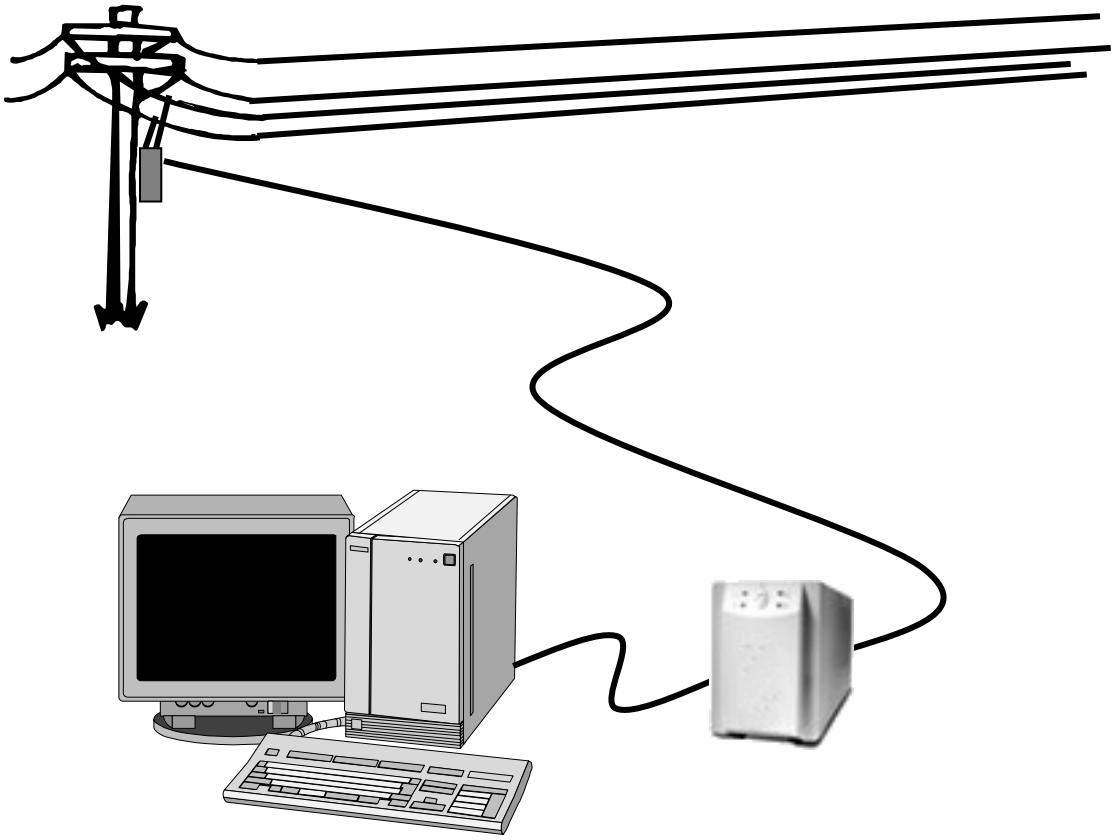
White Paper # 5200



Is a UPS a Power Conditioner, Too?

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Introduction

Power protection devices have traditionally fit neatly into one of two categories; those that alter, change, or otherwise control the character of electricity and those that provide an alternate or secondary source of power in the event of the failure of the primary source.

Products in the first group include surge protectors, filters, voltage regulator, power conditioners, and others. The amount of protection varies from device to device.

The operational requirements of LAN systems along with an emphasis on protecting data, software, and processes have created a significant level of interest in the uninterruptible power supply (UPS) products that comprise the second group. While it is possible for a UPS to also function as a power conditioner, such capabilities cannot automatically be assumed.

Indeed, along with the rapid growth in the number of UPS suppliers, the industry has seen the distinction between a UPS and a power conditioner become too poorly defined. What does the user of these devices need to know to intelligently and properly protect a system?

Fictional Concepts

The best place to start is by highlighting several of the most common misconceptions concerning UPS products. These include:

- **A UPS provides total power conditioning.**
- **For total power conditioning, an on-line UPS (as opposed to a standby design) must be used.**
- **Standby UPS systems are undesirable because they only become active when power is lost.**

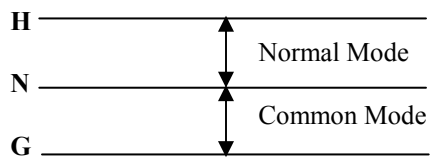
Reality

Much has been said and written in the battle between different UPS technologies. It's important to recognize that today most UPSs are used in applications where the system is powered by a switch mode power supply. These power supplies make electronic systems very tolerant of both voltage variations and short duration (5-20 msec) power losses. The fact is that systems powered by switch mode supplies (and that's most systems today) are perfectly compatible with standby UPS designs.

Equally inaccurate is the assumption that because of its inverter design, an on-line UPS provides superior power conditioning to a standby UPS. It is true that on-line UPS systems provide excellent normal mode protection (between line and neutral). Normal mode protection, however, is only one part of the power-conditioning picture (Fig. 1).

The switch mode supply is a significant improvement in electronic

Figure 1 – Mode of Entry



system design for a number of reasons. Not only does it make systems more tolerant to voltage variations, but it is

also smaller, lighter, more efficient, and quite a bit cheaper to produce.

All these advantages come with a price tag, however. The predecessor to the switch mode supply was the linear supply. It was characterized by a step-down isolation transformer on the input side. Elimination of the transformer in switch mode designs accounts for most of the physical and economic advantages.

However, it also results in a distinct operational disadvantage. That is the loss of common mode (neutral to ground) noise immunity for the system.

Modern microprocessor systems use electrical ground as a signal reference when making logic transitions and for the proper exchange of data between systems and peripherals. For reliable operation, an ultra-quiet ground reference is a necessity. Common mode disturbances disrupt this clean signal reference. Such disturbances can only be eliminated with an isolation transformer. See Figures 2 and 3.

It is important to recognize that a UPS – any UPS – should include an

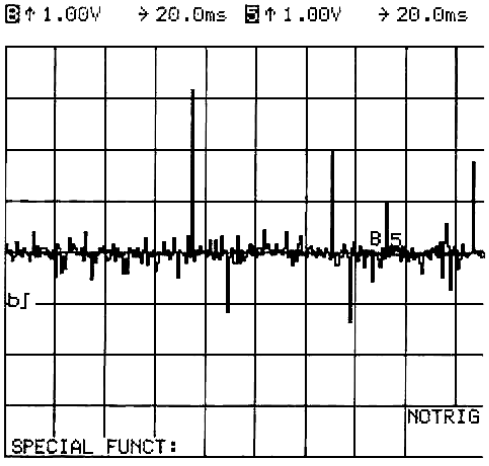


Figure 2 – UPS Output – No Isolation

isolation transformer in it output circuit.

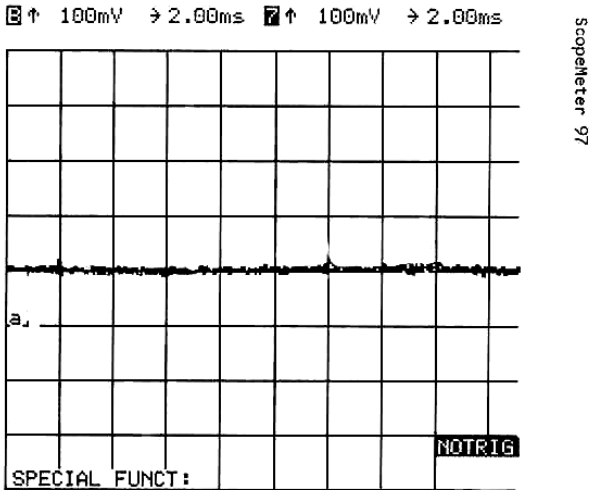


Figure 3 – UPS Output – With Isolation

Without it, the UPS cannot qualify as a power conditioner because it will not be capable of protecting the attached electronic system from common mode noise.

There is a proliferation of UPS systems available in the market place that do not contain all the elements necessary to provide complete protection to the sensitive electronic load. This is true for both on-line as well as standby designs. Examples abound of both types of UPS designs that fail to incorporate an isolation transformer as the final stage of their construction.

A Final Caveat

An often-overlooked factor when selecting UPS products is the inverter design. The UPS inverter is that part of the UPS that changes DC power from the batteries into AC power for use by an electronic load.

A variety of inverter designs exist. These include sine wave, square wave, pseudo wave, rectangular wave, and modified sine/square wave.

Electronics normally run on sine wave power. This is the kind generated and delivered by the power company to

your office or home. Designing a sine wave inverter is time consuming and costly, and, as a result, many manufacturers produce systems that do not provide sine wave power when on batteries.

There are many claims concerning the compatibility of non-sinusoidal inverter designs with switch mode supplies. It is true that switch mode supplies will run on non-sine wave inverters. However, all non-sine wave inverters generate substantial noise and impulse activity that has been demonstrated to cause observable problems for sensitive systems. Sine wave inverters are far preferable to any other design.

Conclusions

When considering a UPS, here are the real issues:

1. Are you buying a UPS because you need power protection or backup power? If the answer is power protection, a power conditioner that includes a surge diverter, noise filter, and an isolation transformer is a better choice. It will do an excellent job of protecting your system at a lower initial cost while reducing the long term cost of ownership associated with battery replacement.
2. If you really do need both power protection and backup power, it is highly likely that a standby UPS will be adequate for your application. Make sure, however, that its design includes a surge diverter, powerline filter, and isolation transformer. If you purchase one (or already own a UPS) without these elements, it is possible to add a power conditioner to the UPS to complete the power protection solution.
3. If your application requires an on-line UPS, or if the peace of mind is worth the extra money, you must still make sure the unit contains an isolation transformer. Many do not, and you may spend a great deal and still not get the protection you really need. Power conditioners can also be used to improve the performance of on-line UPS systems.
4. Make the right waveform choice. It's tempting to save money at the purchase stage, but this often results in hidden costs later. Don't economize on UPS inverter design. Use sign wave UPS products instead of other less expensive designs. Your system will thank you for it.