

Product Safety

- ⚠ Do not attempt to install or use electrical components until you read and understand the manufacturers' installation instructions, warnings, and safety labels.
- ⚠ All equipment must be installed in accordance with applicable national, state, and local electrical and construction codes.
- ⚠ To avoid risk of electrical shock, you must disconnect line power before installing LightRules® Power-related equipment, including all RS-485 components, CT's (Current Transformers), and associated wiring.
- ⚠ Install all RS-485 WattNode® Modbus® Power Meters within a suitable electrical enclosure.
- ⚠ Ensure that the line voltage inputs to the WattNode® Modbus® Power Meters are protected by fuses or circuit breakers (not needed for the neutral wire).
- ⚠ The RS-485 device terminal blocks on the WattNode® Modbus® Power Meters and Moxa® Power Gateways are not shielded. Do not contact metal tools to the terminal blocks if a circuit is live.

Installation Guidelines

- Prior to installation, complete the ordering process defined in the [LightRules Power Hardware Specifications](#) (available on the [Partner Portal](#)). This will identify the specific components and quantities required for a LightRules® Power installation.
- Carefully note and record the Serial Identification Number of all devices in the pre-commissioning worksheet (Appendix A).
- For information on WattNode® Modbus® power meters, refer to the [WattNode Modbus Installation and Operation Manual](#).
- For information on Moxa® Power Gateways, refer to the [Moxa website](#).
- Any brand or model of current transformers can be used as long as they are appropriate to the load.

Power and Data Limits

- When auditing multiple electrical loads via LightRules Power, each load is monitored with a separate WattNode Modbus Power Meter. During installation, connect all Power Meters to each other using an RS-485 connection.
- An RS-485 cable connects one or more WattNode Modbus Power Meters to a single Moxa Power Gateway. Up to 127 devices can share a single RS-485 cable or multiple RS-485 cables with devices in series, which extend up to 4000 ft or 1200 m.

Installation Components

- Current Transformers
- WattNode® Modbus® Power Meters
- Moxa® Power Gateways
- Power supplies for Moxa
- RS-485 data/power cable
- One or more electrical enclosures
- Circuit breakers (optional)

Overview

In a single-, split-, or three-phase system, each load is monitored by its own Power Meter with each phase using a single current transformer. The Power Meters are connected to the power gateway using RS-485 cable. The Power Gateway is then connected to the lighting network switch using an Ethernet cable.

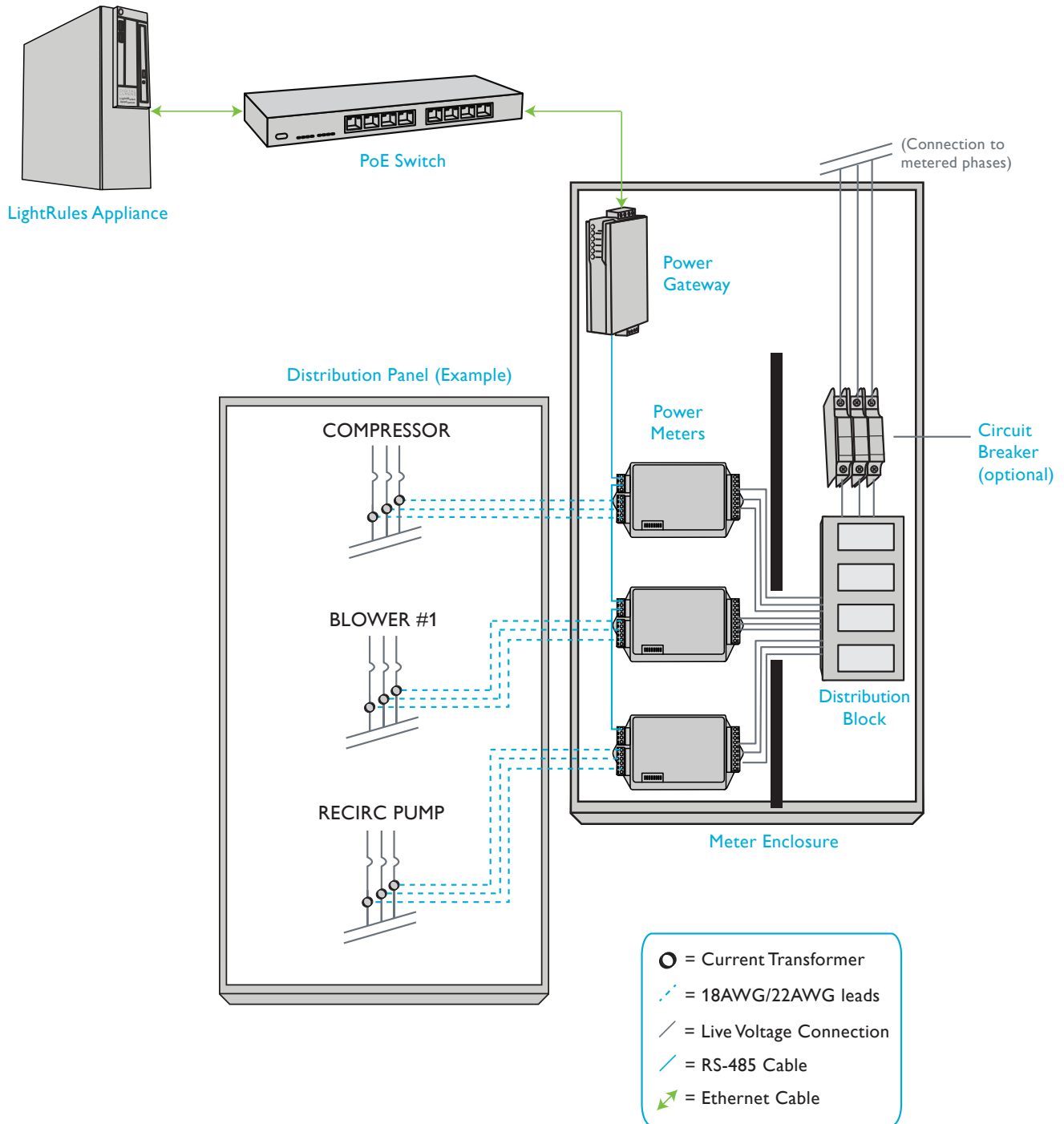


Figure 1: System Diagram

Step 1: Install electrical enclosures and power meters

Install the Power Meter in an environment free of moisture, direct sunlight, high temperatures, and particles such as dust, spray, etc (an electrical service panel, an enclosure, or an electrical room).

1. Mount electrical enclosures according to code.
2. Mount the Power Meter into the electrical enclosure using the two $\frac{1}{8}$ inch mounting holes on the left and right sides of the Power Meter (see Figure 2).
3. Record the Serial Identification Number of each Power Meter in the pre-commissioning worksheet (Appendix A).

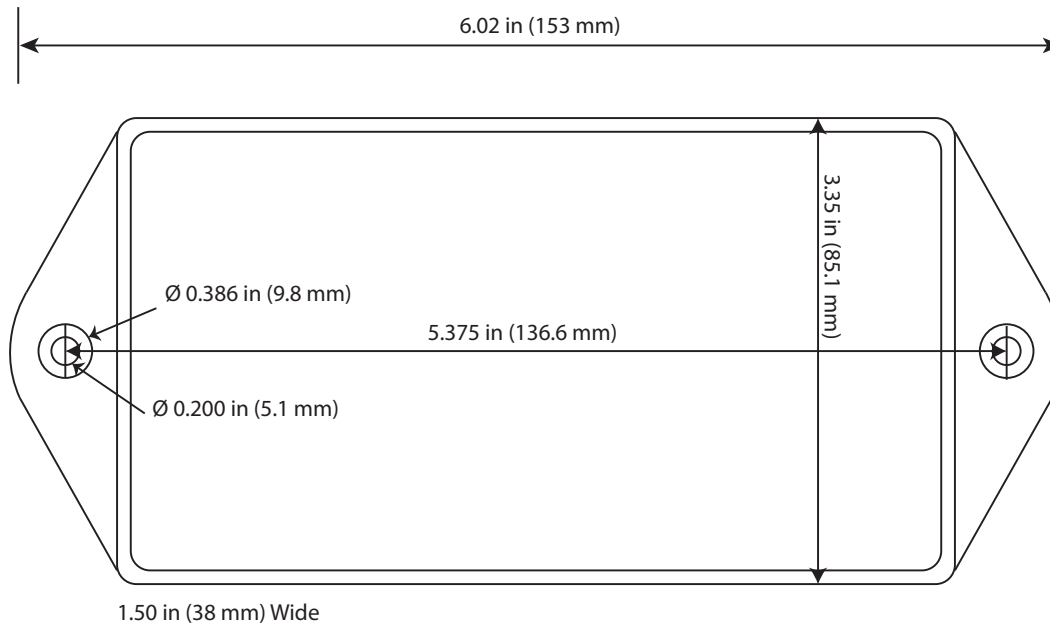


Figure 2: Power Meter Dimensions

Step 2: Install Power Meter Data Wiring

Connect power meters together

1. Connect Power Meters to each other in a daisy chain manner (see Figures 3 and 4).
 - Avoid splits, forks, and Y's in the cables.
 - Use three-conductor, 18-24 AWG, twisted and shielded cable that complies with RS-485 standards.
 - Three connections are necessary at each Power Meter terminal block:

Terminal Label:	Conductor Color:
A-	Black (negative)
B+	Red (positive)
C	White (common)
X	N/A

2. Ensure that the conductors connect the same way to each Power Meter. For example, black always connects to A-, red always connects to B+, and white always connects to C.

Note: The X terminal is not used for RS-485 communication.

Caution: The C (Common) terminal on the last Power Meter in the string must be connected to the enclosure/earth ground along with the drain for the RS-485 cable's shield.

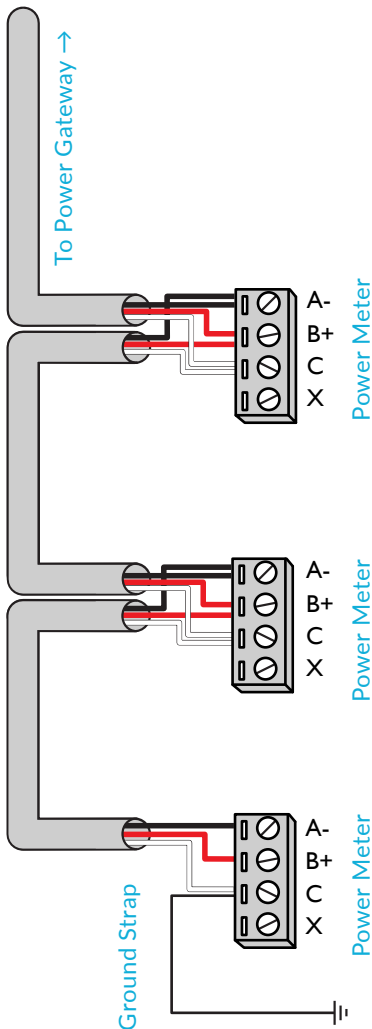


Figure 3: Daisy Chain Wiring

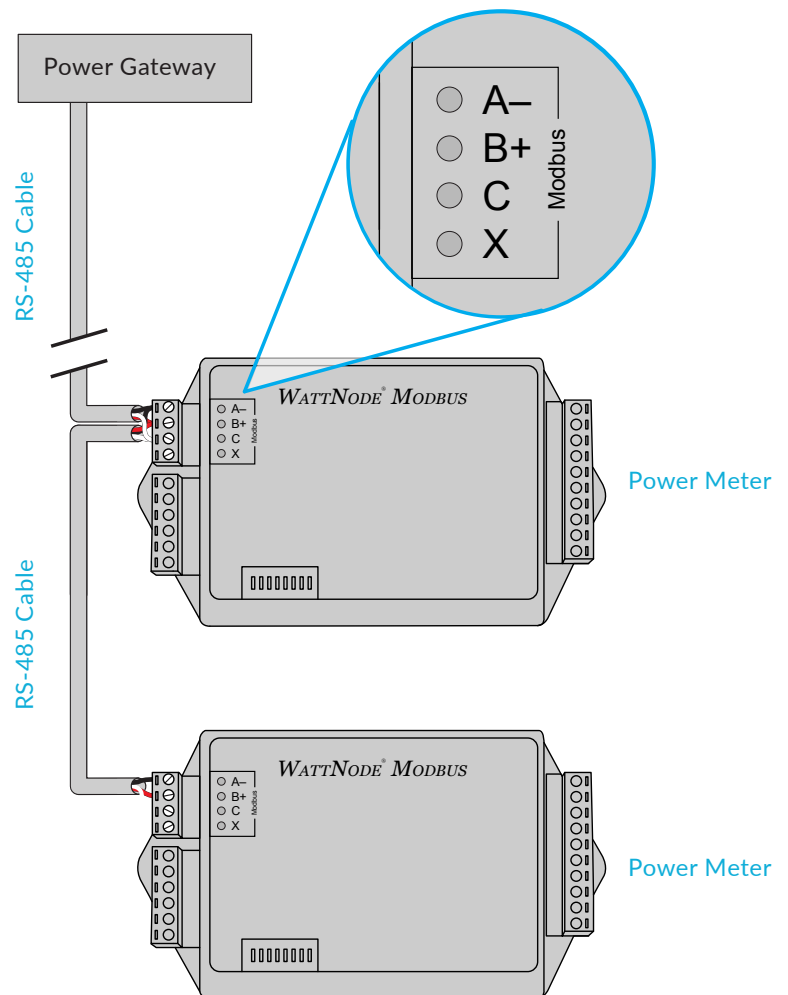


Figure 4: Power Meter Data Wiring

Connect Power Meters to Power Gateway

1. On the first Power Gateway in the daisy chain, use the supplied terminal block to connect the black conductor (A-) to pin #4, connect the red conductor (B+) to pin #3, and the white (C) conductor to pin #5. The serial port on the Power Gateway is not used.

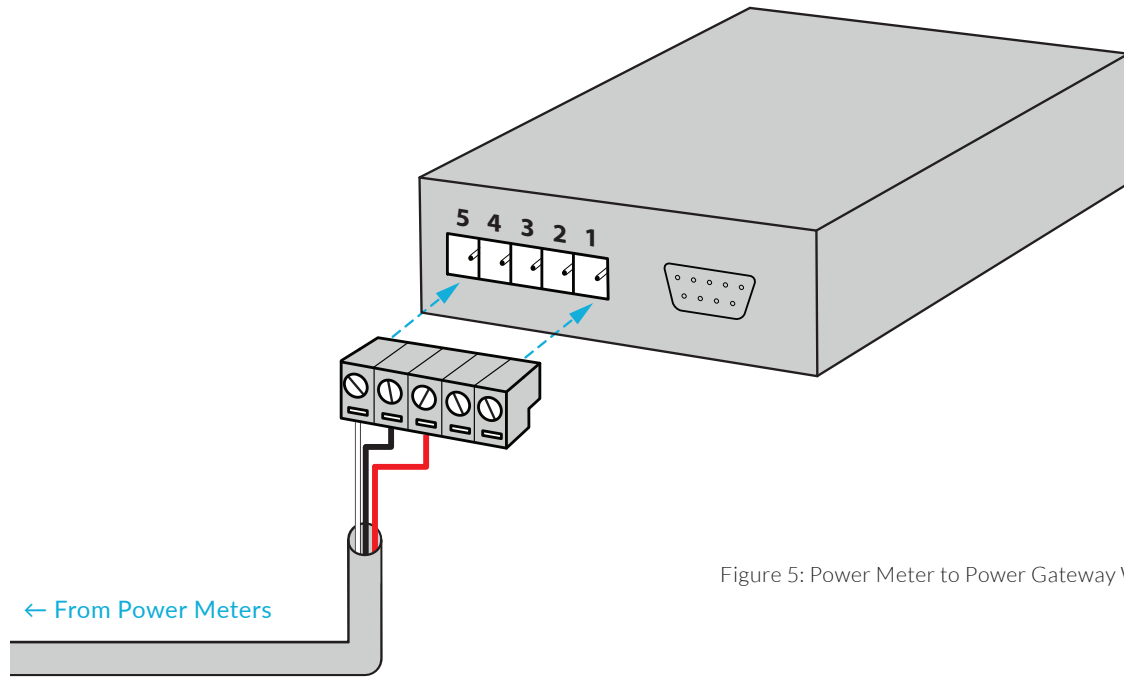


Figure 5: Power Meter to Power Gateway Wiring

The Power Meter is connected to the Power Gateway by an RS-485 cable. The Power Gateway can be installed in the enclosure with the Power Meters or in a separate enclosure. It must be located within 330 ft/100 m of the nearest ethernet switch and within 2000 ft/609 m of the power meters. The Power Gateway must be independently powered by 12-24 V DC and it must be configured via ethernet before it is operational.

Connect Power Gateway to PoE switch

1. Connect a CAT-5 / Ethernet cable to any PoE network switch in the Lighting Network.

Note: Must be in the lighting network, not the facility or enterprise network.

2. Connect the Moxa Power Gateway to provide power.

Step 3: Configure Power Meters

On the lower-left corner of the Power Meter are eight DIP switches. The DIP switches are used to set the Power Meter's Modbus address and the Baud rate for the Power Meter:

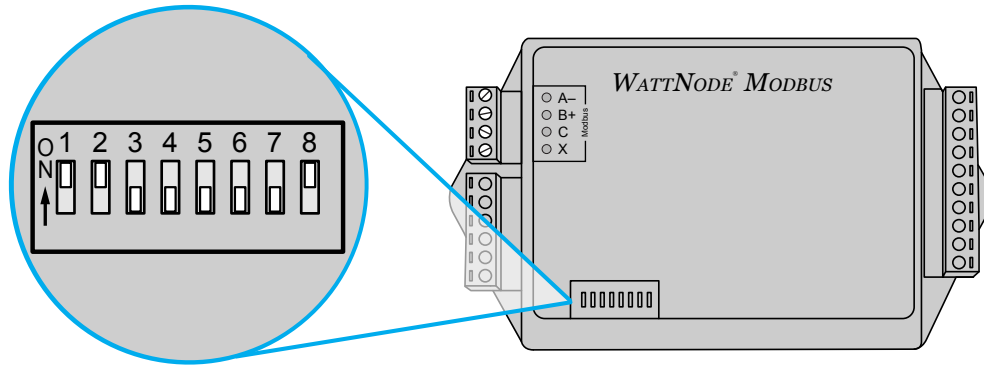


Figure 7: Power Meter DIP Switches

1. Set the Modbus Address.

Each Power Meter needs its own Modbus address, which can be any decimal value from 1 to 127. DIP switches 1-7 correspond to a decimal value, as shown in the table below:

DIP Switch:	1	2	3	4	5	6	7
Up (1) Value:	1	2	4	8	16	32	64
Address:	Examples:						
1	Up	Down	Down	Down	Down	Down	Down
1+2+4 = 7	Up	Up	Up	Down	Down	Down	Down
4+16 = 20	Down	Down	Up	Down	Up	Down	Down
1+2+16+32+64 = 115	Up	Up	Down	Down	Up	Up	Up

From left to right, add up all the corresponding decimal values of the DIP switches to get the Modbus address.

2. Move DIP switch 8 to the “up” position to set the Baud Rate.

DIP switch 8 (the furthest right switch) sets the baud rate. Baud rate is 9,600 when the DIP switch is down, which it is by default, and baud rate is 19,200 when the DIP switch is up. Set the Baud rate to 19,200 for improved performance.

3. Record the load name, physical location, serial number, decimal equivalent of the Modbus address, baud rate, and current transformer amperage of each device in the pre-commissioning worksheet (see appendix A).

Note: For more information, refer to the [WattNode® Modbus Installation and Operation Manual](#).

Step 4: Configure Power Gateways

Prior to configuring the Power Gateway, you must know the baud rate of the Power Meter (see [page 6](#)). The Power Gateway is connected to the Power Meter by an RS-485 cable. Before it's operational, the Power Meter must be independently powered by 12-24 V DC and configured via Ethernet.

Turn on the Power Gateway

1. Apply 12-24 V DC to the Power Gateway's terminal block. LEDs on the side of the Power Gateway will turn on indicating that it has power.
2. Note the Power Gateway's default static IP address located on the product label, along with the serial number and MAC address.

Enable the Ethernet Connection with Mac OSX

1. Turn off all wireless networking protocols (WiFi, cellular modems, etc.) on your computer except for Ethernet.
2. Ensure the LRA is shut down and then connect your computer to the lighting network via Ethernet cable.
3. Configure Ethernet connection using the following settings:
 - Configure IPv4: Manually
 - IP Address: Use an IP address based on the form "192.168.xxx.xxx" where "xxx" is a number between 0 and 254 not currently in use by any Moxa Gateway.
 - Subnet Mask: 255.255.255.0
 - Router: Leave blank
4. Click **Apply**. In the left panel, *Ethernet* should indicate being connected.

Enable the Ethernet Connection with PC

1. Ensure the LRA is shut down and then connect your computer to the lighting network via Ethernet cable.
2. Go to **Control Panel > Network and Sharing Center**. Click **Local Area Connections**.
3. Click **Properties**.
4. In the following screen, select **Internet Protocol Version 4 (TCP/IPv4)**, and select **Properties**.
5. Select **Use the following IP address**:
6. Enter an IP address based on the form "192.168.xxx.xxx" where "xxx" is a number between 0 and 254 not currently in use by any Moxa Gateway.
7. Enter the Subnet Mask of the Power Gateway and click **OK**.

Configure the Gateway

1. Open an Internet browser and enter the Power Gateway default IP address to open the configuration page.
2. Click on **Basic Settings > Serial** in the left navigation panel.
3. Select the appropriate baud rate (should be 19,200 if you have DIP switch 8 of the Power Meter in the up position as described on [page 6](#)).
4. Select the appropriate communication standard (RS-485 2-wire).
5. Save the changes and allow the Power Gateway to reboot itself. After it has rebooted, navigate to the main configuration page.
6. Select **Network** in the left navigation panel.
7. Under "IP configuration," select **DHCP**. The LightRules Appliance will issue the Power Gateway an IP address once it is connected to the lighting network.
8. Save the changes and allow the Power Gateway to reboot itself. Check all of the settings you just edited.

Step 5: Install Current Transformers around Loads

The Power Meter uses solid-core (toroidal), split-core (opening), and bus-bar style current transformers (CTs) with a full-scale voltage output of 0.33333 V AC.

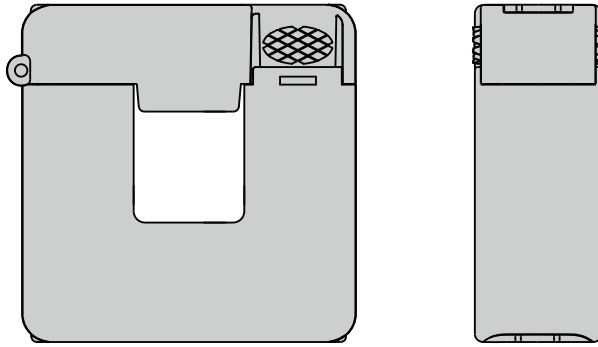


Figure 6: Example Current Transformer

The number of current transformers you need is dependent on the number of phases on each load being monitored. You will need one current transformer for each phase.

1. Position the CT in the proper direction towards the load. The correct sensing direction is labeled on the CT.
2. Pass the wire being measured through the CT.
3. Connect the CT to the Power Meter using the black and white cables.
4. Connect the black and white cables to their respective terminals on the phase being measured.
5. Label each of the cables with the name of the load and the phase being measured.
6. Add jumper connections across any unused black and white phase terminals left on the Power Meter.
7. Record the current rating of each CT, along with the serial number of the connecting Power Meter. This information is required to commission the system.

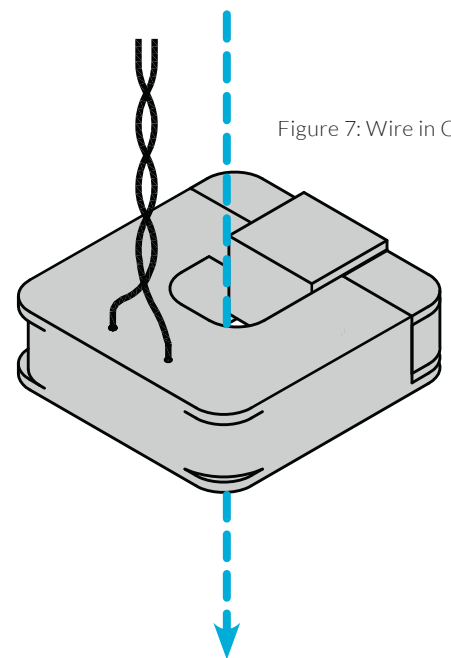


Figure 7: Wire in CT

Step 6: Connect Power Meters to the Electrical Supply

1. Feed conductors for the number of monitored phases protected by a circuit breaker in the distribution panel, into the monitoring enclosure.

To meet most electrical codes, the line voltage feed must be protected by a circuit breaker in the monitoring enclosure as well. Once downstream of the monitoring enclosure, the phases' conductors should route into an appropriately sized distribution block for final connection to the Modbus Power Meter. Each Modbus Power Meter must be connected to a ground and neutral line.

2. Examine the Modbus Power Meter indicator lights after connecting power to them.

Common mistakes include reversing CT direction and confusing the RS-485 connection sequence. The [WattNode Modbus Reference Guide](#) has a detailed information on interpreting error codes.

Step 7: Commission the System

During installation, a map file is created that contains all of the configurable settings the system needs to perform manual control, automated control, and reporting. Additionally, the map file contains basic Power Meter and Power Gateway information, including serial numbers, IP addresses, MAC addresses, DHCP settings, and physical locations.

Refer to the [Commissioner Admin Guide](#) for additional information on adding these details to the map file.

Add a Power Gateway to the Map File

1. In Commissioner, go to **Map > Add Power Gateway**.
2. Enter a logical name for the Power Gateway. For example, name the gateway according to its physical location in the facility.
3. Enter the device MAC address. The MAC address is listed on the product label or product housing and uses the following format: NN:NN:NN:NN:NN:NN. MAC address are unique to each device and not editable.
4. Select the **DHCP** radio button. Enter a description for the power gateway, including the physical location.
5. Click **OK**.

Add a Power Meter to the Map File

1. Open Commissioner and go to **Map > Add Power Meter**.
2. Enter a logical name for the meter. For example name of the equipment to which the meter is connected.
3. Enter the 6-digit serial number. The serial number is listed on the product label or product housing.
4. Select an existing meter group (move on the step 6) or create a new meter group (see step 5).
5. To create a new meter group:
 - In Commissioner, double-click on an existing Power Meter in the map grid, or add a new Power Meter (see steps 1-3).
 - In the meter group drop-down list, select **Create New Meter Group**.
 - Click **OK**.
6. Enter the appropriate decimal Modbus address from the Pre-Commissioning worksheet (see [“Appendix A: Pre-Commissioning Worksheet” on page 12](#)).
7. Enter the Current Transformer (CT) size, in amps.
8. Select the Power Gateway to which the meter is connected.
9. Enter a description (optional).
10. Click **OK**.

Upload map file to LightRules

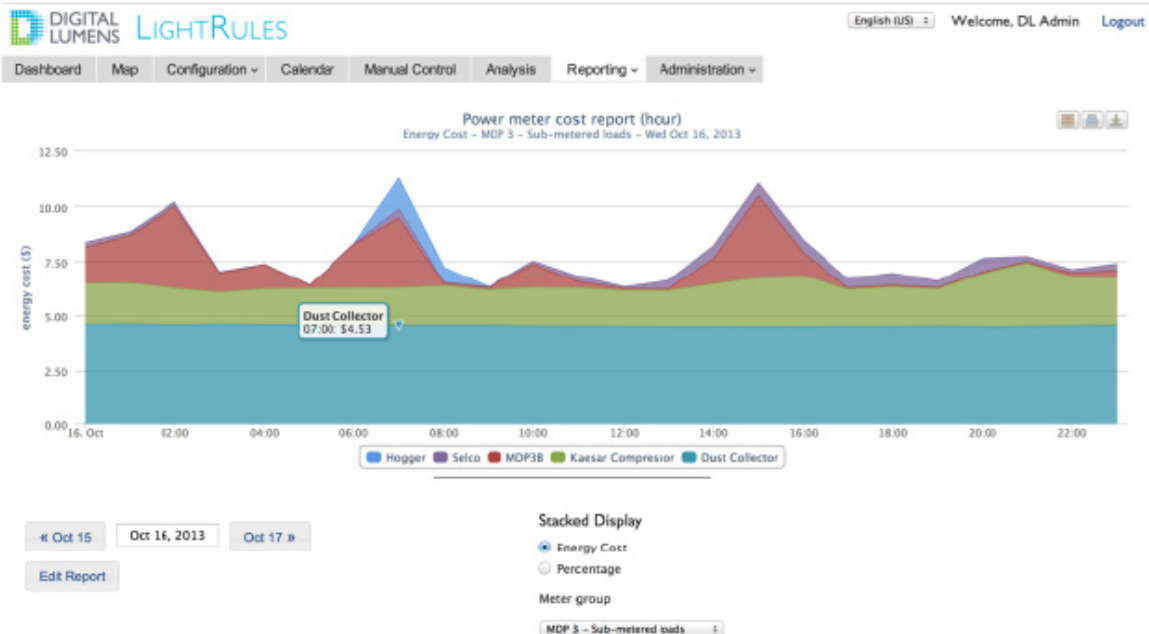
After editing the map file in Commissioner, you must upload the updated file to LightRules:

1. In LightRules, click the **Configuration** tab and then **Manage Map File**.
2. Click **Choose File** to select the map from your computer.
3. Click **Upload**.
4. On the dashboard, in the *Map Changes Pending* prompt, click **Sync** or **Revert**:
 - On the dashboard, click **sync**.
 - Review the list of pending changes.
 - Click **Sync**.

Lightrules Power Reports

When LightRules Power is configured, additional energy use and energy cost reports appear in the LightRules Insight Reporting menu. Additionally, you can create custom energy use and energy cost reports. Data is reported according to meter group; if only one piece of electrical equipment is assigned to a group, then data will be reported for just that equipment. If multiple pieces of equipment are assigned to a group, then the aggregate data for that equipment will be reported.

Refer to the [LightRules Admin Guide](#) for additional information on creating LightRules Power reports.



Filter a Report By Meter Group

1. Run a LightRules Power report; for example, "Metered Power - One Day Cost".
2. In the Meter Groups panel of the report screen, select the meter group by which you want to filter results.
3. LightRules auto-refreshes the results.

Edit a Metered Power Report Template

1. Click the **Reporting** tab and select **Manage Reports**.
2. Click **Edit** for the desired LightRules Power report.
3. Modify one or more of the parameters.
4. Check the **Favorite** box to add the report template to the favorites list on the dashboard (optional).
5. Click **Update Report**.

Create a New Template

1. Click the **Reporting** tab and select **Manage Reports**.
2. Click **New Report**.
3. Select **Metered Power Report**.
4. Type a name for the report.
5. Modify one or more of the parameters.
6. Check the **Favorite** box (optional).
7. Click **Create Report**.

Troubleshooting

This section represents some of the most common issues that arise during installation of LightRules Power.

Negative Power

If you are registering negative power, ensure that the current transformers are in the correct orientation (see [page 8](#)).

Power Meter not Reporting

If the Modbus Power Meter is not reporting to the LightRules Appliance via the RS-485 cable, the connection is bad, or configuration details are not correct, do the following:

- Verify that the addresses set using the DIP switches on each power meter are correct
- Check entered data for serial identification numbers
- Test the RS-485 connection

Power Gateway not operating

If meters serviced by a Power Gateway are not communicating, do the following:

- Check networking configuration of the device to ensure all parameters are set correctly
- Ensure that the Power Gateway is powered

Contact Support

For more information on installation or advanced troubleshooting procedures, contact Digital Lumens technical support via email: support@digitallumens.com

In case of emergency, or for immediate assistance, contact Digital Lumens technical support by phone: **+1 (617) 723-1200, ext. 3.**

Appendix A: Pre-Commissioning Worksheet

Use this worksheet to identify and record information needed to commission the LightRules Power system.

Moxa Power Gateways

Power Gateway 1		Power Gateway 2	
Physical location:		Physical location:	
Default (Static) IP:		Default (Static) IP:	
Serial Number:		Serial Number:	
MAC address:		MAC address:	

Power Gateway 3		Power Gateway 4	
Physical location:		Physical location:	
Default (Static) IP:		Default (Static) IP:	
Serial Number:		Serial Number:	
MAC address:		MAC address:	

Modbus Power Meters

Power Meter 1		Power Meter 2	
Load Name:		Load Name:	
Physical location:		Physical location:	
Serial Number:		Serial Number:	
Decimal equivalent of Modbus address:		Decimal equivalent of Modbus address:	
Baud Rate: (circle one)	9,600 / 19,200	Baud Rate: (circle one)	9,600 / 19,200
CT Amperage:		CT Amperage:	

Power Meter 3		Power Meter 4	
Load Name:		Load Name:	
Physical location:		Physical location:	
Serial Number:		Serial Number:	
Decimal equivalent of Modbus address:		Decimal equivalent of Modbus address:	
Baud Rate (circle one):	9,600 / 19,200	Baud Rate (circle one):	9,600 / 19,200
CT Amperage:		CT Amperage:	