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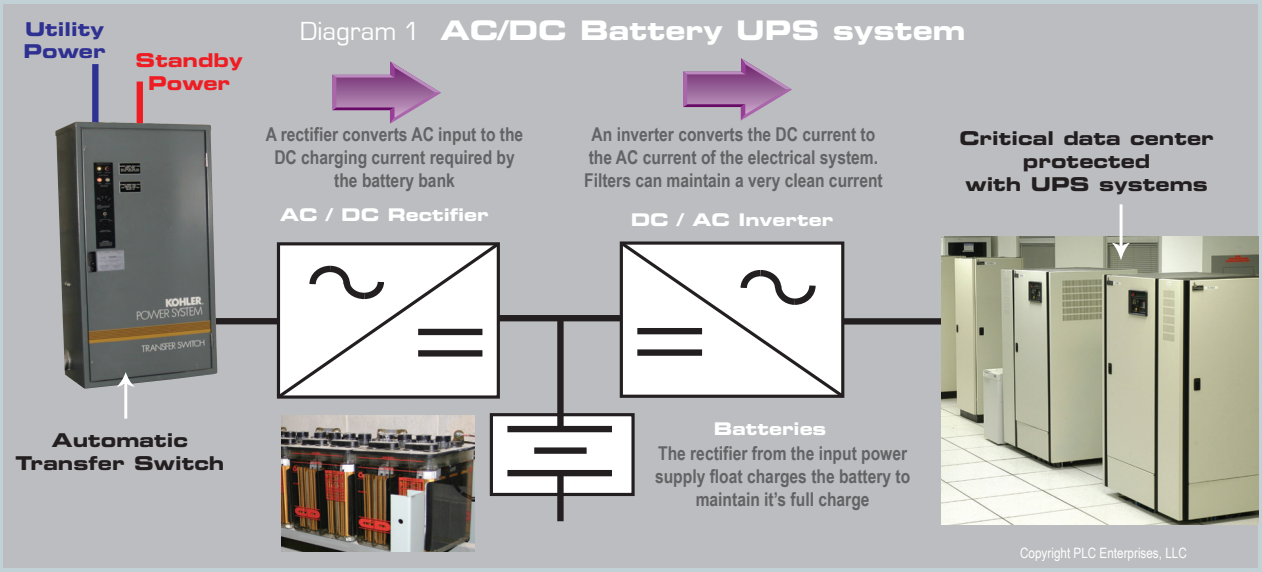
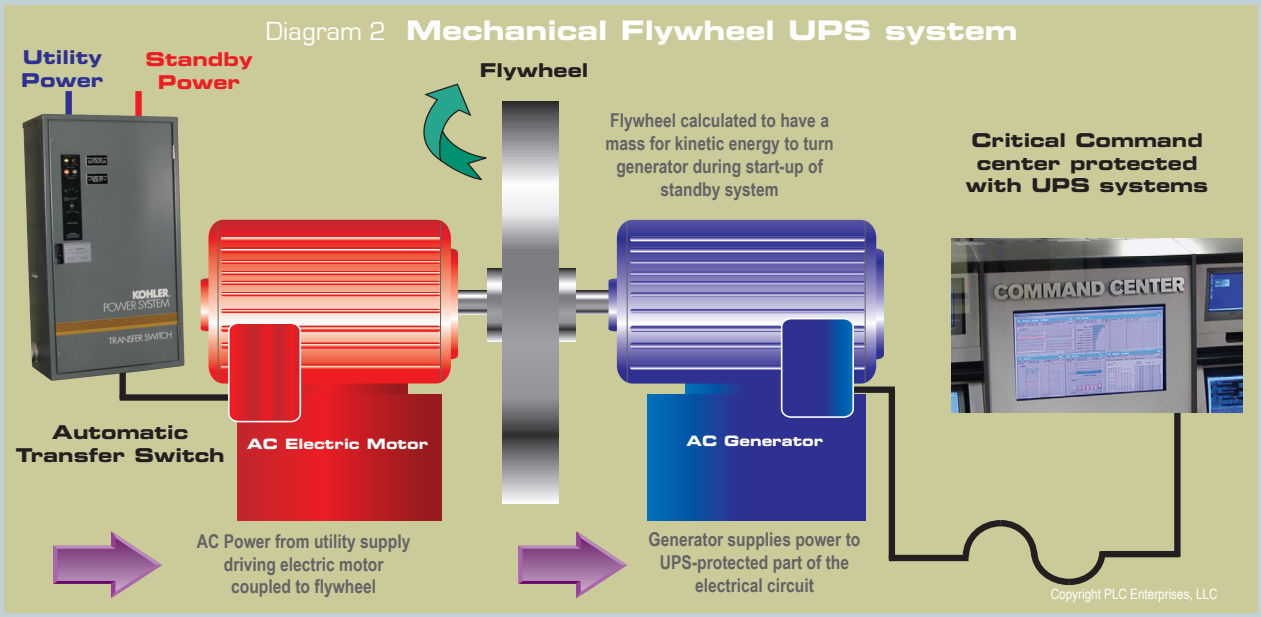
Uninterrupted Power Systems (UPS) - What They Are and Where They Are Required

Information Sheet # 11

Uninterrupted Power Supplies (UPS) are what their name implies. If power to an electrical circuit is interrupted, UPS systems provide continuous power to the circuit until backup power comes on line or primary power is restored.

This information sheet discusses types of UPS systems, how they operate, the electrical loads that require UPS devices, and how the devices interface with standby power systems.





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Generator systems designers must consider the consequences of any interruption of power to an electrical circuit and whether that interruption can be tolerated. Traditional engine-driven standby generator systems can take several seconds to come on line and carry a full load. These brief outages often are merely inconvenient, but in some cases, they may be life threatening or economically devastating.

A system designer must evaluate the following factors to select an appropriate UPS system:

Duration: Traditional engine driven systems take several seconds to start and fully load, even when the load is switched through an automatic transfer switch (ATS) with sensors that automatically detect power outages. If backup power is not automatically transferred, a larger UPS system needed to cover the additional time required to manually start backup power may cost more than a smaller system with an automatic standby.

Power: The power required to bridge the gap between losing main power and switching to backup power is vital to determine which UPS system is needed. Purely electrical systems will handle many loads, but electro-mechanical systems may be needed for larger loads.

Load: Not all parts of a circuit's electrical load may be critical enough to require a UPS system. The system designer can isolate the critical parts and fit a UPS system to the sectors of the circuit that connect those parts.

Key principles of operation and types of UPS systems:

When a power outage occurs, the UPS device must immediately provide uninterrupted power to the critical load. This requires the UPS device to always be connected to the circuit and to have enough independent power to supply the load until main or backup power is restored.

Power Reserve: The most commonly used form of stored electrical energy is the battery. UPS systems that use batteries must convert the DC power in batteries to the AC power required by the utility system. The kinetic mechanical energy in a rotating flywheel also can be used to power UPS systems. Some large devices use this stored energy to continue turning generators while power is interrupted.

Connection: A mechanical UPS system can be connected directly to the electrical circuit as another AC power source. An electrical UPS system using batteries for backup power has to be connected to the electrical circuit via an inverter. An inverter is a device that uses electronics such as thyristors to convert DC power to AC Power. Whether mechanically or electrically powered, a UPS device must be an integral part of the protected circuit and not switched through other contacts, such as with an automatic transfer switch to a standby generator.

Battery and mechanical UPS systems:

The selection of an UPS device depends on economics, size and reliability. Advancements in electronics have reduced the costs of inverters considerably. The most common UPS devices now use batteries to provide uninterrupted power when switching between primary and backup systems.

Mechanical systems have also made technical advancements. While they tend to provide smaller periods of uninterrupted power mechanical systems require less maintenance and are more environmentally friendly than battery systems.

Battery/Inverter System (Diagram 1)

In this system, a bank of batteries sized to provide sufficient UPS power are kept in a fully float-charged condition by a rectifier connected to the AC input. When power is interrupted, the battery's DC power is converted by an inverter into the AC power required by the load connected to the protected circuit. Battery systems are commonly used for loads below 120kW. The cost of batteries required for larger loads favor the selection of mechanical systems.

Flywheel/Motor System (Diagram 2)

This system was more common before advances were made in electronics and battery technology. Now it is used primarily on larger systems. A mechanical UPS system uses an electric motor driven from the AC power supply to turn a flywheel. The flywheel size is determined by the amount of kinetic energy necessary to turn the AC generator that feeds power to the UPS protected part of the electrical circuit. Manufacturers now offer smaller compact systems with a flywheel turning at a high speed for more kinetic energy.

Typical applications of UPS systems

In the electronic world we live in relying on UPS devices has become very common place from a simple plug-in systems for your PC to the back up power needed for main frame computer systems. Examples of the application of UPS devices/ systems are:

Communications: Phone and internet providers have installed UPS systems so that there is zero interruption between communications.

Life support systems: Advances in medical technology have made us more reliant on critical life support systems that have zero tolerance for power interruptions.

Aviation support: Critical systems for air traffic control must be assured a constant uninterrupted power supply.

Security systems: Constant surveillance without periods of black out.

Data systems: Uninterrupted power while key data is recorded, backed up and restored.

UPS maintenance issues

As system is constantly connected power should be shut off in a controlled environment to ensure the UPS is operative. Batteries are a key item and should be constantly maintained as instructed by the manufacturer.