

Power Monitoring and Metering:
How Understanding Power Consumption
Can Lead to a More Efficient Data Center



Overview

Data center managers are continuously faced with the challenge of providing increased levels of power in subsequently reduced areas of space. They must achieve these feats all while adhering to budget constraints, maintaining mission critical levels of both uptime and reliability, and reducing stress on existing data center infrastructures. This seemingly impossible task is only made possible by leveraging the right approach to power monitoring at the outlet, circuit breaker, and inlet levels. Unfortunately, far too many businesses opt for data center solutions that use outdated power monitoring solutions that are unable to provide the insights, alerts, and fail-safes needed to create a scalable, reliable, and agile IT infrastructure.

The following white paper will address how power monitoring solutions can be effectively used to meet the aforementioned demands, while simultaneously delivering an IT environment that is able to achieve evolving business, usage, regulatory, and financial goals.

Where To Measure Power Consumption

In every data center there are several key locations where power usage can and should be measured. A failure to accurately measure power data in the following locations can result in unplanned outages, reduced operating efficiencies, and higher costs.

- 1. Power Entering The Data Center.** In a stand-alone structure, it is typically a simple task to measure the data center's PUE. However, far too often, data centers exist as a floor within a building. In the latter instances, a submeter should be installed for the floor to accurately measure the total power number for the data center.
- 2. Uninterruptible Power Supply (UPS).** The UPS should be measured. In instances where the UPS is only providing power to IT equipment, then it can be used as the denominator for the vital PUE calculation. With this in mind, it is important to note that the UPS might also be providing power to the data center's rack-based cooling equipment, which means that additional considerations must be made before it can be used in a PUE calculation.
- 3. Panel and Floor Measurements.** Floor-mounted power distribution unit (PDU) provides an important management bridge between a building's primary power and various equipment racks within a data center. Each PDU can handle larger amounts of energy than an ordinary power strip and typically provides power to multiple equipment racks.
- 4. Rack-based Power Measurements.** Through metered rack power distribution units (PDUs) the power consumption of specific racks can be measured.
- 5. Individual Outlet Measurements.** The power used at the individual outlets of a rack PDU should be measured. Intelligent PDUs can be used to monitor the power consumption at the outlet level to increase efficiencies and improve uptime.

How is Power Data Gathered in a Data Center?

Measuring and monitoring power data is vital to the IT health of a data center. Without these vital measurements, data centers are more susceptible to higher levels of outages, increased downtime occurrences, higher costs, and in some instances potential damage to the actual IT infrastructure. To avoid these issues, data centers can instead deploy the following solutions to effectively monitor power consumption at the outlet, circuit breaker, and inlet levels.

Basic PDUs

Basic PDUs are an affordable and proven technology. They are typically power strips constructed from high quality components and can be used to support the correct voltage and current distribution to several outlets at once. The downside of a basic PDU is that it doesn't have the instrumentation needed to provide valuable power monitoring insights. Additionally, basic PDUs cannot be remotely managed.

Intelligent PDUs

An intelligent rack PDU is a device that features remote accessibility and management. It provides power monitoring at both the PDU level as well as the individual outlet level. Additionally, it is designed to provide specific user defined threshold alerts, so that data center managers can more effectively monitor their entire data center from on-site or remote locations. These highly customizable power monitoring devices also feature remote power on / off capabilities, outlet level switching, real time environmental data analysis, and the ability to be easily integrated with existing directory servers.

There are four typical types of intelligent PDUs that can assist with data center power monitoring.

1. Metered Inlet PDUs. This type of intelligent PDU measures power consumption at the inlet-level. The gathered data can be displayed locally and over a secure network.

2. Metered Outlet PDUs. This type of intelligent PDU features the same capabilities as a metered inlet PDU, while also providing metering at the outlet level. Once again, the gathered data can be displayed locally and over a secure network.

3. Switched PDUs. This type of intelligent PDU features the same capabilities as an inlet PDU, while also enabling authorized users to securely power-cycle outlets from remote locations. Through remote power-cycle, energy can be conserved, devices can be rebooted more easily and effectively, services can be efficiently restored in the event of an outage, unauthorized device provisioning is prevented, and inrush currents are minimized.

4. Switched PDUs With Outlet Metering. This type of intelligent PDU combines all the aforementioned capabilities of both the switched PDUs and outlet metered PDUs.

For the majority of data centers, intelligent PDUs are the optimal power monitoring solution to reduce costs, increase energy efficiencies, improve availability, and manage the existing capacity of the entire data center.

Branch Circuit Monitors and Individual Device Load Measurement

Branch circuit monitors are incredibly important to effectively measure power consumption across the data center. Typically, these electrical devices are designed to measure the current load for each circuit on a designated electrical panel. The devices will alert operators when the current load is approaching the breaker's designated rating. This heightened level of power monitoring is especially important in data centers where additional servers can accidentally be plugged into a circuit that is close to its designated operating capacity. Finally, branch circuit monitors can be used to continuously measure current across circuits, so that trips, outages, and overloads can be avoided, and the optimal levels of uptime can be enjoyed.

Overhead Busway Systems

Overhead busway systems are an alternative to panels to deliver power. Monitoring solution can also be used in conjunction with busway system to help provide operators exact power usage. All too often when new equipment is added to a rack, the cable ratings can be exceeded, which can subsequently trip circuit breakers and cause unexpected power outages. Fortunately, an overhead busway system is designed to provide power feed monitoring in real time, so that data center managers can more effectively plan for the installation of new equipment at the rack level. This heightened level of monitoring can also help data center managers ensure that the data center's electrical system is properly balanced across phases so that increased savings and energy efficiencies can be enjoyed.

What Other Factors Contribute to Power Consumption in the Data Center?

Environmental Sensors

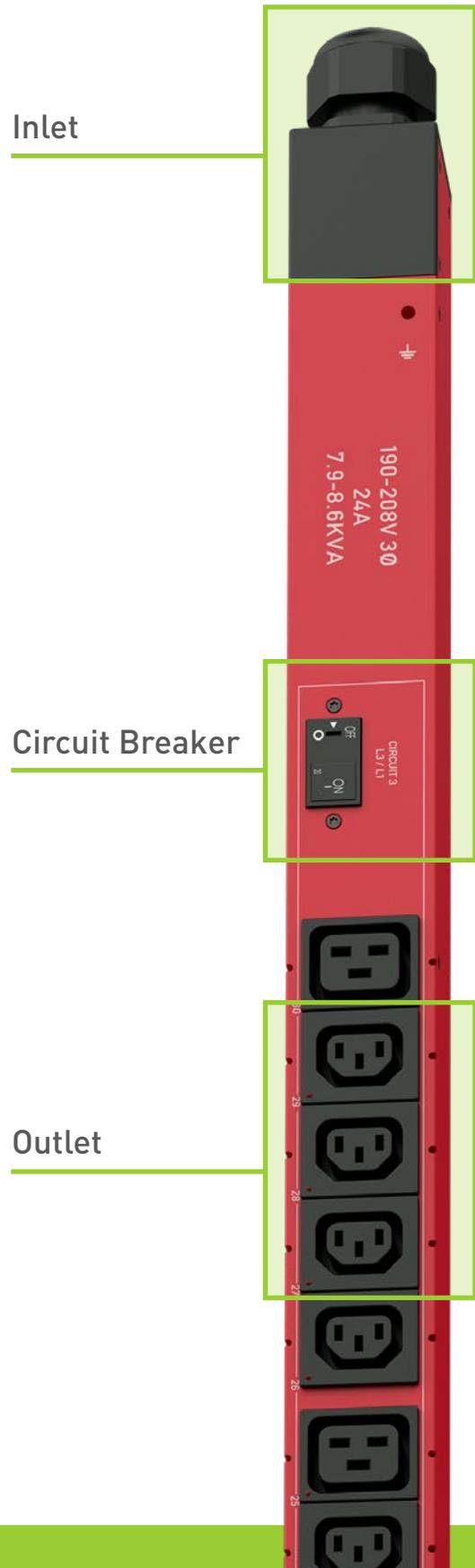
Another major contributor to power consumption in a data center is their HVAC system, which can sometimes be overlooked but plays a crucial role in energy consumption. That's why it is important to have environmental sensors deployed in your data center. At their core, environmental sensors are designed to improve power efficiencies across the data centers. These sensors can be placed at the bottom, middle, and top portions of the racks on the cool air inlet side to ensure that IT equipment is cooled to the appropriate levels. When IT equipment is overcooled, it can not only consume additional power, but it can increase operating costs without providing any type of additional benefit. Thus, environmental sensors play a key role in providing not only power monitoring solutions, but also reducing the overall operating costs within a data center.

What Benefits Does Power Monitoring Deliver Within a Data Center?

By using the right power monitoring tools, data centers can not only enjoy lower operating costs, but also reduce unexpected outages, optimize device power consumption, and more effectively manage the entire data center. In this vein, it is vital that data center managers take the time needed to install devices that can monitor power at the outlet, circuit breaker, and inlet levels. Additionally, individual devices should be monitored at regular intervals to ensure that peak periods are not accidentally overlooked. Through individual device power consumption data, managers will be able to more effectively configure racks so that the equipment power consumption patterns complement each other and thus avoid tripping a breaker, while simultaneously maintaining the optimal load levels.

As part of their power monitoring solutions, data center managers should leverage intelligent PDUs. As was discussed previously within this white paper, intelligent PDUs have the unique capability to effectively measure power consumption at the inlet and individual outlet level. As part of these capabilities, intelligent PDUs can provide kilowatt usage data that can be combined with CPU utilization data to determine which individual servers can handle additional capacity. These insights are needed to improve overall data center efficiencies through the effective redeployment or decommissioning of servers.

Finally, intelligent PDUs combined with environmental sensors can provide the power monitoring solutions needed to improve server uptime, reduce overheating (and overcooling), and provide a complete picture regarding the air flow in and around each server. The latter power data insights are vital to increasing uptime, reducing outages, and lowering operating costs.





Conclusion

Metering at the inlet, outlet, and circuit levels is vital to determining the power usage across an entire data center. Metering at the inlet level not only helps data center managers effectively determine the power usage and available capacity of a rack, but it can reduce the risk of overloading circuits. Inlet level power monitoring also allows data center managers to more easily calculate PUE. Metering at the rack PDU circuit breaker levels is vital to achieving an early warning system. This type of power monitoring provides data center managers with the alerts needed to avoid tripping a circuit breaker. It also provides the information needed to effectively reduce power demands (as needed when the circuit breaker is at lower usage levels). Metering at the outlet level can not only help data center managers determine the power usage and available capacity at the rack, it can also provide vital insights into the power consumption levels at the device and / or

server level. The latter insights are vital to identifying underutilized servers, allocating costs, and identifying ghost servers.

In conclusion, through the right power monitoring tools, data center managers can more effectively run a data center. By accurately identifying servers that are running too hot or too cold, data center managers can more readily save energy, avoid server crashes, redeploy or decommission servers, balance power usage (across servers and the entire data center), and identify opportunities to change or grow. In this vein, through the right combination of tools, data center managers can more effectively measure and understand power data to increase the effectiveness of IT operations and the allocation of resources.

To learn more about how power monitoring solutions can be effectively leveraged at the inlet, outlet, and circuit breaker levels, visit our [PX Intelligent PDUs](https://www.raritan.com/PX-Intelligent-PDUs) website.

About Raritan

Raritan began developing KVM switches for IT professionals to manage servers remotely in 1985. Today, as a brand of Legrand, we are a leading provider of intelligent rack PDUs. Our solutions increase the reliability and intelligence of data centers in 9 of the top 10 Fortune 500 technology companies. Learn more at [Raritan.com](https://www.raritan.com)