisy-chaining Power Feeds using Modbus TCP/IP.....	12
2.4 Tap Off Box Connections	12
3 BCMS Setup: Accumulator Application.....	14
3.1 Download Setup Software and Other Documentation	14
3.2 Start the Accumulator Setup Application	15
3.3 Accumulator Setup Application Tabs	15
3.4 Setup Tab	16
3.4.1 Finding New Devices on the Bus Run	18
3.4.2 Updating Setup Information	18
3.5 Setup Tab: Identifying Devices on a Bus Run.....	18
3.5.1 Addressing on a Bus.....	18
3.5.2 Setup Device Designations.....	18
3.6 Setup Tab: Manipulating the Device List.....	19
3.6.1 Add, Remove, or Swap Devices	19
3.6.2 Identify Tap Off Boxes with Blinking LED	20
3.7 Ibus Setup Tab: Global Settings for Tap Off Boxes	20
3.7.1 Set Electrical Characteristics for All Tap Off Boxes.....	20
3.7.2 Calibrate Voltage for the Bus Run	21
3.7.3 Current Settings	21
3.8 Data Tab.....	22
3.8.1 Set Unit Name.....	24
3.8.2 Setting Point Values and Clearing Alarms.....	24
3.8.3 Option Registers	25
3.8.4 Interacting with EPROM	25
4 7-Inch Local Display.....	26
4.1 Customer Connections	27
4.1.1 Mounting and Opening Enclosure	27
4.1.2 Customer Power Connections to Display Interface Board.....	28

4.1.3	Modbus Network Connections	28
4.1.4	Modbus TCP/IP Network Connection	29
4.2	Home Screen	30
4.3	7-in Local Display Setup.....	30
4.3.1	Login.....	31
4.3.2	Setup Screen Buttons.....	31
4.3.3	Setting Parameters for Upstream Modbus TCP/IP.....	32
4.4	Modbus Addresses with Local Display.....	33
4.5	Operational Use of the Local Display	35
4.5.1	System View Screen.....	35
4.5.2	End Feed Information Screen	35
4.5.3	Tap Off Box Information Screen.....	37
4.6	Setting up System View	37
4.7	Device Configuration: Setting Up Device Screens	39
Bibliography		41
Glossary		42

Figures

Figure 1 Customer Network Connections on Comm Box.....	9
Figure 2 Attach Modbus RTU Cable to Accumulator	10
Figure 3 Daisy-chaining Accumulators.....	12
Figure 4 Tap Off Box with Bus Rail Monitoring Connection	13
Figure 5 Quick Connect Tap Off Box Monitoring Cable	13
Figure 6 Download Busway Customer CD	14
Figure 7 Start the Accumulator Setup Application.....	15
Figure 8 Accumulator Setup: Setup Tab.....	16
Figure 9 Setup Tab: Device Characteristics	17
Figure 10 Setup Tab: Modbus Parameters.....	17
Figure 11 Setup Tab: Identify Tap Off Boxes with Blinking LEDs	20
Figure 12 IBus Setup Tab.....	21
Figure 13 Setup: Data Tab Basic Operations.....	23
Figure 14 Setup Data Tab: Enter Device or Unit Name	24
Figure 15 Setup Data Tab: Selecting and Changing Specific Point Values	24
Figure 16 Setup Data Tab: Setting Option Register Values.....	25
Figure 17 Setup Data Tab: Saving or Rejecting Point Changes	25
Figure 18 7-in Local Display with Six Bus Runs	26
Figure 19 7-in Local Display Enclosure Opened, Rear View	27
Figure 20 Customer Power Connections to Display Interface Board	28
Figure 21 Customer Modbus Connections.....	29
Figure 22 Local Display Ethernet Connection for Modbus TCP/IP.....	29
Figure 23 Home, Setup, and System View Screens.....	30
Figure 24 Setup Screen.....	31
Figure 25 Login and Password Change	31
Figure 26 Setup Options.....	32
Figure 27 System View Screen	35
Figure 28 End Feed Information Screen	36
Figure 29 Tap Off Box Information Screen	37
Figure 30 System View Screen with Corresponding Enable Screen.....	38
Figure 31 End Feed Configuration Screen	39
Figure 32 Tap Off Box Configuration Screen.....	40

Tables

Table 1 Modbus Settings.....	33
Table 2 Modbus Addresses When Using the 7-In Local Display	34

Safety

Please pay special attention to the use of “Danger” symbols throughout this manual indicating electrical or other safety hazards. Following these safety instructions is extremely important to avoid possible injury or death.

**DANGER!**

This symbol is used throughout this manual to indicate the presence of high voltages, representing a hazard for electric shock, burn or explosion. Follow the instructions carefully to avoid serious or fatal injury.

Follow safe electrical work practices:

- Read, understand, and follow the instructions before installing this product.
- Disconnect and lock-out all power supplying equipment before working on or installing PowerWave 2 Bus System components, including the Branch Circuit Monitoring System. Use a properly rated voltage sensing device to confirm power is OFF. However, Tap Off Boxes can be inserted into an operational Bus System, if the Bus System has been tested and certified.
- Install equipment in an appropriate electrical environment per local regulations.
- PCBs are ESD sensitive equipment. Ground yourself, discharge any static charge and ensure that the device is effectively grounded before handling the unit.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel and in accordance with all local safety codes. Power Distribution, Inc. assumes no responsibility for any consequences arising out of the use of this manual. **This document should not be viewed as sufficient by otherwise non-qualified personnel to operate, service, or maintain the equipment discussed.**

1 BCMS Options

PowerWave 2™ Bus Systems can be deployed with optional power monitoring using PDI's Branch Circuit Monitoring System (BCMS). PowerWave 2 Bus Systems integrate power distribution and monitoring into the same bus run. There is no need for a parallel facility to support monitoring and monitoring communications. BCMS on PowerWave 2 Bus Systems is part of a family of PDI BCMS products. PowerWave 2 BCMS can integrate with a WaveStar® BCMS Hub or the site Building Management System (BMS) in the same way as BCMS on other PDI products.

There are several options for monitoring power:

- **Input power source:** BCMS Plus provides current and voltage monitoring at the power feed (Standard End Feed or Center Feed)
- **Tap Off Boxes:** BCMS Plus provides current and voltage monitoring at each Tap Off Box circuit
 - Monitoring is individually selectable by Tap Off Box
 - If any Tap Off Box has BCMS Plus, a communications cable is installed throughout the bus run.
- Up to (32) devices can be monitored on a single bus run:
 - (1) input power source and up to (31) Tap Off Boxes, or,
 - No input power source and up to (32) Tap Off Boxes.

There are also several presentation options:

- Choice of any one of three **upstream** protocols (mutually exclusive options):
 - Modbus RTU (standard) at 9600 or 19200 bps, 4-wire or 2-wire
 - Modbus TCP/IP with a front-end protocol converter
 - Simple Network Management Protocol (SNMP) with a front-end protocol converter
 - **Note:** The protocol converters for Modbus TCP/IP and SNMP are different units. Only one protocol converter can be installed.
- Modbus communication to an **upstream** Modbus master device includes these upstream devices:
 - Building Management System (BMS) or Data Center Infrastructure Management (DCIM) system.
 - WaveStar® BCMS Hub, which can display information from many PowerWave 2 Bus Systems and other PDI products.
 - Modbus RTU or Modbus TCP/IP is required upstream from the power feed to the BCMS Hub
 - Note: SNMP cannot be used as a protocol upstream from the power feed to the BCMS Hub.
 - The BCMS Hub can pass information through to another upstream Modbus master such as a BMS or DCIM system.
 - Upstream Modbus TCP/IP from the BCMS Hub to another Modbus master is available with an optional protocol converter.
 - WaveStar® PowerWave 2 Bus System 7" Local Display, providing a local display hub for Bus Systems:
 - Displays information for up to (6) bus runs with up to (1) power feed and up to (15) Tap Off Boxes per bus run.
 - Modbus RTU is required upstream from the power feed to the 7" Local Display.
 - The Display can pass data through to another upstream Modbus master.

- An optional TCP/IP protocol converter can be installed on the **upstream** side of the 7" Local Display.
- Chapter 4 in this manual describes setup and operation for the 7" Local Display.

2 Customer Network Connections

When you select any BCMS monitoring option, a Comm Box with monitoring PCBs is installed on the power feed (Standard End Feed or Center Feed.). The Comm Box contains monitoring PCBs and may contain an optional protocol converter (for either Modbus TCP/IP or SNMP upstream).

2.1 Comm Box Customer Connections

The following customer network connections are made to the Comm Box:

- (1) Modbus RTU cable entry hole. Installer runs the site network Modbus RTU cable through the Modbus RTU hole and connects it to the Accumulator PCB in the Comm Box.
- (1) or (2) Ethernet ports (IN/OUT):
 - (1) port if a protocol converter is installed for SNMP.
 - (2) ports if a protocol converter is installed for Modbus TCP/IP.
- (1) USB port for connecting a PC to perform BCMS Setup.

With input power source monitoring, (3) fuses are also installed on the power feed to protect PCBs while monitoring power input power phases (ABC).

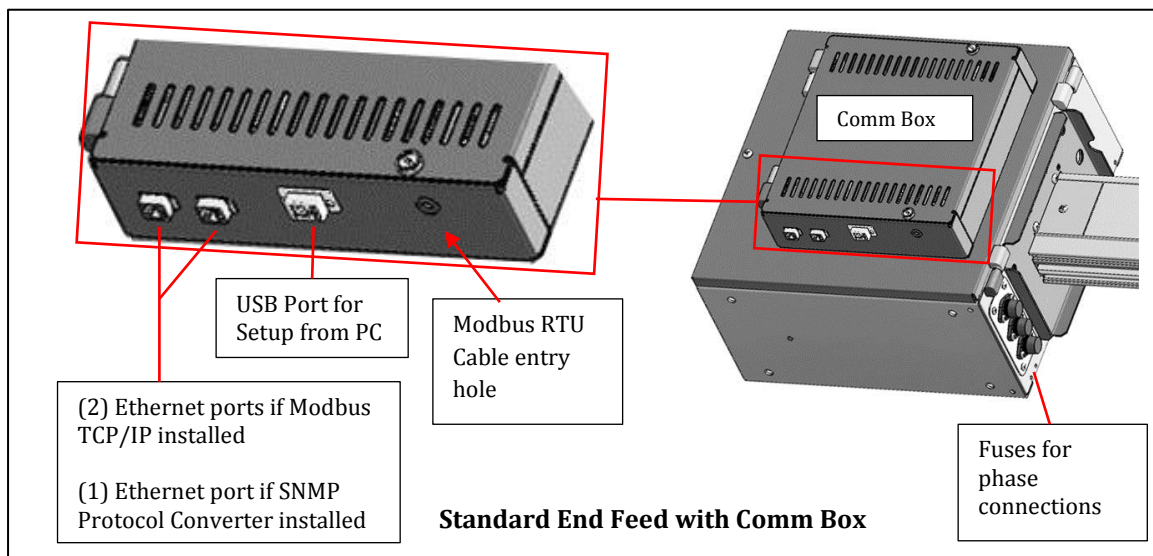


Figure 1 Customer Network Connections on Comm Box

2.2 Making a Modbus RTU Connection

To present monitoring data to an upstream Modbus master, such as a BMS, BCMS Hub, or the 7-inch Local Display, you must connect your upstream Modbus RTU cable directly to the **Accumulator PCB**. This is the only network connection that requires you to open the Comm Box.

Figure 2 Attach Modbus RTU Cable to Accumulator

Attach Modbus RTU Cable to the Accumulator PCB in the Comm Box	
<p>1. Open the Comm Box door.</p> <p>Unscrew the captive screws on the Comm Box door and open the door.</p> <p>The door swings up to 180°.</p>	
<p>2. Locate the Accumulator PCB in the Comm Box.</p> <p>The Accumulator PCB is in the bottom right corner of the Comm Box.</p> <p>Note: If Modbus TCP/IP or SNMP is a selected option, a protocol converter is installed as shown.</p> <p>When either option is selected, you cannot connect a Modbus RTU cable to the Accumulator PCB because the protocol converters and the Modbus RTU cable use the same J5 connection on the PCB.</p>	
<p>3. Run your network Modbus RTU cable through the Modbus RTU cable entry hole on the bottom of the Comm Box.</p>	

Attach Modbus RTU Cable to the Accumulator PCB in the Comm Box

4. Connect your Modbus RTU cable to the Accumulator PCB at **J5**.

Accumulators can be daisy-chained using **J5-J6** connections.

(See Section 2.3.1, **Daisy-chaining Power Feeds using Modbus RTU**.)

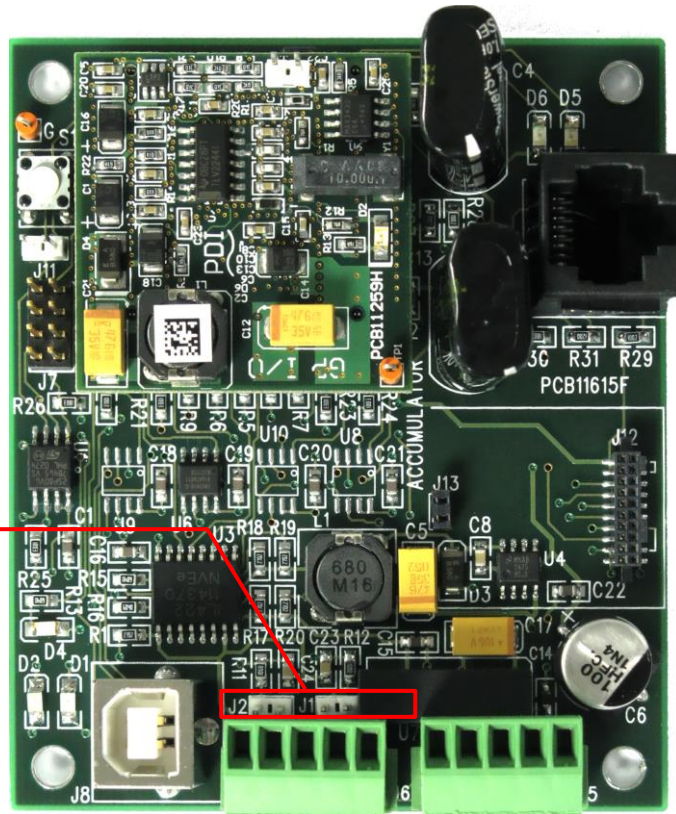
5. Set 4-wire or 2-wire Modbus RTU.

4-wire Modbus RTU is the default configuration.

For 2-wire Modbus RTU install jumpers on **J1** and **J2**.

If Accumulator PCBs are daisy-chained together, Modbus RTU will be 2-wire if jumpers are installed on **J1-J2** on any Accumulator PCB in the chain.

Accumulator PCB is shown here rotated 180° from its orientation in the Comm Box.



J6: G RX⁻ RX⁺ TX⁻ TX⁺

J5: G RX⁻ RX⁺ TX⁻ TX⁺

J6 is input from another daisy-chained Accumulator PCB.

J5 is output to a Modbus master device, such as a BMS or DCIM system or a 7" Local Display, or to another Accumulator PCB.

2.3 Daisy-chaining Power Feeds

It is often desirable to daisy-chain a cluster of nearby power feeds to consolidate data presentation onto a single uplink. Power feeds can be daisy-chained using Modbus RTU or Modbus TCP/IP. All power feeds must use the same upstream protocol. Power feeds cannot be daisy-chained using SNMP.

2.3.1 Daisy-chaining Power Feeds using Modbus RTU

When your upstream network link is Modbus RTU, power feeds are daisy-chained together by daisy-chaining their Accumulator PCBs. Up to (32) Accumulator PCBs (or power feeds) can be daisy-chained

together. However, the total number of devices in the chain—power feeds and Tap Off boxes—cannot exceed the Modbus limit of 247 total devices.

An Accumulator has two (2) RS 485 connectors for Modbus RTU device chaining (see Figure 2, Steps 4-5 and Figure 3). For chaining Accumulators:

- **J5** is the upstream connection to the next Accumulator PCB or to the upstream Modbus master device.
- **J6** is the downstream connection to the previous PCB in the chain.

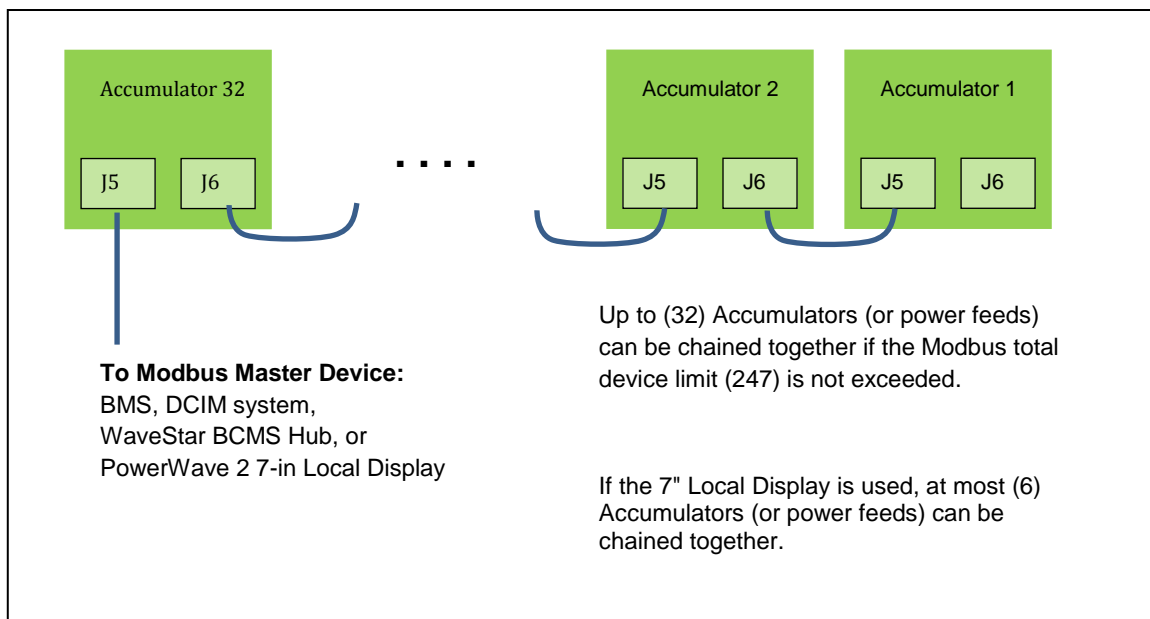


Figure 3 Daisy-chaining Accumulators

2.3.2 Daisy-chaining Power Feeds using Modbus TCP/IP

You can daisy-chain up to (32) power feeds with Modbus TCP/IP using the (2) Modbus TCP/IP Ethernet ports on the Comm Box (see Figure 1).

2.4 Tap Off Box Connections

If you have selected Tap Off Box monitoring, then each Bus Rail, Elbow, and Tee in the bus run will have a Communications Cable installed. The Communications Cable carries 24VDC and Modbus communication for Tap Off Box BCMS (see Figure 4).

See *PowerWave 2™ Bus System, 250A-800A, Installation and Operation, PM375106* for instructions on inserting Tap Off Boxes into a Bus Rail. To connect the Tap Off Box to the Communications Cable, connect the monitoring cable from the left side of the Tap Off Box to the Bus Rail (see Figure 4). The connection to the Communications Cable is the same for all generations of Tap Off Boxes. However, the Quick Connect Tap Off Box has a USB cable that must first be connected to an adapter (Figure 5).

IMPORTANT! Tap Off Boxes should be inserted in the bus run during setup to correctly identify and address the units. Alternatively, you can install Tap Off Boxes, but delay connecting the Tap Off Box Communications Cable to the Bus Rail until setup. See Chapter 3, “BCMS Setup: Accumulator Application,” in this manual.

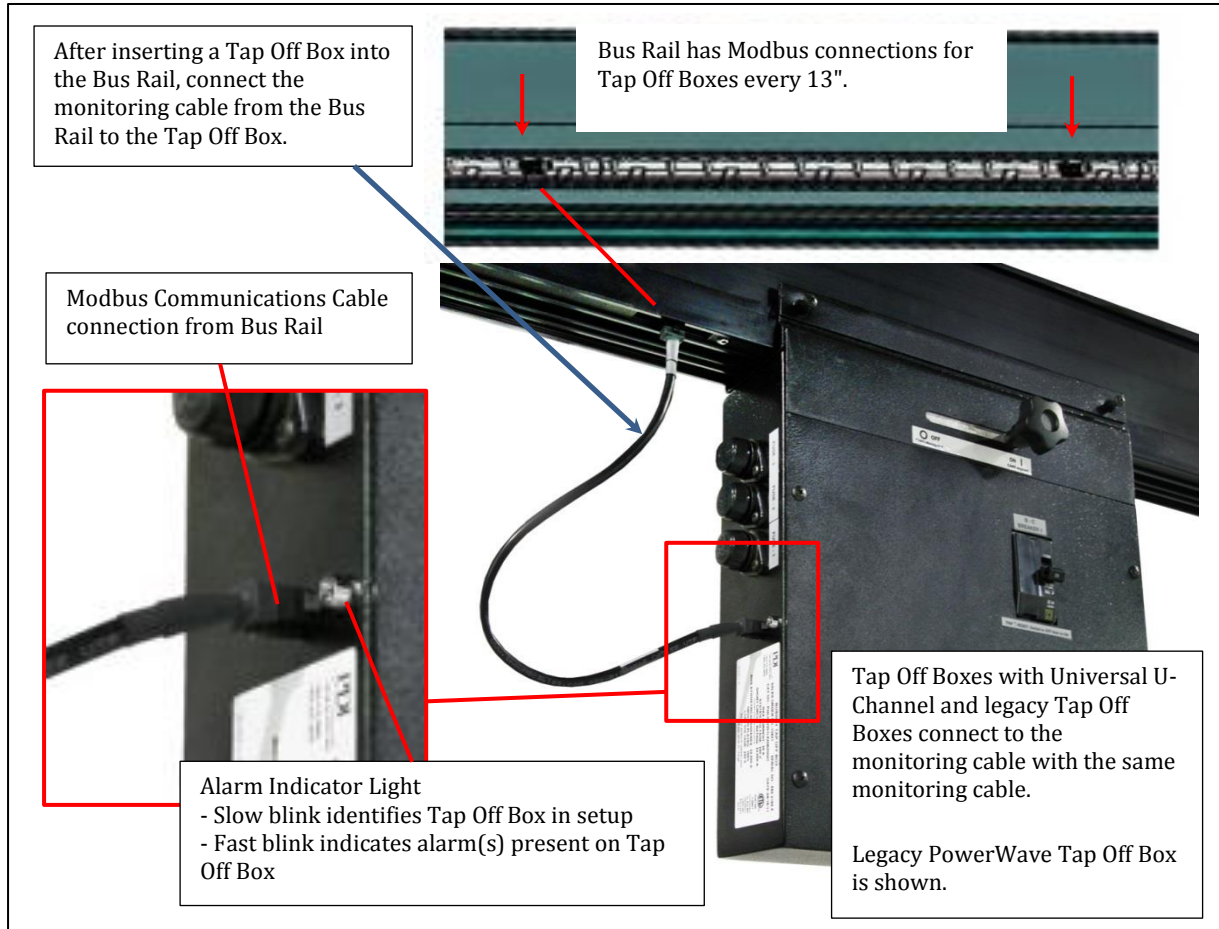


Figure 4 Tap Off Box with Bus Rail Monitoring Connection

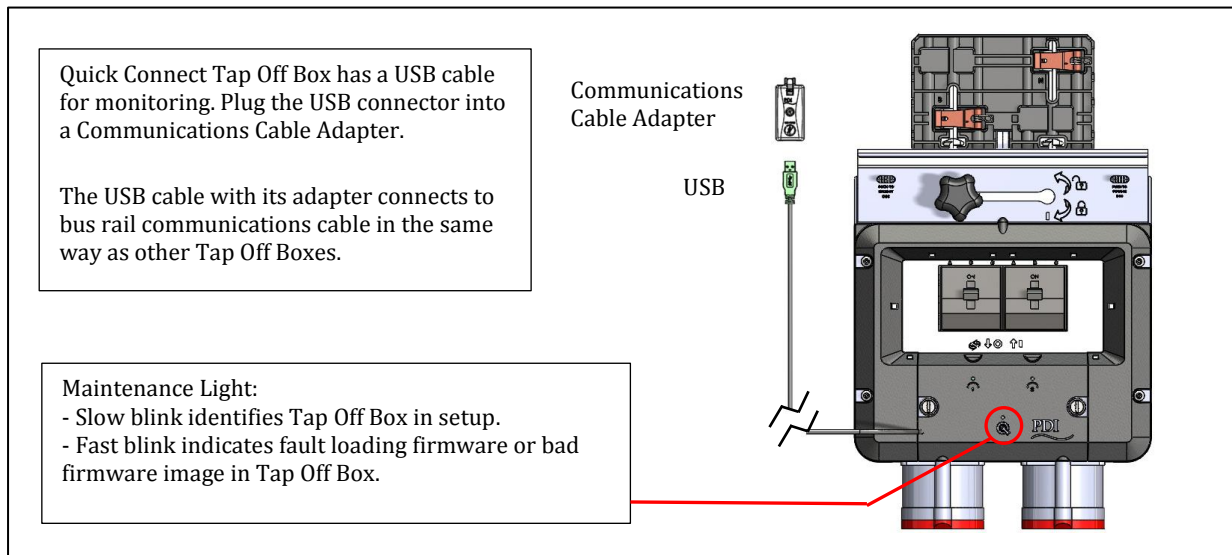


Figure 5 Quick Connect Tap Off Box Monitoring Cable

3 BCMS Setup: Accumulator Application

The **Accumulator Setup** Application lets you identify, define, and calibrate monitored devices in a bus run. A “device” is a monitored unit or connection that is represented by a points list. PowerWave 2 monitored devices are the following:

- The input power source at the power feed.
- Tap Off Boxes (each monitored Tap Off Box has its own points list).

3.1 Download Setup Software and Other Documentation

1. To do busway BCMS setup, you will need the following as prerequisites:
 - a. A PC with Microsoft Windows installed.
 - b. (1) Male A to Male B USB cable sufficient to reach from your PC to the Comm Box on the Power Feed enclosure.
 - c. Setup software and USB device driver:
 - i. Download the software from the PDI website (or use the CD with your shipment):
<http://www.pdicorp.com/services/service-software-downloads>
 - ii. Select **Busway BCMS Customer CD**.

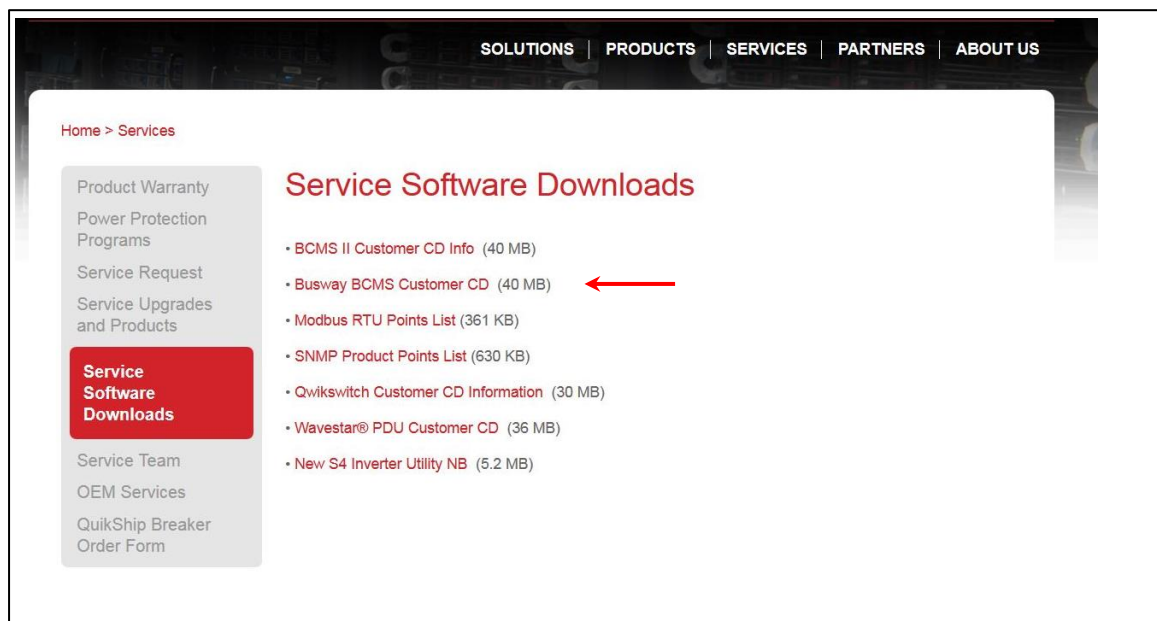
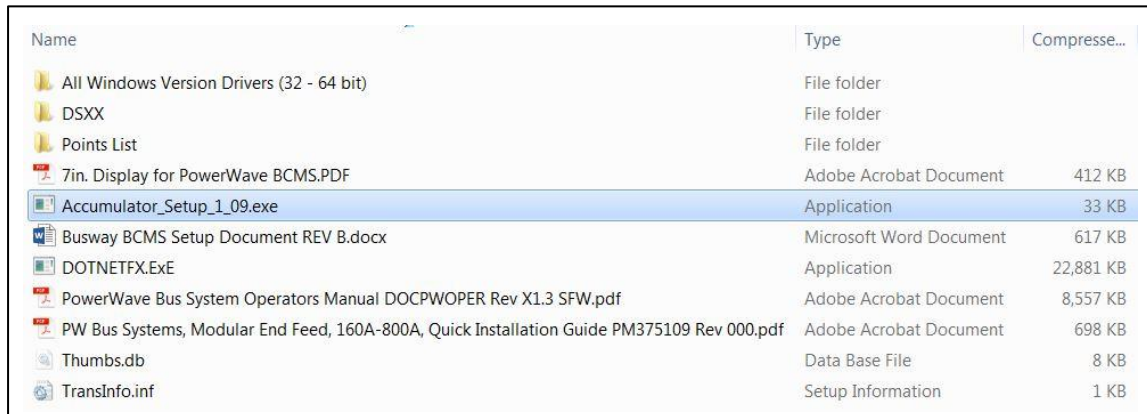


Figure 6 Download Busway Customer CD

2. The Busway BCMS Customer CD is compressed. Extract the contents of the CD to its own directory. The CD includes these files:
 - a. Setup application (Accumulator_Setup_Version)
 - b. Points Lists for input power source monitoring (IN PM) and Tap Off Box monitoring (iBus)
 - c. Documentation

3.2 Start the Accumulator Setup Application

1. Connect your USB cable to the USB connection on the Comm Box. If this is your first time using Setup on this PC, wait for Windows to register the USB device.



Name	Type	Compress...
All Windows Version Drivers (32 - 64 bit)	File folder	
DSXX	File folder	
Points List	File folder	
7in. Display for PowerWave BCMS.PDF	Adobe Acrobat Document	412 KB
Accumulator_Setup_1_09.exe	Application	33 KB
Busway BCMS Setup Document REV 8.docx	Microsoft Word Document	617 KB
DOTNETFX.ExE	Application	22,881 KB
PowerWave Bus System Operators Manual DOCPWOPER Rev X1.3 SFW.pdf	Adobe Acrobat Document	8,557 KB
PW Bus Systems, Modular End Feed, 160A-800A, Quick Installation Guide PM375109 Rev 000.pdf	Adobe Acrobat Document	698 KB
Thumbs.db	Data Base File	8 KB
TransInfo.inf	Setup Information	1 KB

Figure 7 Start the Accumulator Setup Application

2. Start the **Accumulator_Setup (version).exe** application (Figure 7) from the directory to which you extracted the CD files.
 - a. A screen will appear on your PC like the screen in Figure 8 with the **Setup** tab selected. All devices that the Accumulator has found in the bus run are listed on this screen with the device count.
 - b. Possible errors:
 - i. If you get a **DLL error**, you may not have the Microsoft Dot.net core installed.
 - ii. If the message "**Accumulator connected via USB**" does not appear at the top of the application page, you may not have the USB FTDI drivers installed and recognized by Windows.
 - iii. If the message "**No Accumulator found on USB**" appears at the top of the page, you may have disconnected the USB cable.

3.3 Accumulator Setup Application Tabs

The **Accumulator Setup** application has four tabs (Figure 7) that perform the following functions:

- **Setup tab**—set network addresses and parameters
 - Set Modbus network parameters.
 - Manage Tap Off Box positions by address; add, remove, and rearrange Tap Off Boxes along the bus run.
 - Associate devices (input power source and Tap Off Boxes) with Modbus addresses along the bus run.
 - Reserve Modbus addresses for future Tap Off Box additions.
- **iBus Setup tab**—set parameters globally for all Tap Off Boxes on the bus run:
 - Set voltage and current parameters for all Tap Off Boxes globally.
 - Calibrate voltage for all Tap Off Boxes at once.
 - Clear alarms, min/max readings, and KWH for all Tap Off Boxes.
- **Data tab**—set Modbus register values for individual devices
 - Assign name to device

- Set Modbus register values
- Clear individual alarm registers
- Window tab—for use by PDI engineering and service; not for customer use.

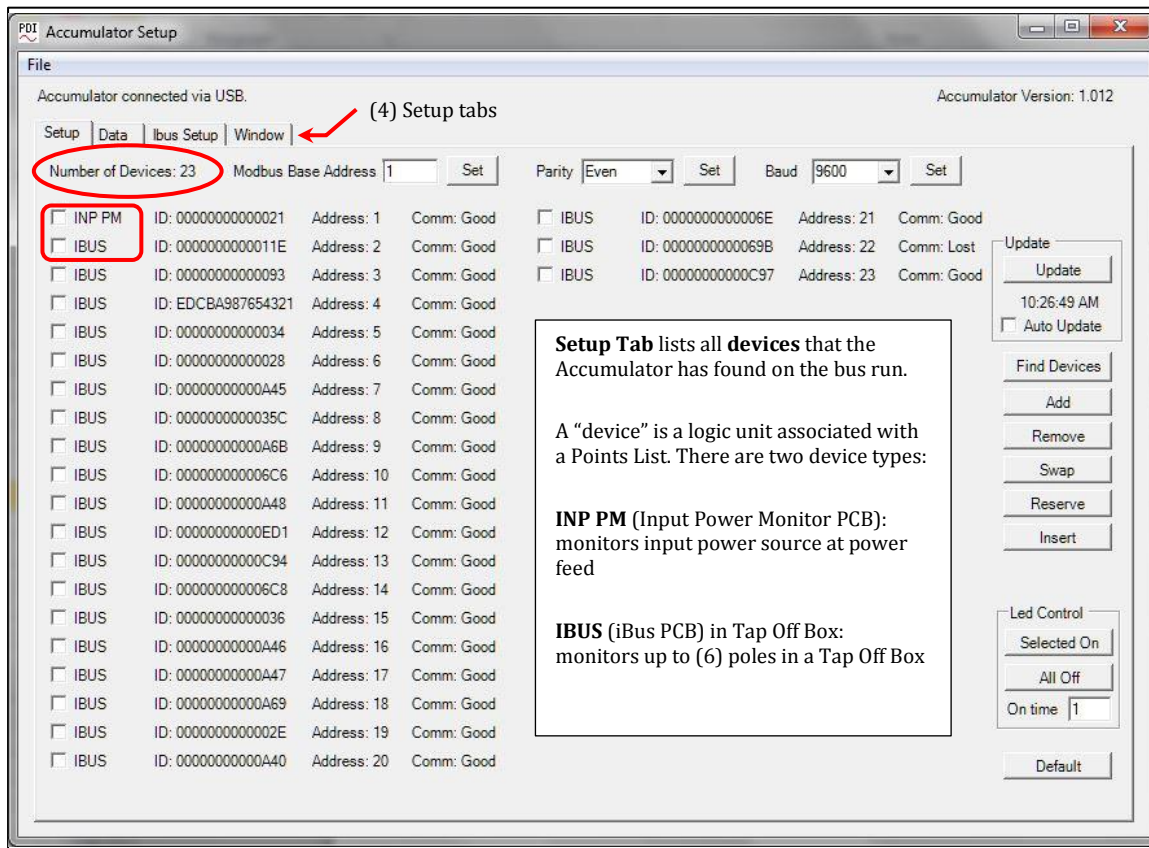


Figure 8 Accumulator Setup: Setup Tab

3.4 Setup Tab

The Setup Tab (Figure 8) lets you identify the monitored devices along the bus run, which are source input power or Tap Off Boxes. Because devices are on a bus, devices are not identified by their order on the bus.

1. Devices are listed by the PCBs that monitor power:
 - a) **Input Power Source:** INP PM = Input Power Monitor PCB. This PCB monitors the input power source. There is only be one of these PCBs.
 - b) **Tap Off Box:** IBUS = iBus PCB. This PCB is in the Tap Off Box and monitors up to (6) poles.
 - c) The Number of Devices = INP PM + IBUS counts, or
 = (0) input power source and ≤ (32) Tap Off Boxes, or
 = (1) input power source and ≤ (31) Tap Off Boxes.
 - d) **Note:** If the bus run is monitored from the 7" Local Display, you are limited to (1) power feed and up to (15) Tap Off Boxes in the bus run. The number of Tap Off Boxes is not increased if you do not monitor the input power source.

	<p>Warning: Connecting more than (32) devices for monitoring on a single bus run may render the monitoring PCBs inoperable.</p>
--	--

2. Devices are listed with these characteristics (Figure 9):

- a) Device type (INP PM or IBUS)
- b) ID = unique device ID (this is not the MAC ID), used to identify the device on the bus run
- c) Modbus address
- d) Comm: Good or Lost (showing whether the Accumulator can communicate with the device)

Device Type	Unique Device ID	Device Modbus address	Comm
<input type="checkbox"/> INP PM	ID: 00000000000021	Address: 1	Comm: Good
<input type="checkbox"/> IBUS	ID: 0000000000011E	Address: 2	Comm: Good
<input type="checkbox"/> IBUS	ID: 0000000000006E	Address: 21	Comm: Good
<input type="checkbox"/> IBUS	ID: 00000000000069B	Address: 22	Comm: Lost

Unique physical device ID is associated with Modbus address.

Comm: Lost indicates that the Accumulator cannot communicate with the device.

Figure 9 Setup Tab: Device Characteristics

3. Set Modbus parameters (Figure 10) for the bus run and the upstream network using boxes in the top row of the Setup tab.

- a) The Modbus Base Address is assigned to the first device in the device list. Other device addresses increment up from this address.
- b) Set network parity and baud rate using drop-down boxes or take defaults.
- c) Addresses are fixed if the bus run is monitored by the PowerWave 2 Bus System 7" Local Display. See the Setup Screen on the display for address requirements. See section **4.4 Modbus Addresses with Local Display**.

Number of Devices: 23	Modbus Base Address <input type="text" value="1"/> <input type="button" value="Set"/>	Parity <input type="text" value="Even"/> <input type="button" value="Set"/>	Baud <input type="text" value="9600"/> <input type="button" value="Set"/>
Modbus address of first device in bus run		Network parameters	

Figure 10 Setup Tab: Modbus Parameters

3.4.1 Finding New Devices on the Bus Run

During setup, the Accumulator searches the bus for new physical devices every 30 seconds.

Click **Find Device** to force an immediate search for new devices. When you are adding Tap Off Boxes, **Find Device** can save you a few seconds getting the device recognized by the Accumulator.

3.4.2 Updating Setup Information

Click **Update** to update all information including new devices and data from the points list for each device.

Check **Auto Update** to have the Accumulator update data every (2) seconds.

Note: Turn off **Auto Update** if you are calibrating voltage or physically configuring the bus run. **Auto Update** can clear or modify data you are entering.

3.5 Setup Tab: Identifying Devices on a Bus Run

3.5.1 Addressing on a Bus

As you add devices to the bus run, Setup assigns Modbus addresses sequentially starting at the specified Modbus base address. The Accumulator can service up to (32) Modbus addresses on the bus run. For example, if the Modbus base address is 64, devices are assigned addresses in sequence: 64, 65, 66, ..., up to a maximum address of 95. There are no gaps in the address list.

The physical order of devices on a bus does not identify them:

- The communication connections along the Bus Rail simply provide a connection into the bus; they are of no importance in assigning addresses.
- A device is identified by its ID and associated in Setup with a Modbus address.
- A Tap Off Box, once identified to the Accumulator by its ID, can be plugged into any bus rail connector and will have the same Modbus address.

Note: If you are using the PowerWave 2 Bus System 7" Local Display, the Modbus addresses of your bus runs have predetermined base addresses and address ranges. See section **4.4 Modbus Addresses with Local Display**.

3.5.2 Setup Device Designations

An Accumulator can monitor (32) Modbus addresses, and each address has one of four designations:

- **INP PM** (input power monitor PCB in end feed): There will be (1) **INP PM** per power feed, if input power source monitoring is selected, or (1) per bus run.
- **IBUS** (iBus PCB in a Tap Off Box): There is (1) **IBUS** for each Tap Off Box that has BCMS monitoring.
- **Reserved.** A **Reserved** device takes one of the (32) address positions in the Accumulator, even though there is no physical device for this position.
- **No Device.** A Modbus address that has no associated physical device, is available for assignment, and is not **Reserved**. When a new physical device (Tap Off Box) is installed, the first available **No Device** address is assigned to it. (Note: This is a Modbus address, not a physical Modbus

connection on the Bus Rail. A new Tap Off Box can be plugged into any available Modbus connector and will be assigned the first available **No Device** Modbus address.)

To monitor (32) physical devices, you cannot have **Reserved** or **No Device** designations in the bus run, once all devices are identified.

When you insert a new Tap Off Box into the bus rail, Setup replaces the first available (lowest address) **No Device** position with an **IBUS** entry for the Tap Off Box. If a **No Device** address is not available, Setup assigns the next sequential Modbus address at the end of the existing address list.

3.6 Setup Tab: Manipulating the Device List

Setup creates the initial device list from the devices it recognizes when it first starts up. Each device will have a Modbus address associated with the ID of the device (assigned during manufacturing).

Recommendation: To better control assignment of Modbus addresses to Tap Off Boxes, do not connect the Tap Off Box monitoring cable to the bus rail until you are ready to assign its address. This will allow you to assign addresses one-by-one in sequence.

3.6.1 Add, Remove, or Swap Devices

Use the buttons on the right side of the Setup Tab screen to add, substitute, swap, or remove devices from the Modbus address list.

“No Device” Entries

A **No Device** entry has a Modbus address, but has no physical device. A **No Device** entry can be replaced by a new device, usually a Tap Off Box or iBus PCB.

- **Insert** Check a device box. Click **Insert** to add a **No Device** entry before the checked device. The Modbus address of every device after the insertion point is incremented by 1.
- **Remove** Check the box for the device to be removed. **Remove** changes this address location to **No Device**:
 - Reserved → No Device
 - IBUS → No Device
 - IN PM → No Device
 - No Device → Deleted Modbus address (**Remove** deletes the address only if **No Device** is the last device in the list. **Remove** has no effect if **No Device** is not the last entry in the address list.)

“Reserved” Entries

- **Add** Adds a new **Reserved** device at this address. This relative address in the device list will be unavailable for use until its status is changed to **No Device**.
- **Reserve** Check the box next to a **No Device** entry.
- **Reserved** addresses must be changed to **No Device** to be available for assignment.

Swap Check two boxes in device list. Click **Swap** to swap the address of the two devices, and hence change their positions in the list.

3.6.2 Identify Tap Off Boxes with Blinking LED

During Setup, to help you locate the Tap Off Box associated with an address, you can set the Alarm LED blinking for up to (2) Tap Off Boxes. Check the box(es) for the specified IBUS unit(s) and click **Selected On** in **Led Control** (Figure 11).

Typically, you will identify one unit only. But if you are swapping Tap Off Boxes, you may wish to select (2) devices.

The Alarm LED (or Maintenance LED on Quick Connect Tap Off Box) on selected Tap Off Box(es) will blink slowly. (When a Tap Off Box has an alarm, the LED blinks faster.) See Figures 4-5 for LED locations.

To stop the blinking, click **All Off**.

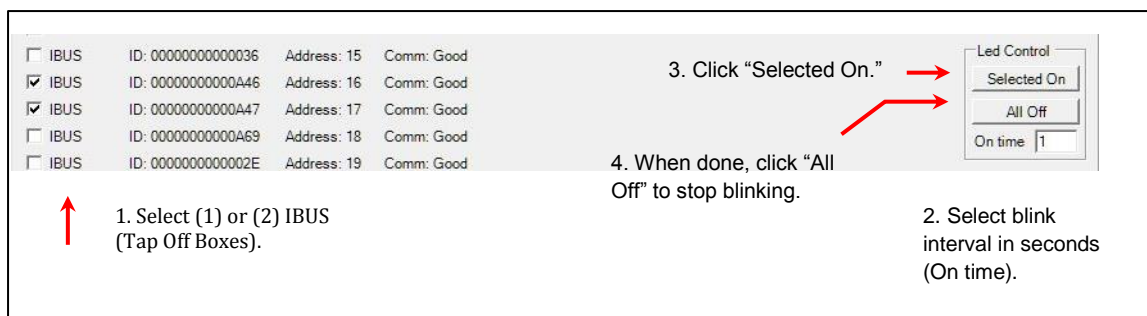


Figure 11 Setup Tab: Identify Tap Off Boxes with Blinking LEDs

3.7 Ibus Setup Tab: Global Settings for Tap Off Boxes

Use the **Ibus Setup Tab** to set electrical characteristics for all Tap Off Boxes in the bus run (Figure 12). After setting global parameters, you can set parameters for individual Tap Off Boxes using the **Data Tab** (see section 3.8 Data Tab).

3.7.1 Set Electrical Characteristics for All Tap Off Boxes

Set Voltage Type: Click the drop-down box to choose a standard AC voltage, such as 208, 400, or 575.

Voltage Settings automatically changes you check an option, for example, **Voltage Enabled**. Check these boxes as appropriate:

- **Voltage Enabled:** Check box to have monitor voltage in addition to current on Tap Off Boxes.
- **Frequency:** Check **50Hz** if 50 Hz frequency; leave the box unchecked if 60 Hz.
- **Blink Led:**
 - Check to turn on for all Tap Off Boxes (useful to check LEDs on all units).
 - Uncheck to turn off LED blinking for all Tap Off Boxes (useful to turn off previous selections, making sure all LEDs are off).
- Un-check **Blink Led** to make turn off blinking on all Tap Off Box LEDs. This essentially resets the LEDs on all Tap Off Boxes. Turn **Blink Led** on to test the LEDs.

Next to **Voltage Type** is **Set Settings**: Click **Set Settings** to accept the listed settings.

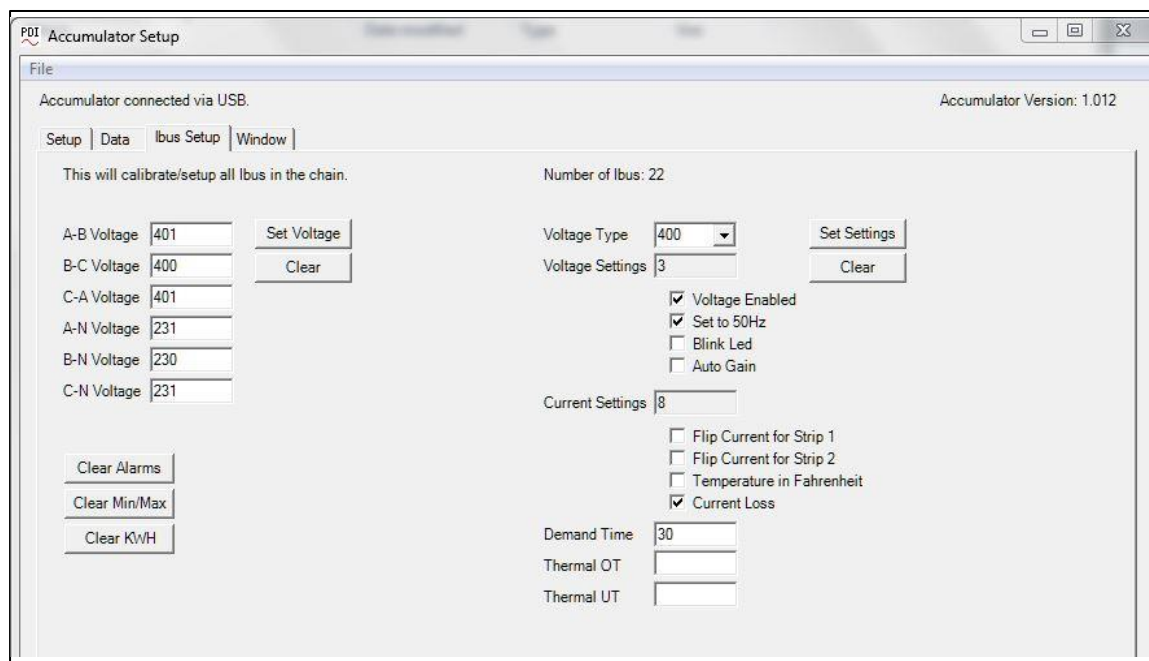


Figure 12 IBus Setup Tab

3.7.2 Calibrate Voltage for the Bus Run

Voltage is uniform throughout the bus run. To calibrate actual voltage, measure voltage with a voltmeter at the power feed's Starter Rail: A-B, B-C, C-A, A-N, B-N, and C-N. Enter the data in the corresponding boxes.

- Click **Set Voltage** to enter these measurements into the point list for all Tap Off Boxes.
- Click **Clear** to blank all fields on this setup page and re-enter data.

If calibration data is not entered, the standard voltage from the voltage type is used.

These buttons clear Alarms, Min-Max Measurements, and KWH accumulations during setup:

- Clear Alarms
- Clear Min/Max—sets the minimum and maximum current measurements to the most recent current measurement value.
- Clear KWH—sets KWH accumulation to 0.

You should clear these values when exiting setup to set the monitoring system to an initial production state. You can also clear any of them for testing during setup.

3.7.3 Current Settings

You can set current options in register 78 in the iBus (Tap Off Box) points list. Check the following boxes on the IBus Setup screen to set the corresponding bits to **on** in register 78, Current Option Setting:

- Flip Current for Strip 1: Tap Off Boxes have (2) CT strips, each measuring current on (3) poles. If CTs are attached to 3-phase ABC (L1-L2-L3) circuit wires in reverse order (CBA), check this box to correctly align measurements with circuits on CT strip 1.

- Flip Current for Strip 2: Check this box to reverse the 3-phase current measurements on strip 2 from ABC to CBA.
- Temperature in Fahrenheit: measurements and alarm thresholds will be given in Fahrenheit, rather than in the default Celsius.
- Current loss: Check this box to enable the Current Loss Alarm. When an active circuit (defined as a circuit that has measured over 1.5A) goes to a 0A measurement, an alarm for Current Loss is raised.

Other settings:

- Demand Time: Demand is the current (amperage) measurement, averaged over a time period. Set the number of minutes over which demand is averaged.
- Thermal OT: Do not set this value, which is the over-temperature alarm threshold for the iBus PCB. Use the default value of 80°C.
- Thermal UT: Do not set this value for under-temperature alarm for the iBus PCB.

3.8 Data Tab

While the IBus Tab sets uniform global values for all Tap Off Boxes in the bus run, the Data Tab lets you set values in the points list of each device individually (Figure 13).

Each device, both the single Input Power Monitor (Input PM) PCB and all IBUS (Tap Off Box) PCBs, has its own points list, which can be displayed and modified in the **Data Tab**. The **Data Tab** lets you display and change data for each point or Modbus register in a specific points list.

How to change a point or Modbus register:

1. Click the **Data Tab** to access the points list (Modbus register map) for a specific device. The screen will show the selected device and its points list. The device is identified by device type (either the input power source at the power feed (**INP PM**) or a Tap Off Box (**IBus**), device unique identifier, and its Modbus address.
2. **Select a device.** Click the top drop-down box to select a device by its Modbus address.
3. The points list for this Modbus address will be shown in the large points-list window. Modbus registers (points) are listed in sequential order with point name and current value of the point.
4. Device with address 1 is usually the **Input Power Monitor (INP PM)**. The remaining devices are Tap Off Box devices, shown as **IBUS**, the PCB containing the Tap Off Box points list.
5. The currently selected register in the points list is also shown in the **Write to Modbus** box.
6. **Select a point.** Scroll through the device's points list. Click to highlight a point to display and/or modify. The point is displayed in **Write to Modbus**.
7. **Modify the point data.**
8. You may wish to change several points. When satisfied with modifications, **save changes** to EPROM by clicking **Save Memory**.

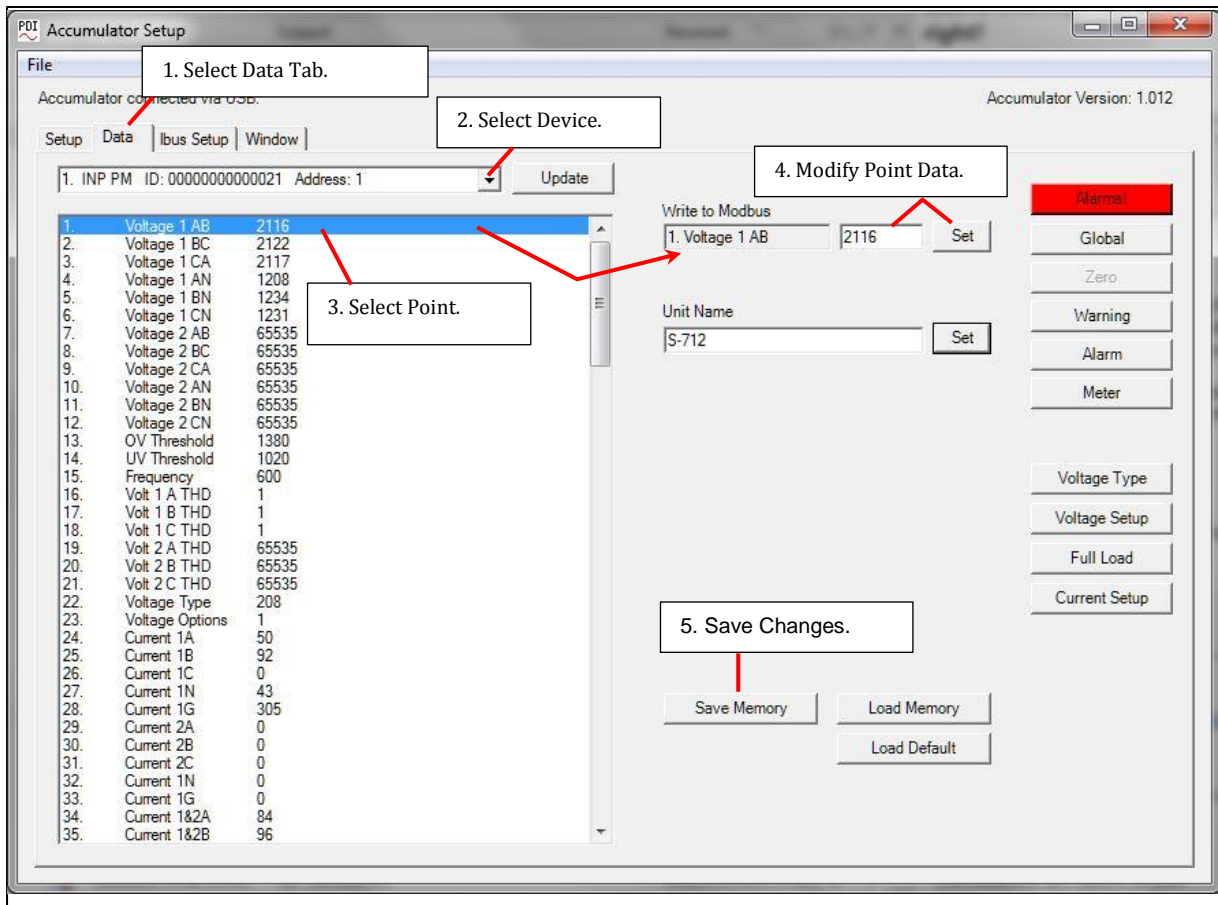


Figure 13 Setup: Data Tab Basic Operations

3.8.1 Set Unit Name

Enter the device name in **Unit Name**, up to (16) characters, then click **Set**. **Unit Name** is a contiguous group of (8) 2-byte Modbus registers in the points list (Figure 14). It is easier to enter the name here than to set individual register values.



Figure 14 Setup Data Tab: Enter Device or Unit Name

3.8.2 Setting Point Values and Clearing Alarms

You can set point values or clear alarms from the Data Tab screen (Figure 15).

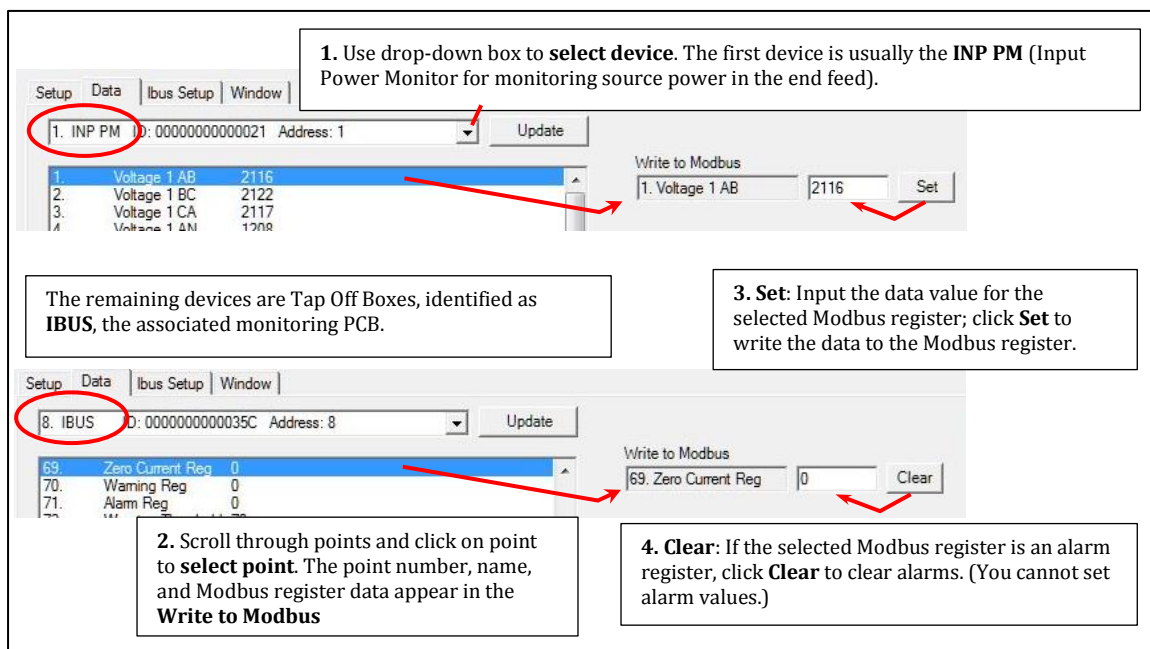


Figure 15 Setup Data Tab: Selecting and Changing Specific Point Values

3.8.3 Option Registers

Common option registers have their own buttons, which display option bit values. Setting bit values this way is easier and less prone to error than combining the bit values into a number yourself (Figure 16).

1. Click an option register button to display its point values.
2. Option registers are bit-oriented. Check the option values you want. They will be written to the **Write to Modbus** data field.
3. The bit-values as combined in the Modbus register are in the **Write to Modbus** data field.
4. Click **Set** to store the values.

(Values are saved, but must be separately saved in EPROM to make them permanent.)

Figure 16 Setup Data Tab: Setting Option Register Values

3.8.4 Interacting with EPROM

Data is not permanently saved until you write it to EPROM memory! (Figure 17)

Click **Save Memory** to write points list to EPROM.

Click **Load Memory** to write registers from EPROM. This is effectively a "Cancel" operation, returning you to your last memory save.

Click **Load Default** to set all points to default values. You are starting over by selecting this option.

Figure 17 Setup Data Tab: Saving or Rejecting Point Changes

4 7-Inch Local Display

A PowerWave 2™ Bus System can be monitored from an optional 7-inch Local Display, which has these characteristics:

- 800 x 480 LED backlit color LCD display with a resistive touch screen interface.
- Wall-mountable.
- Modbus RTU protocol.
- Optional upstream Modbus TCP/IP with Ethernet connection.

The 7" Local Display functions as a local monitoring hub:

- The Local Display can display power information for up to (6) PowerWave 2™ Bus System bus runs (Figure 18).
- Each monitored bus run can have up to (1) power feed and up to (15) Tap Off Boxes per power feed, for a total of (96) devices for a single Local Display. (Note: All power feeds are designated “end feeds” in this application. “End feed” is used for both Standard End Feed and Center Feed.)
- The Local Display can pass monitoring data through to the Building Management System or other upstream Modbus master devices.

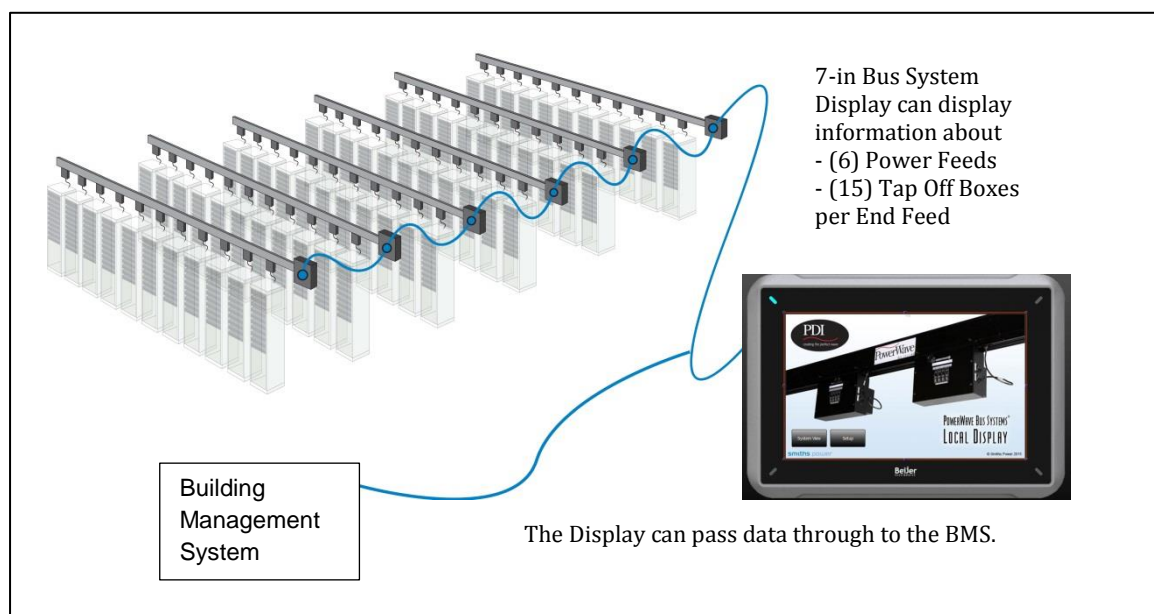


Figure 18 7-in Local Display with Six Bus Runs

The 7" Local Display displays these power feed and Tap Off Box power parameters:

- Power Feeds, Input Source Power:
 - Voltage - L-L, L-N, THD%, Frequency
 - Current - (3) phases, N, G, Max., Demand, Crest Factor
 - Power - kW, kVA, kVAR, PF, kWh[A], kWh[B], kWh[C]
 - Percent Load - (3) phases
- Tap Off Boxes:
 - Voltage - L-L, L-N, THD%, Frequency
 - Current - (3) phases, N, G, Max., Demand, Crest Factor, for all poles
 - Power - kW, kVA, kVAR, PF, kWh[A], kWh[B], kWh[C] for all poles

- Percent Load – (3) phases for all poles (Total load is defined by the user in the points list.)

4.1 Customer Connections

The customer makes power and networking connections to the Display Interface Board and to the base of the Local Display.

4.1.1 Mounting and Opening Enclosure

See Figure 19:

1. The 7" Local Display can be wall-mounted.
2. Remove the Philips retaining screw on the left side of the display enclosure. Open enclosure to access the interface board.
3. For cable entry, remove the plug on the bottom right of the enclosure.

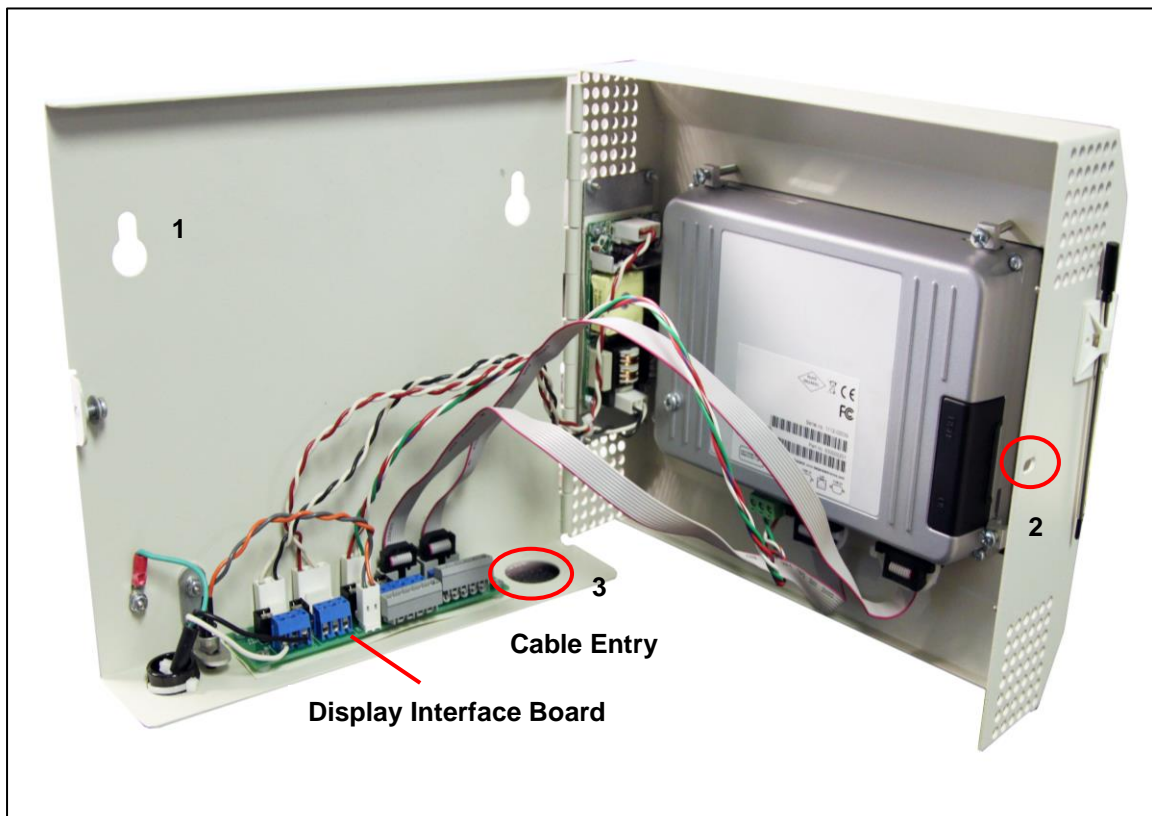


Figure 19 7-in Local Display Enclosure Opened, Rear View

4.1.2 Customer Power Connections to Display Interface Board

The Local Display accepts 120VAC (1P) or +24VDC power input at TB1 and TB2 on the Display Interface Board. Connections are labeled on the board (Figure 20).

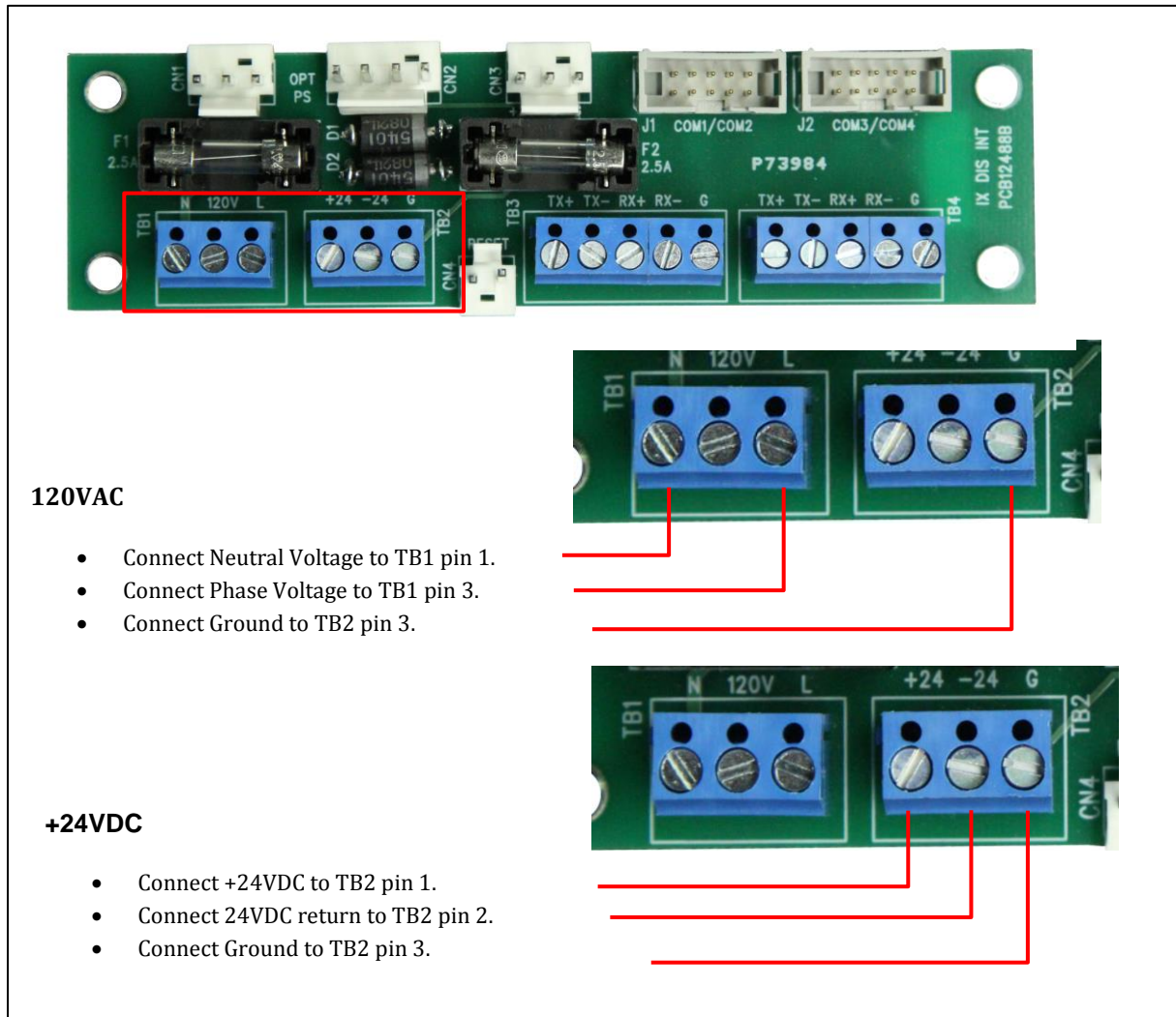


Figure 20 Customer Power Connections to Display Interface Board

4.1.3 Modbus Network Connections

Modbus RTU connections are also made to the Display Interface Board (Figure 21):

- **Upstream Modbus** connection is to Modbus master device, such as a BMS or DCIM system
- **Downstream Modbus** connection is to the Accumulator PCB in the power feed of the first (nearest) bus run in the monitored chain.

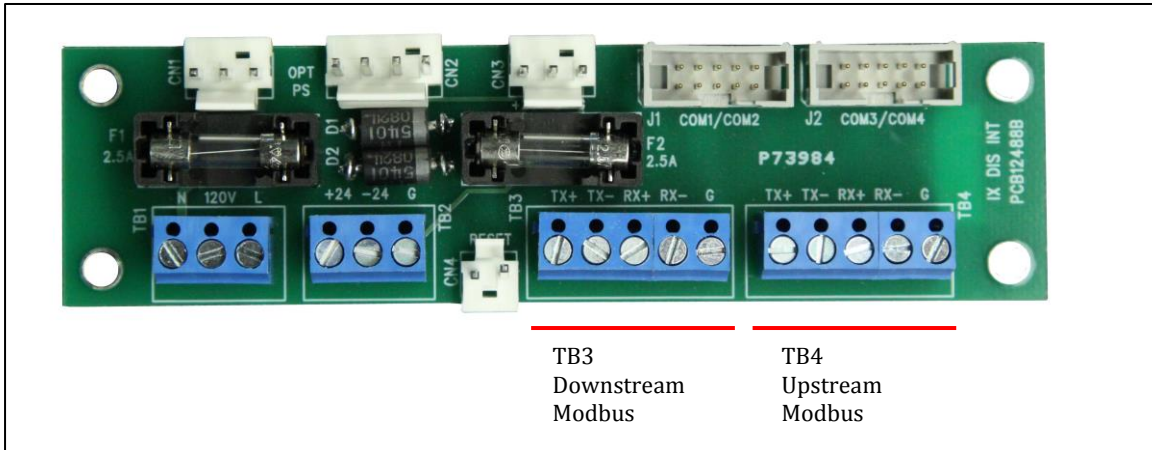


Figure 21 Customer Modbus Connections

4.1.4 Modbus TCP/IP Network Connection

As an optional feature, Modbus TCP/IP can be used **upstream** of the Local Display. It requires an Ethernet connection and a front-end protocol converter. The Ethernet connection is made directly to the Local Display (Figure 22). (Connections downstream of the Display to the bus runs remain Modbus RTU connections.)

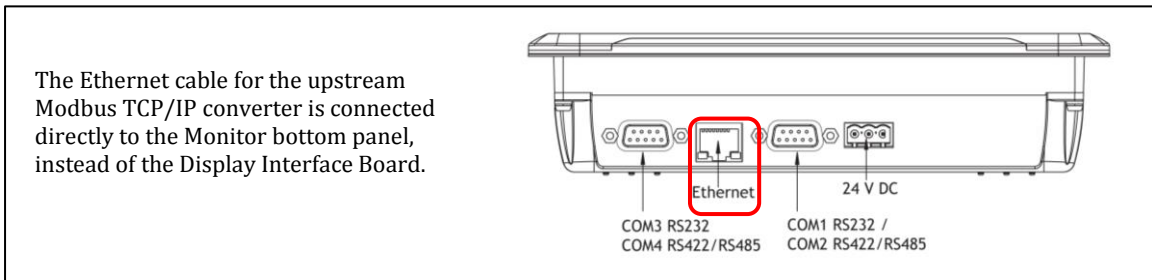


Figure 22 Local Display Ethernet Connection for Modbus TCP/IP

4.2 Home Screen

The **Home Screen** appears when the Local Display is powered on and initialized (Figure 23).

Touch **System View** to see the main operational screen for monitoring power.

Touch **Setup** to set Local Display parameters



Figure 23 Home, Setup, and System View Screens

4.3 7-in Local Display Setup

Touch the **Setup** button on the **Home** Screen to bring up the **Setup** Screen (Figure 24).

There are buttons displayed for several tasks that initialize the Local Display’s environment.

Note: On all 7" Local Display screens, “End Feed” can refer to any power feed (Standard End Feed or Center Feed).

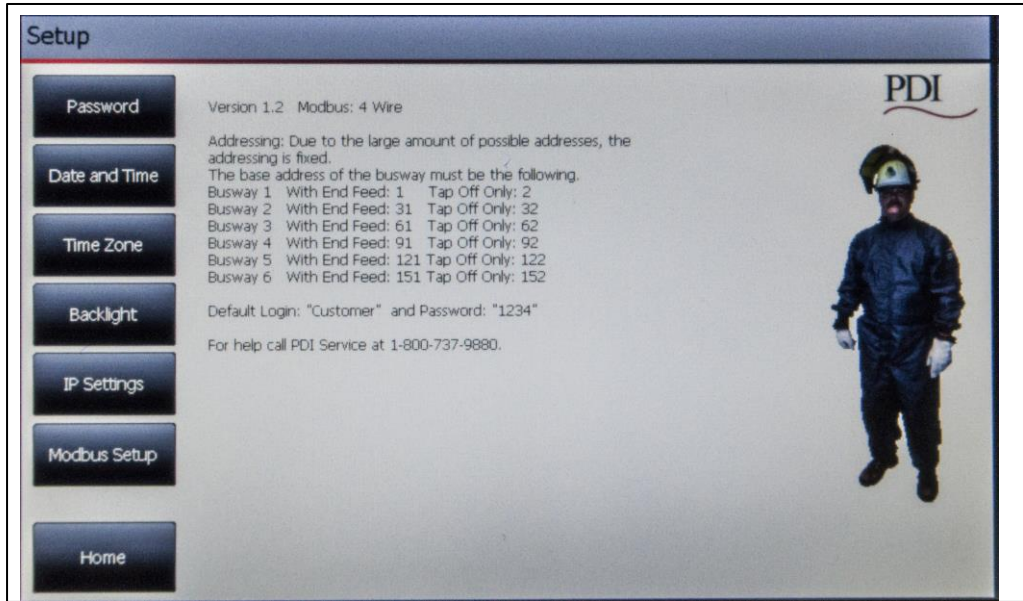


Figure 24 Setup Screen

4.3.1 Login

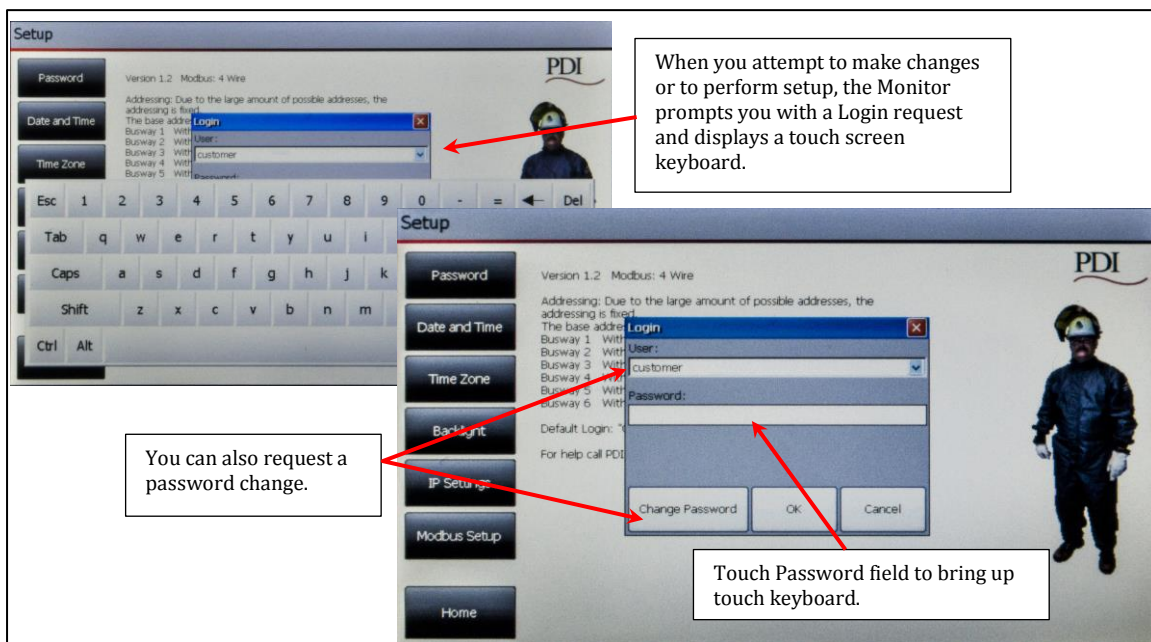


Figure 25 Login and Password Change

When you attempt to make changes or to perform setup, the Local Display prompts you with a Login request (Figure 25) and displays a touch screen keyboard. Enter the **default ID** from the **Setup** screen. Touch the password field to bring up the touch keyboard. You will then be prompted for the **password**. The initial default password is shown on the **Setup** screen.

4.3.2 Setup Screen Buttons

Buttons on the **Setup** screen let you set parameters for the Local Display and network. Usage is mostly self-explanatory (Figure 26).

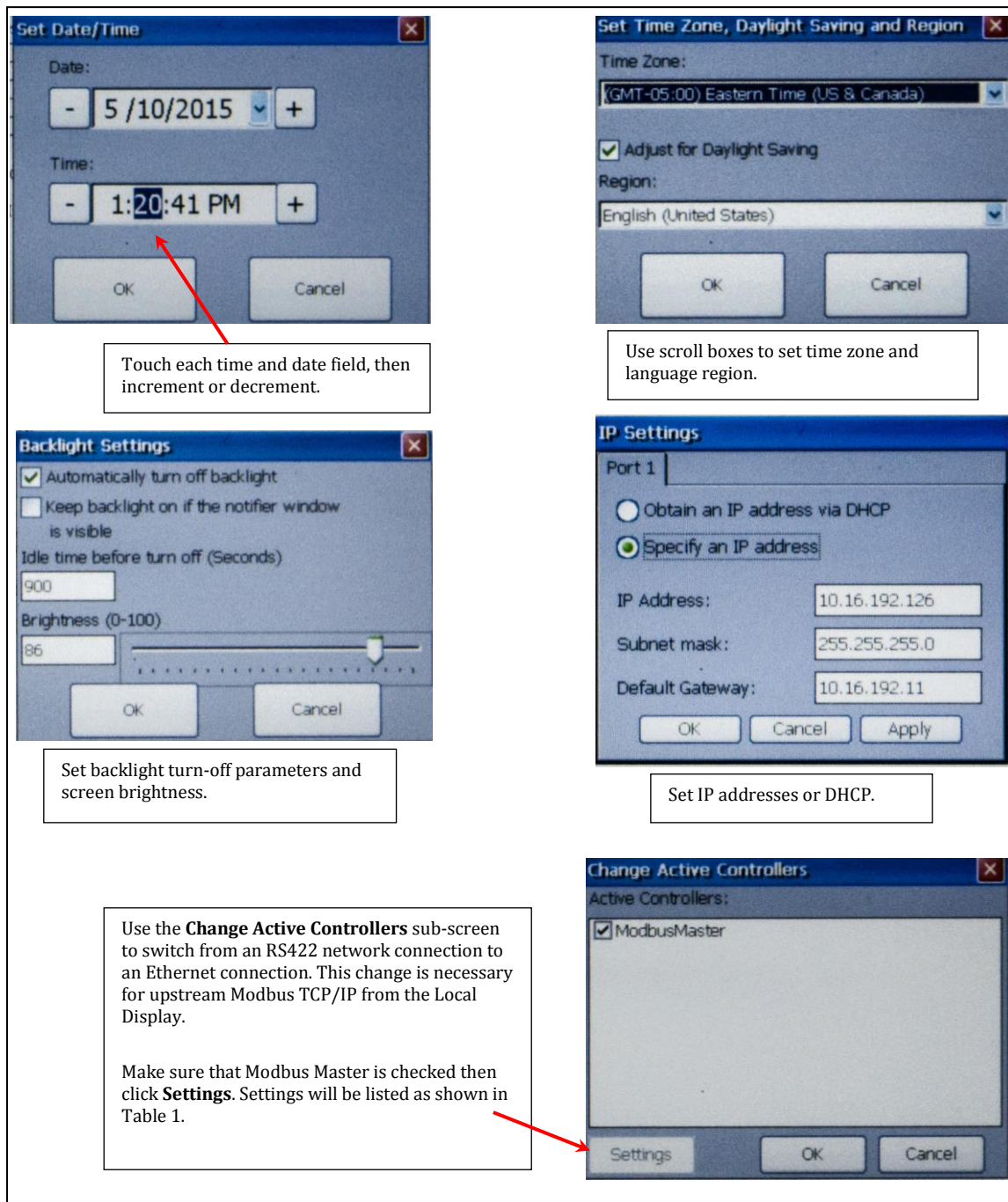


Figure 26 Setup Options

4.3.3 Setting Parameters for Upstream Modbus TCP/IP

1. On the SETUP screen press the “Modbus Setup” button.
2. Enter User ID and Password and press the “Modbus Setup” button again.
3. From the CHANGE ACTIVE CONTROLLER screen, select “Modbus Master” so it is highlighted, and press “Settings” button. The screen will show Modbus settings like those in Table 1.
4. To change from RS422 to Ethernet, change the “Communication” box under Routing from “Serial” to “TCP” or vice versa.
5. Press OK on Properties Box. (Scroll screen to see box if necessary.)

6. Press OK on Change Active Controller box.
7. Press OK on Project Must Restart.
8. Press Reset button on bottom left of the Local Display enclosure.
9. Wait for Local Display to reboot.

Table 1 Modbus Settings

MODBUS MODE	VIA RS422	VIA ETHERNET
Settings		
- Communication Mode	Serial	Serial
- Default Station	1	1
- Modbus Protocol	RTU	RTU
- 32bit Work Mapping	Motorola	Motorola
- Addressing	Decimal	Decimal
- Start Address	1-based	1-based
- Max Block Size (words)	16	16
- Force Function Code 0x10	Disabled	Disabled
- String Swap	Disabled	Disabled
- Silent Time (ms)	1	1
- Clock Register	0	0
- Serial		
- Port	Com2	Com2
- Baud	9600	9600
- Parity	Even	Even
- Data bits	8	8
- Stop bits	1	1
Advanced		
- Enable Unicode	False	False
- Byte Order	Intel	Intel
- Timeout	400	400
- Retries	3	3
- Offline station retry time	10	10
- Hide Comm. Error	False	False
- Command Line Option		
Routing		
- Communication	Serial	TCP
- Mode	Transparent	Transparent
- Timeout	5s	5s
- Serial Port	Com4	Com4
- Baud	9600	9600
- Parity	Even	Even
- Data bits	8	8
- Stop bits	1	1
- Ethernet Port	502	502

4.4 Modbus Addresses with Local Display

When using the 7" Local Display, Modbus addresses are predetermined for the bus runs connected to the Local Display. Six (6) bus runs can be connected downstream from a single Local Display. When assigning Modbus addresses for these bus runs, you must use the predetermined addresses, which are given on the **Setup** Screen and listed in Table 2 below:

Table 2 Modbus Addresses When Using the 7-In Local Display

Bus System or Busway	Base Modbus Address with Input Source Power monitoring	Base Modbus Address with only Tap Off Box monitoring	Reserved Modbus Addresses
Bus System 1	1	2	17-30
Bus System 2	31	32	47-60
Bus System 2	61	62	77-90
Bus System 4	91	92	107-120
Bus System 5	121	122	137-150
Bus System 6	151	152	167-180

4.5 Operational Use of the Local Display

It is easy to use the 7" Local Display to display device power information.

Touch **HOME** → **SYSTEM VIEW** → **DEVICE**.

The device page appears, showing information from the device's points list.

4.5.1 System View Screen

The **System View** Screen (Figure 27) displays the end feeds (power feeds) and Tap Off Boxes that you select for display.

On the **System View** Screen, touch a device box to display its monitoring data. Monitoring data is formatted onto single-screen views of end feeds and Tap Off Boxes.

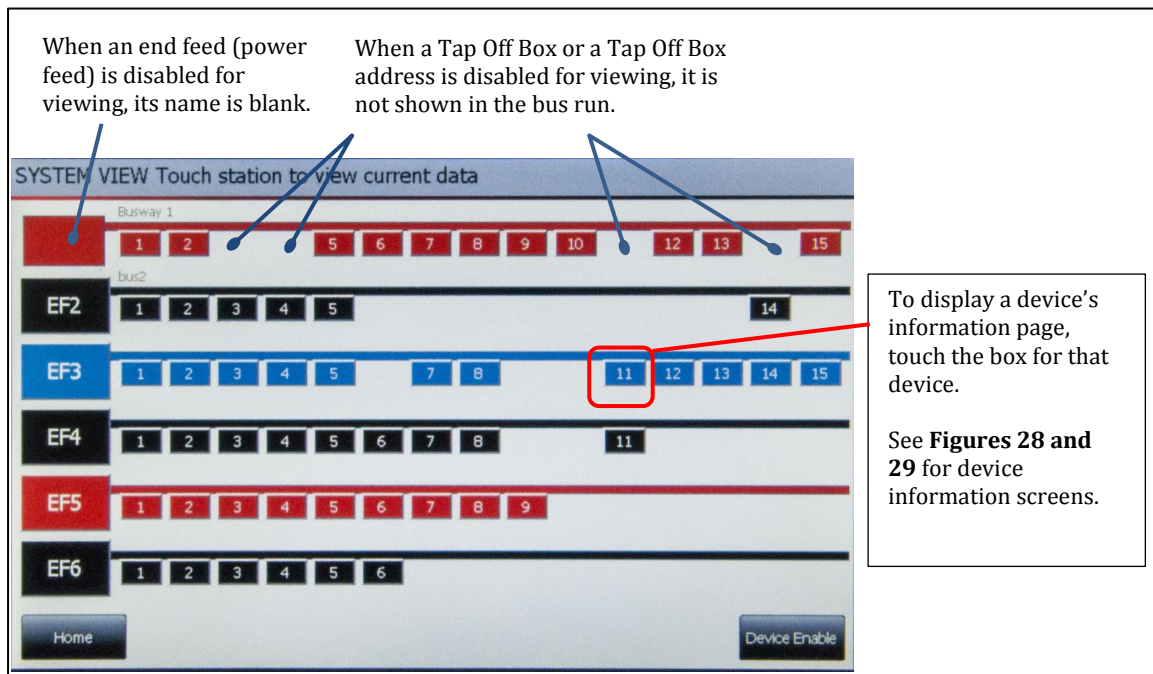


Figure 27 System View Screen

4.5.2 End Feed Information Screen

To access an **End Feed Information** Screen,

- Touch an End Feed Box on **System View** Screen, OR,
- On an End Feed Information Screen, touch **Next End Feed**. Once on a **Device Information** Screen, you can use screen buttons to move along the end feed or Tap Off Box chain.

The **End Feed Information** Screen displays measurements from options in the end feed's points list (Figure 28).

Resets, touch to reset (see red boxes):

- **Power**, Clear All KWH – resets to 0
- **Min, Max, Demand** Measurements – resets to 0

Status Light for this device only:

- Green = No Alarms
- Red = Alarms present on this device
- Yellow = Warnings present on this device

Current Device: **END FEED 1** Source 1 STATUS PDI PM Bd. 001

VOLTAGE			
	A	B	C
VOLTAGE (L-L)	208.0	208.1	208.2
VOLTAGE (L-N)	120.0	120.1	120.2
THD (%)	0.1	0.2	0.3
FREQUENCY (Hz)	60.0		

CURRENT					
	A	B	C	N	G
CURRENT (A)	10.0	11.0	12.0	5.0	0.6
MIN CURRENT	9.0	10.0	11.0	3.0	0.2
MAX CURRENT	13.0	14.0	15.0	10.0	1.0
DEMAND	1.0	1.1	1.2		
CREST FACTOR	1.440	1.441	1.442		

POWER			
	A	B	C
KW	1.20	1.21	1.22
KVA	1.30	1.31	1.32
KVAR	0.01	0.02	0.03
PF	1.00	0.99	0.98
KWH A		10	
KWH B		20	
KWH C	4294967295		

PERCENT LOAD

0 20 40 60 80 100

A		4.0%
B		5.0%
C		6.0%

Full Load is a parameter defined by the user in the device points list. Demand is shown here as percent of full load.

System View Next End Feed To Tap Off End Feed Config

- To next sequential end feed
- To first Tap Off Box in this bus run
- To Configuration Screen for this end feed

Figure 28 End Feed Information Screen

4.5.3 Tap Off Box Information Screen

The Tap Off Box Information Screen formats data from the device's points list (Figure 29).

Resets, touch to reset (see red boxes):

- Power, Clear All KWH – resets to 0
- Min, Max, Demand Measurements – resets to 0

Status Light for this device only:

- Green = No Alarms
- Red = Alarms present on this device
- Yellow = Warnings present on this device

VOLTAGE				CURRENT						
	A	B	C		A1	B1	C1	A2	B2	C2
VOLTAGE (L-L)	208.0	208.1	208.2	CURRENT (A)	10.0	11.0	12.0	13.0	14.0	15.0
VOLTAGE (L-N)	120.0	120.1	120.2	MIN CURRENT	5.0	6.0	7.0	8.0	9.0	10.0
THD (%)	0.1	0.2	0.3	MAX CURRENT	20.0	21.0	22.0	23.0	24.0	25.0
FREQUENCY (Hz)	60.0			DEMAND	1.0	1.1	1.2	1.3	1.4	1.6
				CREST FACTOR	1.414	1.415	1.416	1.417	1.418	1.419

POWER						
	A1	B1	C1	A2	B2	C2
KW	0.30	0.31	0.32	0.33	0.34	0.35
KVA	0.40	0.41	0.42	0.43	0.41	0.45
KVAR	0.00	0.01	0.02	0.03	0.04	0.05
PF	1.00	0.99	0.98	0.97	0.96	0.95
KWH A1		10	KWH A2		40	
KWH B1		20	KWH B2		50	
KWH C1		30	KWH C2		4294967295	

PERCENT LOAD

0 20 40 60 80 100

A1 1.0%
B1 2.0%
C1 3.0%
A2 4.0%
B2 5.0%
C2 6.0%

Buttons: System View, Next Tap Off, To End Feed, Tap Off Config

Callouts:

- To next Tap Off Box in this bus run
- To end feed for this bus run
- To Configuration Screen for this Tap Off Box

Full Load is a parameter defined by the user in the device points list. Demand is shown here as percent of full load.

Figure 29 Tap Off Box Information Screen

4.6 Setting up System View

To select which devices will be displayed on the Local Display, touch **Device Enable** on the **System View** Screen. The **Enable Screen** appears (Figure 30). Touch a device box to toggle between enabled (green) and disabled (red).

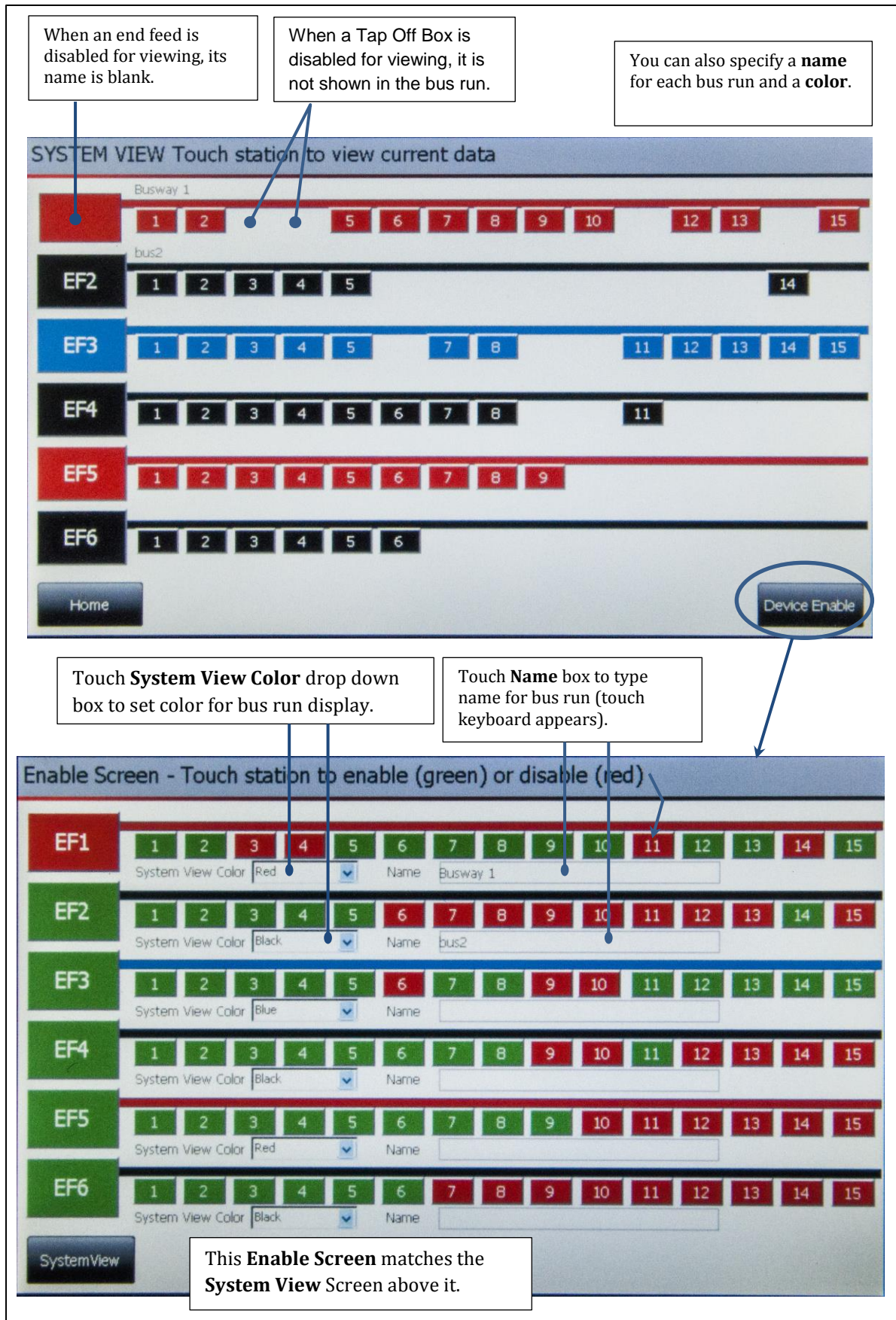


Figure 30 System View Screen with Corresponding Enable Screen

Device addresses are fixed in the Local Display. Addressing is set up for (1) end feed and (15) Tap Off Boxes per bus run.

If device is not present or not monitored with BCMS at an address, that device should be disabled in System View. For example, if you do not monitor end feeds, you should disable all end feeds for viewing in System View. The Local Display will raise a communications alarm if a device is not monitored, but you have selected it for display in System View.

4.7 Device Configuration: Setting Up Device Screens

You can modify the monitoring parameters for each device (end feed or Tap Off Box) by displaying its device data screen, then linking to the device’s configuration page. On the lower right of each device screen, touch the **End Feed Config** (Figure 31) or **Tap Off Config** (Figure 32). Changing device parameters makes changes to the device’s points list.

Note: For Voltage Options and Current Options, Source 2 is not used.

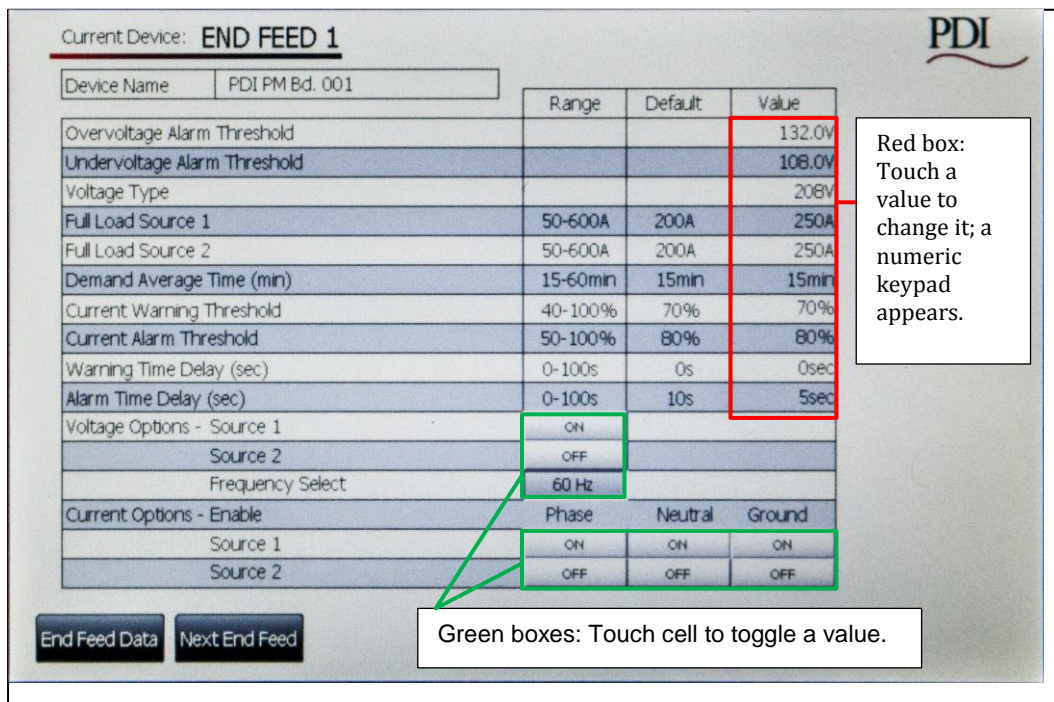


Figure 31 End Feed Configuration Screen

Current Device: **END FEED 1 TAP OFF 1**

Device Name: PDI IBus Bd. 002

	Range	Default	Value
Overvoltage Alarm Threshold			132.0V
Undervoltage Alarm Threshold			108.0V
Voltage Type			208V
Demand Average Time (min)	15-60min	15min	2min
Current Warning Threshold	40-100%	70%	70%
Current Alarm Threshold	50-100%	80%	80%
Warning Time Delay (sec)	0-100s	0s	0sec
Alarm Time Delay (sec)	0-100s	10s	5sec
Breaker Size	Phase A	Phase B	Phase C
Side 1	30	30	30
Side 2	30	30	30
Voltage Options - Enabled	ON		
Frequency Select	60 Hz		
External LED Blink	OFF		
Current Options - Flip CTs 1	ON		
Flip CTs 2	OFF		

Touch cell; a touch keypad appears; enter new value.

Touch cell to toggle value.

Tap Off Data Next Tap Off

Figure 32 Tap Off Box Configuration Screen

Bibliography

PowerWave 2™ Bus System 250 - 800A Installation and Operation PM375106

BCMS Points Lists (Modbus Register Maps) can be downloaded from the PDI website:

<http://www.pdicorp.com/services/service-software-downloads>

Follow the instructions in section **3.1 Download Setup Software and Other Documentation**.

There are two Points Lists, one for Input Source Power monitoring (IN PM) and one for Tap Off Box monitoring (IBus).

Glossary

1P	One phase
CT	Current transformer.
EF	End feed; the 7" Local Display uses "end feed" for any power feed.
BCMS	Branch Circuit Monitoring System.
Input PM	Input Power Monitor (PCB).
MIB	SNMP Management Information Block
PIB	Power Inserter Board.
Power feed	Standard End Feed or Center Feed; the enclosure where site power is connected to the bus run's Starter Rail
SNMP	Simple Network Management Protocol.