MicroPMU Quick Start Kit

First Steps

Revision 9

> **WARNING:** Death, serious injury, or fire hazard could result from improper connection or operation of the instruments of this kit. Carefully read and understand manual before connecting this instrument.
>
> **AVERTISSEMENT:** Si l'instrument est mal connecté, la mort, des blessures graves, ou un danger d'incendie peuvent s'en suivre. Lisez attentivement le manuel avant de connecter l'instrument.
>
> **WARNUNG:** Der falsche Anschluß dieses Gerätes kann Tod, schwere Verletzungen oder Feuer verursachen. Bevor Sie die Instrument von dieses Start Kit anschließen, müssen Sie die Anleitung lesen und verstanden haben.
>
> **ADVERTENCIA:** Una conexión incorrecta de los instrumentos de esta Start kit puede producir la muerte, lesiones graves y riesgo de incendio. Lea y entienda el manual antes de conectar.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Installation, service, and maintenance of your MicroPMU must only be done by qualified personnel for electrical installations.

The information contained in this document is subject to change without notice.

Produced in the United States of America.

IMPORTANT: It is HIGHLY recommended that the Quickstart Kit (server, MicroPMUs, network switch) is backed up by and uninterruptable power supply (UPS) in the event of a power surge or failure. This will greatly reduce the likelihood of damage caused to any of the hardware or potential data corruption as a result of a power outage or fluctuation. A recommended UPS model is the **APC-SMT750**.

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1 MicroPMU Quick Start Kit

1.1 What Is the MicroPMU Quick Start Kit?

Microsynchrophasors measurement is a new technology. It involves continuous monitoring and recording of phenomena on the distribution or micro grids. The MicroPMU Plotting Application software has been developed specifically to assist researchers and engineers to manage and navigate through the large amount of measurements generated by the MicroPMU's. The Quick Start Kit serves as a convenient way to start a measurement campaign in just a few hours. It includes instruments, cables, connectors, software and a basic communication infrastructure: all is provided in a single pack to give you a head start!

1.2 Requirements prior to installation

IMPORTANT: It is HIGHLY recommended that the Quickstart Kit (server, MicroPMUs, network switch) is backed up by and uninterruptable power supply (UPS) in the event of a power surge or failure. This will greatly reduce the likelihood of damage caused to any of the hardware or potential data corruption as a result of a power outage or fluctuation. A recommended UPS model is the **APC-SMT750**.

The following is a list of requirements before installing any MicroPMUs.

- Monitor with a VGA display port and a VGA cable
- **Google Chrome Browser** (Windows, Linux, Mac OSX) or **Safari** (iOS and Mac OSX), or Microsoft Internet Explorer (Windows)
- Laptop with an Ethernet port and an Ethernet cable

1.3 MicroPMU Quick Start Kit Contents

Linux Server
- 1x Linux server (hosts the MicroPMU Plotter Application)
- 1x Power cord for Linux server
- 1x Mouse, Keyboard for Linux server

MicroPMUs
- 4x MicroPMU packages: each package includes a MicroPMU and its PM1, MS1, GPS1 and UPS1 modules
- 4x DIN rails

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- 4x single phase voltage cables
- 4x current transformers

Networking

- 5x 10-meter Cat 5e patch cables (Ethernet)
- 1x 16 port 10/100 Desktop switch

The Quick Start Kit comes preconfigured as follows:

Server:	172.17.6.100
Subnet:	255.255.255.0
uPMU_1:	172.17.6.101
uPMU_2:	172.17.6.102
uPMU_3:	172.17.6.103
uPMU_4:	172.17.6.104

2 Connecting and setting up the MicroPMUs

The following top level diagram illustrates the entire physical setup and connections for the Quick Start Kit.
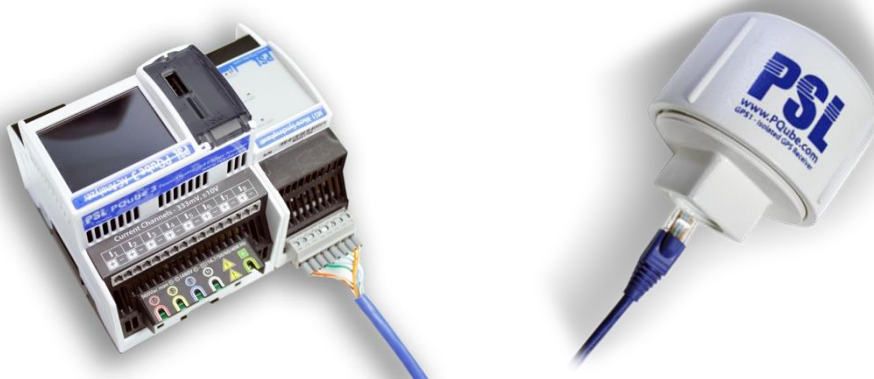
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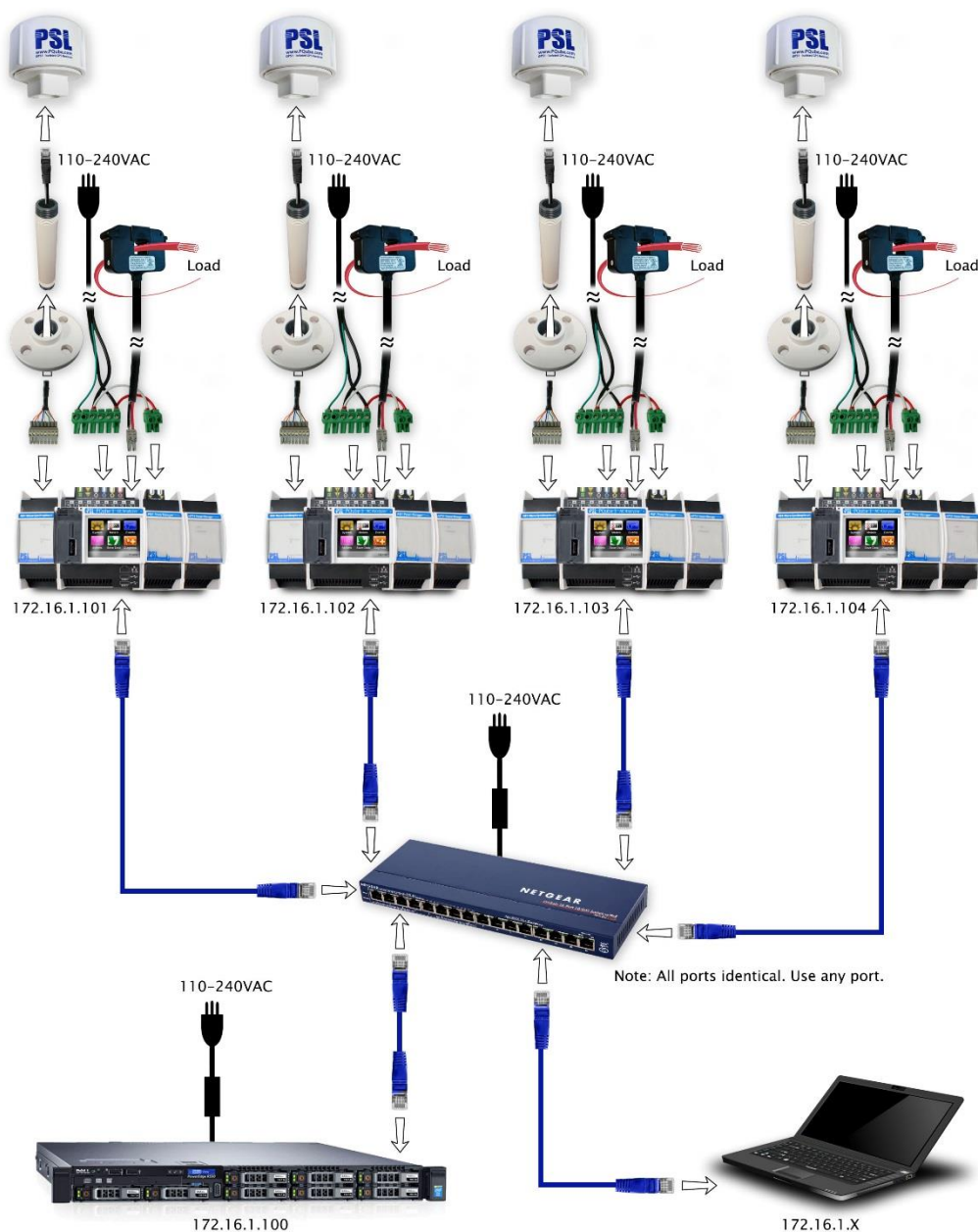
MicroPMU Setup:

1. **The MicroPMU, MS1, PM1 and UPS1 come preassembled on a DIN rail**

2. **Mount the GPS**
   The GPS cable has an 8-pin terminal block on one end and an RJ-45 jack on the other end. The 8-pin terminal block plugs into the MS1 module, the other end plugs into the GPS1 receiver.

IMPORTANT: Do not plug the RJ-45 end of the GPS cable into a network switch or router.

Place the GPS1 receiver in an area with direct line of sight to the sky.
For maximum exposure to satellites, mount it on the roof.

If necessary, the GPS cable can be extended using a standard RJ-45 coupler and a standard CAT5, CAT5E, or CAT6 Ethernet cable (to a maximum length of 500 feet / 150 meters).

3. **Connect the MicroPMU to the network switch**

Plug in one of the provided Ethernet cables between the MicroPMU and the provided 16-port Ethernet switch. Ethernet status lights will turn on when connection is established.

4. **Connect wires to mains AC terminals and PM1**

Make sure the power is OFF before servicing these terminals.

Connect the wires to the high voltage terminal block on the MicroPMU. They will be labeled L1, L2, L3, N, and Ground.

Connect the wires to the PM1 AC Input Terminals.

IMPORTANT: You **must** ensure that the ground wire is connected to your MicroPMU. This is critical for accurate phase angle measurements.

5. **Connect the server to network and power**

    Once all of the MicroPMU units have been set up. Use one of the provided Ethernet cables to connect the server to the provided 16 port Ethernet switch. Then, connect the server to a suitable power supply and press the power button next to the "Dell" icon on the top left corner of the front panel.

3 Using the MicroPMU Plotter

3.1 Accessing the MicroPMU Plotter

The Quick Start Kit server comes with a pre-installed data plotting web application, known as the MicroPMU Mulitple-Resolution Plotter. The MicroPMU Plotter can be accessed using an internet browser and by typing the IP address of the Quick Start Kit server: http://172.16.1.100. This IP address is pre-configured with the Quick Start Kit. If this needs to be changed, refer to the MicroPMU Administrator Manual.
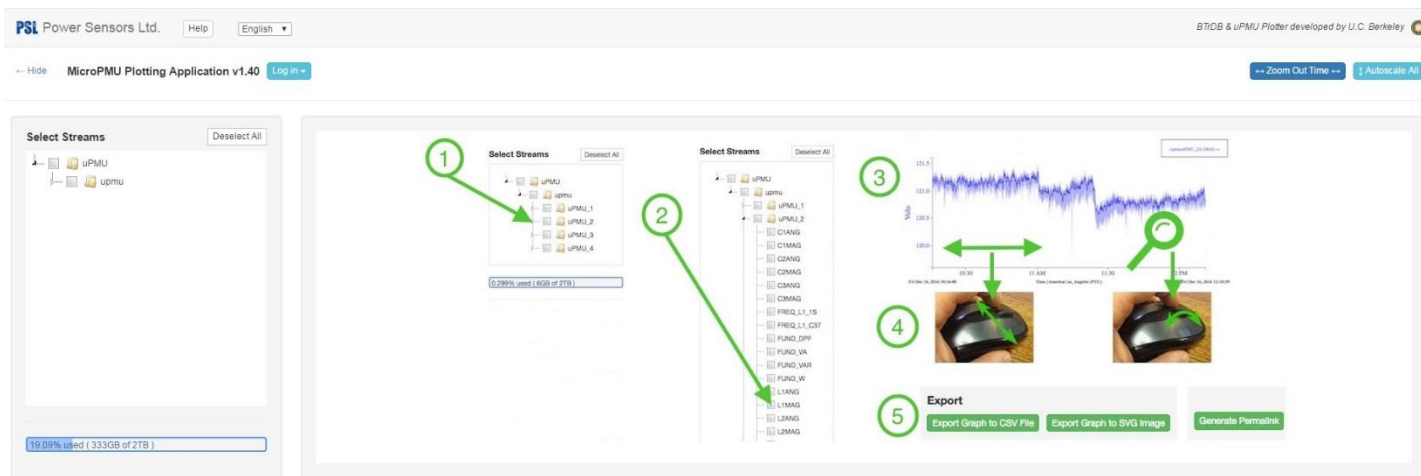
The different areas of the plotter interface are indicated in the following figure:

3.2 Plotter Header
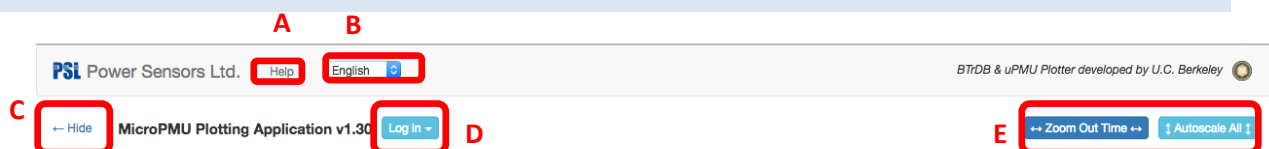
A. The help button will open the Quick Start Kit First Steps manual on a new browser page.
B. Click for a list of languages to choose from for display in the application.
C. Click to hide or show the left-hand panel.
D. If there are any user accounts set up for the plotter application, then the login button will be displayed. By default, there are no user accounts and all streams are viewable to whoever uses the application. Refer to the Quick Start Kit Administrator manual for instructions on setting up user accounts.
E. The "Zoom Out Time" button scales the X-axis (time) to fit all recorded data into the graph. The "Autoscale All" button scales the Y-axis (measurement values) to fit all recorded values within the time scale.

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3.3 Selecting Streams

A stream is a parameter recorded over time by the MicroPMUs, e.g. phasor amplitude. To view a stream:

1. Click the dropdown arrow to the left of "uPMU" in "Select Streams" section
2. Click the dropdown arrow to the left of "upmu" (database collection name) to show MicroPMUs
3. Expand by clicking the dropdown arrow to the left of a MicroPMU name
4. Select a MicroPMU stream to display (ex. L1MAG or FREQ_L1_1S) by check marking the box to the left of the stream name
5. Data will appear in the graphing area like in the following image:

The server disk usage is displayed in between the streams tree and time parameter options.

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3.4 Using The Plotter Graph

When the mouse cursor is placed over the graph, its scroll wheel can be used to zoom in and out. The Plotter displays time ranges from a year's worth of data, down to half cycle intervals.
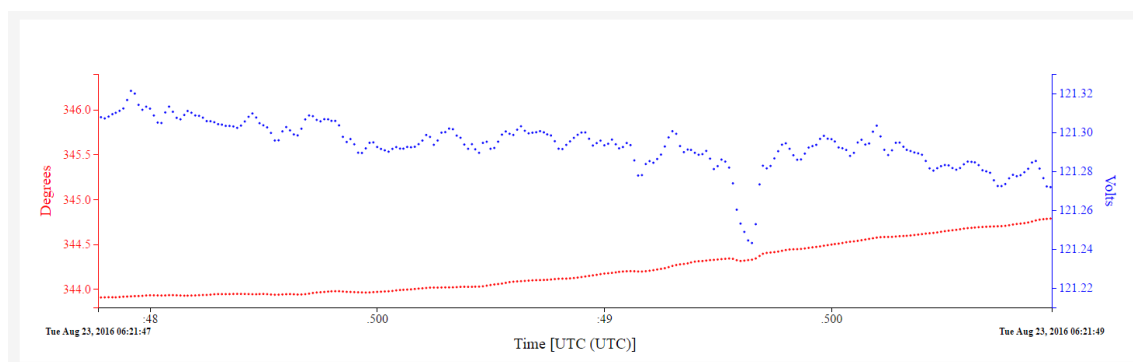

The graph can be panned to the left or right along the X-axis (time) by holding the mouse's left click on the graph and dragging the mouse either left or right.

When the time span displayed on screen is such that the individual half cycle points cannot be plotted, the Plotting Application switches to a min/average/max.

The following graphs demonstrate how the data is represented for different zoom levels on the X-axis (time).

The more time that is displayed on the X-axis, the higher the density of data per pixel on the graph. When the data density in the graph is high, average values are plotted as the original stream color, and minimum and max values are plotted in a lighter shade of the stream color.

As the time zoom level increases, individual plot points can be seen on the graph.
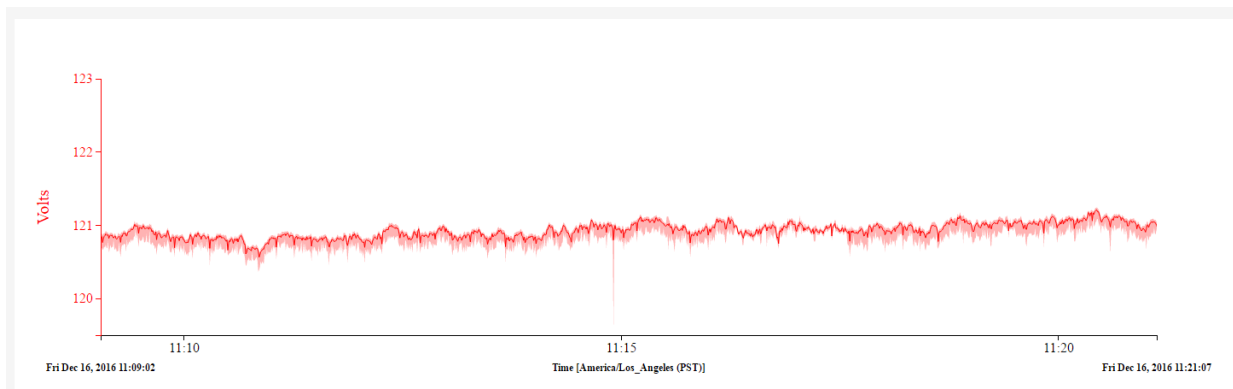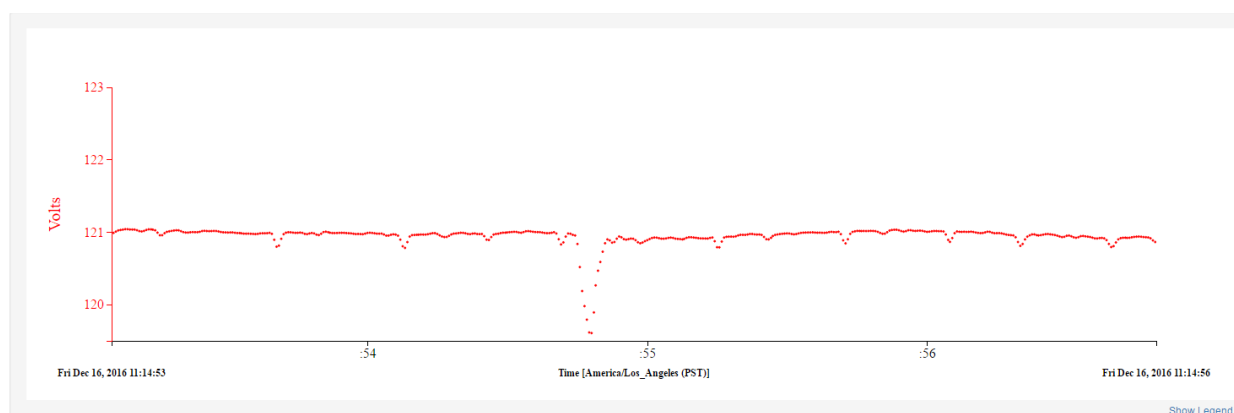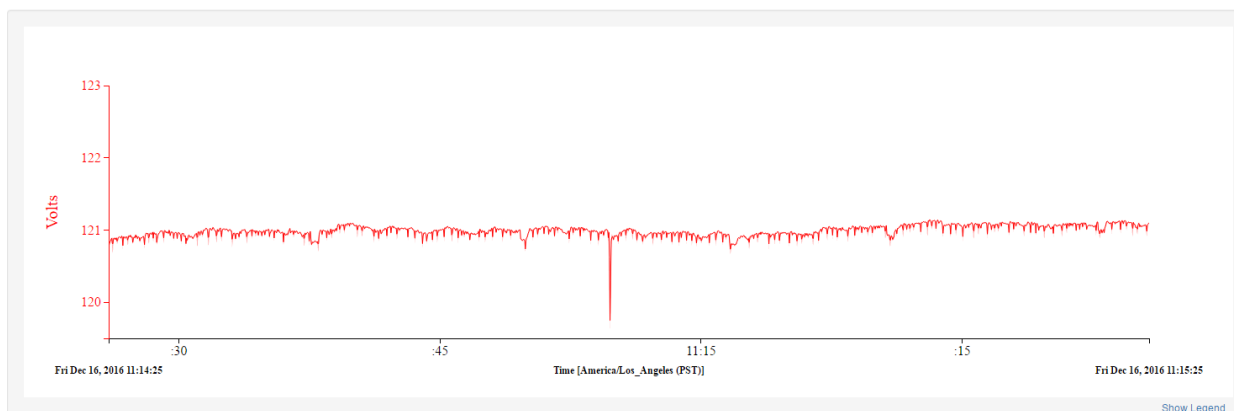
3.5 Legend

In the "Legend" section, any axis name from the dropdown can be selected. Each data stream's color, data stream name, and axis name is included in the legend. Clicking the color box in the "Legend" section allows color selection. This turns the data stream to a different color for visibility or user preference.

Clicking the name of the channel highlights the individual channel on the graph. This is useful for quickly identifying data when multiple streams are plotted. In addition, clicking the name of the stream also displays a number on the graph that describes the density of data points per pixel and any gaps in data recording are indicated on the graph.

3.6 Axes and Scaling Options

The name of each axis can be changed by clicking the "Add a Y-axis" button and entering a new name in the "Axis Name" field. Then use the "Axis Name" dropdown list in the Legend area to select a custom axis for a stream. Any custom axis may be removed with the red "X" button.

In the "Axis Position" section, there is an arrow pointing left, an "X", and an arrow pointing right. Clicking the arrows will move the axis on the graph to the left or right side of the graph. Clicking on the "X" disables the axis from being shown. Clicking "Autoscale" will fit and adjust the vertical scale. Also, scale ranges can be manually entered.
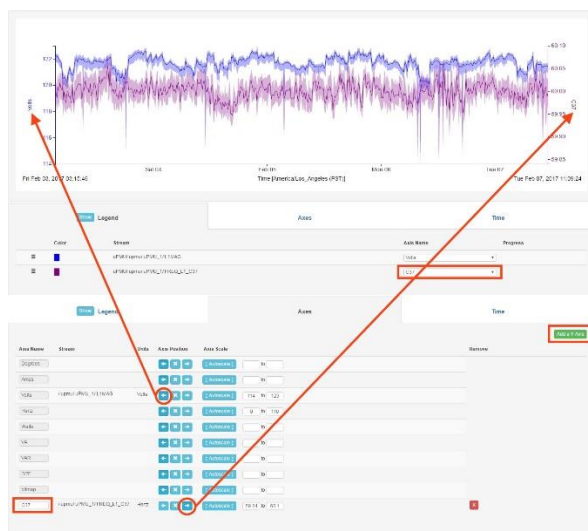
3.7 Time Options

The manual zoom start and end date may be adjusted by clicking on the date which displays a calendar to choose a date and time down to the second. Alternatively, the zoom may be quickly set to display data for the past year by clicking the "-1Y" and "Now" buttons to the right of the start and end date respectively.

The time zone may also be adjusted below using the time zone drop down list.

Click the "Manual Zoom" button to refresh the plotter graph.

3.8 Export Tools

Generate Permalink

The "Generate Permalink" button creates an Internet URL that opens the MicroPMU Plotting Application and displays the measurements with the associated time, axes, and parameters selected at the time of permalink generation.

The link can be copied, saved, or emailed. Clicking the link will display the exact same graph.

Export to SVG Image

Click "Export Graph to SVG Image" to generate a picture of the graph. Click "Download Image" to save it to your computer.

Export Graph to CSV Files

The "Export Graph to CSV File" button is used to create a CSV (comma separated values) file of the plotter graph's data for the values seen within the current graphing canvas.

You must plot streams in your desired time range before you can generate a CSV file.   ✕

Export to CSV File

Data frequency:
○ 50Hz
◉ 60Hz

Time per row in your CSV file: [30 minutes ▲▼]

[Cancel] [Create CSV File]

After clicking "Export Graph to CSV File", there is a prompt displayed to choose the time per row in the CSV file. This selection will aggregate data into intervals of the given time span and generate minimum, average and maximum values in each row of the CSV file for the given time interval. The available time intervals to choose from are 1 day, 1 hour, 30 minutes, 5 minutes, 1 minute, 1 second, 1 cycle and ½ cycle.

The wave form frequency may also be selected using either the 50Hz or 60Hz radio button. Make sure this frequency matches the frequency of the input signal to the MicroPMUs or the resulting CSV file will have inaccurate sample data.

Click "Create CSV File" to create a csv file which will be saved to the downloads folder by default.

Below is a sample CSV export file.

	A	B	C	D	E	F	G	H	I
1	Time[ns]	Time	uPMU/ upmu/ uPMU_	uPMU/ upmu/ uPMU_5/	uPMU/ upmu/ uPMU_	uPMU/ upmu/ uPMU_5	uPMU/ up	uPMU/ up	uPMU/ up u
2	1481915682726600000.00	14:42.7	129	120.824318	121.003723	121.036087	129	59.99189	59.99651
3	1481915683800350000.00	14:43.8	128	120.744331	120.951002	121.00885	128	59.98978	59.99651
4	1481915684874090000.00	14:44.9	129	120.830063	121.007603	121.052856	129	59.99076	59.99685
5	1481915685947830000.00	14:45.9	129	120.815857	120.962761	121.024643	129	59.99106	59.99659
6	1481915687021570000.00	14:47.0	129	120.827072	120.969933	121.037949	129	59.99217	59.99842
7	1481915688095310000.00	14:48.1	129	120.832947	120.997668	121.046928	129	59.99521	59.99877
8	1481915689169050000.00	14:49.2	129	120.683647	120.934873	121.027084	129	59.99545	59.99965
9	1481915690242800000.00	14:50.2	128	120.845345	121.013445	121.05584	128	59.99656	60.00053
10	1481915691316540000.00	14:51.3	129	120.881027	120.996742	121.04821	129	59.99427	59.99944
11	1481915692390280000.00	14:52.4	129	120.817802	121.005727	121.045639	129	59.99273	59.99917
12	1481915693464020000.00	14:53.5	129	120.783745	120.970856	121.011147	129	59.99329	59.99899
13	1481915694537760000.00	14:54.5	129	119.60791	120.87103	121.015205	129	59.92365	59.9949
14	1481915695611510000.00	14:55.6	129	120.795418	120.970242	121.034714	129	59.98822	59.99482
15	1481915696685250000.00	14:56.7	129	120.785278	120.937713	120.974312	129	59.98708	59.99297
16	1481915697758990000.00	14:57.8	128	120.77063	120.950664	120.991058	128	59.9861	59.99201
17	1481915698832730000.00	14:58.8	129	120.768166	120.936498	120.989639	129	59.98597	59.99118
18	1481915699906470000.00	14:59.9	129	120.768456	120.916374	120.987747	129	59.98605	59.991
19	1481915700980210000.00	15:01.0	129	120.657997	120.886401	120.993767	129	59.98119	59.989
20	1481915702053960000.00	15:02.1	129	120.731773	120.896657	120.940506	129	59.98404	59.98896
21	1481915703127700000.00	15:03.1	129	120.730286	120.939378	120.981712	129	59.98136	59.98915
22	1481915704201440000.00	15:04.2	129	120.767555	120.946361	120.983238	129	59.98359	59.98954
23	1481915705275180000.00	15:05.3	128	120.763824	120.93255	120.965706	128	59.98466	59.99032
24	1481915706348920000.00	15:06.3	129	120.789543	120.983137	121.051872	129	59.98468	59.99111
25	1481915707422670000.00	15:07.4	129	120.82531	121.003409	121.043381	129	59.98325	59.99142

The first column displays a Unix time stamp (number of seconds elapsed since January 1, 1970 00:00:00 UTC) for the beginning of the time interval. The second column displays the same time formatted to the selected time zone when the CSV file was generated. Columns following after will display data for each stream in the graph. Each stream will have four columns to display "cnt", "min", "mean" and "max". The "cnt" column displays the number of ½ cycles in the chosen time interval (row). The "min", "mean", and "max" columns display, respectively, the minimum, average, and maximum values recorded in the chosen time interval.

4 Troubleshooting

For technical assistance or the latest version of this document, please call 1-510-522-4455 or email: support@powersensorsltd.com if you have any further questions.

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