ENERGY STAR® Program Requirements for Computer Servers

Partner Commitments

Following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacture and labeling of ENERGY STAR qualified products. The ENERGY STAR Partner must adhere to the following partner commitments:

Qualifying Products

1. Comply with current ENERGY STAR Eligibility Criteria, which define performance requirements and test procedures for computer servers. A list of eligible products and their corresponding Eligibility Criteria can be found at www.energystar.gov/specifications.

2. Obtain certification of ENERGY STAR qualification from a Certification Body recognized by EPA for computer servers prior to associating the ENERGY STAR name or mark with any product. As part of this certification process, products must be tested in a laboratory recognized by EPA to perform computer server testing.

Using the ENERGY STAR Name and Marks

3. Comply with current ENERGY STAR Identity Guidelines, which define how the ENERGY STAR name and marks may be used. Partner is responsible for adhering to these guidelines and ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance. The ENERGY STAR Identity Guidelines are available at www.energystar.gov/logouse.

4. Use the ENERGY STAR name and marks only in association with qualified products. Partner may not refer to itself as an ENERGY STAR Partner unless at least one product is qualified and offered for sale.

5. Provide clear and consistent labeling of ENERGY STAR qualified computer servers.

   5.1. Partner shall adhere to the following product-specific commitments regarding use of the ENERGY STAR certification mark on qualified products:

      5.1.1. Partner must use the ENERGY STAR mark in all of the following ways:

         1) On the Partner's website where specification sheets, product information, and configuration information is displayed;

            a. This ENERGY STAR mark must serve as a link from the product specification sheet to the corresponding Power and Performance Data Sheet for the ENERGY STAR qualified configuration or Product Family.

         2) On the product's ENERGY STAR Power and Performance Data Sheet.

         3) In collateral materials, which may include printed or electronic user manuals, product guides, and marketing brochures.

      5.1.2. If additional information about the ENERGY STAR program or other products is provided by the Partner on its website, Partner must comply with the ENERGY STAR Web Linking Policy, which can be found at www.energystar.gov/partners;

6. Work with Value Added Resellers (VARs) of Partner's products to help ensure that computer server products remain in compliance with ENERGY STAR requirements.

6.1. Any party within the distribution channel of an ENERGY STAR qualified computer server that alters the power profile of a product after its date of manufacture through hardware or software modifications must ensure that the product continues to meet the ENERGY STAR requirements before delivering this product to the end customer. If the product no longer meets the requirements, it may not bear the ENERGY STAR mark;

6.2. If a VAR makes any modifications to a computer server that was previously qualified as ENERGY STAR, re-brands the product, and promotes it as ENERGY STAR, the VAR must become an ENERGY STAR Partner and follow the requirements outlined in this document.

Verifying Ongoing Product Qualification

7. Participate in third-party verification testing through a Certification Body recognized by EPA for computer servers.

8. Comply with tests that EPA/DOE may conduct at its discretion on products that are referred to as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily supplied by Partner at the government's request.

Providing Information to EPA

9. Provide unit shipment data or other market indicators to EPA annually to assist with creation of ENERGY STAR market penetration estimates, as follows:

9.1. Partner must submit the total number of ENERGY STAR qualified computer servers shipped in the calendar year or an equivalent measurement as agreed to in advance by EPA and Partner. Partner shall exclude shipments to organizations that rebrand and resell the shipments (unaffiliated private labelers).

9.2. Partner must provide unit shipment data segmented by meaningful product characteristics (e.g., type, capacity, presence of additional functions) as prescribed by EPA.

9.3. Partner must submit unit shipment data for each calendar year to EPA or an EPA-authorized third party, preferably in electronic format, no later than March 1 of the following year.

Submitted unit shipment data will be used by EPA only for program evaluation purposes and will be closely controlled. Any information used will be masked by EPA so as to protect the confidentiality of the Partner;

10. Report to EPA any attempts by laboratories or Certification Bodies (CBs) to influence testing or certification results or to engage in discriminatory practices.

11. Notify EPA of a change in the designated responsible party or contacts within 30 days using the My ENERGY STAR Account tool (MESA) available at www.energystar.gov/mesa.

Performance for Special Distinction

In order to receive additional recognition and/or support from EPA for its efforts within the Partnership, the ENERGY STAR Partner may consider the following voluntary measures, and should keep EPA informed on the progress of these efforts:

- Provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.

- Consider energy efficiency improvements in company facilities and pursue benchmarking buildings through the ENERGY STAR Buildings program.

- Purchase ENERGY STAR qualified products. Revise the company purchasing or procurement specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA for periodic updates and coordination. Circulate general ENERGY STAR qualified product information to employees for use when purchasing products for their homes.

- Feature the ENERGY STAR mark(s) on Partner website and other promotional materials. If information concerning ENERGY STAR is provided on the Partner website as specified by the ENERGY STAR Web Linking Policy (available in the Partner Resources section of the ENERGY STAR website), EPA may provide links where appropriate to the Partner website.

- Ensure the power management feature is enabled on all ENERGY STAR qualified displays and computers in use in company facilities, particularly upon installation and after service is performed.

- Provide general information about the ENERGY STAR program to employees whose jobs are relevant to the development, marketing, sales, and service of current ENERGY STAR qualified products.

- Provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, communicate, and/or promote Partner's activities, provide an EPA representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR website, etc. The plan may be as simple as providing a list of planned activities or milestones of which Partner would like EPA to be aware. For example, activities may include: (1) increasing the availability of ENERGY STAR qualified products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrating the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) providing information to users (via the website and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products; and (4) building awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event.

- Join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. The SmartWay Transport Partnership works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway.

- Join EPA's Climate Leaders Partnership to inventory and reduce greenhouse gas emissions. Through participation, companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders. For more information on Climate Leaders, visit www.epa.gov/climateleaders.

- Join EPA's Green Power Partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities. For more information on Green Power, visit www.epa.gov/greenpower.

ENERGY STAR® Program Requirements
Product Specification for Computer Servers

Eligibility Criteria
Draft Version 1.1

1 Following is the Version 1.1 ENERGY STAR Product Specification for Computer Servers. A product shall
2 meet all of the identified criteria if it is to earn the ENERGY STAR.

3 # 1 DEFINITIONS

4 A) Product Types:

5   1) Computer Server: A computer that provides services and manages networked resources for other
6   computers or networked devices. Computer servers are sold through enterprise channels for use
7   in data centers and office/corporate environments. A computer server is designed to be primarily
8   accessed via network connections, and not through direct user input devices such as a keyboard,
9   mouse, etc. In addition, a computer server has all of the following characteristics:

10   a) Marketed and sold as a computer server;

11   b) Designed for and listed as supporting computer server operating systems (OS) and/or
12   hypervisors, and targeted to run user-installed enterprise applications;

13   c) Support for error-correcting code (ECC) and/or buffered memory (including both buffered
14   DIMMs and buffered on board (BOB) configurations);

15   d) Packaged and sold with one or more ac-dc or dc-dc power supplies; and

16   e) All processors have access to shared system memory and are independently visible to a
17   single OS or hypervisor.

18   2) Blade System: A system comprised of a blade chassis and one or more removable blade servers
19   and/or other units (e.g., blade storage, blade network equipment). A blade system provides a
20   scalable means for combining multiple blade server or storage units in a single enclosure, and is
21   designed to allow service technicians to easily add or replace (hot-swap) blades in the field.

22   a) Blade Server: A computer server that is designed for use in a blade chassis. A blade server is
23   a high-density device that includes at least one processor and system memory but is
24   dependent upon shared blade chassis resources (e.g., power supplies, cooling) for operation.

25   b) Blade Chassis: An enclosure containing shared resources for the operation of blade server,
26   blade storage, and other blade form factor units. Shared resources provided by a blade
27   chassis may include power supplies, shared data storage, and hardware for dc power
28   distribution, thermal management, system management, and network services.

29   c) Blade Storage: A storage device that is designed for use in a blade chassis. A blade storage
30   device is dependent upon shared blade chassis resources (e.g., power supplies, cooling) for
31   operation.

32   3) Direct Current (Dc) Server: A computer server with one or more dc-dc power supplies that runs
33   directly off dc power.

34 4) Fully Fault Tolerant Server: A computer server designed with complete redundancy, in which
35   every computing component is replicated between two nodes running identical and concurrent
36   workloads. If one node fails or needs repair, the second node can run the workload alone to avoid
37   any downtime. A fully fault tolerant server uses two systems to simultaneously and repetitively run
38   a single workload for continuous availability in a mission critical application.

39 5) Managed Server: A computer server designed for a high level of availability in a highly-managed
40   environment. A managed server has all of the following characteristics:

41   a) Capable of operation with redundant power supplies; and

42   b) An installed dedicated management controller (e.g., service processor).

43 6) Dual-node Server: Two independent computer servers (or nodes) contained in a single enclosure
44   and sharing one or more power supplies. The combined power for all nodes is distributed through
45   the shared power supplies. A dual-node server is designed and built as a single enclosure and is
46   not designed to be hot-swappable.

47 7) Multi-node Server: Greater than two independent computer servers (or nodes) contained in a
48   single enclosure and sharing one or more power supplies. The combined power for all nodes is
49   distributed through the shared power supplies. A multi-node server is designed and built as a
50   single enclosure and is not designed to be hot-swappable.

51 8) Server Appliance: A self-contained computer server bundled with a pre-installed OS and
52   application software that is used to perform a dedicated function or set of tightly-coupled functions.
53   A server appliance delivers services through one or more networks (e.g., IP or SAN), and is
54   typically managed through a web or command line interface. Server appliance hardware and
55   software configurations are customized by the vendor to perform a specific task, and are not
56   intended to execute user-supplied software, including name services, firewall services,
57   authentication services, encryption services, and voice-over-IP (VoIP) services.

58 B) Other Data Center Equipment

59 1) Network Equipment: A product whose primary function is to provide data connectivity among
60   devices connected to its several ports. Data connectivity is achieved via the routing of data
61   packets encapsulated according to Internet Protocol, Fibre Channel, InfiniBand or similar protocol.
62   Examples of network equipment commonly found in data centers are routers and switches.

63 2) Storage Equipment: A system composed of integrated storage controllers, storage devices (e.g.,
64   hard drives or solid state storage) and software that provides data storage services to one or more
65   computer servers. While storage equipment may contain one or more embedded processors,
66   these processors do not execute user-supplied software applications but may execute data-
67   specific applications (e.g., data replication, backup utilities, data compression, install agents, etc.).

68 C) Computer Server Components

69 1) Computer Server Power Supply Unit (PSU): A self-contained component that converts a voltage
70   input to one or more dc voltage outputs for the purpose of powering the computer server. The
71   input voltage may be from an ac source or a dc source. A computer server PSU is separable from
72   the main computer board and connects to the system via a removable or hard-wired male/female
73   electrical connection, cable, cord or other wiring (i.e. separate from, and not integrated with, the
74   system motherboard). This definition includes the following sub-types:

75   a) Ac-Dc Power Supply: A PSU that converts line voltage ac input power into one or more
76   different dc outputs.

77   b)   <u>Dc-Dc Power Supply</u>: A PSU that converts a dc voltage input to one or more different dc
78   voltage outputs. This definition excludes internal dc-to-dc converters (also known as voltage
79   regulators) that are used to convert low voltage dc (e.g. 12 Volts dc) into other dc voltages for
80   use by computer server components.

81   c)   <u>Single-Output Power Supply</u>: A PSU that delivers most of its rated power through one primary
82   dc output. Single-output PSUs may include one or more standby outputs which remain active
83   whenever connected to an input power source. There may be additional outputs besides the
84   primary output and standby outputs, however, the combined power from all additional outputs
85   is less than or equal to 20 watts. PSUs with multiple outputs at the primary voltage are
86   considered single-output PSUs, unless these outputs:

87   (1)   are generated from separate converters or have separate output rectification stages,
88   and/or

89   (2)   have independent current limits.

90   d)   <u>Multi-Output Power Supply</u>: A PSU that delivers its power through more than one primary
91   output, including one or more standby outputs which remain active whenever connected to an
92   input power source. For multi-output PSUs, the combined power from additional outputs other
93   than the primary and standby outputs is greater than 20 watts. This definition also applies to
94   power supplies with multiple outputs at the same voltage that do not meet the definition of a
95   single-output PSU.

96   2)   <u>I/O Device</u>: A device that provides data input and output capability to the computer server from
97   other devices. An I/O device may be integral to the main computer board or may be a separate
98   device connected though expansion slots such as PCI or PCIe. Examples of I/O devices include:

99   a)   Ethernet devices;

100   b)   InfiniBand devices;

101   c)   External RAID/SAS controllers; and

102   d)   Fibre Channel devices.

103   3)   <u>I/O Port</u>: Physical circuitry within an I/O device where an independent I/O session can be
104   established. A port is not the same as a connector receptacle, since a single receptacle/connector
105   may service multiple ports of the same interface.

106 D)   <u>Operational Modes</u>

107   1)   <u>Idle State</u>: An operational state in which the operating system and other software have completed
108   loading and the computer server is capable of completing workload transactions, but no active
109   workload transactions are requested or pending by the system (i.e., the Computer Server is
110   operational, but not processing any useful work).

111

112   E)   <u>Product Family</u>: A group of product models that are (1) made by the same manufacturer, (2) subject to
113   the same ENERGY STAR qualification criteria, and (3) of a common basic design. Product models
114   within a family differ from each other according to one or more characteristics or features that either
115   (1) have no impact on product performance with regard to ENERGY STAR qualification criteria (e.g.,
116   housing and color), or (2) are specified herein as acceptable variations within a product family. For
117   Computer Servers, product families consist of product models that satisfy the following criteria:

118   1)   Are from a single model line;

119   2)   Include the same model motherboard;

120   3)   Include processors per the following guidelines:

121   a)   Incorporate processors from a single model line, with identical power specifications (e.g.,
122   TDP) and core count;

123   b)   Incorporate the same quantity of installed discrete processor packages (e.g., a branded
124   processor, not a number of cores);

125   c)   Processor clock speed may vary within a product family.

126   4)   Include power supplies per the following guidelines:

127   a)   Incorporate power supplies from a single model line, with identical technical and power
128   specifications (e.g., maximum rated output power);

129   b)   The number of power supplies may vary within a product family.

130   5)   Include memory (DIMMs) per the following guidelines:

131   a)   Incorporate memory modules of a single type (e.g., DIMM, FB-DIMM) and interface (pin
132   configuration);

133   b)   The number and capacity of memory modules may vary within a product family.

134   6)   Include hard drives per the following guidelines:

135   a)   Incorporate hard drives of a single type (e.g., Hard Disk Drives (HDD) or Solid State Drives
136   (SSD)), spindle speed, and interface (e.g., SCSI);

137   b)   The number and capacity of hard drives may vary within a product family;

138   c)   A configuration without an internal hard drive, but otherwise identical to the Minimum
139   Configuration, may be included in a product family.

140   **Note:** Provisions (e) and (f) reflect clarifications to the product family structure implemented as part of the
141   Computer Servers program over the past year.

142

143   7) Include I/O devices per the following guidelines:

144   a) Incorporate I/O devices with identical technical and power specifications.

145   b) Multiple types of I/O devices may be included in a product family.

146   c) A configuration without an add-in I/O device may be included in a product family, with any
147   number of add-in I/O devices included in other configurations.

148 F) <u>Product Configurations</u>:

149   1) <u>Maximum Configuration</u>: A highly configured product that includes the combination of power
150   supplies, memory, hard drives, I/O devices, etc. that results in the maximum possible power
151   consumption within a product family.

152   2) <u>Minimum Configuration</u>: A minimally configured product that includes at least one hard drive and
153   is currently available and sold in the marketplace (i.e., not under-configured). The Minimum
154   Configuration typically has the minimum quantity of power supplies, minimum quantity of memory
155   modules, a single hard drive, and a single integrated or add-in I/O device.

156   3) <u>Typical Configuration</u>: An intermediate configuration between the Maximum Configuration and
157   Minimum Configuration. The Typical Configuration is representative of a product with high-volume
158   sales.

159   4) <u>Base Configuration</u>: A reference configuration that does not qualify for any additional power
160   allowances. The Base Configuration includes:

161   a) One hard disk drive or solid state drive;

162   b) 4 Gigabytes (GB) of system memory;

163   c) The minimum number of power supplies required to operate the Computer Server (i.e., no
164   redundant power supplies); and

165   d) Two ports of 1 Gigabit per second (Gbit/s) onboard Ethernet.

2 SCOPE

2.1 Included Products

168 2.1.1   Products that meet both of the following conditions are eligible for ENERGY STAR qualification,
169   with the exception of products listed in Section 2.2:

170   i. Meet the definition of a Computer Server; and

171   ii. Host 1 to 4 individual processor sockets.

2.2 Excluded Products

173 2.2.1   Products that are covered under other ENERGY STAR product specifications are not eligible for
174   qualification under this specification. The list of specifications currently in effect can be found at
175   www.energystar.gov/products.

176   2.2.2   The following products are not eligible for qualification under this specification:

177   i.   Blade Systems including Blade Servers and Blade Chassis;

178   ii.   Fully Fault Tolerant Servers;

179   iii.   Server Appliances;

180   iv.   Multi-Node Servers;

181   v.   Storage Equipment, including Blade Storage; and

182   vi.   Network Equipment.

3 QUALIFICATION CRITERIA

183

3.1 Significant Digits and Rounding

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185   3.1.1   All calculations shall be carried out with actual measured or observed values. Only the final result
186   of a calculation shall be rounded. Calculated results shall be rounded to the nearest significant
187   digit as expressed in the corresponding specification limit.

188   3.1.2   Unless otherwise specified, compliance with specification limits shall be evaluated using exact
189   values without any benefit from further rounding.

3.2 Power Supply (PSU) Requirements

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191   3.2.1   <u>Efficiency</u>: Computer Server PSUs shall meet efficiency requirements as specified in Table 1.

192   **Table 1: Power Supply Efficiency Requirements**

Load Level as a Percentage of Nameplate Output Current	Multi-Output (Ac-Dc & Dc-Dc)	Single-Output (Ac-Dc & Dc-Dc)		
	All Output Levels	≤ 500 watts	> 500 to 1000 watts	> 1000 watts
10%	N/A	0.70	0.75	0.80
20%	0.82	0.82	0.85	0.88
50%	0.85	0.89	0.89	0.92
100%	0.82	0.85	0.85	0.88

193   3.2.2   <u>Power Factor</u>: Computer Server ac-dc PSUs shall meet power factor requirements as specified in
194   Table 2.

195

Table 2: Power Factor Requirements for Ac-Dc Power Supplies

Load Level as a Percentage of Nameplate Output Current	Multi-Output	Single-Output		
		≤ 500 watts	> 500 to 1000 watts	> 1000 watts
10%	N/A	N/A	0.65	0.80
20%	0.80	0.80	0.80	0.90
50%	0.90	0.90	0.90	0.90
100%	0.95	0.95	0.95	0.95

3.3 Power Management Requirements

3.3.1 Three-socket (3S) and four-socket (4S) servers shall be configured with processor-level power management to reduce power consumption of the processor during periods of low utilization. Power management for three- and four-socket servers shall be implemented as follows:

    i. Power management functionality shall be enabled in the system BIOS, and/or a management controller or service processor.

    ii. For systems that ship with a pre-installed supervisor system (OS or hypervisor), power management functionality shall be enabled by default in the supervisor system.

    iii. All processors shall be capable of reducing power consumption in times of low utilization, by either (1) reducing voltage and/or frequency through Dynamic Voltage and Frequency Scaling (DVFS), or (2) using processor or core reduced power states when a core or socket is not being used.

    iv. Power management techniques that are enabled by default shall be reported on the Power and Performance Data Sheet, per the requirements in Section 3.5 of this specification.

3.3.2 Dual-node servers with three or four sockets per node shall meet the processor power management requirements specified for 3S and 4S servers.

3.3.3 One-socket (1S) and two-socket (2S) servers may be configured with processor level power management to reduce power use of the processor during times of low utilization.

3.4 Idle State and Full Load Power Requirements

3.4.1 <u>1S and 2S Servers</u>: Measured Idle State power (P_{IDLE}) shall be less than or equal to the Maximum Idle State Power Requirement (P_{IDLE_MAX}), as calculated per Equation 1.

219 **Equation 1: Calculation of Maximum Idle State Power**

$$P_{IDLE\_MAX} = P_{BASE} + \sum_{i=1}^{n} P_{ADDL\_i}$$

221 *Where:*
222 - *P_{IDLE_MAX} is the Maximum Idle State Power Requirement,*
223 - *P_{BASE} is the base idle power allowance, as determined per*
224 *Table 3*
225 - *P_{ADDL_i} is the Idle State power allowance for additional*
226 *components, as determined per Table 4*

227 **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

228 **Table 4: Additional Component Idle State Power Allowances for 1S and 2S Servers**

Installed Component	Applies To	Idle State Power Allowance for Additional Components, P_{ADDL_i} (watts)
Additional Power Supply	PSUs installed explicitly for power redundancy[i]	20.0 watts per Power Supply
Additional Hard Drive (HDD and SSD)	Installed hard drives greater than one	8.0 watts per Hard Drive
Additional Memory (rounded to the nearest GB)	Installed memory greater than 4 GB	2.0 watts per GB
Additional I/O Device (single connection speed rounded to nearest Gbit)	Installed I/O devices greater than two ports of 1 Gbit, onboard Ethernet[ii,iii,iv]	< 1 Gbit: 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

229 i. The Additional Power Supply allowance may be applied for each PSU in addition to the
230 minimum quantity necessary to operate the Computer Server.

231 ii. The Additional I/O Device allowance may be applied for all I/O Devices over the Base
232 Configuration (i.e., Ethernet devices additional to two ports of 1 Gigabit per second (Gbit/s),
233 onboard Ethernet, plus any non-Ethernet I/O devices), including on-board I/O devices and
234 add-in I/O devices installed through expansion slots.

235 iii. The Additional I/O Device allowance shall be calculated based upon the rated link speed of
236 a single connection, rounded to the nearest Gbit. I/O devices with less than 1 Gbit speed
237 do not qualify for the Additional I/O Device allowance.

238   iv.   The Additional I/O Device allowance shall only be applied for I/O devices that are
239   active/enabled upon shipment, and are capable of functioning when connected to an active
240   switch.

241   3.4.2   <u>Dual-node Servers</u>: For dual-node servers with one or two sockets per node, measured Idle State
242   power on a per-node basis shall be less than or equal to the Maximum Idle State Power
243   Requirement (P_{IDLE_MAX}), as calculated per Equation 1.

244   i.   If both nodes in the system are identical in configuration and use identical components, Idle
245   State power per node shall be calculated by measuring the Idle State power of the entire
246   system (including both server nodes) and dividing by two.

247   ii.   Idle power for each node and the Full Idle power of the entire system (including both server
248   nodes) shall be measured and reported on the Power and Performance Data Sheet per the
249   requirements in Section 3.5 of this specification.

250   3.4.3   <u>3S and 4S Servers</u>: Idle State power requirements are not applicable to three-socket (3S) and
251   four-socket (4S) computer servers. However, both Idle State and Full Load power for these
252   products shall be measured per the ENERGY STAR Test Method and reported on the Power and
253   Performance Data Sheet.

254   **3.5   Standard Information Reporting Requirements**

255   3.5.1   Detailed information about OS, software, and power management settings used for ENERGY
256   STAR qualification shall be included in printed and electronic product literature.

257   3.5.2   A standardized Version 1.0 <u>Power and Performance Data Sheet</u> (PPDS) shall be completed for
258   each ENERGY STAR qualified Computer Server and posted with other product configuration
259   information on the Partner's website. Partners are encouraged to provide one data sheet per
260   qualified configuration, but may also provide one data sheet per Product Family (as defined in
261   Section 1) with data on the power and performance in Maximum, Minimum and Typical
262   configurations.

263   3.5.3   If one PPDS is used to represent a Product Family, Partners are encouraged to provide a link to a
264   more detailed power calculator where information on the power consumption of specific system
265   configurations can be found.

266   3.5.4   Templates for the PPDS can be found on the ENERGY STAR Web page for Computer Servers at
267   www.energystar.gov/products. Partners are encouraged to use the template provided by EPA, but
268   may also create their own template provided that it has been approved by EPA and contains the
269   following information, at a minimum:

270   i.   Model name and number, identifying SKU and/or configuration ID;

271   ii.   System characteristics (form factor, available sockets/slots, power specifications, etc.);

272   iii.   System configuration(s) (including maximum, minimum and typical configurations for
273   product family qualification);

274   iv.   Power data for Idle State and Full Load, estimated energy consumption in kWh/year, link to
275   power calculator (where available);

276   v.   Additional power and performance data for at least one benchmark chosen by the Partner;

277   vi.   Available and enabled power saving features (e.g., power management);

278   vii.   Information on the power measurement and reporting capabilities of the Computer Server;

279   viii.   Select thermal information from the ASHRAE thermal report; and

280   ix.   A list of additional qualified SKUs or configuration IDs, along with specific configuration
281   information (for Product Family qualification only).

3.6   Data Measurement and Output Requirements

282

283   3.6.1   <u>Data Elements</u>: One-socket and two-socket (1S and 2S) Managed Servers and all Computer
284   Servers with greater than two sockets (3S and 4S) shall be capable of measuring and reporting
285   the following data elements:

286   i.   <u>Input Power</u>, in watts, with recommended accuracy at the system level of ± 10%, with a
287   cutoff of ± 10 watts (i.e., accuracy is not required to be better than ±10 W).

288   ii.   <u>Inlet Air Temperature</u>, in degrees Celsius, with accuracy of ± 3°C.

289   iii.   <u>Estimated Processor Utilization</u>, for each logical CPU that is visible to the OS. This data
290   shall be reported to the operator or user of the computer server through the operating
291   environment (OS or hypervisor).

292   3.6.2   <u>Reporting Implementation</u>:

293   i.   Data shall be made available in a published or user-accessible format that is readable by
294   third-party, non-proprietary management systems;

295   ii.   Data shall be made available to end users and third-party management systems over a
296   standard network connection;

297   iii.   Data shall be made available via embedded components or add-in devices that are
298   packaged with the Computer Server (e.g., a service processor, embedded power or thermal
299   meter or other out-of-band technology, or pre-installed OS);

300   iv.   Products shipped with a pre-installed OS shall include all necessary drivers and software
301   installed to make this information openly available. Products that do not include a pre-
302   installed OS shall be packaged with printed documentation of methods to access registers
303   that contain relevant sensor information;

304   v.   When an open and universally available data collection and reporting standard becomes
305   available, manufacturers should incorporate the universal standard into their products.

306   3.6.3   <u>Sampling Requirements</u>: Data shall be averaged on either a rolling basis or over a manufacturer
307   specified time period. A default rolling average or time period of 30 seconds is recommended.

308   3.6.4   <u>Documentation Requirements</u>: The following information shall be included on the Power and
309   Performance Data Sheet:

310   i.   Guaranteed accuracy levels for power and temperature measurements, and

311   ii.   The time period used for data averaging.

312 **3.7 Additional Requirements**

313 3.7.1 <u>Energy Efficient Ethernet</u>: EPA plans to investigate the use of the Energy Efficient Ethernet (IEEE
314 802.3az) standard for all external physical layer Ethernet (e.g., 1 Gbit and 10 Gbit wired Ethernet)
315 following its ultimate approval by IEEE. More information on the developing standard can be found
316 at http://grouper.ieee.org/groups/802/3/az/.

317 **4   TESTING**

318 **4.1   Test Methods**

319 4.1.1   When testing Computer Server products, the test methods identified in Table 5 shall be used to
320   determine ENERGY STAR qualification.

321   **Table 5: Test Methods for ENERGY STAR Qualification**

Product Type	Test Method
All Products	ENERGY STAR Test Method for Computer Servers, Rev. Aug-2010 (Idle Testing as outlined in Section 4.B for Idle power requirements of Single- and Dual-socket Computer Servers, and for Idle power and full load power reporting of all Computer Servers on the Power and Performance Data Sheet)
All Products with an Internal Power Supply	EPRI Generalized Internal Power Supply Efficiency Test Protocol, Rev. 6.4.2 (available at www.efficientpowersupplies.org)

322 **4.2   Number of Units Required for Testing**

323 4.2.1   Representative Models shall be selected for testing per the following requirements:

324   i.   For qualification of an individual product model, a product configuration equivalent to that
325   which is intended to be marketed and labeled as ENERGY STAR is considered the
326   Representative Model;

327   ii.   For qualification of a product family, both the Maximum and Minimum Configurations that
328   are intended to be marketed and labeled as ENERGY STAR are considered
329   Representative Models. Both the Maximum and Minimum Configuration Representative
330   Models shall be configured for testing with (1) memory module(s) of the maximum available
331   density (GB/module) and (2) hard drive(s) of the maximum available capacity (GB) options.

332 4.2.2   A single unit of each Representative Model shall be selected for testing.

333 4.2.3   All tested units shall meet ENERGY STAR qualification requirements.

334 **4.3   Input Power Guidelines**

335 4.3.1   Products shall be tested for qualification at the input voltage/frequency combinations specified in
336   the ENERGY STAR Test Method for Computer Servers.

337 4.3.2 Ac-powered products with multi-output PSUs shall be tested for qualification at all relevant input
338 voltage/frequency combinations for each market in which the unit is capable of operation.

339 4.3.3 Products intended to be sold into Japan may optionally be tested at Japanese input
340 voltage/frequency for Idle and Full Load testing.

4.4 Power Supply Testing

342 4.4.1 PSUs shall be tested using the input test conditions specified in Table 6, and as specified in the
343 ENERGY STAR Test Method for Computer Servers.

344 i. Ac-dc multi-output PSUs capable of operating with both 230V and 115V input shall be
345 tested at both input voltages.

346 ii. Ac-dc multi-output PSUs capable of operating with only one of these indicated voltages
347 shall be tested only at the applicable voltage.

348 iii. Testing with 230V input may be conducted with input frequency of either 50Hz or 60Hz.

349 **Table 6: Input Conditions for Power Supply Efficiency Testing**

350

Power Supply Type	Input Test Conditions
Ac-Dc Single-output	230 Volts, 50Hz or 60 Hz
Ac-Dc Multi-output	115 Volts, 60 Hz and/or 230 Volts, 50Hz or 60Hz
Dc-Dc	+53 Volts DC or -53 Volts DC

351 iv. 10% Load Condition: Single-output PSUs shall be tested at 10% load conditions, in addition
352 to the 20%, 50% and 100% load conditions specified in the ENERGY STAR Test Method
353 for Computer Servers.

354 v. Fan Power: Fan power may be excluded from measurements and/or efficiency calculations
355 for single-output PSUs. Fan power shall be included in measurements and efficiency
356 calculations for multi-output PSUs.

357 vi. Efficiency and Power Factor Reporting: PSU efficiency test results shall be reported to the
358 first decimal place (e.g. 85.2%). PSU power factor test results shall be reported to three
359 decimal points (e.g., 0.816).

5 USER INTERFACE

361 5.1.1 Manufacturers are encouraged to design products in accordance with the user interface standard
362 IEEE P1621: Standard for User Interface Elements in Power Control of Electronic Devices
363 Employed in Office/Consumer Environments. For details, see http://eetd.LBL.gov/Controls.

364 **6 EFFECTIVE DATE**

365 6.1.1 <u>Effective Date</u>: The Version 1.1 ENERGY STAR Computer Server specification shall take effect
366   on the dates specified in Table 7. To qualify for ENERGY STAR, a product model shall meet the
367   ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is
368   specific to each unit and is the date (e.g., month and year) on which a unit is considered to be
369   completely assembled.

370 6.1.2 <u>Future Specification Revisions</u>: EPA reserves the right to change this specification should
371   technological and/or market changes affect its usefulness to consumers, industry, or the
372   environment. In keeping with current policy, revisions to the specification are arrived at through
373   stakeholder discussions. In the event of a specification revision, please note that the ENERGY
374   STAR qualification is not automatically granted for the life of a product model.

375 **Table 7: Specification Effective Dates**

Effective Date
May 15, 2009

APPENDIX A:
Sample Calculations

Idle State Power Requirements

To determine Maximum Idle State Power Requirement for ENERGY STAR qualification, determine the base Idle level from Table 3, then add power allowances from Table 4. An example is provided below:

EXAMPLE: A standard single processor Computer Server with 8 GB of memory, two hard drives, and two I/O devices (the first with two 1 Gbit ports and the second with six 1 Gbit ports).

1. Base allowance:
   a. Determine base idle allowance from Table 3.
   b. The example server is evaluated under Category A and could consume no more than 55.0 watts in Idle to qualify for ENERGY STAR.

Category	Number of Installed Processors (# P)	Managed Server	Base Idle Power Allowance (W)
A	1	No	55.0
B	1	Yes	65.0
C	2	No	100.0
D	2	Yes	150.0

2. Additional Idle Power Allowances: Calculate additional idle allowances for extra components from Table 4.

System Characteristic	Applies To	Additional Idle Power Allowance
Additional Power Supplies	Power supplies installed explicitly for power redundancy[a]	20.0 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**Error! Reference source not found.**	2.0 watts per GB
Additional I/O Devices (single connection speed rounded to nearest Gbit)	Installed Devices greater than two ports of 1 Gbit, onboard Ethernet[ii]	< 1 Gbit: 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

   a. The example server has one hard drive in excess of the base configuration. It therefore is provided with an additional 8.0 watt allowance for the hard drive (1 HDD x 8.0 watts).
   b. The example server has 4 GB in excess of the base configuration. It therefore is provided with an additional 8.0 watt allowance for memory (4 extra GB x 2.0 watts/GB).

399　　　　　　　c.　The example server has one I/O card that does not qualify for an adder: the first device
400　　　　　　　　　 has only two Ethernet ports and does not exceed the two-port threshold. Its second
401　　　　　　　　　 device does qualify for an adder: the server is provided with an additional 12.0 watt
402　　　　　　　　　 allowance for the device (6 Gbit ports x 2.0 watts/active port).
403
404　　　3.　Calculate the final Idle allowance by adding the base allowance with the additional power
405　　　　　 allowances. The example system would be expected to consume no more than 83.0 watts at Idle
406　　　　　 to qualify (55.0 W + 8.0 W + 8.0 W + 12.0 W).

Additional Idle Allowance - Power Supplies

The following examples illustrate the idle power allowances for additional power supplies:

　　A.　If a Computer Server requires two power supplies to operate, and the configuration includes three
　　　　 installed power supplies, the server would receive an additional 20.0 watt Idle power allowance.

　　B.　If the same server were instead shipped with four installed power supplies, it would receive an
　　　　 additional Idle power allowance of 40.0 watts.

1 OVERVIEW

The following test method shall be used for determining compliance with requirements in the ENERGY STAR Eligibility Criteria for Computer Servers, and when acquiring test data for reporting of Full Load power on the ENERGY STAR Power and Performance Data Sheet.

2 APPLICABILITY

The following test method is applicable to all products eligible for qualification under the ENERGY STAR Eligibility Criteria for Computer Servers.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions contained in the ENERGY STAR Eligibility Criteria for Computer Servers.

4 TEST SETUP

A) <u>Test Setup and Instrumentation</u>: Test setup and instrumentation for all portions of this procedure shall be in accordance with the requirements of IEC 62301, Ed. 1.0, "Measurement of Household Appliance Standby Power", Section 4, "General Conditions for Measurements", unless otherwise noted in this document. In the event of conflicting requirements, the ENERGY STAR test method shall take precedence.

B) <u>Input Power</u>: Input power shall be as specified in Table 1.

19
20

Table 1: Input Power Requirements for Computer Servers with Single-Output or Dc-Dc Power Supplies

Product Type	Supply Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
Servers with Ac-Dc Single-Output PSUs	230 Vac	+/- 1.0 %	2.0 % (for products which are rated for ≤ 1.5 kW maximum Power) or 5.0 % (for products which are rated for > 1.5 kW maximum Power)	50 Hz or 60 Hz	+/- 1.0 %
Servers with Ac-Dc Multi-Output PSUs1	230 Vac and/or 115 Vac	+/- 1.0 %		@ 230 Vac: 50 Hz or 60 Hz @ 115 Vac: 60 Hz	+/- 1.0 %
Optional Testing Conditions For Ac-Dc Japanese Market	100 Vac	+/- 1.0 %		50 Hz or 60 Hz	+/- 1.0 %
Dc Servers	+/- 53 Vdc	+/- 1.0 V		N/A	N/A

21

22 C) <u>Ambient Temperature</u>: Ambient temperature shall be from 18 ^{o}C to 27 ^{o}C.

23 D) <u>Relative Humidity</u>:

24   1) *Low-End Moisture*: 5.5 °C Dew Point

25   2) *High-End Moisture*: 60% Relative Humidity, 15 °C Dew Point.

26 E) <u>Power Meter</u>: Power meters shall possess the following attributes:

27   1) <u>Crest Factor</u>: Capability to measure the current waveform without clipping.

28
29   a) The peak of the current waveform measured during On Mode shall determine the crest factor rating requirement and the appropriate current range setting.

30
31   b) The full-scale value of the selected current range multiplied by the crest factor for that range shall be at least 15% greater than the peak current.

32
33
34   2) <u>Bandwidth</u>: Minimum bandwidth as determined by an analysis of current and voltage to determine the highest frequency component (harmonic) with a magnitude greater than 1% of the fundamental frequency under the test conditions.

35   3) <u>Minimum Frequency Response</u>: 3.0 kHz

36   4) <u>Minimum Sampling Frequency</u>: 60 Hz

37

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1 Computer Servers with Multi-Output PSUs must be tested in <u>all</u> applicable conditions (e.g., 115 Vac and/or 230 Vac) at which the unit is capable of operating.

38   5) <u>Minimum Resolution</u>:

39   a) 0.01 W for measurement values less than 10 W;

40   b) 0.1 W for measurement values from 10 W to 100 W; and

41   c) 1.0 W for measurement values greater than 100 W.

42 F) <u>Measurement Accuracy</u>:

43   1) Power measurements with a value greater than or equal to 0.5 W shall be made with an
44   uncertainty of less than or equal to 2% at the 95% confidence level.

45   2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less than
46   or equal to 0.01 W at the 95% confidence level.

5   TEST CONDUCT

48 A) <u>Measurement Location</u>: All power measurements shall be taken at a point between the ac or dc power
49   source and the unit under test (UUT). No UPS units may be connected between the power meter and
50   the UUT. The power meter shall remain in place until all Idle and full load power data is fully recorded.

51 B) <u>UUTs with Multiple Power Supplies</u>: All power supplies must be connected to the ac or dc power
52   source and operational during the test. If necessary, a Power Distribution Unit (PDU) may be used to
53   connect multiple power supplies to a single source. If a PDU is used, any overhead electrical use from
54   the PDU shall be included in the measurement of Idle power for the UUT.

55 C) <u>As-shipped Condition</u>: Products shall be tested in their "as-shipped" configuration, which includes both
56   hardware configuration and system settings, unless otherwise specified in this test method. Where
57   relevant, all options and software shall be set to their default condition.

58 D) <u>Power Management and Operating System</u>: The as-shipped operating system or a representative
59   operating system must be installed. Products that are shipped without operating systems must be
60   tested with a representative OS installed. For all tests, manufacturers must ensure that only the power
61   management techniques and/or power saving features which are enabled on shipment are those
62   enabled on systems under test. Any power management features which require the presence of an
63   operating system (i.e. those that are not explicitly controlled by the BIOS or management controller)
64   must be tested using only those power management features enabled by the operating system by
65   default.

66 E) <u>Storage (HDD, SSD)</u>: Products that do not include pre-installed hard drives (HDD or SSD) must have
67   an identical hardware and software configuration as a product that was tested and qualified with at
68   least one installed hard drive.

69 F) <u>Network Connection</u>: The UUT must have at least one port connected to an Ethernet network switch
70   capable of the UUT's highest and lowest network speeds. The network connection must be live during
71   all tests, and although the link must be ready and able to transmit packets, no specific traffic is
72   required over the connection during testing.

73 G) <u>Dual-Node Servers</u>: The UUT must have identical configurations for each node including all hardware
74   components and software/power management settings. These systems must also be measured in a
75   way to ensure that all power from both nodes is being captured by the power meter during the entire
76   test.

6   PRE-TEST UUT INITIALIZATION

78   A)   Prior to the start of testing, the UUT shall be initialized as follows:

79   1)   Record the UUT manufacturer, model name, and configuration details, including; operating
80   system name and version, processor type and speed, installed power supplies, physical memory,
81   hard drive configuration, installed I/O devices, power management features enabled, etc.

82   2)   Connect the UUT to a live Ethernet (IEEE 802.3) network switch. The live connection must be
83   maintained for the duration of testing, except for brief lapses necessary for transitioning between
84   link speeds. If a controller system is required to provide workload harness control, data
85   acquisition, or other UUT testing support, the controller system shall be connected to the same
86   network switch as the UUT and satisfy all other UUT network requirements.

87   3)   Connect the power meter to the input power source.

88   4)   Connect the UUT to the power outlet on the power meter.

89   5)   Power on the UUT and perform initial system configuration, as applicable.

90   6)   Verify that the UUT is configured in its as–shipped configuration. Maintain configuration and tuning
91   parameters throughout the testing process for both full load power and Idle power.

92   7)   Install the benchmark software intended for use to acquire power at full load. This benchmark
93   shall be run when testing for full load power in Section 7, below, and shall not significantly impact
94   the power levels during the Idle power measurement (e.g. automated benchmark software may
95   automate a system Idle state, but this simulated Idle state must be functionally equivalent to the
96   Idle state achieved in step 7.1.6), below). The UUT shall be configured to boot from the primary
97   internal boot device (hard disk drive or solid state drive).

98   8)   Configure primary storage devices integral to the UUT so they are not power managed ("spun-
99   down") during Idle testing unless they contain non-volatile cache memory integral to the drive (e.g.
100   "hybrid" hard drives). If more than one internal hard drive is installed as-shipped, the non-primary
101   hard drive(s) shall be tested with hard drive power management enabled as shipped.

102 9)   Record the installed benchmark workload and configuration, including any custom parameters or
103   settings.

104 10) Verify that only those system and hard drive power management features that are enabled upon
105   shipment to a customer are enabled for testing.

106 11) Measure and record the ac input voltage and frequency or dc input voltage.

107 12) Measure and record the test room ambient temperature.

108 13) Shut down the UUT.

109

7 TEST PROCEDURES FOR ALL PRODUCTS

7.1 Measuring Full Load and Idle Power

1) Power up the UUT. Dual-Node Servers shall be booted and logged on concurrently.

2) Once logged in with the operating system fully loaded and ready, close any open windows so that the standard operational desktop screen or equivalent ready screen is displayed.

3) Begin recording elapsed time immediately after completing any log in activity necessary to fully boot the system.

4) Between 5 and 15 minutes after the initial boot or log in, set the power meter to begin accumulating power values at an interval of greater than or equal to 1 reading per second and commence benchmark operation at the greatest possible output (e.g., 100% load). For benchmarks that measure multiple load points, only the greatest load point should be measured.

5) At the end of benchmark operation, calculate and record the average (arithmetic mean) power observed during benchmark operation at maximum load.

6) Between 5 and 15 minutes after the full load benchmark test has been completed, accumulate Idle power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period. The UUT must maintain an Idle state throughout this period and must not enter lower power states with limited availability (e.g., computer sleep or hibernate states).