



Keatec Energy Technology Guide

UPS Basics

Keatec Energy designs, manufactures, installs and services DC and AC uninterruptible power solutions for Telecommunication, Commercial Information Technology (IT), Public Safety and Industrial clients across the Americas.

Table of Contents

	Page
The Basics - Voltage, Amps, Frequency	3
The Basics - Single Phase, Three Phase	4
Why Use an UPS?	5
UPS On-line Double Conversion	6
UPS On-line Double Conversion - Eco Mode	7
UPS - Key Features	8
UPS - Input Plugs, Output Outlets	9
UPS - Battery System	9
UPS - Indoors and Outdoors	10
What are the Different Types of UPS?	11
VRLA and AGM Batteries	12
Battery FAQ	13
UPS Systems Key Considerations	16
Why Keatec Energy? - We Bring the Energy	18

Headquarters

13283 - 20A Avenue,
Surrey, B.C. CANADA V4A 9K2

Telephone

+1 844 307 7998

Sales Showroom - Mexico & Latin America

Oficina A-407, Laguna de términos 221,
Col Granada, Ciudad de Mexico,
CP 11460 Mexico

Telephone

(+52) 55 7258 0352

The Basics – Voltage, Amperes, Frequency

Volt (V)

- The measure of the “pressure” with which electricity moves through a wire or circuit,

Ampere (A)

- The measure of the “volume” - amps.

‘Volts and amps are often compared to water in a hose, with volts representing the amount of pressure and amps the volume of water.’

UPS are rated in VA (kVA)

$$\text{Volts (V) x Amps (A) = VA}$$

VA can be converted to Watts (W) by multiplying by the output power factor of the UPS

- UPS power factors are usually 0.8, 0.9 or 1.0, where 1.0 is the best

Frequency (Hz)

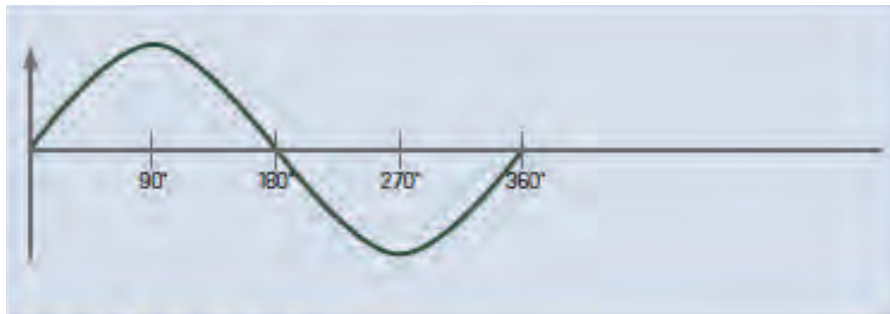
- The measure of how many times a second the electrical signal oscillates.

The Basics – Single Phase

The frequency of alternating current (AC) voltage varies according to geographical location

Single Phase = 110, 120, 127 Vac, 60 Hz
 Single Phase = 220, 230, 240 Vac, 50 Hz

Central America: 120 Vac, 60 Hz
 South America: 220 Vac, 50 Hz



1. Large electricity generators generate AC naturally, so conversion to DC requires an extra step.
2. Electrical transformers, which the power distribution grid depends on, need alternating current to operate.
3. Converting AC to DC is easy, whereas converting DC to AC is not – and its more expensive.

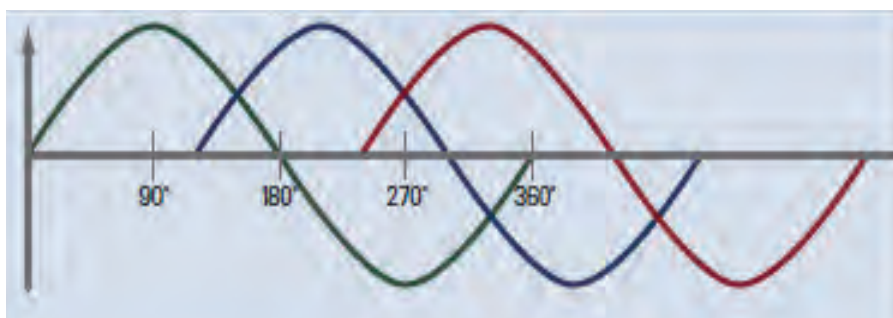
The Basics – Three Phase

The most efficient way to distribute power over long distances, three-phase power also enables industrial equipment to operate more efficiently.

Three-phase power is characterized by three single-phase waves that are offset in their phase angle by 120 degrees, or one third of the sine wave period

Three Phase = 200, 208, 220 Vac, 60 Hz
 Three Phase = 380, 400, 415 Vac, 50 Hz

Central America: 208 Vac, 60 Hz
 South America: 380 Vac, 50 Hz



Why Use an UPS?

The UPS protects IT equipment and other electrical loads from problems that plague the electrical supply.

1. UPS prevents hardware damage typically caused by surges and spikes.
 - Many UPS models continually condition incoming power as well.
2. UPS prevents data loss and corruption.
 - Without a UPS, data stored on devices that are subjected to a hard system shutdown may become corrupted or even lost completely. In conjunction with power management software, a UPS can facilitate a graceful system shutdown.
3. UPS provides uninterruptible power availability preventing downtime.
 - UPSs can be paired with generators to provide sufficient time to start up a generator in the event of a power loss.



Outage



Sag



Surge



Spike



Noise



Switching
Transient



Frequency
Deviation



Under-
voltage



Over-
voltage

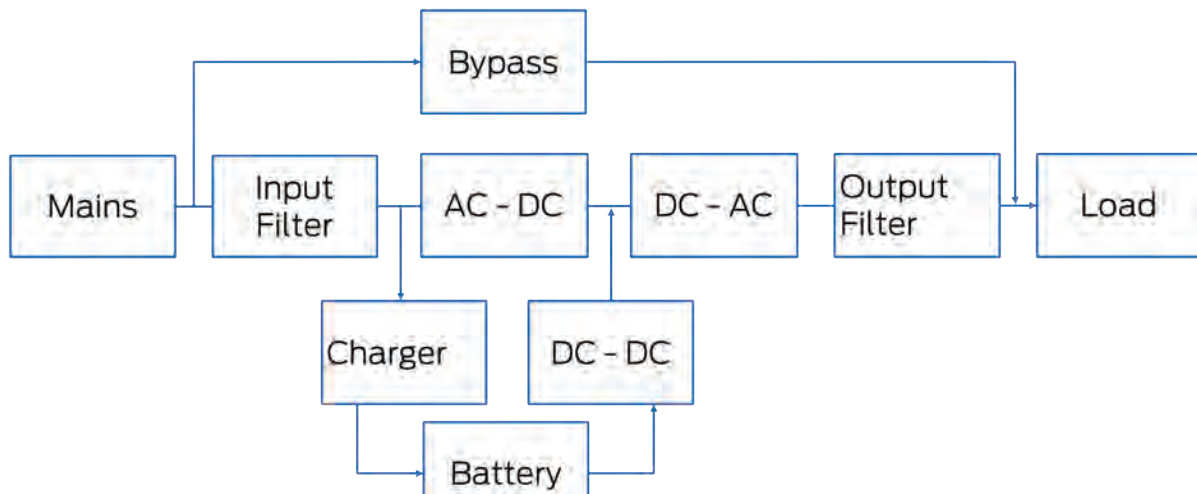


Harmonic
Distortion

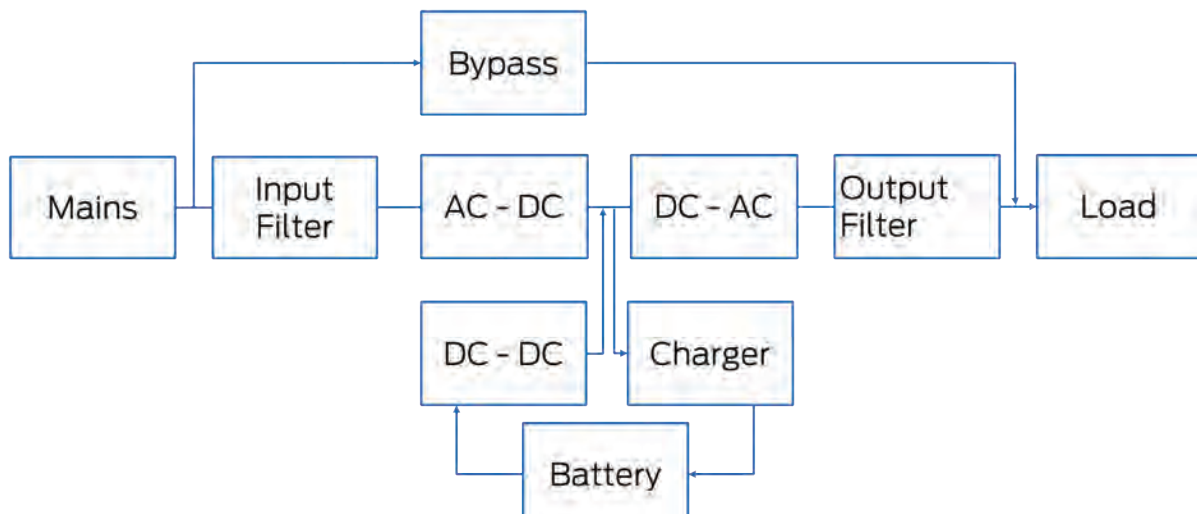
On-line Double Conversion UPS

- UPS On-line Double-conversion topology is designed for continuous power protection of critical equipment against all of the common power problems.
- It ensures a consistent quality of power supply regardless of disturbances in the incoming mains (AC).
- The output voltage is entirely regenerated by a sequence of AC to DC conversion followed by DC to AC conversion in order to create a clean power supply without any electrical interference.
- Double-conversion UPSs can be used with any type of equipment as there are no transients when changing over to battery power.

Power Protection for Critical Loads – RT Series



Power Protection for Critical Loads – M Series, C Series, T Series



On-line Double Conversion UPS - Eco Mode

Eco Mode addresses the drawbacks of the double conversion online UPS design.

With 'basic' Eco Mode the load is normally powered by the bypass path, allowing raw mains power to supply the load, and the UPS inverter is engaged only when the utility mains fails.

With 'Advanced' Eco Mode, the load is directly supported by the line and in parallel the converter only spends energy conditioning line power and keeping the battery charged.

Should the mains power fail, the UPS operates in the same way as a double-conversion UPS.

Advantages of include voltage regulation, harmonic suppression, and low waveform distortion.

The sinusoidal output voltage regulation offers low input current and output voltage distortion in both backup and standby mode. Eco Mode's online design not only provides controlled input power to regulate the charging of the battery system, but also controlled output power for attached loads.

The input power control also minimizes the harmonics reflected onto the utility, making the UPS compatible with generator sets without requiring additional power factor correction equipment.

The most important benefit is the significant reduction in energy losses.

During steady state conditions, the inverter delivers power to the load with much greater efficiency without having to convert all of the incoming AC power to DC and then back to AC.

- Eco mode is popular in applications where electrical isolation is necessary and the downstream loads are sensitive to power fluctuations.

UPS – Key Features

Efficiency

The ratio % of output power to input power

- ‘Normally’ measured at full-load and nominal line conditions - Efficiency % is lower at less than full load.
- Losses due to inefficiency mainly dissipated as heat.

Output Power Factor

The ratio of real power to apparent power: Watts divided by VA.

- Most quality UPS have a power factor of 0.9 (PF = 0.9).
- A power factor of at least 0.8 is required for switch mode power supplies found in IT equipment.
- A power factor of 1.0 is ideal for driving the variety of non-linear loads found in Industrial applications.

Total Harmonic Distortion (THD)

The amount by which the circuit voltage deviates from a perfect sine wave.

- Low Output THD % responds better to the demands of non-linear loads.
- Low Input THD % does not interfere severely with the mains input and loads attached to the mains.

Charging

- The size of the battery charger (Amps) determines how fast the battery can be recharged.
- A multi-stage charger is faster than a constant current charger.
- Three-stage or multi-stage charging is superior to trickle charging.

Capacity Test

- UPS will often provide an automated load test which estimates runtime (capacity)
- The estimated runtime is notoriously unreliable due to the nature of batteries which are electrochemical in nature.

Hot Swappable

- The ability to change a module without taking the critical load off the UPS

Display

- Thin Film Transistor (TFT) color are higher resolution than monochromatic (LCD) Liquid Crystal Displays.
- Mimic displays provide pictogram style system layouts, usually with real-time data.

UPS - Input Plugs, Output Outlets

Plugs and Outlets are mostly used on Rack Tower type UPS.

Tower, Cabinet and Modular UPS use terminal blocks for hard wired input and output.

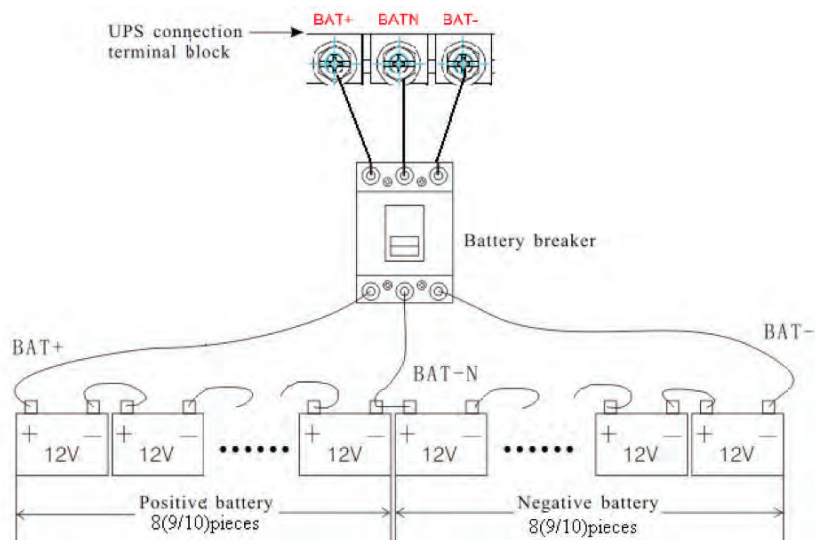
- Note: the use and the correct sizing of breakers



UPS - Battery System

Many UPS battery systems employ a plus/minus (+/-) DC voltage system (battery system).

- The neutral cable, the battery Positive and the battery Negative are all connected to the UPS.
- A neutral cable is attached between the positive and negative connections of the batteries in the middle of the string.
- The +/- voltage of the UPS determines the number of batteries in a string.
- Users can choose the capacity Ah of the batteries used, but all must be of the same type and Ah.



UPS - Indoors



- UPS Rack
- UPS Tower
- UPS Cabinet
- UPS Modular
- UPS Integrated Unit
- UPS Battery Cabinet



Rack Tower (Mini) Tower Battery Cabinet



Tower / Cabinet Modular Integrated

UPS - Outdoors



- Broadband CATV
- Traffic Control
- Security CCTV
- Outdoor Enclosure
- Battery Enclosure



Broadband CATV



Traffic Control

What are the different types of UPS?

There are basically three types: Standby, Line-Interactive, On-line

Standby (“off-line”)

Power comes directly from the AC outlet until the voltage sags or the power fails. After the power sags or fails, a battery powered inverter almost immediately turns on and continues to supply power. Batteries are charged, as necessary, when direct AC power is available. Even while power is coming directly from the AC outlet, the UPS provides protection from voltage spikes and surges.

Standby units are the low cost solution in the UPS family.

Line-interactive

Line-interactive UPS provide protection from spikes and surges, as well as supplying auxiliary power if a voltage sag or a blackout occurs. Unlike the standby units, line-interactive UPS provide automatic voltage boost when the power dips, without accessing the batteries. This feature provides continuous line power conditioning, promotes longer battery life, and eliminates electronic “noise” that can cause minor application errors and loss of data.

On-line:

On-line UPSs provide the highest quality of power protection by using a double-conversion technique. The UPS takes the incoming AC power converting the voltage to DC, conditioning the DC power to eliminate noise, sags, or surges, and then finally converting DC back to AC to power the load. Since the power runs continuously through the inverter, there is no transfer or switching time to battery mode in the event of a blackout.

Sealed VRLA and AGM Batteries

Valve regulated lead acid VRLA and Absorbed Glass Matt AGM batteries are rechargeable and designed for safe, trouble free operation in any position. They can be shipped by sea, road or air without special handling or packaging precautions due to their sealed construction. VRLA and AGM batteries are maintenance free, there is no need to check the specific gravity of the electrolyte, refill electrolyte, or add water during normal operation.

FM Series – Regular 12V

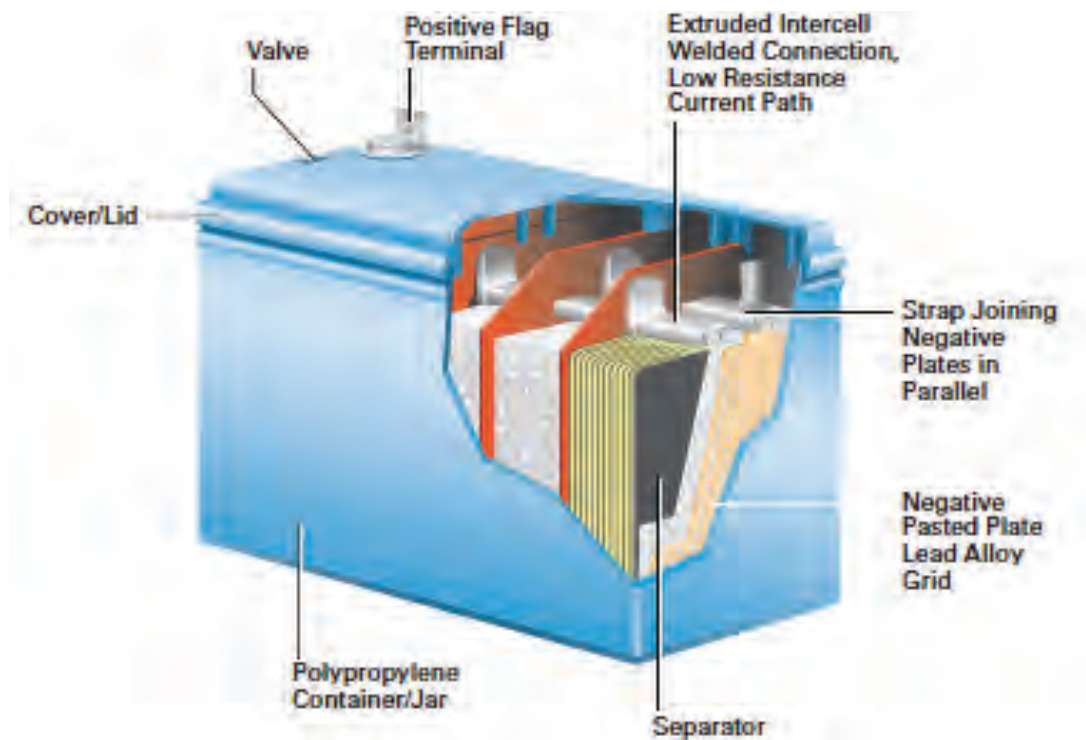
FMH Series – Front Terminal 12V

FML Series – High Cycle 12V

GFM Series – 2V

Solar Series – Deep Cycle 12V

Gel Series – AGM 12V



Battery FAQ

1. **What is the “end of useful life”?**
 - The IEEE defines end of useful life for a UPS battery as being the point when it can no longer supply 80 per cent of its rated capacity in ampere-hours - the battery should be replaced.
 - As batteries sit unused, without being charged, their useful life will decrease. Due to the self-discharge characteristics of lead acid batteries, it is imperative that they be charged every six to 10 months.

2. **Is there any difference between the batteries used by smaller UPS and the ones used by larger UPS?**
 - Smaller UPS typically use maintenance free Battery Packs. Multiple Battery Packs are connected in parallel to extend run times.
 - Larger systems require multiple strings of batteries and battery racks or cabinets which require space and increase overall costs. They also introduce the requirement for battery maintenance.
 - Large battery systems should be monitored to prevent a single bad battery from taking down the entire system.

3. **What is the difference between hot-swappable and user-replaceable batteries?**
 - Hot-swappable batteries can be changed out while the UPS is running.
 - User replaceable batteries are found in Battery Packs and require no special tools or training to replace.

4. **How is battery runtime affected if I reduce the load on the UPS?**
 - Runtime will increase if the load is reduced, as a general rule: Reduce the load by half, triple the runtime.

5. **If I add more batteries to a UPS can I add more load?**
 - Adding more batteries to a UPS will increase the battery runtime. However, adding more batteries to the UPS does not increase its capacity to run bigger loads.

6. **What is the average lifespan of UPS batteries?**
 - The standard lifespan for VRLA batteries is three to five years. However, expected life can vary greatly due to environmental conditions, number of discharge cycles, and maintenance.

Battery FAQ

7. How can you be sure UPS batteries are in good condition?

- UPS include battery testing programs which can test for holdup and estimate runtime capacity.
- Battery monitoring systems are available to monitor battery condition and provide advance warning regarding the end of battery life upon detection of a weak battery.
- Large battery systems should be professionally inspected and maintained.

8. How long does it take for the UPS batteries to recharge?

- It can take 10 times the discharge time for the UPS batteries to recover. (A 30-minute battery discharge can require about 300 minutes to recharge.) UPS with high rate chargers are available.
- After each power outage, the recharge process begins immediately. It is important to note that the load is fully protected while the batteries are recharging. However, if the batteries are needed during the recharge time, the holdup and runtime available will be less than it would have been if the batteries were fully charged.

Factors Affecting Lead Acid Battery Life and Performance

- Charging at high or low voltage
 - Low or excessive charge current
 - High room temperatures
 - Overcharging or undercharging
 - Loose interconnections between batteries in the string
 - Improper maintenance
- Lead acid batteries lose capacity (runtime) based on age, usage and operating temperature.
- Every time a battery is discharge, it shortens the remaining lifetime.
- Typically lead acid batteries start to lose capacity and fail within 3 - 5 years.
- Discharging and charging of a lead acid battery is an electrochemical process that ultimately results in the destruction of the lead plates (shedding) and the degradation of the electrolyte liquid.
- A high battery cell temperature indicates severe internal issues and that battery replacement is required.

UPS Systems – Key Considerations

Weight / Footprint / Electrical Connections / Cooling

- The weight and footprint of UPS can significantly impact shipping and installation costs.
- Double check that UPS and battery system can fit into the allocated space and be supported by the floor.
- Confirm the availability of the mains power connection and factor in the distribution of output, if necessary.
- Confirm the UPS and battery room has proper ventilation and if necessary, a cooling system.

Redundancy

- A backup system delivering full system redundancy (2 N) is often a requirement for UPS.
- Modular systems can deliver system redundancy (2 N) and/or component redundancy (N+1, N+X).

Future Expansion - Scalability

- Parallel UPS - often the affordable option in the short term; can be a more expensive in the long term due to additional hardware and installation costs.
- Modular UPS - a large centralized modular system can be a cost-effective long term solution.

Generator Compatibility

- UPS with a wide AC voltage input range is necessary for working with AC power from a generator.

Bypass

- Static Bypass - Ensures the load transfers automatically onto the mains input feed, usually can be engaged manually by pressing a switch on the UPS.
- Maintenance Bypass – a wraparound bypass fitted externally to the UPS that enables the UPS to be isolated for maintenance or repair without interrupting power to the load.

Connectivity Cards

- Communication slots in the UPS allows for the addition of SNMP, Modbus or Relay and Dry Contact cards to enable connectivity and interfacing capabilities.

UPS Management Software - PC

- Continuously monitor and diagnose the state of the grid, batteries and power sources, together with the condition of the UPS' internal electronics.
- Remote monitoring and management capability, including notification and sequential shutdown of connected IT equipment and UPS upon AC failure or low battery.

UPS Systems – Key Considerations

Battery Runtime

- Battery runtime is based on the level of kVA required over a defined period of time without mains support.
- High kVA output and long periods of independence from mains support require larger quantities of batteries.
- Battery support configurations should be determined by professional design engineers.

Battery Voltage

- The +/- voltage of the UPS determines the number of batteries in a string
- The number of batteries required to deliver the +/- is a key system cost driver!
- Example: +/-144Vdc (24 x 12V batteries) vs. +/-102Vdc (17 x 12V batteries)

Battery for UPS in Parallel

- Some UPS in parallel can share a 'single common battery' others must have a separate battery for each UPS
- The number of battery systems is a key system cost driver!
- Example: Four UPS in parallel; one battery system vs. four battery systems.

Battery Cabinets

- Most UPS above 10kVA require the use of external battery cabinets.
- Ensure that Battery Cabinet costs include: cables to UPS, breakers, fuses, battery interconnect cables



Keatec RT Series UPS 1 - 3 kVA 120 Vac 1PH with Battery

RT Series UPS provides instant backup power for critical commercial equipment and clean power for sensitive loads in a compact design that is easy to use and is a plug and play installation.

- Light weight, rack mount or tower.
- Built-in battery, more than 4 minutes of operating time.
- PC management software included.

Options: RT Series Battery Pack extends backup runtime.



Keatec RT Series UPS 6-10 kVA 208/240/230/220 Vac 2PH

RT Series UPS provides instant backup power for critical commercial equipment and clean energy for sensitive loads in a compact design. The available output transformer provides 120 Vac outlets for loads.

- Light weight, rack mount or tower.
- PC management software included.

Options: RT Series Battery Pack. RT Series 120 Vac Output Transformer.



Keatec T Series UPS 10-15-20 kVA 208 Vac 3PH with Battery

T Series UPS has the smallest footprint and the lowest weight on the market in a mini-tower design with integrated batteries. The T Series also has the highest output power factor, the highest efficiency and the widest AC input range on the market.

- Built-in battery, more than 4.5 minutes of operating time.
- Color screen with real-time energy diagrams.
- PC management software included.

Options: T Series Battery Tower extends backup time.



Keatec C Series UPS 30 - 260 kVA 208 Vac 3PH

C Series UPS has one of the smallest footprints and lowest weights for a cabinet design. The C Series has a high output power factor, high efficiency and the widest AC input range on the market.

- Dual input: static and manual bypass (maintenance).
- Redundant parallel operation of up to 4 units.
- PC management software included.

Options: External battery cabinet.



Keatec M Series UPS 208 Vac 3PH

M Series modular UPS system has the latest technology, including Eco Mode, which offers additional energy savings. The M Series has a high output power factor, high efficiency and the widest AC input range on the market.

- 20kVA hot swap power module with 10A charger.
- M Series Cabinet frames: 100 kVA, 160 kVA, 260 kVA.
- Redundant parallel operation (4x) with synchronized transfer to 'bypass'
- Dual input: static and manual bypass (maintenance).
- PC management software included.

Options: External battery cabinet.



VRLA and AGM Batteries

Why Keatec Energy? - We Bring the Energy

We design, manufacture, service and install DC and AC uninterruptible power solutions for Telecommunication, Commercial Information Technology (IT), Public Safety and Industrial clients. Keatec Energy is headquartered in British Columbia, Canada, with operations in Mexico serving customers across the Americas.

Services

- Critical Power Solutions
- Startup and Commissioning
- Preventative Maintenance - Batteries / UPS
- System Capacity and Performance Audit - UPS



Why Pay More?

- Great Pricing
- Great Warranty
- Compact Solutions
- Advanced Technology



Exceptional Service

- Solutions and proposals are usually delivered within 48 hours.
- We are local for quick delivery, startup and commissioning.
- Customer support and service 365 days a year.
- Maintenance services and replacement batteries.



Reliable Products

- Quality products
- Proven solutions
- Easy to use



Sales Office and Showroom - Mexico

Oficina A-407, Laguna de términos 221,
Col Granada, Ciudad de Mexico,
CP 11460 Mexico

Teléfono (+52) 55 7258 03

Keatec Energy

We design, manufacture, service and install DC and AC uninterruptible power solutions for Telecommunication, Commercial Information Technology (IT), Public Safety and Industrial clients.

Keatec Energy is headquartered in British Columbia, Canada, with operations in Mexico serving customers across the Americas.

Services

Integration of Power Solutions
Startup and Commissioning
Preventative Maintenance – Batteries
Preventative Maintenance – UPS
System Capacity and Performance Audit – UPS

Headquarters

13283 - 20A Avenue,
Surrey, B.C. CANADA V4A 9K2

Telephone

+1 844 307 7998

Sales and Showroom- Mexico & Latin America

Oficina A-407, Laguna de términos 221,
Col Granada, Ciudad de Mexico,
CP 11460 Mexico

Telephone

(+52) 55 7258 0352

