

# Eagle 120 Recorder User's Manual

Power Monitors, Inc.



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## 1 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 Eagle 120 Voltage Recorders have also been developed by following these same principles. The Eagle 120 Recorder combines the powerful, high technology voltage analysis capabilities of our larger Voltage Recorders with precisely targeted end use specifically by plugging directly in a receptacle.

The Eagle 120 Voltage Recorder was developed for diagnosing electric power problems at the outlet. The unit plugs into any standard 15 amp US wall receptacle, to detect outages, sags, swells, and flicker. Detectable voltage range is 0 to 170 volts, allowing the measurement and recording of severe voltage variations on 120VAC single-phase lines. Inside its lightweight enclosure, state-of-the-art electronics measure and record true RMS line to neutral and neutral to ground voltage and load current.

Each unit has been individually calibrated to ensure high accuracy and stability. With its voltage and current measurement and digital processing circuitry based on the established Voltage Recorder line, the Eagle 120 Recorder provides a voltage measurement, processing, and reporting system with a proven performance history.

In summary, the Eagle 120 Recorder Voltage was created with your needs in mind. It is perfect for analyzing voltage disturbances at the consumer level. After looking through this manual and using the Eagle 120 Recorder, please contact us if you have any questions about its operation, ideas for new features, or ideas for additional products. We want you to be happy with this product, and would appreciate any input that could help us develop products to meet your future needs.

## 2 Safety Issues

Please read before installing the Eagle 120 Recorder.

The Eagle 120 Recorder Voltage contains dangerous voltage levels during operation. Do not disassemble the Recorder. **THERE ARE NO USER SERVICEABLE PARTS INSIDE.**

Do not install or operate near open bodies of water. The Eagle 120 is intended for use with a standard, indoor, 15 amp 120VAC receptacles. Do not use outdoors or in a wet location (as determined by the National Electrical Code).

The Eagle 120 Recorder is intended for use with a standard 15 amp receptacle.

The USB port is optically isolated from the 120VAC line. However, to insure user safety and prevent damage to the unit, only the supplied Eagle 120 Recorder USB cable should be plugged into this jack. The other end of the USB cable should only be plugged into an USB port.

The Eagle 120 Recorder contains a lithium battery. This battery is not user replaceable. Follow all applicable regulations concerning disposal of batteries if the Eagle 120 Recorder is discarded, or return the unit to the factory for disposal.

Although the Eagle 120 Recorder Voltage has been designed and built to be as safe as possible, great care should be exercised at all times during operation and installation. The National Electric Code should be followed at all times.

The Eagle 120 convenience receptacle is rated at 15 amps, for use with a 15 amp branch circuit. As per the National Electric Code, the maximum allowable load on this receptacle is 12 amps. When the Eagle 120 is plugged into a 120VAC receptacle, this voltage is present on the convenience outlet. Use the same caution with this convenience outlet as with any 120VAC source.

Do not use this outlet where normal breaker operation could cause a loss of power to life-critical equipment or cause a dangerous situation to exist.

A three-wire to two-wire isolation adapter may be used with the VP-2 to plug the Eagle 120 into a two-wire receptacle with no earth ground. If this is done, the ground on the convenience receptacle is not connected to earth ground. Do not plug devices which require an earth ground into the convenience receptacle if this grounding scheme has been defeated.

The Eagle 120 is not designed for use with medical equipment or situations where life-critical equipment is being used. The convenience outlet in the Eagle 120 is not a hospital grade receptacle.

Do not use near heat sources such as radiators and electric heaters.

### **3 Getting Started with the Eagle 120 Recorder**

The Eagle 120 Recorder is an electronic recording device which plugs into a standard 15 amp receptacle. The unit measures and records voltages from line to neutral and neutral to ground. The Eagle 120 Recorder powers itself from the 120V line. After data has been recorded, the unit is connected to a PC with a USB cable. ProVision, the PC data analysis software, is used to extract the data from the Eagle 120 Recorder. With ProVision, data may be graphed, turned into reports, and exported to spreadsheets.

#### **3.1 Contents of the Eagle 120 Recorder Package**

The Eagle 120 Recorder is packaged with the following items:

- The Eagle 120 Recorder
- CD-ROM containing ProVision and all documentation
- USB communications cable

If any of these items are missing, please call PMI immediately. The CDROM includes the latest version of ProVision, example data files, and documentation for ProVision and all

Recorders in Adobe Acrobat format, Acrobat reader, and the latest firmware for all Voltage Recorders.

### **3.2 Installing the PC software (ProVision)**

Insert the CD-ROM into your CD drive. If the installation program doesn't start automatically, run setup.exe from the CD. The installation program will guide you through the rest of the process.

### **3.3 Eagle 120 Recorder Operation**

Using the Eagle 120 Recorder consists of initialization, installation, recording, downloading, and analyzing. First, the Eagle 120 Recorder is initialized with parameters appropriate for the recording session. These parameters include voltage thresholds, flicker limits, and a graph time interval, among others.

These parameters are set using ProVision. After sending the initialization to the Eagle 120 Recorder, it is ready for installation in a receptacle. When plugged in, the Eagle 120 Recorder begins a 60-second countdown. After the countdown, the Eagle 120 Recorder starts recording. Later, after the desired data is recorded, the data from the Eagle 120 Recorder is downloaded into ProVision. ProVision is then used to analyze and save the data. The Eagle 120 Recorder may be reinitialized

## **4 Using the Eagle 120 Recorder**

### **4.1 Initialization**

The Eagle 120 Recorder must be initialized before recording data. This is done by connecting the Eagle 120 Recorder to your PC with the Eagle 120 Recorder USB cable, and running ProVision. See the section "PC Communications with the Eagle 120 Recorder" for information on how to connect the Eagle 120 Recorder to the PC. See the ProVision documentation for details on how to initialize a Voltage Recorder.

### **4.2 Installation**

Please read the safety section before installation. Always exercise extreme caution when installing an Eagle 120 Recorder. Install the Eagle 120 Recorder in the receptacle socket by sliding the blades of the Recorder into the receptacles in the outlet. If you wish to monitor a load, plug in its AC cord into the front of the Recorder.



When the Recorder is plugged in, the LED on the front of the Recorder will start blinking. This indicates that the one-minute countdown to recording is in progress. At the end of the countdown, the Recorder will begin recording information. The LED will blink once every six seconds to indicate that the countdown is complete and the unit is recording.

Note: If you have interrupted power to the receptacle during installation, the countdown will not begin until the power is reapplied.

#### **4.4 Downloading Data**

After the Eagle 120 Recorder has recorded the desired data, it is downloaded into ProVision or a Palm PDA. The Eagle 120 Recorder may be downloaded in the field by connecting the USB cable into a laptop (see PC Communications with the eagle 120 Recorder).

The Eagle 120 Recorder stops recording when a PC is connected to the USB port and “Identify” is selected in ProVision. The data is then downloaded into ProVision. If the USB cable is unplugged from the Eagle 120 Recorder, the Eagle 120 Recorder will continue recording, appending data to the existing recording session. If the Eagle 120 Recorder is re-initialized, it will start a 60-second countdown. The Palm PDA can also download a Eagle 120 Recorder via the Blue tooth wireless communications (if the Eagle 120 has that option installed)– no cable is needed.

The Eagle 120 Recorder also may be downloaded later. Simply remove the unit from the outlet and take it back to the office. The Eagle 120 Recorder automatically stops recording when it is disconnected from an outlet. The recorded data is held in non-volatile memory so no data is lost. When the Eagle 120 Recorder is back in the office, connect it to a PC with the USB cable, then plug the Recorder into an outlet. The green LED lights up steadily in this mode to indicate that it is in communications mode, and ready for downloading.

The recorded data is still in the Eagle 120 Recorder and can be downloaded again even after it has been re-initialized. The old data is not erased until the end of the 60 second countdown of the next recording session.

#### **4.5 Analyzing Data**

See the ProVision documentation to learn about using ProVision to analyze Voltage Recorder data. The documentation is located in the “Manuals” folder on the ProVision CD-ROM.

#### **4.6 PC Communications with the Eagle 120 Recorder**

The Eagle 120 Recorder may communicate with ProVision running on a PC or laptop to receive its initialization and to download data. Use the supplied Recorder USB cable to connect the Eagle 120 Recorder to a PC. Plug the connector into an available USB port on the PC. Plug the other end of the USB cable into the jack on the bottom of the Eagle 120 Recorder. The green LED lights up steadily in this mode to indicate that it is in communications mode, and ready for communications.

In ProVision, the recorder serial number will appear within 2 minutes automatically in the devices window. The Eagle 120 Recorder and ProVision are now ready for communications. For details on how to use ProVision to initialize and download a Voltage Recorder, see the ProVision documentation located on the CD-ROM. The Eagle 120 Recorder does not have a modem. References to modem communications in the ProVision documentation do not apply to the Eagle 120 Recorder.

##### **4.6.1 Communications Troubleshooting**

Failure to establish USB communications is usually a result of a faulty PC setup or an improperly installed driver. Follow these steps to isolate and correct the problem.

Make sure the Eagle 120 Recorder is in communications mode. If the Eagle 120 Recorder red LED is not lit steadily, the unit is not in communications mode, and will not communicate through the USB port. Make sure the cable is plugged firmly into the 6-pin female connector on the Eagle 120 Recorder. Also check that the USB connector is plugged securely into the PC USB port. If the Eagle 120 Recorder is in communications mode, the problem is probably on the PC side.

A USB cable must be used to communicate directly with a laptop.

#### **4.8 Using a Palm PDA**

Initialization: In order to initialize the recorder it must have power from the line the recorder is installed. Also, the PDA must be able to communicate with the recorder, by

Bluetooth. Older recorders employed only the rs-232 cable, while newer Eagle 120 recorders may have Bluetooth installed as an option.

Once the recorder is powered and the PDA is communicating with the recorder, tap the PMIScan icon to reach the Main Menu, consisting of 3 commands: LDU, Comm, and Files.

#### **4.8.1 LDU**

This mode allows the user to scroll through a number of screens showing real-time display of the measurements that have been enabled: voltage, current, power, phase angle, power factor, displacement power factor, and harmonics are possible. The “1 Chan” display option shows the measurements on fewer screens than the “4 Chan” option, but both sequences show the same information.

- Tap More to scroll through the measurements.
- Tap Next to view other channels.

#### **4.8.2 Comm**

This mode allows the user to perform 6 functions, most importantly Download and Initialize:

1) “Download” identifies the recorder in the heading, allows editing of the Identification, and leads to a download.

- Tap Done and OK to initiate the download. See “Downloading Data” below.

2) “Identify” lists information about the individual recorder.

3) “Date/Time” allows the user to synchronize the recorder with the PDA.

- Tap Set Time to change the Date/Time of the PDA.

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4) “Initialize” allows the user to set parameters and choose options from a of screens similar to those in ProVision. By default, “Recorder Settings” shows the recommended or usual quantities.

- Tap Edit to change the settings.
- Tap Previous or Next to scroll through the numbered screens.
- Tap Done and OK to accept the defaults or the user-selected settings.

5) “Retrieve Set” uploads the prior group of settings.

6) “Done” leads back to the Main Menu and accepts the chosen settings.

#### **4.8.3 Downloading Data**

When the Technician wishes to collect data from the recorders in the field, the PDA serves as a storage medium to convey the data to the office PC. Depending on what records are enabled, the memory of the PDA holds downloads from several recorders.

Connect the PDA to the recorder via Bluetooth. To implement the download:

- Tap Comm, Download, and OK to initiate the transfer.

Depending on the size of the file, the process could take several minutes.

The download is complete when the Main Menu appears. Back at the office, the PDA may be connected to the PC through the HotSync docking cradle:

- Connect the cradle to the PC according to the instructions for the Palm.

- Place the Palm in the cradle.
- Press the HotSync button, and the HotSync Progress screen appears. HotSync places the .isf file in the folder you specify during the installation program. The .isf file can now be opened and viewed as usual with the ProVision software:
- Click on File, Open, and choose the file from the Open dialog box.

#### **4.9 Eagle 120 Recorder Options**

The Eagle 120 Recorder is available with a number of options. All options are installed internally inside the Eagle 120 Recorder housing. The most common option is the extended memory (8 MB).

The Bluetooth option lets the Eagle 120 Recorder to communicate wirelessly to a pc or a palm based PDA.

Standard features include current, power, harmonics, and waveform capture. The currents are sampled just like the voltage channels, 256 times per cycle. These samples are used to create one cycle RMS values, and are recorded like the voltage channels. The Eagle 120 Recorder contains 1 shunt to pick up the current signal from AC Hi– no external CTs or clamps are necessary.

The power feature allows the Eagle 120 Recorder to compute and record the power consumed by the loads on the service. Real power (watts), reactive power (vars), apparent power (volt-amps), and power factor are computed for each leg. These are computed using the voltages from line to neutral, and current through each leg. The power option also includes extra memory so that all the power quantities may be recorded without reducing the recording time. The Eagle 120 Recorder must have current measuring capability to compute power.

The Harmonics and Waveform Capture feature give the Eagle 120 Recorder the ability to measure and record voltage and current harmonics, as well as raw waveform data. graphs of selected voltage and current harmonics may be recorded, up to the 51st, as well as daily profiles of total harmonic distortion. In addition, raw voltage and current waveforms may be captured based on trigger conditions set with ProVision. This option also includes extra memory so that harmonic graphs may be recorded without lessening the total recording time.

##### **4.9.1 Eagle 120 Recorder Serial Numbering**

The Eagle 120 Recorder serial number indicates if Bluetooth has been installed.

The addition of Bluetooth is signified by the serial number label containing a serial number above 45000 and a Bluetooth symbol.

To see if extended memory is installed, connect to ProVision and identify the unit.

## **5 What the Eagle 120 Recorder Records**

### **5.1 Introduction**



The job of any power monitor is to record all interesting data, and leave unrecorded the vast majority of boring, unremarkable data. The tricky part for a monitor is deciding which events are important. This is a problem of data reduction. A recorder that captured every 60 Hz waveform during a week's recording would never miss an event, but would present the user with millions of useless cycles. Conversely, a recorder whose thresholds are set incorrectly may not record anything. Staying somewhere between these two extremes involves a balance of thresholds, settings, and record types. The monitor will see an enormous amount of data on its voltage and current inputs— the Eagle 120 Recorder sees over 1 billion samples per day! Ideally, all this data is reduced to a small report which just shows the important events and measurements. The sifting of data into specific record types accomplishes this task.

### **5.1.1 Triggered Record Types**

PMI Recorder records can be divided into two classes. The first is event driven. These record types are triggered by a combination of triggering logic and adjustable thresholds, usually voltage-based. If a trigger never happens, nothing is recorded for that record type. As more triggers occur, more records are collected for that record type. The advantage of this class is that nothing is recorded unless something happens. In the ideal case, no problems occurred, so nothing was recorded, and no data analysis is necessary. If a trigger did occur, then the monitor logged the event for later analysis. This is a powerful data-reduction tool, and can reduce huge amounts of data into a few small records containing all the significant events. The disadvantage is that success completely depends on good thresholds and settings. A threshold that is too tight will cause the Recorder to log records that aren't really worth analyzing.

These extraneous records often hide the (hopefully) few important ones. A threshold that is too loose will cause the Recorder to ignore important disturbances. Although it is often possible to use regulatory limits or other known standards to set thresholds, this can be a chicken-and-the-egg type problem:

sometimes you need to know something about the disturbance before you can set proper thresholds to capture it. Despite these potential pitfalls, triggered record types are powerful tools in power line monitoring. They are most useful for capturing voltage disturbances and power quality problems. The captured events are usually presented in a text report. Triggered record types include Power Outage, Abnormal Voltage, Event Change, Significant Change, and Waveform Capture.

### **5.1.2 Non-triggered Record Types**

The second class of record types is not event driven. These record types are always logging data, regardless of how interesting or important the data is. The classic example is a paper graph, which continuously logs data. There are no thresholds to set, although there may be a parameter to determine how often to collect data. The logged data is usually presented as a graph of data points. Although there may be a large amount of data, using a graph lets the eye pick out important data. Problems such as sags and swells are easy to see in the graph graphs. In addition to voltage quality studies, these record types are used for finding daily trends in current or power values, measuring power factor, etc. The advantage of not having thresholds to set is that there is no question about what data will be recorded. The disadvantage is that sometimes there is no question that a lot of data will be recorded, most of it unimportant. For non- power quality data such as

power factor measurement, there is no disadvantage. These record types include graphs, Daily Profiles, Histograms, and Energy Usage.

### **5.1.3 Using the Recorder**

The PMI Recorder can record every available record type simultaneously. Each record type has its own fixed memory allocation, so there is no danger of one errant record type filling the Recorder memory to the exclusion of other record types (for example, Event Capture can never overflow into graph memory). Thus the choice usually isn't what to record types to record, but what record types to examine. In order to answer that question, a good understanding of each record type is required. The details of each record type, and potential uses, are described in the ProVision manual.

## **6 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 which 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. 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 work required.
4. A list of the enclosed items and USB 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 air freight or premium services) will be refunded or credited to the customer's account.

**Return equipment to:  
Power Monitors, Inc.  
1661 Virginia Avenue**

**Harrisonburg, VA 22802**  
**Attn: Repair Dept.**