

Boomerang User's Manual

Power Monitors, Inc.



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Please contact us at the email powerquality@powermonitors.com

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Safety Issues

Please read before installing the Boomerang Recorder.

The Boomerang Recorder Voltage contains dangerous voltage levels during operation. Do not disassemble the Recorder. **THERE ARE NO USER SERVICEABLE PARTS INSIDE.**

Although the Boomerang Monitors has been designed and built to be as safe as possible, great care should always be exercised during operation and installation. The National Electric Code should always be followed.

This Safety Notice has been included to emphasize the danger of hazardous voltages on the input connection leads of your 3-phase Boomerang power quality recorder. **USE EXTREME CAUTION WHEN CONNECTING** your instrument. Hazardous potentials exist on voltage input leads and banana jacks. Please read the entire contents of the “Connecting the 3-phase Boomerang®” section before attempting to connect or service your instrument.

Warning

To avoid electric shock, use only the test leads and Current Transformers (CTs) supplied with the 3-phase Boomerang.

- Inspect the voltage test leads and CT cables for damage to the insulation prior to use.
- Do not use exposed non-sheathed banana plug connectors or adapters, or retractable sheath type connectors.
- Remove all test leads that are not in use. The maximum permissible input voltage is 300V between banana jack inputs (channel-channel, or channel to common).
- Use only one connection to the COM banana jack on the 3-phase housing.

Safety Issues

Please read this safety information carefully before installing or using the 3-phase Boomerang. The interior of the recorder contains dangerous voltage levels during operation.





TO AVOID ELECTRIC SHOCK AND TO PRESERVE THE ENVIRONMENTAL INTEGRITY OF THE HOUSING, do not attempt to remove the lid or otherwise disassemble the unit. THERE ARE NO USER SERVICEABLE PARTS INSIDE THE RECORDER.

This device is manufactured for use by trained and qualified personnel only. Do not install or operate while in contact with standing water or wet ground. Protective gloves, glove covers, safety glasses, and any other PPE required by your organization’s applicable safety policies, should always be worn during installation, operation, and removal of the recorder. Where possible during installation, disconnect power from any lines to which the recorder will be attached.

PMI flexible CTs and True Low-Amperage Reading (TLAR) CTs available for use with the 3-phase Boomerang are manufactured with 600V rated integral cables, preventing accidental disconnection. Although the recorder has been designed and built to be as safe as possible, great care should always be exercised during operation and installation.

Glossary of Symbols

Below is a glossary of symbols that appear on the 3-phase Boomerang. Please read this section carefully to familiarize

	<p>Bluetooth® This symbol indicates that the device has Bluetooth</p>
	<p>C-UL-US, C-ETL-US These marks indicate compliance with both Canadian and United States Underwriters Laboratories (UL) requirements.</p>
	<p>Double Insulation This symbol indicates that the equipment is protected throughout by double insulation or reinforced insulation.</p>
	<p>Caution This mark indicates that caution should be exercised due to risk of danger. Refer to the safety specifications on page 1 and the installation procedure on pages 19-23 for more information.</p>

Introduction

We founded Power Monitors Incorporated (PMI) to provide state-of-the-art, easy-to-use, and affordable electronic test equipment to the power industry. Our products have been developed by working directly with electric utilities to determine their specific needs. The Boomerang Voltage Recorders have also been developed by following these same principles

The Boomerang family of wireless power monitors extends your SCADA system to anywhere needed: a voltage regulator on a pole, the end of a distribution line. Every Boomerang includes an integrated cell modem with internal antenna for unobtrusive real-time voltage, current, and power monitoring from anywhere or optional external antenna for low-signal areas.

The Boomerang can also interface with Canvass, PMI's web-based database and data analysis package. With Canvass, all historical data is available in a web browser, accessible through powerful graphs and reports. Use Canvass to analyze voltage trends and regulator responses over geographic regions. Canvass can also be configured to send email and text messages based on Boomerang voltage, current and power events.

Additional Resources

Refer to the technical documents listed on the PMI library. The library has a search option to narrow down the vast list of available documentation. Visit: <https://library.powermonitors.com>

Available Models

The Boomerang models are available in Voltage only or Voltage and Current options. All Boomerangs models are cellular except for the Ethernet model. Verizon Cellular plans can be purchased through PMI or through your company's Verizon account.

All models are 300v maximum except for the Ethernet versions, which have a 600-volt channel-channel, or channel to comm limit.

- Boomerang 2S form factor
- Boomerang 3-phase
- Boomerang Pole Mount Single-phase
- Boomerang Pole Mount 3-phase
- Boomerang 3-phase Ethernet Line-Powered
- Boomerang 3-phase Ethernet Power-over-Ethernet (PoE)

Getting Started with the Boomerang

MODEL		2S	3-PHASE	POLE MOUNT
VOLTAGE	Input	80-300V RMS	80-300V RMS*	80-300V RMS
	Accuracy	0.50%	0.50%	0.50%
	Resolution	0.1V	0.1V	0.1V
CURRENT	Ranges	0-400A RMS Total (200A per leg)	20,200A TLARs 100, 1K, 5KA, w/ Flex CT	20,200A TLARs 100, 1K, 5KA, w/ Flex CT
	Accuracy	1%	1%	1%
POWER		1%	1%	1%
COMMUNICATION	4G LTE	YES	YES	YES
	Ethernet	NO	Optional*	No
DIMENSIONS	L	6.75"	4.8"	6.5"
	W	6.75"	3.35"	6.5"
	H	4.625"	1.84"	4.25"
CASE PROPERTIES		NEMA 4X	NEMA 4X	NEMA 4X

**Model with Power over Ethernet feature can measure up to 600V RMS. However, unit will not power through voltage leads.*

FORM 2S METER SOCKET



Standard pass-through Form 2S meter socket adapter, for single-phase applications. With no external antenna or ports, the low profile and unobtrusive Boomerang is perfect for residential locations, giving readings right at the point of common coupling

POLE MOUNT



Single-phase or 3-phase Boomerangs used for power pole applications such as voltage regulator or capacitor bank measurements, or end of line monitoring. Rugged NEMA 4X enclosure includes terminal block and mounting feet for permanent installations.

The optional Flex CTs or TLAR current clamps connect to the nine-pin connector on the side of the outer grey housing. The Boomerang automatically detects the type of CT connected. The Boomerang monitor can be equipped with TLARs rated for 20A or 200A, or Ultra Slim Flexible CTs that can be set to multiple ranges of 100A, 1000A, or 5000A.

3-PHASE STANDALONE



Shown with Optional Magnetic Mount

Pocket-sized, weatherproof form factor for 3-phase monitoring anywhere. The small size gives maximum flexibility for monitoring in almost any location.

The standard model 3-phase Boomerang measures up to 300V, while the Power over Ethernet (PoE) version can measure up to 600V.

The standard 3-phase Boomerang includes an internally mounted cell antenna. For challenging cell coverage locations, the external side mount antenna model may be utilized. The side mount antenna model also has an external antenna kit available.

The 3-phase Boomerang has current monitoring ability which connect to both standard Flex CT and TLAR current clamps. This enables the user to measure up to 5000A using the Flex CT's, or up to 200A using the TLAR clamps.

The optional power over Ethernet model removes the requirement to power from the channel 1 voltage input and allows for voltage inputs up to 600V. This unit is powered by 15V sent over an Ethernet cable via a special power injector (available from 3rd party sources). The other model of Ethernet 3-phase Boomerang powers from channel 1 and has a 600v maximum input.

3-PHASE ETHERNET



This Boomerang communicates over a LAN (Local Area Network) via Ethernet communications and connects to your local area network using the supplied Ethernet communications. Upon connection, the Boomerang Ethernet IP address is assigned by the network DHCP (Dynamic Host Configuration Protocol) Server. The DHCP supplied IP address is Dynamic, meaning that the IP address may change when the Boomerang is power-cycled or rebooted. After initial powerup, the IP address can be set to an IP address of your choice using the NMS or DMU software describe later in this document.

For SCADA access the IP will be within the SCADA network range. For Canvass access the IP will need to be a public IP or have access to the public network (changes to firewall settings may be needed to allow communication with Canvass).

Optionally a VPN can be configured for SCADA to communicate with both Canvass and the SCADA system. The Power over Ethernet (PoE) model will need a non-supplied 15v PoE injector if your routers do not supply power or do not supply the required power needed to operate the Boomerang.

Installing the Boomerang Recorder

Please read the safety section before installation. Always exercise extreme caution when installing a Boomerang Recorder.

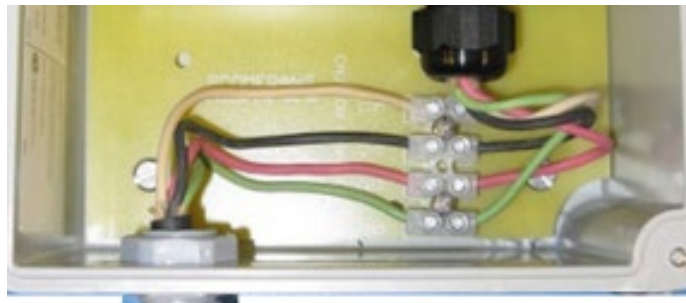
There is no internal battery in the Boomerang monitors. A charge is maintained on the internal supercapacitors to allow the unit to send an outage notification or alert for a brief period (1-2 minutes) without applied voltage. Therefore, there are no internal user serviceable parts contained in a Boomerang Unit.

After installation, the LED will be flashing to indicate power is applied. See the Frequently Asked Questions (FAQs) at the end of this manual for specific LED flash patterns. Additionally, you can verify voltage if the Boomerang is configured to report to the Canvass database.

The **2S Boomerang** acts as a simple passthrough module, and all that is required for the user is to plug the Boomerang into the meter base and then install the revenue meter into the monitor.

The **Pole mount Boomerang** is wired with a user supplied voltage cord. A voltage cord must be installed by the user to connect the voltage inputs. For outdoor applications, an SOOW 600V multiconductor 18AWG cable is recommended, for UV and oil resistance. The cord's diameter should be between 0.375" and 0.47" to properly seal with the supplied strain relief (if a larger diameter is needed, please contact PMI before placing an order).

The Pole mount Boomerang unit will come with a Strain Relief Nut inside the housing. When inserting your voltage cable, pass the cable through the non-threaded end of the nut and into the housing. The strip back length should be 4" with 3/8" exposed copper. Insert each corresponding wire to the correct screw terminal, which are labeled COM and CH 1-3. The Common connection is the terminal farthest from the edge of the housing.



Once these are connected, tighten the strain relief nut hand tight.

Then, use a 15/16" wrench to tighten the nut a further ½ turn. If the unit is to remain in place for a prolonged period, a liquid thread locker can be used to ensure the nut does not loosen over time. It is recommended to connect channel 1 voltage lead last. This connection sequence will assure that all measured voltages and currents begin recording simultaneously and will prevent false event triggering that could occur during voltage lead or CT connection.

Connect the Boomerang side of the voltage cord first, before connecting the other end to the voltage supply.

A **single-phase Pole Mount Boomerang** has one voltage input with one pair of wires. Since there is no current option with the single-phase Boomerang, phasing on the voltage input is not important, and either terminal may be used as the common or hot input.

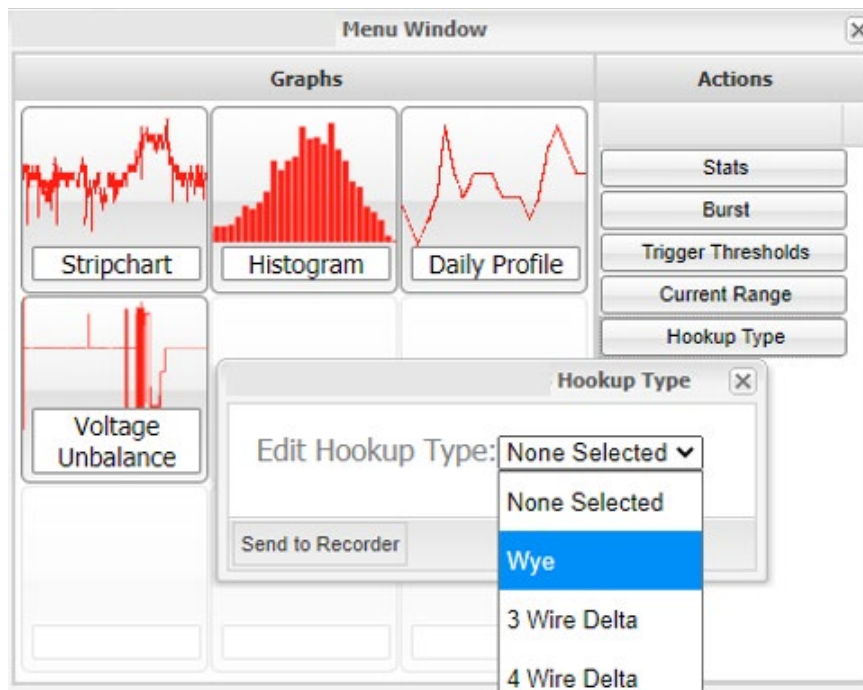
The **3-phase Boomerang**, **3-phase Pole Mount Boomerang** and **Ethernet Boomerang** features three voltage inputs and can accommodate several circuit types.

For a wye circuit, channels 1, 2, and 3 connect to phases A, B, and C, and the white common lead connects to the neutral.

For a delta, the channel inputs also go to phases A, B, and C, but the white common lead goes on phase B along with Channel 2 lead.

The **PoE 3-phase Ethernet Boomerang** will need an Ethernet cable connected to the PoE injector and the PoE injector connected with another Ethernet cable to the local network. The PoE injector will have a cord to plug into an AC receptacle for power.

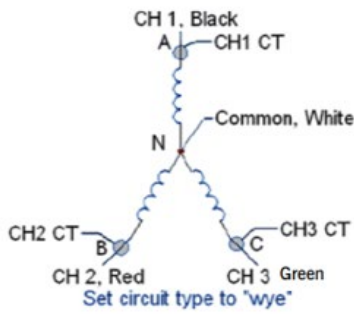
The **3-phase Ethernet Boomerang** powered from the channel 1 voltage lead will need an Ethernet cable connected to the local network.



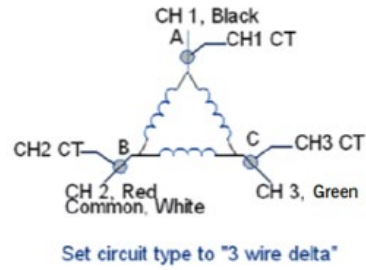
Once the Boomerang is Powered and Communicating, Canvass is used to set the Hookup Type Options.

For SCADA devices, refer to the DNP point map table setting Group 40 point 24

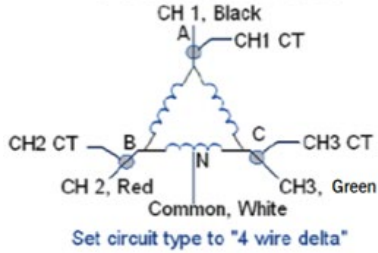
Three Phase WYE



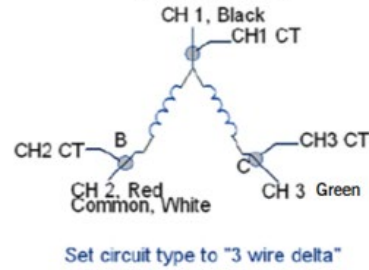
Three Phase Delta



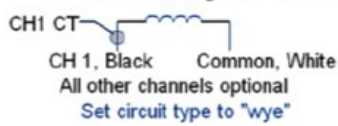
Four Wire Delta



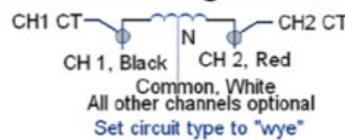
Open Delta



2 Wire Single Phase



3 Wire Single Phase



3-Phase Boomerang Circuit Hookup Diagram

To connect the **Flex CT or TLAR probes** to the 3-Phase, Pole mount, or Ethernet Boomerangs insert the 9-pin MALE connector of the CT output cable into the 9-pin FEMALE connector on the top or side of the recorder and rotate the locking ring. Loop each flexible CT element, or TLAR probe, around the corresponding conductor or bus to be monitored. The raised plastic arrow on the Flex CT connector body, or at the top of the handle of the TLAR current clamps, must point toward the load that is being measured for the correct current-to-voltage phase relationship. Insert the plastic connector plug on one end of the flex CT into the plastic connector socket on the other end and snap firmly together.



Canvass

The screenshot displays the Canvass web application interface. At the top, the browser address bar shows `canvass.powermonitors.com/index.php`. The main header contains the 'CANVASS' logo and navigation menus for 'File', 'Preferences', 'Administration', '3D Groups', 'Windows', and 'Help'. A search bar is located below the header.

The interface is divided into several sections:

- 5 Recorders:** A table listing active recorders with columns for SIN and Label. The list includes:

SIN	Label	Action
14173	Revolution	Edit
455333	Allen	Edit
455336	Tina	Edit
455364	Jason	Edit
82973	water pump	Edit
- Recorders Map:** A map of the Eastern United States showing the locations of recorders. Active devices are marked with blue pins, and non-active devices are marked with black pins. A 'Map Legend' is visible in the top right of the map area.
- Help Panel:** A detailed view for the selected '82973 water pump' recorder. It shows:
 - Status: Alive
 - Alarms: A search bar for alarms.
 - Legend: A table of alarm types with checkboxes:

Alarm Type	Status
Low alarm	<input type="checkbox"/>
High alarm	<input type="checkbox"/>
Unlock alarm	<input type="checkbox"/>
Low low alarm	<input type="checkbox"/>
High high alarm	<input type="checkbox"/>
No alarm	<input checked="" type="checkbox"/>
 - RMS Voltage: A table of three voltage readings, all with checkmarks.

Index	Value
1	<input checked="" type="checkbox"/>
2	<input checked="" type="checkbox"/>
3	<input checked="" type="checkbox"/>
 - RMS Current: A table of three current readings, all with checkmarks.

Index	Value
1	<input checked="" type="checkbox"/>
2	<input checked="" type="checkbox"/>
3	<input checked="" type="checkbox"/>
 - Real Power: A table of three power readings, all with checkmarks.

Index	Value
1	<input checked="" type="checkbox"/>
2	<input checked="" type="checkbox"/>
3	<input checked="" type="checkbox"/>

- Map Markers:** A section with checkboxes for '3D Groups' and 'Recorders', both of which are checked.

At the bottom of the interface, there is an 'export (1).csv' button and a 'Show all' button.

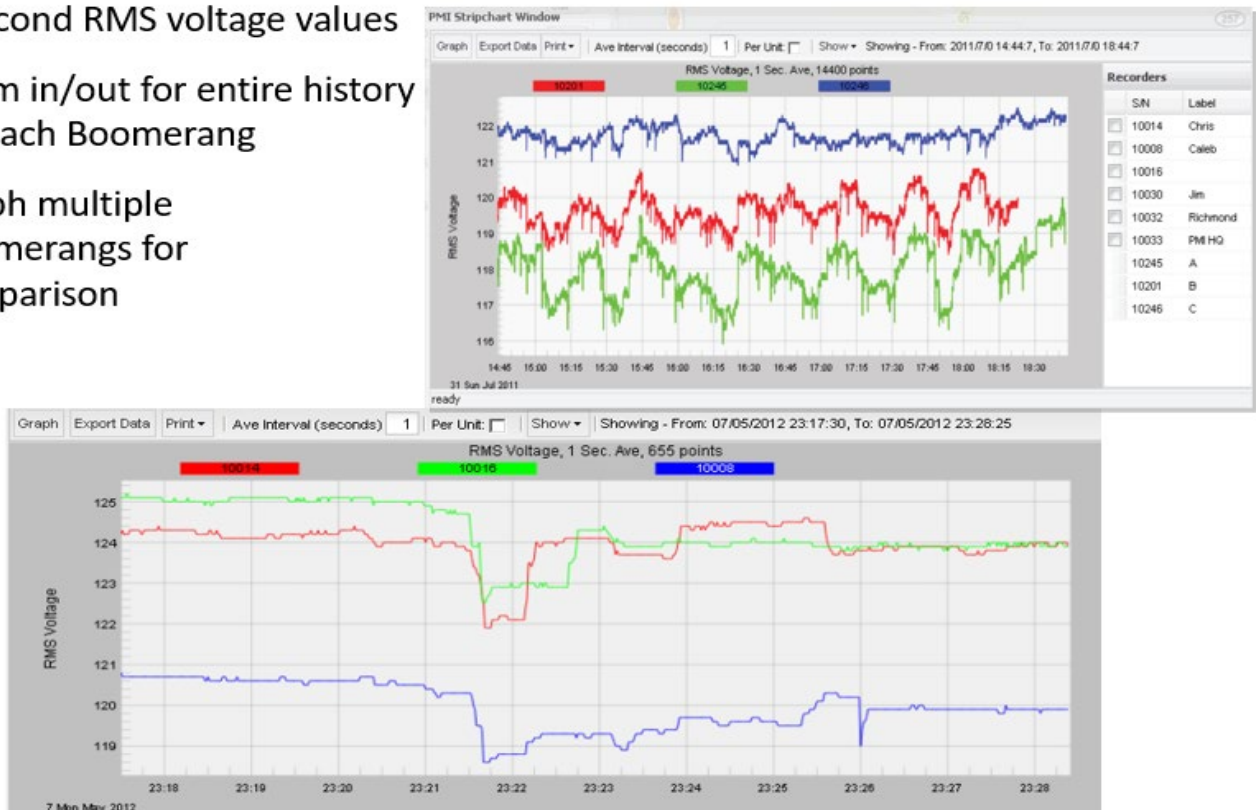
Canvass map page showing active (blue) devices and non-active (black) devices

Canvass Overview

The Canvass web application and data storage service enables Boomerangs to measure and store large amounts of measurement data at one-second intervals in the cloud, and enables users to analyze this data in the form of graphs via Canvass' web application interface. No additional software is needed to install on your PC, Laptop, Tablet or Phone.

Canvass' graphing interface, paired with the Boomerang, provides a powerful tool set for analyzing vast amounts of voltage, current and power data. It has the benefit of never having to provide storage for, or back up this data yourself, and provides you the ability to access and analyze your data from anywhere, using a powerful graphing interface, on any Internet-connected device via the browser. Contact your PMI sales representative for the cost of a Canvass subscription.

- 1 second RMS voltage values
- Zoom in/out for entire history of each Boomerang
- Graph multiple Boomerangs for comparison



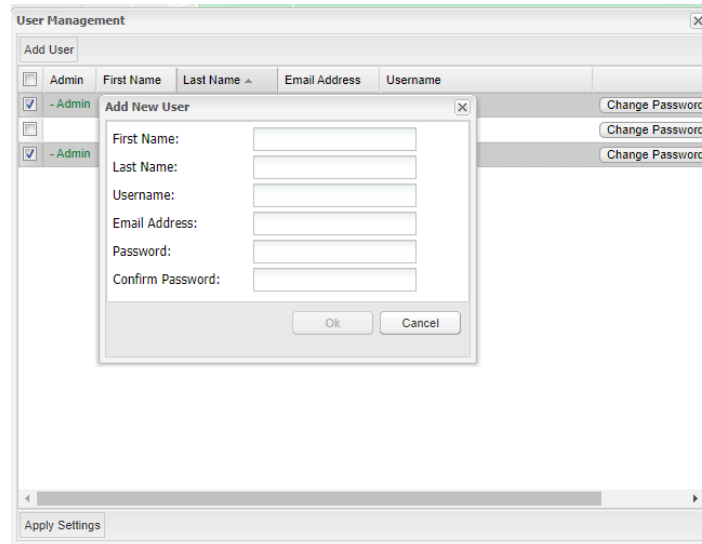
When a Canvass subscription is purchased along with a Boomerang, PMI will configure and send the login information to the user. Once the Boomerang is powered and communicating, it will immediately begin sending data to the Canvass servers. New Boomerang devices will be added to an existing Canvass account as needed.

Canvass Security

Canvass transmits and receives all application code and user data over a secure connection. You can verify that Canvass (or any web page, or web application) is using a secure connection by looking for the “padlock” icon in the browser’s address bar. This indicates that the web site is communicating via SSL (Secure Sockets Layer). PMI brought in outside security consultants that verified Canvass passed all cybersecurity requirements.

Canvass Users

Each account and subaccount contain a distinct set of Canvass users - a user is always associated with a single account. To maintain a login into a master account and underlying subaccounts, multiple users may be created. These users may be standard or administrative users. Users of the master account have access to all devices in each subaccount but have no access to users, distribution lists, or other non-device information in those subaccounts. Admin users will have an Administration tab that standard users will not see.



Administrative Users can add new users to the Canvass account

Sharing Canvass Data

Canvass provides a cloud-based system for gathering, storing, and analyzing voltage, current, and power data from Boomerangs and Revolutions. In large deployments, with hundreds or thousands of devices, it is more convenient to group devices into regions and Canvass subaccounts. With Canvass subaccounts, one master account shows all devices, while subaccounts allow other users full administrative access or normal access to view a subset of devices. In addition to its usefulness in handling large deployments, the subaccount feature works well with special device situations.

Each Boomerang can belong to multiple accounts.

One case for this feature may be where two utilities wish to share a device's data at a single location. Another may be where devices belong to a larger utility but are also utilized by a regional cooperative served by that larger utility.

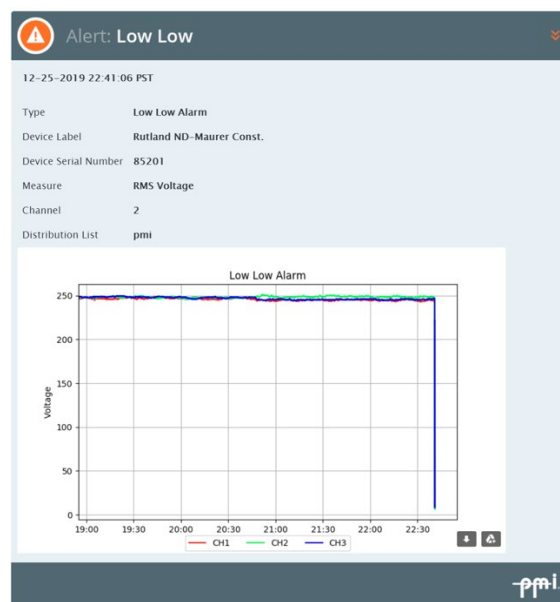
A third case may be where a utility installs a device at a customer location and wishes to share that single device with the customer, but also include it in the larger, private utility account. PMI Technical Support can assist in setting up accounts and sub-account.

Notification Alerts

Alert triggers are specified as thresholds above and below the expected values for each measurement type.

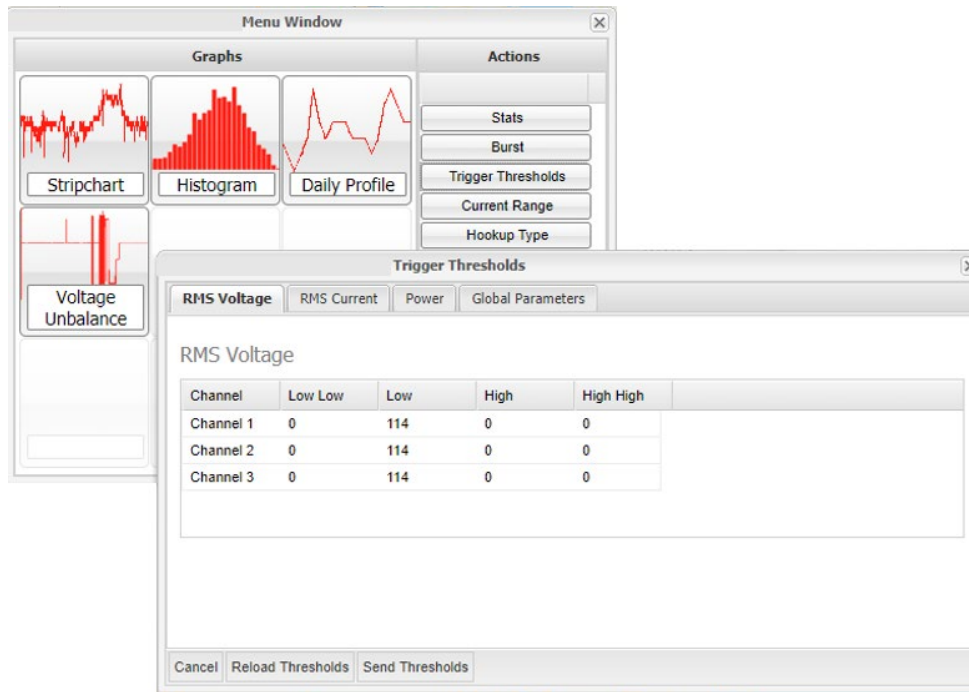
The thresholds are designed to define an expected window of normal operation, a band of high or low operation and an upper or lower extreme limit. Each time a measured value crosses into one of these zones an alert will be triggered. The contents of the alert will show the device serial number, the boundary crossed, the value that caused the alert, the time of occurrence and the device channel. An alert will be generated when the threshold is crossed in either direction so that successive alerts can show a timeline of abnormal behavior and the return to normal operation.

Alerts (email or text) can be sent to one or more users as specified by the distribution list.



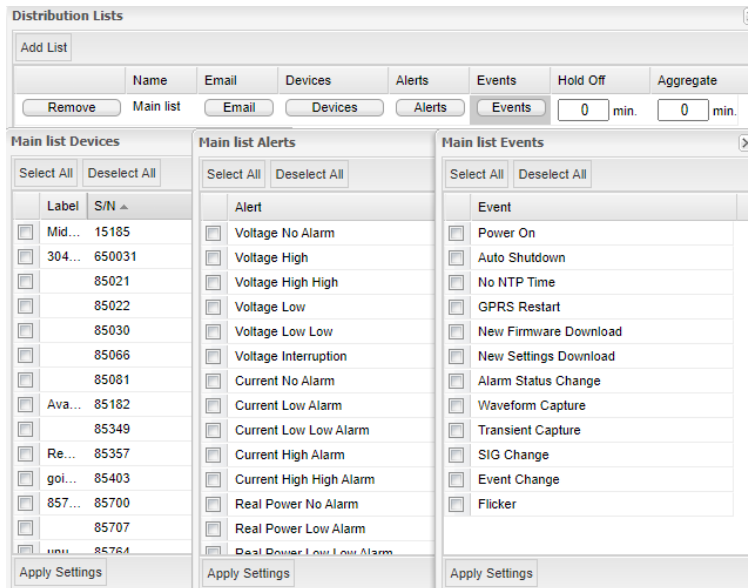
Trigger Thresholds

Set alert thresholds in Canvass by selecting a device and modifying the threshold(s) to match the alert(s) specified in the Distribution List.



Distribution List

Create list(s) of user(s) and device(s) the alert notification is being sent to. The list can be an individual user with one or more devices or many users with several devices. Select the Alert to match the configured Trigger Threshold(s).



Create a list, then add the user's email, the device(s), the Alert(s) and any Events

Downloading Data

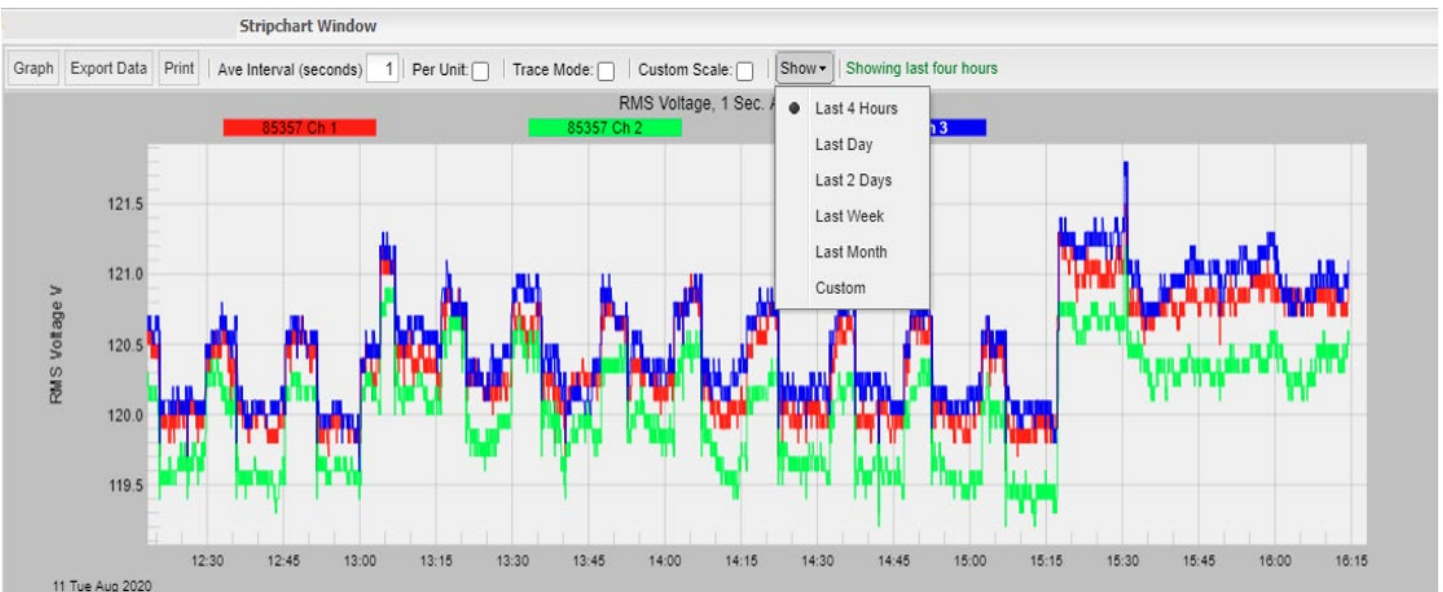
Boomerang data is compressed and sent to the Canvass server about every 15 minutes. There is no manual intervention needed to force a download. SCADA devices can be polled or send data at specified intervals.

Analyzing Data

Canvass has several graph options available. The default view shows the last 4 hours of data. Since the data is one continuous stream, older data can be viewed by selecting a specific time period or a custom period of time.



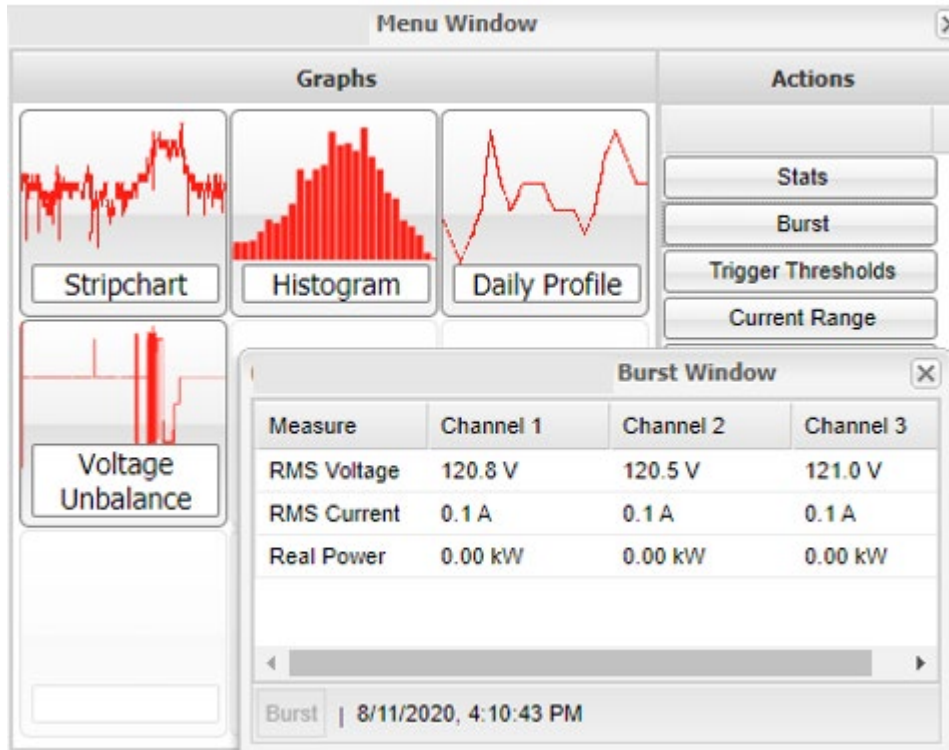
The graph choices displayed in Canvass will vary depending on the device and options for that device



The default graph view is displayed showing 4 hours of data, select **[Show]** to see additional choices

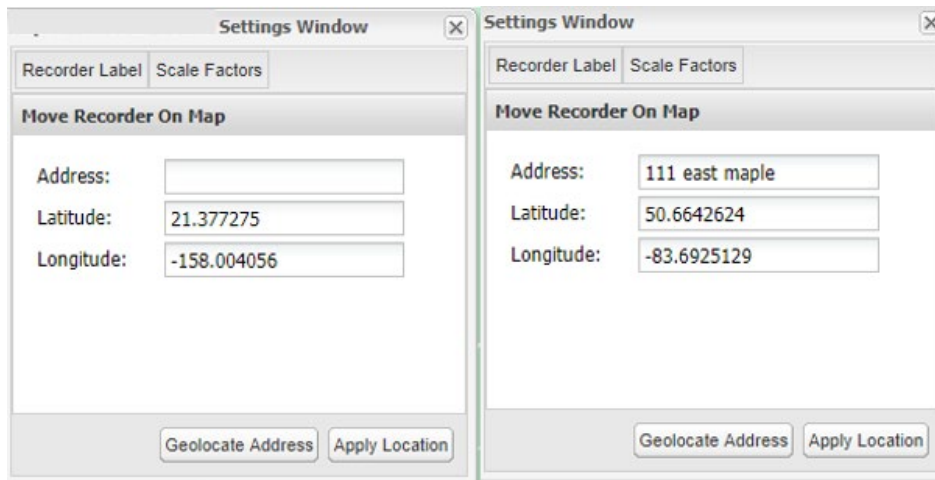
Viewing Live Data

To see live data readings in Canvass, select **[Burst]** in the Menu window. Canvass can also do Multi-Bursts over a specified time frame.



Setting Map Location

The address or longitude and latitude will need to be modified when the Boomerang is moved between locations. Boomerang devices do not have GPS locators installed. Select the **[Edit]** button next to the listed device. If longitude and latitude are available enter the numbers and select **[Apply Location]**. If using the address, enter the address, city and state may be needed, then select **[Geolocate Address]**. The Longitude and Latitude will be updated. If correct select **[Apply Location]**.

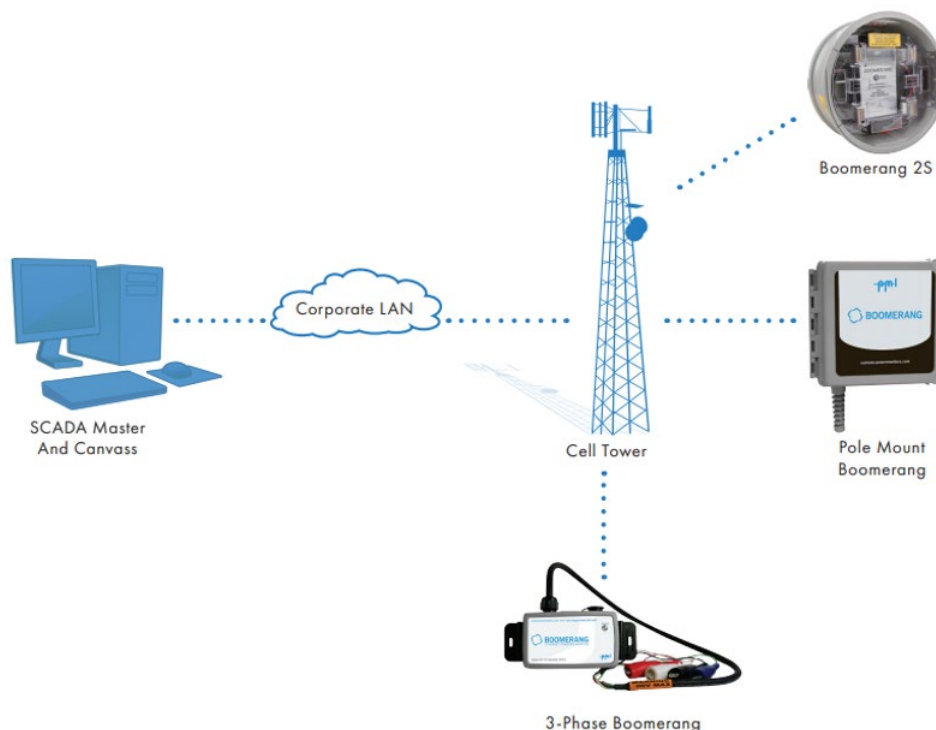


SCADA

The SCADA (Supervisory Control and Data Acquisition) system master is programmed to collect and possibly act on specific information from each Boomerang in its network. A typical setup will have the SCADA master requesting data from each device on a timed basis. A short time interval between requests yields a more “real-time” look at the data but at the expense of data transmission. Since most Boomerangs are using the cellular data network it is important to balance the frequency of data collection against the amount of data being transmitted to avoid exceeding the Boomerang’s monthly data limit.

It is also possible to set up each Boomerang to report data without a specific request from the master but instead based on custom thresholds in the data being monitored. This is referred to as unsolicited data because the outstation (Boomerang) sends the information based on preprogrammed parameters instead of responding to a query from the master. A combination of slower timed requests for data along with the Boomerang’s capability to deliver unsolicited data based on significant changes in monitored data makes for an especially efficient data acquisition

The Boomerang adheres to an industry standard protocol, DNP3 (Distributed Network Protocol) and is therefore able to communicate with third party SCADA systems. Since Boomerangs utilize an IP data network (cellular or wired), each must be configured correctly to communicate with the SCADA master. To configure a Boomerang for SCADA, use the NMS or DMU software (see section later in this manual) from PMI.



For SCADA settings see WP262 ‘Boomerang Configuration for SCADA Systems’ in the PMI Library: <https://library.powermonitors.com> also see; WP316 ‘DNP3 Point Map 2.0 Update’

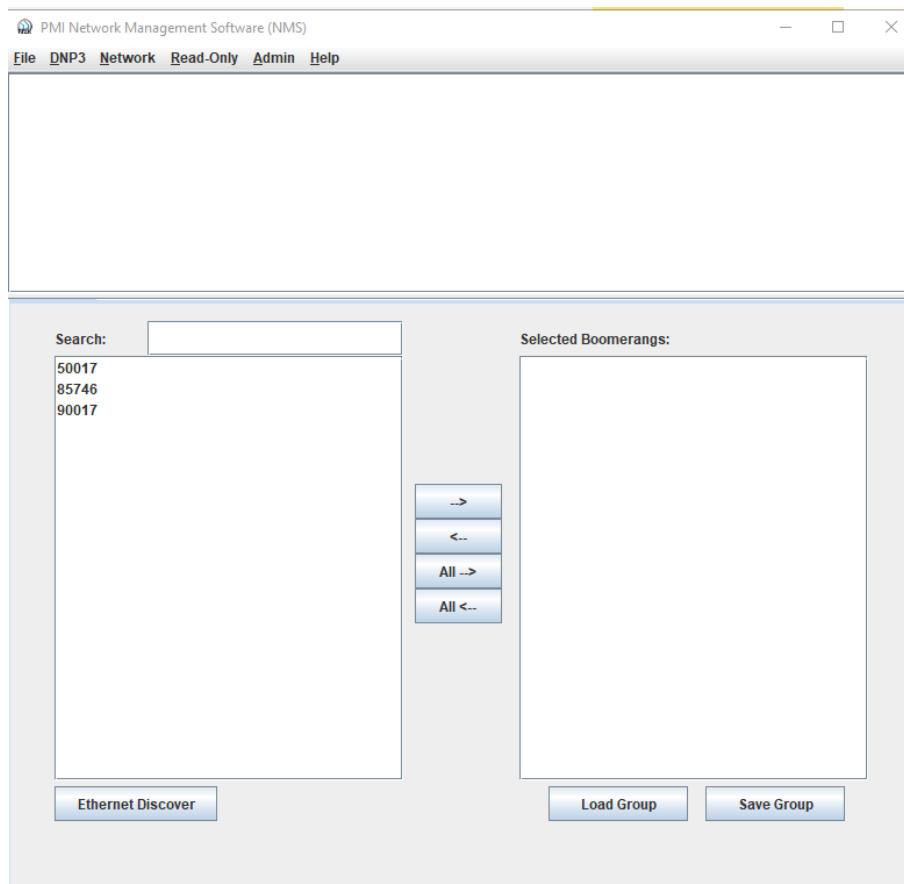
NMS Network Management Interface

The primary purpose of the NMS is to allow the user to configure multiple devices either individually, in batches or one at a time. NMS also provides reporting capabilities that allow the user to identify the device, retrieve the devices status and to look at some of the key points of the device's configuration and logs. Since the NMS was primarily designed for users who wish to deploy the Boomerang to their SCADA systems– which are typically very heavily secured– the NMS was designed with security in mind. One of the primary security features within NMS is role-based access integrated with an LDAP server (to include Microsoft Active Directory). Some other security features: each Boomerang can have its own password for password-protected communication with the NMS; AES 128-bit encryption is used between the NMS and the Boomerang during communication and all sensitive NMS related data is encrypted with AES 128-bit encryption using files that reside on the local operating system, allowing system administrators to apply additional security through file permissions and other local or site-specific protocols.

NMS is also used for finding the dynamic IP of the Ethernet Boomerang and then setting the desired static IP address. The PC running NMS and the Ethernet or cellular Boomerang will need to be on the same network in order to communicate.

NMS is JAVA based and JDK or JRE will need to be downloaded from the Oracle website before using.

PMI Technical Support can provide you with the NMS utility software

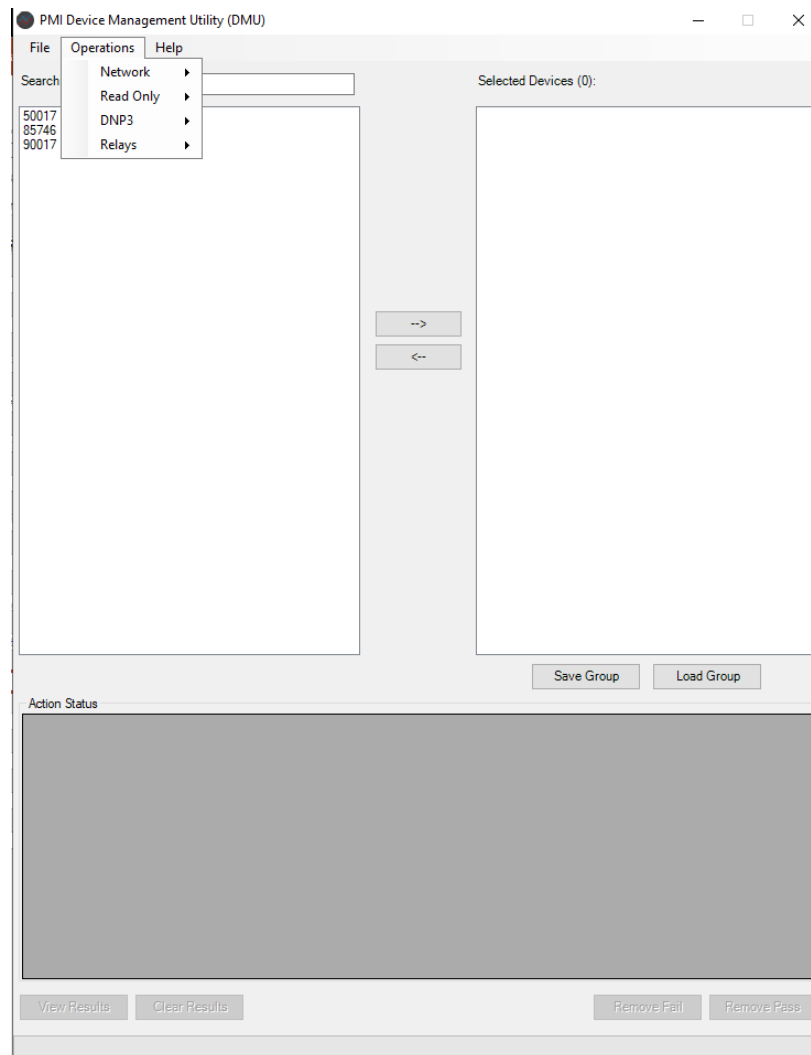


NMS Main view

DMU Device Management Utility

DMU is similar to NMS but does not rely on Java.

PMI Technical Support can provide you with the DM utility software.



Technical Support

Help is always available if one needs additional assistance. The technical support team at PMI is widely considered to be the best in the industry. Use one of the following methods to obtain technical support:

E-mail Support

Send e-mail to: techsupport@powermonitors.com

Web Support

Submit a support request via the web at <https://www.powermonitors.com/support>

Telephone Support

Contact PMI 24 hours a day, 7 days a week for live tech support by calling: (800) 296-4120

Postal Mail Support

All correspondence by post should be addressed to:

Power Monitors, Inc.

800 North Main Street

Mt. Crawford, VA 22841USA

Appendix 1: Frequently Asked Questions (FAQs)

Firmware: How do I check the Boomerang firmware version?

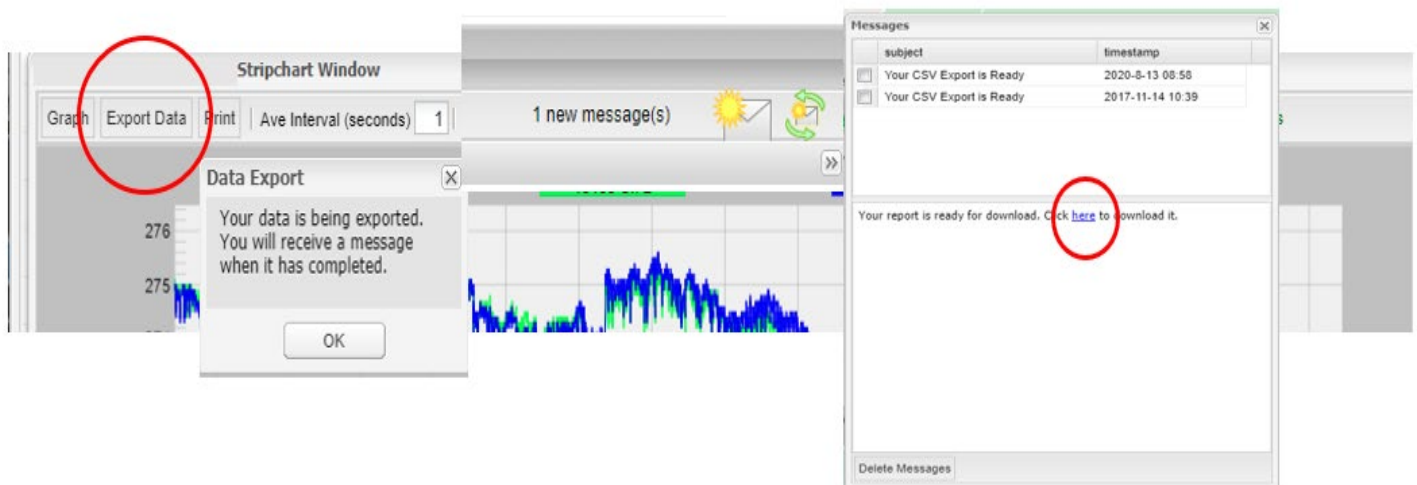
1. The DMU or NMS software can be used to check the firmware version in a Boomerang
2. Do not upload firmware files unless requested by PMI

Firmware: How do I upgrade the Boomerang's firmware?

1. For SCADA based Boomerangs, the firmware can be updated using DMU or NMS. PMI engineering will specify which Boomerang models and which firmware is applicable, then send the correct firmware file to upload.
2. For Canvass Boomerangs, PMI will upload the updated firmware to the Boomerang
3. Do not upload firmware files unless requested by PMI

How do I export graph data to a report in Canvass?

1. In Canvass open the graph and adjust the timeline for the needed data
2. Select the **[Export Data]** tab
3. A message will appear stating 'your data is being exported'. Close message.
4. In the upper right corner of Canvass, the **[Letter]** will have a 'sun' emblem and a notice of a 'new message' will appear when the document is generated
5. Select the **[Letter]** icon to see completed reports, or to remove older reports
6. Select the report, then click the word: **[here]** to download the document to your PC
7. The csv document will be sent to your PC's downloads folder for viewing



How should I interpret the data recorded by my Boomerang?

1. There are many Documents listed on the Power Monitors website.
2. To View, Download and Search Technical Documents and Case Studies, go to the Library on the Power Monitors website: <https://library.powermonitors.com>
3. Or call the Technical Support Team at 1-800-296-4120

How do I change the scaling (upper or lower bounds) on a graph?

1. Open the graph in Canvass
2. Place a check in the [Custom Scale] box
3. Enter the [Max] and [Min] limits you want to see
4. Select [Graph] tab to refresh the graph view



My Boomerang will not communicate. What should I do?

1. See Appendix 2: Troubleshooting
2. Contact the Technical Support Team at 1-800-296-4120

Will I need to buy Canvass?

1. Your data is stored and accessible for several years and to maintain the servers, there is a yearly charge per device for Canvass.
2. Contact the PMI Sales Team for information

How do I activate my cell Boomerang data plan?

1. To communicate with your cell Boomerang, the cell modem must be set up with a Verizon cell plan (a public static IP address is preferred) using the SIM and IMEI numbers that can be found in the shipping material.
 - a. A cell plan can be purchased through PMI and the Boomerang or other cell device will be configured with an IP address and tested before shipping
2. Internal IP addresses can be supplied to Verizon by you company's IT group
 - a. Your PC must be on the internal network to access internal IP addresses
3. The Boomerang will auto-connect to the cell tower once Verizon has configured the cell data plan
4. The Boomerang will begin sending data to the Canvass servers and is accessible to SCADA control

Appendix 2: Troubleshooting

There are several things that could cause communication/connection problems with PMI devices

1. If your device connects using a cable, or if the load is directly connected to the device, check all connections for a tight fit and free of any corrosion or any debris
 - a. For safety always check connections for physical defects, such as cuts or abrasions and missing connector pins
2. Check the external antenna connection and coax

LED Flash Patterns for LTE Boomerang: 3-phase and meter socket models

1. Color | State | LED pattern (all repeat) | Comment

Color	State	LED pattern (all repeat)	Comment
Blue	Bootloader	low, med, high, off	Approx. 10 sec duration
Red	Sys Idle	.5s on, .5s off, .5s on, 2s off	Modem connection in progress, 1-2 min
Green	Modem connect	5s on, 1s off	Connected to network with RSSI > 8
Orange	Modem connect	5s on, 1s off	Connected to network with RSSI <= 8
Green	Canvass/DNP3	1s on, 5s off	Canvass/DNP3 success with RSSI > 8
Orange	Canvass/DNP3	1s on, 5s off	Canvass/DNP3 success with RSSI <= 8
Aqua	Modem Wait	.5s on, .5s off, .5s on, 2s off	Wait for modem start, approx. 75 sec
Purple	FW Updating	.5s on, .5s off	Approx. 3-5 min, reboots when finished
White	Locate mode	.5s on, .5s off	Visual locate mode, 30 sec
Red	System Err	.5s on, .5s off	Hardware failure

2. When all is well the LED (green or orange) is 1 second on, 5 seconds off, repeating

Typical startup sequence assuming no errors and activated SIM card

1. Red, briefly at power on or reset
2. Blue, Bootloader, approx. 10 seconds
3. Aqua, Modem wait, approx. 80 seconds
4. Red, Modem setup, approx. 60 seconds (with occasional aqua blip)
5. Green or Orange, Modem connected to network (5s on, 1s off)
6. Green or Orange, Canvass/DNP3 success (1s on, 5s off)

Startup sequence with non-activated SIM or no signal (RSSI) present

1. Red, briefly at power on or reset
2. Blue, Bootloader, approx. 10 seconds

To reset a Boomerang

1. Disconnect the recorder and allow it to power down until LED is off

If you still have communication or connection problems after trying the above suggestions, then there is possibly a hardware problem in the recorder

1. Call Technical Support at 1-800-296-4120
2. If there appears to be a hardware problem, call PMI at 1800-296-4120 to arrange for a return authorization (RA) to send your unit to the repair department

Appendix 3: Warranty Clause

Power Monitors Inc. (PMI) warrants each new product manufactured and sold to be free from defects in material, workmanship, and construction, and that when used in accordance with this manual will perform to applicable specifications for a period of one year after shipment.

If examination by PMI discloses that the product has been defective, then our obligation is limited to repair or replacement, at our option, of the defective unit or its components. PMI is not responsible for products that have been subject to misuse, alteration, accident, or for repairs not performed by PMI.

The foregoing warranty constitutes PMI's sole liability and is in lieu of any other warranty of merchantability or fitness. PMI shall not be responsible for any incidental or consequential damages arising from any breach of warranty.

Equipment Return

If any PMI product requires repair or is defective, call PMI at (800) 296-4120 before shipping the unit to PMI. If the problem cannot be resolved over the phone, PMI will issue a return authorization number. For prompt service, all shipments to PMI must include:

1. The billing and shipping address for return of equipment
2. The name and telephone number of whom to contact for further information
3. A description of the problem or the work required
4. A list of the enclosed items and serial numbers
5. A return authorization number
6. If possible, a copy of the original invoice

Equipment returned to PMI must be shipped with freight charges prepaid. After repair, PMI will return equipment F.O.B. factory. If equipment is repaired under warranty obligation, freight charges (excluding airfreight or premium services) will be refunded or credited to the customer's account. Return equipment to:

Power Monitors Inc.
800 North Main Street
Mount Crawford, VA 22841 USA
Attention: Repair Department

Appendix 4: Regulatory Information

U.S. FCC Part 15 and Industry Canada RSS 210 Statements

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference
and
2. This device must accept any interference received, including interference that may cause undesired operation.

The FCC and Industry Canada (IC) ID numbers applicable to the Boomerang product are:

FCC ID: R09REVOL0608

IC: 4806A-REVOL0608

FCC Warning

Changes or modifications to this product not expressly approved by Power Monitors Inc. could void the user's authority to operate this equipment.

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.