



ENERGY STAR for Data Center Products: UPS ...plus Servers, Storage, and more **April 24, 2012**

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Overview



- Main presentation:
 - Uninterruptible Power Supplies (UPS)
- Product updates:
 - Servers
 - Storage
 - Large Network Equipment
 - Data Center Cooling Systems

UPS Defined



- UPSs are devices that sit between an outside power source and an IT load and which reduce or eliminate undesirable features of the incoming power supply.
 - Undesirable features = power outages, voltage sags or surges, poor frequency harmonics, etc.
- Also provide some limited battery or flywheel backup power.

Scope of the ESTAR Specification



- AC and DC power
- VFD, VI, and VFI products
- Static electronics and Rotary systems
- Systems with Battery and Flywheel storage
- Traditional, Multi-mode, and Modular systems
- Consumer through Data Center scale
 - No upper or lower bounds—full market range

AC and DC



- Both AC and DC products covered.
- DC newer for data centers, less common
 - Traditionally in telecom or other sectors
- If your data center is designed for it, DC provides efficiency boost.
 - Roughly a few percentage points increase

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Input Mode: VFD



- Voltage and Frequency Dependent (VFD)
 - Basic IT load protection
 - Highest energy efficiency (96 – 98% peak)
 - Deployed in “Passive Standby” topology
- Tend to be smaller, individual-device oriented
 - Consumer, light commercial
 - Battery backup, surge protection

Input Mode: VI



- Voltage Independent (VI)
 - Enhanced IT load protection
 - Moderate energy efficiency (94 – 97% peak)
 - Deployed in “Line Interactive” topology
- Range from small single-device to larger “server rack” size

Input Mode: VFI



- Voltage and Frequency Independent (VFI)
 - Highest IT load protection
 - Lower energy efficiency (84 – 95% peak).
 - Increases with output power.
 - Deployed in “Double Conversion” topology
 - Isolates load completely from mains power
- Range from single-device coverage to large data center systems

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UPS Type: Traditional



- Historically, majority of UPS products
- Single product/enclosure
- Some maximum output power
- Single input mode (either VFI, VI, or VFD)
- Example:
 - 50 kW VFI system

UPS Type: Multiple Normal Mode



- Newer product type, only offered by a few companies
- >1 input dependency in operation
 - Ex.: 500 kW Multi-mode UPS
 - Functions in VFD at 97% efficiency
 - Voltage drop occurs
 - Rapidly switches to VFI at 92% efficiency to protect load from disruption
- Fast switching time—on the order of 4 – 10ms.
- Can gain 5 – 10% efficiency from VFD mode.

UPS Type: Modular



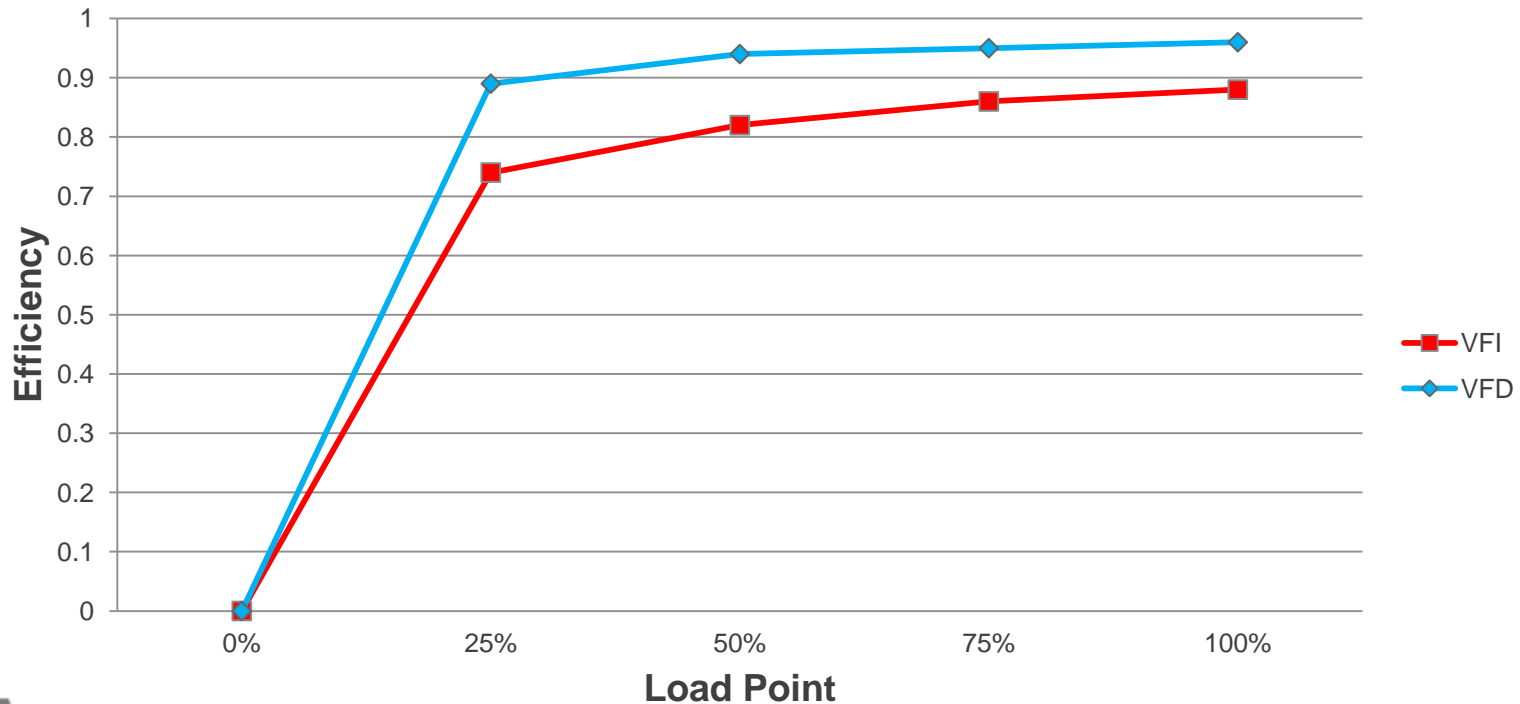
- A frame plus individual modules
- Ex.: 500 kW Modular VFI UPS, with 5 modules of 100 kW each.
 - Only need 200 kW for initial deployment, will expand out to 500 kW.
 - Buy frame with 2 modules installed, 3 empty slots.
 - Purchase additional modules as needed to expand.
- Enables longer operation at higher loading point
 - Greater energy efficiency

Typical UPS Efficiency Curve



- Much higher efficiency from maintaining high load
- Moving from 25% - 100% load:
 - Nearly 7 – 15% efficiency gain

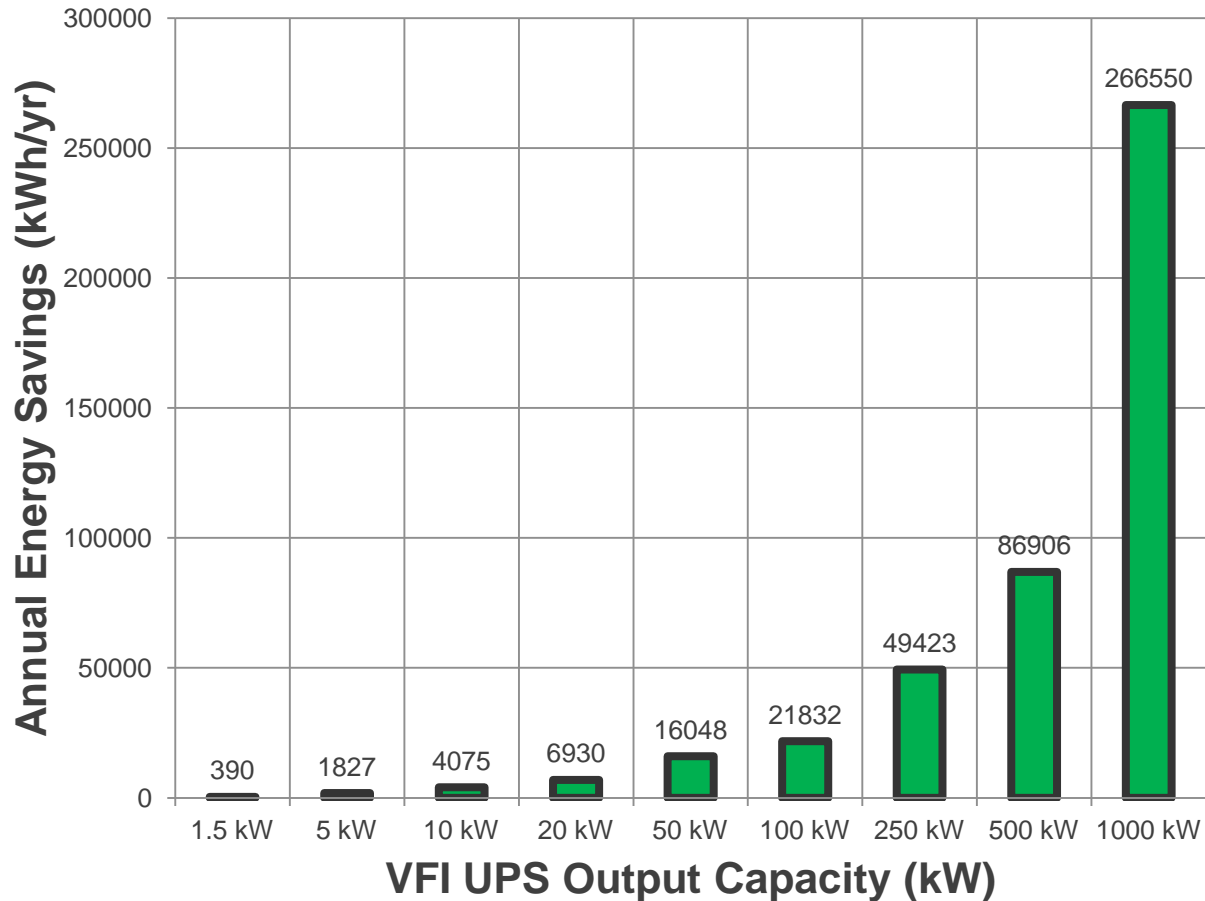
Example UPS Efficiency Curves



Savings from ENERGY STAR



Expected Energy Savings from Purchasing an ENERGY STAR UPS (VFI)



Example Savings from Purchasing ENERGY STAR



Assumes ~50% load on VFI UPS. Average ESTAR vs. average non-ESTAR efficiency used to derive energy savings per year

Power (kW)	Capex (\$)	Elec. Rate (\$/kWh)	Energy Savings (kWh/yr)	Cost savings (\$/yr)	Lifetime (yrs)	Lifetime savings (\$)	Savings as fraction of capex
10	\$9k	0.1	4,075	\$407	10	\$4k	44%
100	\$90k	0.1	21,832	\$2.1k	15	\$32.7k	36%
1000	\$800k	0.1	266,550	\$26.6k	15	\$400k	50%

Indirect Savings



- Cooling energy savings
 - **Rule of thumb:** 25 – 50% of direct IT savings
 - High efficiency = less energy lost to heat, less energy expended to remove heat.
- Ex.: 1MW VFI UPS saves \$400k direct
 - Avoided cooling: Add another \$100k – 200k lifetime.

Metering Incentive



- Specification provides a 1% incentive to UPS products that meter their output kWh.
- Ex.: Rather than be >94%, a VFI product with a meter must be >93%.
- Enables measurement of PUE
 - Accuracy enough to determine trend
- Measure PUE and get the ENERGY STAR label for your data center!

Power and Performance Datasheet (PPDS)



- Contains information on product energy performance
- Enables comparisons between products
- Developing online “PPDS widget” to search ESTAR database

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ENERGY STAR Product Comparison

Print Results Save as Excel file

	Manufacturer 1 XXX-1500-120	Manufacturer 2 YYY-2000-120	Manufacturer 3 ZZZ-2200-120	Manufacturer 4 111-1500-120
General Characteristics				
Manufacturer	Manufacturer 1	Manufacturer 2	Manufacturer 3	Manufacturer 4
Model Name	XXX-1500-120	YYY-2000-120	ZZZ-2200-120	111-1500-120
Model Number	XXX-1500-120	YYY-2000-120	ZZZ-2200-120	111-1500-120
Electrical Characteristics				
Energy Conversion Mechanism	Static	Static	Static	Static
Topology	Double-conversion	Double-conversion	Double-conversion	Double-conversion
Model Meets Definition of Modular UPS (Y/N)	N	N	N	N
Single-normal-mode UPS or Multiple-normal-mode UPS?	Single-normal-mode	Single-normal-mode	Single-normal-mode	Single-normal-mode
Total Number of Outlets	6	6	6	4
Number of Backup Outlets	6	6	6	4
Number of Surge Outlets	0	0	0	0
Minimum Input Voltage	110 V rms	90 V rms	90 V rms	89 V rms
Maximum Input Voltage	130 V rms	150 V rms	150 V rms	142 V rms
Minimum Output Voltage	110 V rms	110 V rms	110 V rms	100 V rms
Maximum Output Voltage	127 V rms	127 V rms	127 V rms	127 V rms
Minimum Output Frequency	60 Hz	50 Hz	50 Hz	50 Hz
Maximum Output Frequency	60 Hz	60 Hz	60 Hz	60 Hz
ENERGY STAR Efficiency Values¹				
Test Input Frequency	120 V rms	120 V rms	120 V rms	120 V rms
Test Output Voltage	60 V rms	60 V rms	60 V rms	60 V rms
Test Output Frequency	120 Hz	120 Hz	120 Hz	120 Hz

Final Word: UPS



- Newer, high efficiency technologies on market
 - Standard, modular, multi-mode
- Data center DC power share small but growing, with efficiency bonus
- Huge lifetime savings from purchasing ESTAR
- Absolutely **must** examine operational costs in addition to capex/installation
- More easily measure PUE with output meters

Data Center Product Updates



- Servers:
 - Working on v2.0
 - Extending scope to include blade servers
 - Test and publish active power consumption with SPECpower Server Efficiency Rating Tool (SERT)
 - Effective early 2013
- Storage:
 - Working on v1.0
 - Cover majority of HDD and SSD Online systems
 - Test and publish idle and active efficiency
 - Effective late 2012

Future Data Center Products



- Large Network Equipment
 - Launch development Q3/Q4 2012
 - Plan to cover switches, routers, examine modular units
- Data Center Cooling Systems
 - Launch development Q3/Q4 2012
 - Scoping still active

Thank you!



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