

# The Surge

Exploring issues around power quality equipment

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ELECTRICAL DISTRIBUTION

## Digital Energy™ SG Series UPS Energy Efficiency

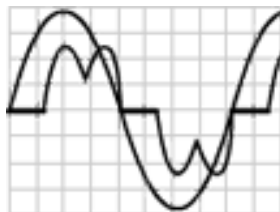


### Market Overview

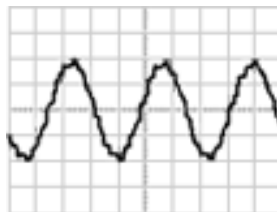
- Higher electrical cost and increasing critical load demand is forcing customers to focus on energy efficiency in mission critical data centers.
- Mission critical customers expect power quality and reliability **without sacrificing** energy efficiency.
- Double Conversion UPS is the preferred UPS technology to achieve customer expectations on power quality and reliability.
- Double conversion UPS consumes energy and GE has two technologies available to **improve the efficiency** of traditional double conversion UPS:
  - Smart Input Filter – customers require 5%-10% input THD and **GE offers an energy efficient** 6-pulse rectifier w/ Smart input filters that achieves low input THD.
  - SVM for Optimized Energy Efficiency – the GE system uses Space Vector Modulation (SVM) to minimize switching losses especially at part loads (less than 100%).
- Target applications including Data Centers, Medical Institutions, Broadcast installations.
- Target end user customers including the CIO's/IT managers, CFO's/finance managers, facility managers and their engineering consultants.

### Smart Input Filter

- Reduced input THD **eliminates oversized** generators, oversized neutral bus/cables, etc.
- GE's Smart Input Filter lowers input THD and improve power factor over traditional Double Conversion UPSs.
- The 5th harmonic Smart Input Filter lowers input THD to 7% and is available option on all SG Series UPSs.
- The 11th harmonic filter is available on SG Series **400-500 kVA modules** and reduces reflected THD to <5% when combined with 5th filter.
- The Smart Filter is programmed to prevent leading power factor (PF) by isolating @ low loads.
- Smart Filters are internally mounted inside the UPS cabinet and **do not require additional footprint**.



Input current THD **without** filter



Input current THD **with** filter



**150kVA SG Series UPS internal front view** (cover removed)




### 5th Harmonic Smart Filter

- Cancels the 5th harmonic generated by the UPS rectifier
- Reduces reflected THD to <7%
- Internally mounted in UPS cabinet
- Available on SG Series UPS's 10-500kVA

## GE's 500kVA 6-Pulse Rectifier w/Smart Filters vs. Competitor's 12-Pulse Rectifier


- Engineering consultants specify <5% THD on data centers to minimize risk of generator-to-UPS compatibility. General rule of thumb:
  - Generator size = **2.5 times UPS rating with no filter.**
  - Generator size = **1.5 times UPS rating with input filter.**
- Most consultants do not specify 6-Pulse or 12-Pulse rectifier... just input THD.
- **GE is only supplier to achieve <5%** with 6-Pulse w/filters (5th & 11th harmonic) integrated.
- Competitors (see below) require 12-Pulse rectifier w/filters to obtain <5% input THD
- The competitor's 12-Pulse rectifier **requires an input isolation transformer.**
- The Input Isolation Transformer increases footprint, **increases weight & increases installed cost.**
- The competitor's Input Isolation Transformer **lowers energy efficiency and reduces reliability.**

		Liebert	Powerware
Model	SG Series	610 Series	9315
kVA (range)	400-500	500	500
<b>Input % THD</b>			
- 6-pulse without filters	30%	30%	30%
- 6-pulse with 5th harmonic filter	7%	7%	7%
- 6-pulse with 5th & 11th harmonic filters	<5%	not available	not available
- 12-pulse without harmonic filter	not needed	12%	not available
- 12-pulse with harmonic filter	not needed	<5%	not available

Input THD comparison

## SG Series UPS Energy Efficiency Advantage

- GE's efficiency advantage is driven by use of Space Vector Modulation (SVM). **SVM reduces inverter switching losses.** SVM also improves UPS efficiency at partial load (50% full load) operation.
- GE efficiency advantages widens at partial loads (50% full load), which is a common load operating point for UPS installations. **Competitor's efficiency gets worse** (0.5%-1% less) @ partial load (50% full load) operation.
- With 500kVA modules, **GE's advantage gets wider** if competitors are required to offer 12-Pulse rectifier with input isolation transformer. The transformer lowers energy efficiency by 1-1.5%.
- A UPS's energy losses are converted to heat adding to customer's cooling load.

Company		Liebert	Liebert	Powerware	Powerware
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Model	SG Series	610 Series	610 Series	9315	9315
#Pulse Rectifier	6-Pulse	12-Pulse	12-Pulse	6-Pulse	12-Pulse
KVA Range	400-500	500	750	500	750
Efficiency (no filters)					
@100% Load	93.8%	92.0%	93.5%	92.0%	93.0%
@50% Load	94.4%	91.5%	93.0%	91.0%	92.0%

Energy efficiency comparison


## Case Study

GE SG Series 500kVA vs. Liebert 610 Series 500kVA

- Project required S+S with (2)x500kVA modules for each System (S). A total of (4) 500kVA modules. **Customer required <5% input THD.**
- Modules operating at <50% load in S+S configuration.
- Powerware's 9315 did not comply** with specification requirement of <5% input THD.
- Liebert 610 Series required use of 12-Pulse rectifier w/filters and **input isolation transformer** to achieve <5%.
- GE SG Series offered with 6-Pulse rectifier w/Smart Filters (5th&11th) to achieve customer's <5% THD specification.
- GE wins \$1 MM project** with significant energy efficiency and footprint/installed cost advantage.

## Summary of GE Advantages in Energy Efficiency and Footprint/Installed Cost

- GE is **2.9% more efficient** (see below) than competitor.
- GE had **smaller footprint**, and **uses less wall space** (see below) than competitor.
- GE has SG Series module is **less weight** (see below) than competitor.
- GE unit **saves end user over \$45k annually** (see below) in electricity costs.

		Liebert	Absolute Difference	Percentage Difference	
Model	SG Series	610S			
Module Configuration	6-Pulse w/ filters	12-Pulse w/ filters			
Module Rating	500kVA	500kVA			
kW Rating	450	450			
Power Factor	0.9	0.9			
Efficiency (@ 50% load)	94.4%	91.5%	-2.9%		GE has advantage!
Efficiency (@ 100% load)	93.8%	92.0%	-1.3%		GE has advantage!
Module kW Losses	25.2	38.3	13.1	51.8%	GE has advantage!
Input THD (5% spec)	<5%	<5%			GE does not require 12-pulse rectifier to meet spec of <5% input THD
Physical					
Footprint (sq feet)	75	145	70	92.8%	GE has advantage!
Wall Space (feet)	27	42	15	56.8%	GE has advantage!
Weight (#)	20,904	42,620	21,716	103.9%	GE has advantage!
Energy Efficiency					
Total kW Losses	100.8	153	52	51.8%	GE has advantage! Electric cost of

Annual Power Cost	\$88,301	\$134,028	\$45,727	51.8%	\$.10/kw-hr (GE has advantage!) 10 years @10% cost of capital (GE has advantage!)
NPV Power Cost	\$542,570	\$823,544	\$280,974	51.8%	

Case study summary of results

For more information see [GE UPS website](#) and/or contact Mark Szalkus @ [mark.szalkus@ge.com](mailto:mark.szalkus@ge.com).

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