ENERGY STAR® Program Requirements Product Specification for Computer Servers

Draft 3 Test Method
Rev. Aug-2012

1 OVERVIEW

The following test method shall be used for determining compliance with requirements in the ENERGY STAR Product Specification 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 Product Specification for Computer Servers.

3 DEFINITIONS

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

4 TEST SETUP

A) <u>Input Power:</u> Input power shall be as specified in Table 1 and Table 2. The frequency for input power shall be as specified in Table 3.

Table 1: Input Power Requirements for Products with Nameplate Rated Power Less Than or Equal to 1500 W

Product Type	Supply Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion
Servers with Ac-Dc Single-Output Power Supply Units (PSUs)	230 V ac	+/- 1.0 %	2.0 %
Servers with Ac-Dc Multi-Output PSUs	230 V ac and/or 115 V ac		
Optional Testing Conditions For Ac-Dc Japanese Market	100 V ac		

16 **Table 2: Input Power Requirements for Products with Nameplate Rated Power Greater Than**
17 **1500 W**

Product Type	Supply Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion
Servers with Ac-Dc Single-Output PSUs	230 V ac		
Servers with Ac-Dc Multi-Output PSUs	230 V ac and/or 115 V ac	+/- 4.0 %	5.0 %
Optional Testing Conditions For Ac-Dc Japanese Market	100 V ac		

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Note: DOE has removed dc Server Input Power Requirements from Table 1 and Table 2 since dc Server testing is not currently available with SERT.

In addition, DOE requests stakeholder feedback on incorporating testing for Servers that operate on three phase power, prior to the finalization of Version 2.0, specifically, information on operating voltage and power range for three phase powered servers.

19 **Table 3: Input Frequency Requirements for All Products**

Supply Voltage	Frequency	Frequency Tolerance
100 V ac	50 Hz	
115 V ac	60 Hz	±1.0%
230 V ac	50 Hz or 60 Hz	

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21 B) <u>Ambient Temperature</u>: Ambient temperature shall be no less than 18 °C and no greater than 28 °C
22   over the duration of the test.

23 C) <u>Relative Humidity</u>: Relative humidity shall be within 15% and 80%.

24　D)　Power Meter: The power meter shall report true Root Mean Square (RMS) power and at least two of
25　　　the following measurement units: voltage, current and power factor. Power meters shall possess the
26　　　following attributes:

27　　1)　Calibration: The meter shall have been calibrated within a year of the test date, by a standard
28　　　　traceable to National Institute of Science and Technology (USA) or a counterpart national
29　　　　metrology institute in other countries.

30　　2)　Crest Factor: An available current crest factor of 3 or more at its rated range value. For analyzers
31　　　　that do not specify the current crest factor, the analyzer must be capable of measuring an
32　　　　amperage spike of at least 3 times the maximum amperage measured during any 1 second
33　　　　sample.

34　　3)　Minimum Frequency Response: 3.0 kHz.

35　　4)　Minimum Resolution:

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

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

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

39　　5)　Logging: The reading rate supported by the meter shall be at least 1 set of measurements per
40　　　　second, where set is defined as a power measurement, in watts. The data averaging interval of
41　　　　the analyzer shall equal the reading interval. Data averaging interval is defined as the time period
42　　　　over which all samples captured by the high-speed sampling electronics of the analyzer are
43　　　　averaged to provide the measurement set.

44　　6)　Measurement Accuracy: Measurement uncertainty as introduced by the instrument that measures
45　　　　the input power to the product under test, including any external shunts.

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

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

50　E)　Temperature Sensor: The temperature sensor shall possess the following attributes:

51　　1)　Logging: The sensor shall have a minimum reading rate of 4 samples per minute.

52　　2)　Measurement Accuracy: Temperature must be measured no more than 50mm in front of (upwind
53　　　　of) the main airflow inlet of the UUT and reported by the sensor with an overall accuracy of
54　　　　± 0.5 °C or better.

5 TEST CONDUCT

5.1 Active Mode Efficiency Test Configuration

Power and efficiency must be tested and reported for the computer servers being tested. Testing shall be conducted as follows:

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

B) <u>Measurement Location</u>: All power measurements shall be taken at a point between the ac power source and the unit under test (UUT). No Uninterruptible Power Supply (UPS) units may be connected between the power meter and the UUT. The power meter shall remain in place until all Idle and full load power data are fully recorded.

C) Purposefully directing air flow in the vicinity of the measured equipment in a way that would be inconsistent with normal data center practices is not allowed.

D) <u>Power Supplies</u>: All power supply units (PSUs) must be connected and operational.

   1) <u>UUTs with Multiple PSUs</u>: All power supplies must be connected to the ac power source and operational during the test. If necessary, a Power Distribution Unit (PDU) may be used to connect multiple power supplies to a single source. If a PDU is used, any overhead electrical use from the PDU shall be included in the power measurement of the UUT. When testing blade servers with half-populated chassis configurations, the power supplies for the unpopulated power domains can be disconnected.

E) <u>Power Management and Operating System</u>: The as-shipped operating system or a representative operating system must be installed. Products that are shipped without operating systems must be tested with any compatible operating system installed. For all tests, manufacturers must ensure that only the power management techniques and/or power saving features which are enabled on shipment are those enabled on the UUT. Any power management features which require the presence of an operating system (i.e. those that are not explicitly controlled by the Basic Input Output System (BIOS) or management controller) must be tested using only those power management features enabled by the operating system by default.

F) <u>Storage</u>: Products shall be tested for qualification with at least one Hard Disk Drive (HDD) or one Solid State Drive (SSD) installed. Products that do not include pre-installed hard drives (HDD or SSD) must be tested using a configuration that is identical in all respects with the exception of at least one installed hard drive available for sale with the product. Products that do not support installation of hard drives (HDD or SDD) and instead rely exclusively on external storage solutions (e.g. storage area network) shall be tested using external storage solutions.

G) <u>Blade and Dual/Multi-Node Servers</u>: A Blade or Dual/Multi-Node Server must have identical configurations for each node or blade including all hardware components and software/power

91   management settings. These systems must also be measured in a way to ensure that all power from
92   all tested nodes/blades is being captured by the power meter during the entire test.

93   H) <u>Blade Chassis</u>: The blade chassis, at a minimum, shall have power, cooling and networking
94   capabilities for all the blade servers. The chassis shall be populated as specified in section 5.2 C). All
95   power measurements for blades shall be made at the input of the chassis.

96   I) <u>BIOS and UUT System Settings</u>: All BIOS settings shall remain as-shipped unless otherwise
97   specified in the test method.

98   J) <u>I/O and Network Connection</u>: The UUT must have at least one port connected to an Ethernet network
99   switch. The switch shall be capable of supporting the UUT's highest and lowest rated network
100   speeds. The network connection must be live during all tests, and, although the link must be ready
101   and able to transmit packets, no specific traffic is required over the connection during testing. The
102   UUT shall be set up with minimal I/O add-in cards; for testing, ensure the server offers at least one
103   Ethernet port (using a single add-in card only if no onboard Ethernet support is offered).

104   1) <u>Ethernet Connections</u>: Products shipped with support for Energy Efficient Ethernet (compliant
105   with IEEE 802.3az) shall be connected only to Energy Efficient Ethernet compliant network
106   equipment during testing. Appropriate measures shall be taken to enable EEE features on both
107   ends of the network link during all tests.

108   **5.2 UUT Preparation**

109   Computer Server power and efficiency must be determined and reported under the following conditions:

110   A) Record the UUT manufacturer, model name, and configuration details, including, but not limited to:
111   operating system name and version, processor type and speed, installed power supplies, physical
112   memory, hard drive configuration, installed I/O devices, power management features enabled.
113   Record nameplate power ratings.

114   1) When testing a blade server, also record the blade chassis model.

115   *Note: For qualification, the ENERGY STAR Specification requires that the UUT be tested with all*
116   *available processor sockets populated.*

117   B) Install the UUT in a test rack or location. The UUT shall not be physically moved until testing is
118   complete.

119   C) If the UUT is a blade system, the UUT shall be tested for per blade power consumption in the half
120   chassis configuration with an additional option of testing the UUT in the full chassis configuration. For
121   blade systems, populate the chassis as follows:

> **Note:** Due to high cost burden and stakeholder feedback, DOE has made full blade chassis testing
> optional. As such, DOE has modified the language to specify that per blade power values shall be tested
> and reported in the half chassis configuration.

122   1) All blade servers installed in the chassis must be identical, sharing the same configuration
123   (homogeneous).

124   2) Full Chassis Population (Optional)

125   a) Populate all available chassis bays. All power supplies and cooling fans shall be connected.
126   Proceed with all required tests in the test procedure.

127   3) Half Chassis Population (Required)

128   a) Populate half of the available chassis bays.

129   b) Follow all user manual recommendations for partially populating the chassis, which may
130   include disconnecting some of the power supplies and cooling fans for the unpopulated
131   power domains.

132   c) If user manual recommendations are not available or are incomplete, then use the following
133   guidance:

134   i.   When loading blades, completely populate one power domain of the chassis at a time.

135   ii.   For partially-populated power domains, place the blades from the center outward.

136   iii. If possible, disconnect the power supplies and cooling fans for the unpopulated power
137   domain. Do not remove any power supplies or cooling fans used for chassis functions or
138   redundancy for a populated power domain.

139   iv.   Fill all empty bays with blanking panels or an equivalent airflow restriction for the duration
140   of testing.

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

146   E) Connect the power meter to an ac voltage source set to the appropriate voltage and frequency for the
147   test as specified in Section 4 of this test method.

148   F) Plug the UUT into the measurement power outlet on the power meter, using the following guidelines:

149   1) No UPS units shall be connected between the power meter and the UUT;

150   2) The power meter shall remain connected until all testing is complete;

151   3) When testing a blade system, power shall be measured at the input of the blade chassis (i.e., at
152   the power supplies that convert data center distribution power to chassis distribution power);

153   4) If a controller system is being used, connect the data output interface of the power meter to the
154   appropriate input of the controller system.

155   G) Verify that the UUT is configured in its as–shipped configuration.

156   H)   Install manufacturer specified workload software on the UUT. Record the installed workload and
157   configuration, including any custom parameters or settings.

158   I)   Record the input voltage and frequency.

6   TEST PROCEDURES FOR ALL PRODUCTS

6.1   Power and Efficiency Testing

161   A)   Power on the UUT, either by switching it on or connecting it to mains power.

162   B)   If necessary, power on the controller system.

163   C)   Begin recording elapsed time.

164   D)   Between 5 and 15 minutes after the completion of initial boot or log in, set the power meter to begin
165   accumulating power values at an interval of greater than or equal to 1 reading per second.

166   1)   When testing using a controller system, the controller system may automate data accumulation
167   and benchmark workload operation provided the measurement interval requirements are met.

168   E)   Idle power measurement can be performed one of two ways:

169   1)   Automatic idle measurement: The workload automates the measurement of Idle power.

170   2)   Manual idle measurement: Accumulate Idle power values for 5 minutes before engaging the
171   workload. The UUT must maintain an Idle state throughout this period and must not enter lower
172   power states with limited functionality (e.g., server sleep or hibernate states).

> **Note:** DOE received a stakeholder comment that memory scrubbing, a maintenance function on
> Computer Servers, is triggered on regular intervals during idle mode operating periods. The initiation of a
> memory scrubbing cycle results in an increase in the server's idle mode power consumption as a result of
> moving the server out of idle state into an active state of operation.
>
> DOE is looking for additional feedback from stakeholders on memory scrubbing and any other
> maintenance cycles initiated during idle mode operation and their effects on idle mode power
> consumption of servers. Specifically, DOE is requesting feedback on the duration, the frequency, and
> data showing the difference in power consumption values of these types of maintenance cycles.

173   F)   Engage workload operation.

174   G)   Record the following data at the end of workload operation:

175   1)   Average Idle power (arithmetic mean) during the automated Idle state period; or

176   2)   Average Idle power (arithmetic mean) during the 5 minute test period.

177   H)   Record On Mode power averaged over the workload duration. If the workload is composed of
178   different worklets stressing different functionalities, then the average power for each worklet shall be
179   reported.

180   I)   When testing a Blade System, proceed as follows to derive single blade power:

181   1) Divide the measured total power by the number of blades installed during the test;

182   2) Record the per-blade power values for each measurement and the measured total power.