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Cap-Ex, Op-Ex, and Energy Savings from Automatic Voltage Regulators



A high-performance precision PWM voltage regulator protects sensitive equipment from unstable AC mains voltage, and provides Cap-Ex, Op-Ex, and energy savings when battery backup is not required

Abstract

UPS is not always an optimal power protection solution due to its high purchase price ... and high costs

In order to protect sensitive electronic and electrical equipment from unstable AC mains voltage, UPS (uninterruptible power supply) is commonly used. However, UPS is not always an optimal power protection solution due to its high purchase price, low power conversion efficiency (typically around 90%) and high costs due to maintenance, repair and battery replacement.

In applications where five to ten minutes of UPS battery backup is not required, a high-performance automatic voltage regulator, such as TSi Power's VRP line, can provide substantial Cap-Ex, Op-Ex, and energy savings.

Background

TSi Power's VRP line of high-performance precision PWM automatic voltage regulators provides cycle-by-cycle voltage regulation. It uses 20 kHz microprocessor-controlled IGBT switching technology with extremely fast voltage detection and correction time of 20 ms, which is about 20 to 100 times faster than traditional servo-motor or tap-changing relay based AVR products.

The 20 ms voltage correction time provides maximum protection for highly sensitive electrical and electronic equipment from unstable AC mains at a fraction of the cost of an equivalent UPS system.

Advantages of a high-performance precision PWM automatic voltage regulator over a traditional UPS with batteries

1. Because TSi Power's VRP is a 100% solid-state device and batteries are not required, it is inherently more reliable than a traditional UPS system with batteries.
2. VRP is only a fraction of the size, weight and cost of a UPS system of equal capacity; therefore significant Cap-Ex savings can be achieved by using VRP instead of large, heavy and expensive UPS systems (see fig. 1 and fig. 2 photographs for size and weight comparisons).
3. VRP is about 97% efficient, while a typical double-conversion online UPS is only about 90% efficient, resulting in substantial energy savings.
4. VRP does not require periodic maintenance or battery replacement, resulting in substantial Op-Ex savings over UPS.



FIGURE 1. Left, TSi Power's 45 kW 3-phase VRP (size of a small file cabinet, and weight is about 150 kg)

FIGURE 2. Right, Typical 60 kVA (45 kW) double-conversion online UPS system (size of two large refrigerators and weight is about 1000 kg)

Suitable applications for high-performance precision PWM automatic voltage regulators

In applications where the loss of any data or uncontrolled computer shutdown is not acceptable, such as data center computers used for financial transactions and applications requiring very high system availability of 99.99% or higher, a UPS with backup generator must be used.

However, in many less demanding applications where battery backup is not mandatory, TSi Power's VRP high-performance precision PWM automatic voltage regulator can be used to protect sensitive equipment against sags, swells, brownouts, chronic over-voltages, surges, spikes, transients and noises on mains (utility) AC power.

Suitable applications for TSi Power's VRP line include:

- Large-format, industrial and commercial-grade printers and copiers
- Medical diagnostic and imaging equipment such as MRI, CT, sonar and X-ray machines
- Scientific and lab equipment such as mass spectrometers and NMR machines
- X-ray, CT or XRD-based personnel, baggage and cargo inspection systems used in airports, seaports, border crossing stations and high-security facilities such as nuclear power plants
- Laser-welding machines, production/test/inspection and industrial robotic equipment
- Telecom rectifiers, TV/radio broadcasting and transmitting equipment, air conditioner, heat-exchangers and UPS systems used in countries or areas with highly unstable AC mains voltage

An example of VRP's Op-Ex, Cap-Ex and energy savings

Below is an example of the savings achieved by using a 45 kW high-performance precision PWM automatic voltage regulator, such as TSi Power's VRP, instead of a 60 kVA / 45 kW online UPS:

Cap-Ex savings

- 60 kVA (45 kW maximum output), three phase double-conversion online UPS is about \$40,000
- VRP-45000-0339 (45 kW, three phase precision AVR) is about \$10,000
- Cap-Ex savings: \$30,000

Op-Ex savings

UPS systems typically require a 20% annual maintenance contract, which includes battery replacement. Automatic transfer switches need only about 5% per year budgeted for repairs.

- Maintenance and repair costs for 60 kVA UPS system over 15 years of operation: 13 years (the first 2 years could be covered by warranty) x \$8,000 per year = \$104,000
- Maintenance and repair costs for TSi Power's VRP-45000-0339 over 15 years of operation: 13 years (as first 2 years are covered by warranty) x \$500 per year = \$6,500
- Op-Ex Savings using VRP (over 15 years of operation): \$97,500

Energy savings

The typical 60 kVA double-conversion online UPS efficiency is about 90%.

- At average load of 30 kW, a UPS will use an extra 3 kW x 365 days/year x 12 hours/day (assuming 50% equipment operation time) x 15 years x \$0.15 per kWh of electric power = \$29,565

TSi Power's VRP-45000-0339 is about 97% efficient.

- At average load of 30 kW, each ATS will use an extra 0.9 kW x 365 days/year x 12 hours/day x 15 years x \$0.15 per kWh of electric power = \$8,870
- Total energy savings (over 15 years of operation) is \$29,565 - \$8,870 = \$20,695

Total savings over 15 years of operation using a high-performance precision PWM automatic voltage regulator instead of UPS

\$30,000 (Cap-Ex) + \$97,500 (Op-Ex) + \$20,695 (Energy Saving) = \$148,195

Cost of ownership comparison over 15 years of operation (in thousands of dollars)

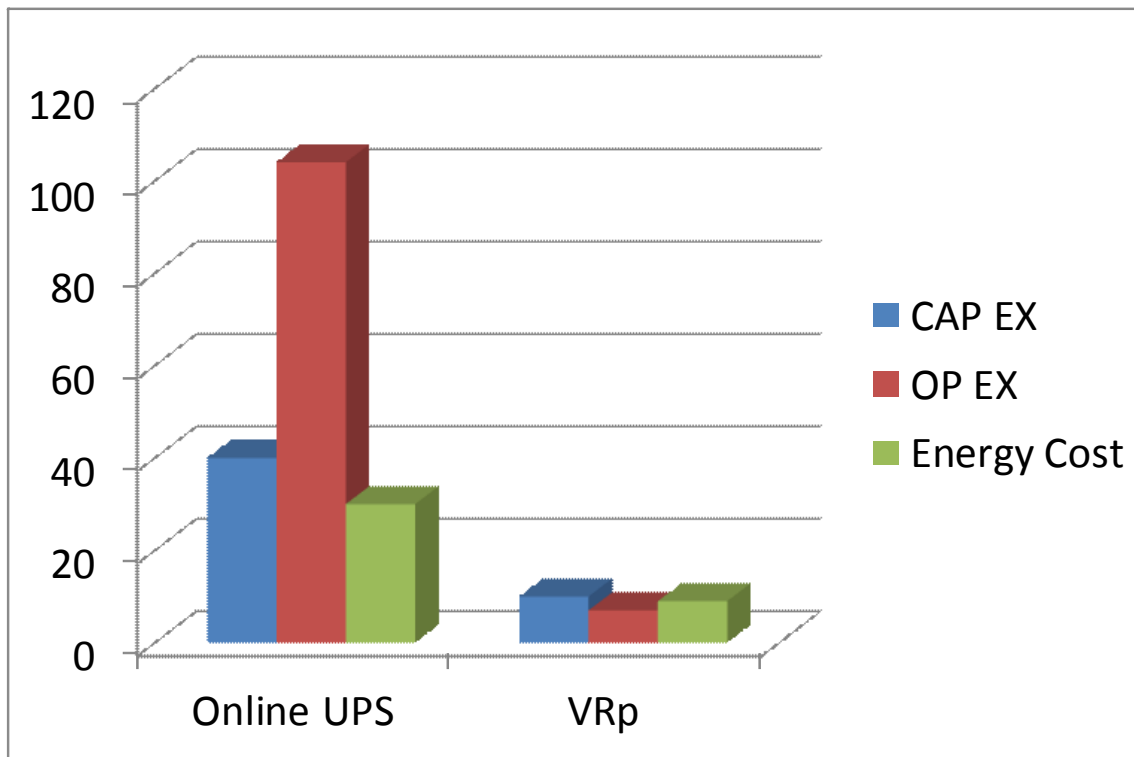


FIGURE 3. Online UPS: 60 kVA (45 kW), 3 phase UPS system
VRP-45000-0339: 45 kW, 3 phase precision voltage regulator

Conclusion

For electrical and electronic equipment which do not require about 10 minutes of UPS battery backup, substantial Cap-Ex, Op-Ex, and energy cost savings can be achieved by using a high-performance automatic voltage regulator instead of a UPS system.

About the author

Nam Paik is director of sales at TSi Power. He has over 25 years of experience in the power protection industry and began his career at TSi Power designing UPS products. He can be reached at: nam@tsipower.com.

TSi Power is a manufacturer of UPS, line conditioner, precision automatic voltage regulator, automatic transfer switch and DC-AC inverter products designed to operate in even the most challenging telecom, security, industrial, outdoor and/or international applications.



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