ENERGY STAR Servers Version 2.0 Draft 2 Webinar

May 24, 2012

RJ Meyers, US Environmental Protection Agency

Evan Haines, ICF International

Al Thomason, TBWC, LLC

Bryan Berringer, U.S. Department of Energy

Agenda

Time (all EST)	Topic
11:00 AM	Introduction
11:10 AM	Updates from SERT Development Effort
11:45 AM	PPDS: Revised Format
12:10 PM	Break - Lunch
12:40 PM	Testing and Blade Servers
1:15 PM	Idle Requirements
1:45 PM	Definitions, Other Topics
1:55 - 2:00 PM	Timeline and Closing

Version 2.0 Goals

- Revise Product Family Structure
- Evaluate Blade Servers
- Continue to push Standard Information Reporting (PPDS)
- Generate public Active Mode efficiency dataset for future use (SERT)

Server Efficiency Rating Tool (SERT) Development

Klaus-Dieter Lange

SPECpower Committee Chairman

Standard Performance Evaluation Corporation

SERT Overview

- Consistent measure of performance and power for all candidate ENERGY STAR servers on various load levels
- Significant improvements over prior art (SPECpower_ssj2008)
  - GUI to assist with setup and execution
  - Broader coverage of system loads and stress of components via various synthetic worklets:
    - Processor
    - Memory
    - In-frame storage
  - Design for power / performance modifier
  - Enhanced automated validation of results

SERT Development Milestones

SERT Milestone	Status
Alpha Release	Successfully Complete
Review Period and Development	Successfully Complete
Beta 1 Release	Successfully Complete
Review Period and Development	Successfully Complete
Beta 2 Release	**Sign up starts 12th June 2012**
Review Period and Development	TBD
Release Candidate (RC) Release	TBD
Final	TBD

SERT
Status Update

Near Complete

- Measurement framework
- Worklet Candidates for:
  - CPU
  - Memory
    Storage
  - Hybrid CPU/Memory
- GUI
- Extensive testing
- Documentation

In Progress

- Results representation
- Final Worklet selection
- Recommendation for:
  - allowable or required tuning parameters
  - number of Java Virtual Machines (JVM)
- Final UI
- HW / SW discovery for all environments to assist with setup and report

SERT
Worklet Candidates

Workload	Worklet	Alpha	Beta 1	Beta 2	RC1
CPU	CPU_Compress	Included	Included	TBD	TBD
CPU	CPU_CryptoAES	Included	Included	TBD	TBD
CPU	CPU_SOR	Included	Included	TBD	TBD
CPU	CPU_SHA256	-	-	TBD	TBD
CPU	CPU_FFT	Included	Included	TBD	TBD
CPU	CPU_LU	Included	Included	TBD	TBD
CPU	CPU_XMLvalidate	Included	Included	TBD	TBD
Memory	Mem_Flood	Included	Included	TBD	TBD
Memory	Mem_XMLvalidate1	Included	Included	TBD	TBD
Memory	Mem_XMLvalidate2	Included	Included	TBD	TBD
Storage	Storage_Random	-	Included	TBD	TBD
Storage	Storage_Sequential	-	Included	TBD	TBD
Storage	Storage_Mixed	Included	Included	TBD	TBD
Hybrid	Hybrid_CSSJ	Included	Included	TBD	TBD
Idle	Idle	Included	Included	Included	Included

Please see the SERT Design Document for detail description of each worklet: http://www.spec.org/sert/docs/SERT-Design_Doc.pdf

SERT
Direct Current (DC) Support

- SERT is neither supported nor tested with DC loads today and currently no resources are devoted to including this support.
- The SPECpower Committee is in favor of including DC support and the decision to start the implementation of DC measurements could be positively influenced by companies whose focus is DC computing by making volunteers available to the SPECpower committee.
- Besides code changes, significant effort would have to be spent defining acceptance criteria for DC power analyzers and the evaluation of uncertainty calculation for DC measurements, as well as testing and documenting them.
- Later this year the subcommittee will create a detailed plan for adding DC support in order to accurately state the additional required resources.

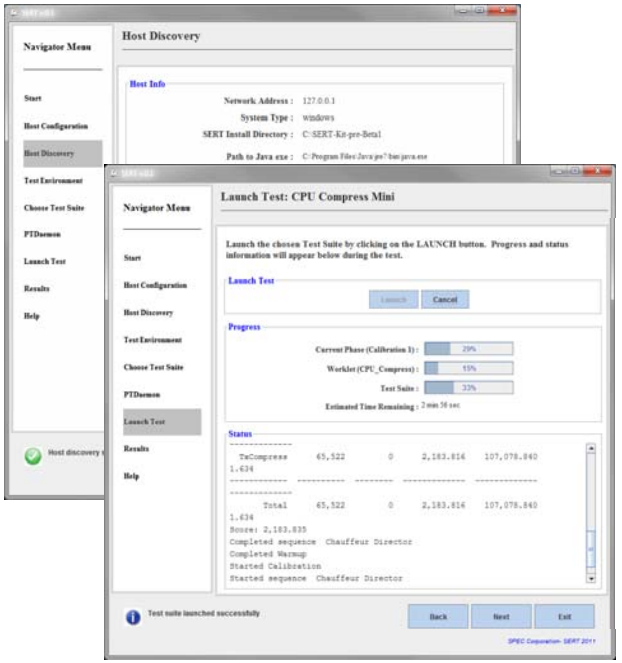
SERT
Metric / Score / Platform

- Each worklet will produce a measure representing the performance achieved by the SUT as well as the average power consumption at multiple target load levels. An overall score is not provided and not recommended.
- Complexity of performance and power measures across components at multiple target load levels makes creation of a single metric difficult.
- The available resources enabled SERT to be implemented and tested on the following platform / OS (64-bit only) combinations:

Platform	X86 (AMD)	X86 (AMD)	X86 (Intel)	X86 (Intel)	Itanium	Power
OS	Windows Server 2008 R2	LINUX	Windows Server 2008 R2	LINUX	HP-UX 11i	AIX

SERT
Graphical User Interface (GUI)

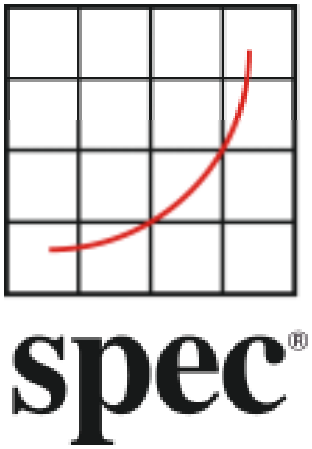
- Gathering SUT hardware and software configuration
- Archiving the measured results and log files
- Setup and Executing
- Default Mode
  - EPA compliant test record
  - Executes the entire SERT suite
- Advanced Research Mode
  - Subset of workloads and worklets
  - Customization of worklets



SERT
Beta 2

- Head start on expertise needed to qualify servers for ENERGY STAR V2 specification
- Gain experience to better comment on the next iteration of Version 2 draft
- Help SPEC to identify and resolve problems prior to your ENERGY STAR qualification
- Open to all ENERGY STAR Stakeholders
  - Must have accepted power analyzer and temperature sensor (http://www.spec.org/power/docs/SPECpower-Device_List.html)
  - Must commit to providing feedback on SERT to SPEC and ENERGY STAR to support further development
  - Must commit to share numerical results with EPA and SPEC (will not be made public)

SERT
Q&A



sertsupport@spec.org

www.spec.org/sert

SERT and Servers v2.0

- EPA will require SERT testing, reporting of information
- No active mode levels set in v2.0
  - Will be major objective of v3.0
- Results reported on ENERGY STAR website, also in PPDS

For Review

- SERT Design Document:
  - http://www.spec.org/sert/docs/SERT-Design_Doc.pdf

PPDS: Introducing a New Format

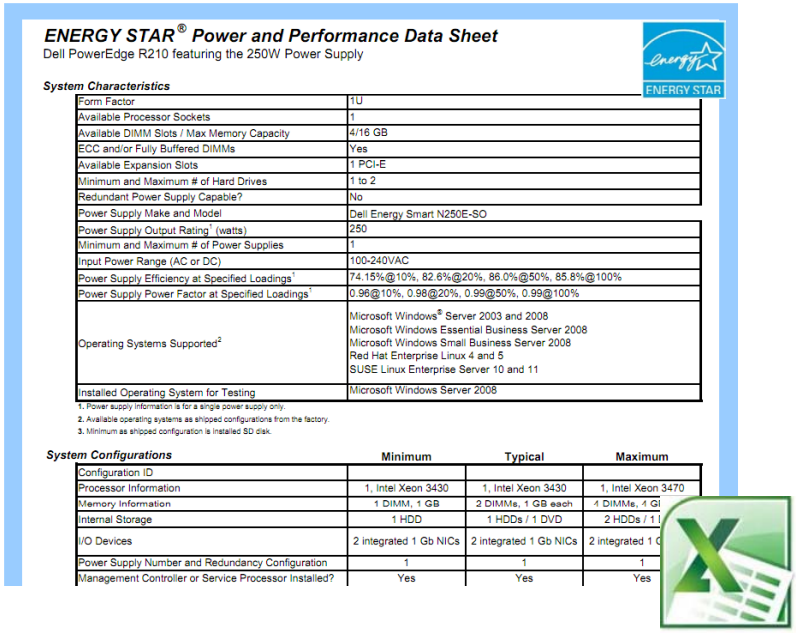
RJ Meyers

US Environmental Protection Agency

Meyers.Robert@epa.gov

Reporting Requirements

- Under Version 1.0, manufacturers are required to generate a Power and Performance Datasheet to accompany ENERGY STAR qualified Servers



ENERGY STAR® Power and Performance Data Sheet

Dell PowerEdge R210 featuring the 250W Power Supply

System Characteristics

Form Factor	1U
Available Processor Sockets	1
Available DIMM Slots / Max Memory Capacity	4/16 GB
ECC and/or Fully Buffered DIMMs	Yes
Available Expansion Slots	1 PCI-E
Minimum and Maximum # of Hard Drives	1 to 2
Redundant Power Supply Capable?	No
Power Supply Make and Model	Dell Energy Smart N250E-SO
Power Supply Output Rating[1] (watts)	250
Minimum and Maximum # of Power Supplies	1
Input Power Range (AC or DC)	100-240VAC
Power Supply Efficiency at Specified Loadings[1]	74.15%@10%, 82.6%@20%, 86.0%@50%, 85.8%@100%
Power Supply Power Factor at Specified Loadings[1]	0.96@10%, 0.98@20%, 0.99@50%, 0.99@100%
Operating Systems Supported[2]	Microsoft Windows® Server 2003 and 2008 Microsoft Windows Essential Business Server 2008 Microsoft Windows Small Business Server 2008 Red Hat Enterprise Linux 4 and 5 SUSE Linux Enterprise Server 10 and 11
Installed Operating System for Testing	Microsoft Windows Server 2008

1. Power supply information is for a single power supply only.
2. Available operating systems as shipped configurations from the factory.
3. Minimum as shipped configuration is installed SD disk.

System Configurations	**Minimum**	**Typical**	**Maximum**
Configuration ID			
Processor Information	1, Intel Xeon 3430	1, Intel Xeon 3430	1, Intel Xeon 3470
Memory Information	1 DIMM, 1 GB	2 DIMMs, 1 GB each	4 DIMMs, 4 GI
Internal Storage	1 HDD	1 HDDs / 1 DVD	2 HDDs / 1
I/O Devices	2 integrated 1 Gb NICs	2 integrated 1 Gb NICs	2 integrated 1
Power Supply Number and Redundancy Configuration	1	1	1
Management Controller or Service Processor Installed?	Yes	Yes	Yes

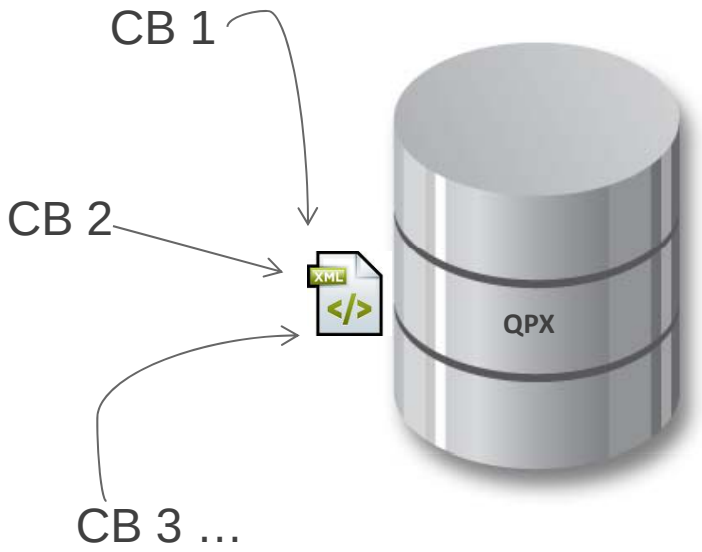
Development Activities - Interactive Comparison Tool

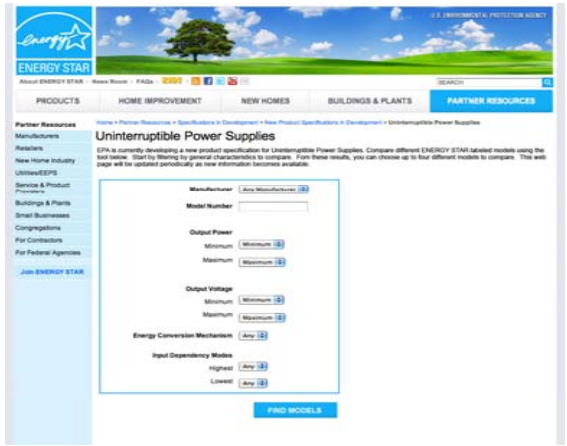
- EPA is working to develop a more centralized and user-friendly format for the requirement
- As part of the Uninterruptible Power Supplies effort, EPA has shared updates on development of an approach to allow electronic display of PPDS data and eliminate the use of “loose” Excel-based files
- Interactive “widget” that will allow the publication of qualified products’ performance information in an ***easily accessible, dynamic format***

PPDS Data Submission

Qualified Product Exchange (QPX)
EPA-recognized certification bodies submit data for PPDS

Power and Performance Data Sheet Widget
Aggregated data for online display

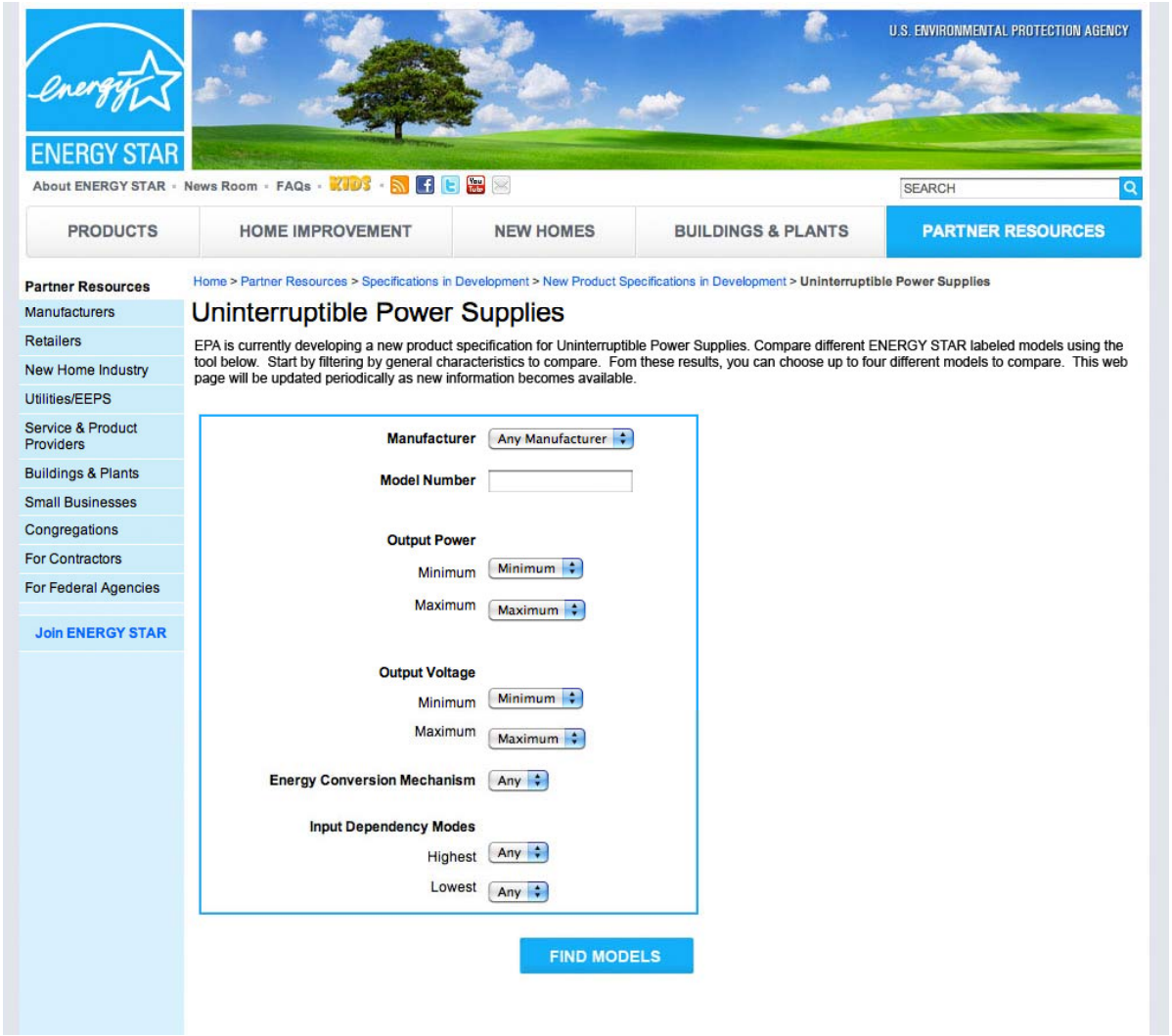




Benefits

- Data centralized and associated with other ENERGY STAR product data
  - Update once, appears everywhere
- Widget design allows for incorporation both on the ENERGY STAR web site and on Partner sites

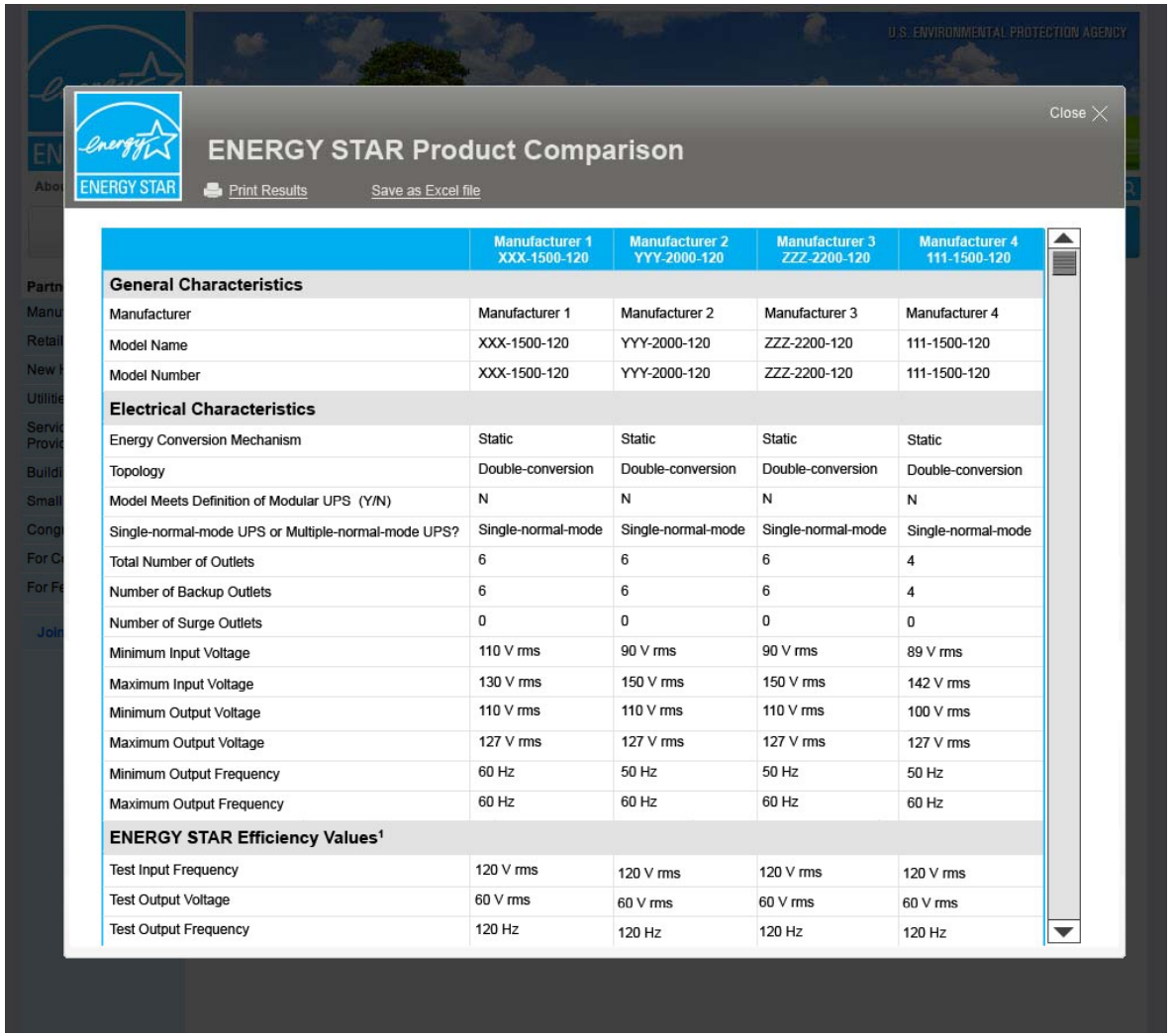
Screenshots – UPS Tool



Screenshots – UPS Tool

Compare?	Manufacturer	AC/DC Output	Output Power	Output Voltage	Energy Conversion Mechanism	Topology	Average Efficiency
☐	Manufacturer 1	AC	xxx-yyy	xxx-yyy	Static	Double-conversion	0.888
☐	Manufacturer 2	AC	xxx-yyy	xxx-yyy	Static	Double-conversion	0.8875
☐	Manufacturer 3	AC	xxx-yyy	xxx-yyy	Static	Double-conversion	0.875
☐	Manufacturer 4	AC	xxx-yyy	xxx-yyy	Static	Double-conversion	0.8625
☐	Manufacturer 5	AC	xxx-yyy	xxx-yyy	Static	Double-conversion	0.881
☐	Manufacturer 6	AC	xxx-yyy	xxx-yyy	Static	Double-conversion	0.8825
☐	Manufacturer 6	AC	xxx-yyy	xxx-yyy	Static	Double-conversion	0.8705
☐	Manufacturer 7	AC	xxx-yyy	xxx-yyy	Static	Double-conversion	0.8805

Screenshots – UPS Tool



ENERGY STAR Product Comparison

Close

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 Values[1]				
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

Screenshots – UPS Tool

		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
Modular UPS Module Model Number					
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
Input Voltage	Minimum	110 V rms	90 V rms	90 V rms	89 V rms
	Maximum	130 V rms	150 V rms	150 V rms	142 V rms
Output Voltage	Minimum	110 V rms	110 V rms	110 V rms	100 V rms
	Maximum	127 V rms	127 V rms	127 V rms	127 V rms
Output Frequency	Minimum	60 Hz	50 Hz	50 Hz	50 Hz
	Maximum	60 Hz	60 Hz	60 Hz	60 Hz
ENERGY STAR Efficiency Values[1]					
Test Input Voltage Insert Test Input Voltage		120 V rms	120 V rms	120 V rms	120 V rms
Test Input Frequency		60 V rms	60 V rms	60 V rms	60 V rms
Test Output Voltage		120 Hz	120 Hz	120 Hz	120 Hz
Test Output Frequency		60 Hz	60 Hz	60 Hz	60 Hz
Representative Models Under Test[2]					
Single-Configuration UPS/ UPS Product Family Minimum Configuration					
Model Number of Representative Model Tested		111-1500-120	YYY-2000-120	ZZZ-2200-120	111-1500-120
Active Power		1350	1400	1400	1350
Apparent Power		1500	2000	2000	1500
Redundancy as Tested (N, N+1, N+N, etc.)		N+0	N+0	N+0	N+0
ENERGY STAR Weighted Calculation of Average Efficiency for Multiple-normal-mode UPS					
ENERGY STAR Minimum Average Efficiency (EffAVG_MIN) Requirement for Given Output Power and Lowest Available Input Dependency					
If Multiple-normal-mode UPS, efficiency values for each Normal-mode are reported[3]					
Input Dependency of Normal Mode(s) Tested (VFI, VI, or VFD)[4]					
Normal mode	Highest input dependency	VFI	VFI	VFI	VFI
	Lowest input dependency				
ENERGY STAR Weighted Calculation of Average Efficiency for Each Tested Normal Mode					
Normal mode	Highest input dependency	0.881	0.878	0.888	0.881
	Lowest input dependency				
ENERGY STAR Minimum Average Efficiency (EffAVG_MIN) Requirement for Given Output Power and Input Dependency					
Normal mode	Highest input dependency	0.876	0.877	0.878	0.876

Testing and Blade Servers

Bryan Berringer

US Department of Energy

Bryan.Berringer@ee.doe.gov

Overview

- This section will cover both general Test Method items and Blade Server considerations
- Many of the key points of discussion for Blades overlap with Test Method revisions for Draft 2
- Revised Chassis and Idle requirements for Blades in next section

Introduction – Program History

- Draft 1 specification released April 9, 2010
  - Blade servers incorporated into the specification
  - Active mode power – for data collection
- Additional test method drafts released for data collection
  - March 11, 2011 and August 9, 2011
  - Changes based on stakeholder comments
  - Divide by N instead of N-1 method to calculate single blade power
- Draft 2 specification released May 11, 2012
  - Draft 2 Test Method - revision based on August 9, 2011 draft

Introduction – Testing Summary

- 4 servers tested for idle mode power consumption

Product	Form Factor	Processor	Operating System
Single Socket Server	Tower	X86-64	• Windows
Two Socket Server	Rack	X86-64	• Windows Linux
Two Socket Server	Rack	X86-64	• Windows • Linux
Blade Server	Blade		

Draft 2 Test Method – Anticipating SERT Testing

- Language added to harmonize with Server Efficiency Rating Tool (SERT)
  - Power meter
    - Calibrated by a standard national metrology institute (e.g., NIST)
    - Logging – At least 1 set of data measurements per second
    - Set is defined as watts
  - Temperature sensor
    - Overall accuracy of ± 0.5 °C or better
    - Minimum reading rate of 4 samples per second

Blade Testing

- The Draft 2 Test Method reflects procedures distributed with the V2 dataset development in 2011

- Clarifications incorporated based on further feedback from stakeholders

Recommendation 1
Populating Half Blade Chassis

- The Test Method includes provisions for Full- and Half-Chassis Testing

- Draft 1 Test Method – Half-Chassis testing case
  - Fill top row of the chassis first and then proceed downwards
  - Fill partially populated rows from center outwards

- Issue
  - May end up operating power supplies in low efficiency conditions due to partial population of power domain

Recommendation 1
Populating Half Blade Chassis

- Proposed change
  - **Follow manufacturer recommended approach**
  - If user manual recommendation is not available:
    - Completely populate one power domain before proceeding to the next
    - Fill partially populated power domains from center outwards

- Advantages
  - Real world configuration
  - Improves power supply efficiency
  - Fewer power supplies used

Recommendation 1
Populating Half Blade Chassis - Example

Blade Configuration – 8 blades

Slot 1	Slot 2	Slot 3	Slot 4
Slot 5	Slot 6	Slot 7	Slot 8

Power Domain 1 Power Domain 2

Draft 1 Test Method

Slot 1	Slot 2	Slot 3	Slot 4
Slot 5	Slot 6	Slot 7	Slot 8

Draft 2 Test Method

Slot 1	Slot 2	Slot 3	Slot 4
Slot 5	Slot 6	Slot 7	Slot 8

Recommendation 2
Idle Power Test

- Draft 1 Test Method
  - Measure idle power *after* the completion of workload run
- Issue
  - UUT may not enter idle state of operation due to background processes and daemons initiated by the workloads

Recommendation 2
Idle Power Test

- Proposed change
  - Measure idle power *before* engaging workload
- Advantages
  - UUT will be in idle state throughout the power measurement period

Follow Up
Divide by N Method for Per Blade Power

- N-1 method provided inconsistent results
  - Per blade power consumption varied with blade position

Table 1: Single Blade Power consumption (N-1) method

Scenario #	Single Blade AC Power (kW)
1	0.186
2	0.176
3	0.196

- ~ 12% variation in idle power measurements

Follow Up
Divide by N Method for Per Blade Power

- Divide by N method
  - Power consumed by the whole system divided by the number of blades populated
  - Observed 4% variation in per blade power

Table 2: Single Blade Power Consumption divide by N method

Chassis configuration	Single Blade AC Power (kW)
Full Chassis	0.181
Half chassis	0.189

- Advantages
  - Amortize chassis overhead across installed blades
  - Reduces testing burden for stand alone chassis power

Idle Power Requirements

Evan Haines

ICF International

evan.haines@icfi.com

Requirement Summary

	1S/2S	3S/4S	Blade Servers
Idle – Levels	Yes		
Idle Disclosure	Yes	Yes	Yes
Full Power – Disclosure	Yes	Yes	Yes
SERT	Yes	Yes	Yes

1S/2S

Table 4: Additional Idle Power Allowances for Extra Components

System Characteristic	Applies To:	Additional Idle Power Allowance
Additional Power Supplies	Power supplies installed explicitly for power redundancy[iii]	[TBD] watts per Power Supply
Additional Hard Drives (including solid state drives)	Installed hard drives greater than one	8.0 watts per Hard Drive
Additional Memory	Installed memory greater than 4 GB[iv]	0.75 watts per GB[iv]
Additional I/O Devices[v], [vi], [vii]	Installed Devices greater than two ports of 1 Gbit, onboard Ethernet	< 1Gbit: No Allowance = 1 Gbit: 2.0 watts / Active Port > 1 Gbit and < 10 Gbit: 4.0 watts / Active Port ≥ 10 Gbit: 8.0 watts / Active Port

- Adders changes incorporated:
  - Memory: Per-GB memory adder reduced after evaluation of component-level data provided by stakeholders and the Draft 2 dataset
    - Systems present in the dataset that had Idle Power more than offset by eligible Version 1 adders
  - Redundant PSU: TBD
    - EPA is seeking feedback on alternatives to the flat 20 W adder present in Version 1 (i.e., an appropriate value that scales with functionality)

1S/2S

Table 3: Base Idle State Power Allowances for 1S and 2S Servers

Category	Number of Installed Processors (# P)	Managed Server	Base Idle State Power Allowance, P_{BASE} (watts)
A	1	No	55.0
B	1	Yes	65.0
C	2	No	100.0
D	2	Yes	150.0

- Base Idle levels are maintained from Version 1 in recognition of the current dataset and opportunity for these levels to continue to recognize more energy efficient products

3S/4S and Blades

- Some server manufacturers provided data for products in these categories with great effort
- Unfortunately, the dataset does not support setting of an Idle Power level applicable to the market as a whole
- With the implementation of the revised product family approach, EPA believes that Version 2 will generate a fuller picture of power demands across ranges of similar platforms and allow for better investigation of levels

Blades

- Chassis-level Power Requirements
  - Requirements for power limits on chassis overhead removed
    - Included as placeholders in previous documents
    - “Divide by N” testing approach amortizes chassis overhead into blade assessment
    - Overhead functionality hosted uniquely to different blade system designs (chassis vs. in-blade)
  - Thermal Management and identification criteria remain, along with general PSU criteria

GPGPUs

- Stakeholders raised the topic of GPGPUs (and later, expandable compute capability via add in cards)
- Section 3.9.1 included a requirement to test with and without GPGPUs installed
  - Will allow the program to evaluate the Idle Power impact of such features
- Further feedback encouraged from stakeholders:
  - Similar technologies that may require investigation
    - (The approach proposed for GPGPUs is not intended for broad application)
  - Assessment and Test procedures beyond Idle measurements.

Definitions and Other Topics

Evan Haines

ICF International

evan.haines@icfi.com

Definition Change Summary

- Computer Servers
  - An exemption from the core requirement for ECC memory in Servers is proposed for systems offering greater than 50 nodes
- Resilient Server
  - EPA understands that stakeholders are actively developing a more cohesive set of criteria describing Resilient Servers. EPA plans to evaluate the resulting proposal once available and welcomes comments on this issue
- High Performance Computing (HPC) System
  - EPA intends to remove the definition unless further development of requirements requires a description of HPC systems

Other Topics

- Solidifying on Five-Point Product Family test approach
  - Balance between testing burden and creation of product dataset
- Adding Time Stamping to reported Environmental Data (Power and Temperature)
  - Seeking Stakeholder input on this potential addition

Closing

Timeline

Topic	Timeframe
Draft 2 Distributed	May 11, 2012
End of Draft 2 Comment period	June 6, 2012
SERT Beta 2 launch	Mid-June 2012
Draft 3 (TBD)	Early July
End of Draft 3 Comment period (TBD)	Early August
Final Draft	Late August
Final Specification	Early September

References and Resources

- ENERGY STAR Servers specification revision: www.energystar.gov/RevisedSpecs (click on Computer Servers)

- SERT Design Document:
  - http://www.spec.org/sert/docs/SERT-Design_Doc.pdf

Thank you!

Bryan Berringer, DOE
Bryan.Berringer@ee.doe.gov

Robert Meyers, EPA
Meyers.Robert@epamail.epa.gov

Akshay Odugoudar, Navigant
Akshay.Odugoudar@navigant.com

Evan Haines, ICF International
ehaines@icfi.com

Bizhan Zhumagali, ICF International
bzhumagali@icfi.com

servers@energystar.gov