



ENERGY STAR® Program Requirements Product Specification for Computer Servers

Draft Test Method Version 3.0

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 Idle State power and Active State power for certification purposes.

Note: DOE and EPA have removed the reference to the Power and Performance Data Sheet (PPDS) as that document no longer exists. Data is now submitted to EPA through the Qualified Product Exchange (QPX) process.

2 APPLICABILITY

The following test method is applicable to all products eligible for certification 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) Input Power: 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 watts (W)

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

Product Type	Supply Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion
Three-phase Servers (North American Market)	208 V ac		
Three-phase Servers (Europe Market)	400 V ac		

19
20

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

Product Type	Supply Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion
Servers with ac-dc Single-Output PSUs	230 V ac or 115 V ac*	+/- 4.0 %	5.0 %
Servers with ac-dc Multi-Output PSUs	230 V ac or 115 V ac*		
Optional Testing Conditions For ac-dc (Japanese Market)	100 V ac		
Three-phase Servers (North American Market)	208 V ac		
Three-phase Servers (Europe Market)	400 V ac		

21

Table 3: Input Frequency Requirements for All Products

Supply Voltage	Frequency	Frequency Tolerance
100 V ac	50 hertz (Hz) or 60 Hz	±1.0%
115 V ac	60 Hz	
230 V ac	50 Hz or 60 Hz	
Three-phase (North American Market)	60 Hz	
Three-phase (Europe Market)	50 Hz	

22

* Note: 230 V ac refers to the European market and 115 V ac refers to the North American market

- 23
- 24 B) Ambient Temperature: Ambient temperature shall be within 25 ± 5 °C.
- 25 C) Relative Humidity: Relative humidity shall be within 15% and 80%.
- 26 D) Power Analyzer: The power analyzer shall report true Root Mean Square (RMS) power and at least
27 two of the following measurement units: voltage, current, and power factor. Power analyzers shall
28 possess the following attributes:
- 29 1) Compliance: The power analyzer shall be chosen from the list of power measuring devices
30 specified in the most current¹ Server Efficiency Rating Tool (SERT)^{TM 2} Design Document³.
- 31 2) Calibration: The analyzer shall have been calibrated within a year of the test date, by a standard
32 traceable to the National Institute of Science and Technology (USA) or a counterpart national
33 metrology institute in other countries.
- 34 3) Crest Factor: An available current crest factor of 3 or more at its rated range value. For analyzers
35 that do not specify the current crest factor, the analyzer must be capable of measuring an
36 amperage spike of at least 3 times the maximum amperage measured during any 1 second
37 sample.
- 38 4) Minimum Frequency Response: 3.0 kHz.
- 39 5) Minimum Resolution:
- 40 a) 0.01 W for measurement values less than 10 W;
- 41 b) 0.1 W for measurement values from 10 W to 100 W; and
- 42 c) 1.0 W for measurement values greater than 100 W.
- 43 6) Logging: The reading rate supported by the analyzer shall be at least 1 set of measurements per
44 second, where set is defined as a power measurement, in watts. The data averaging interval of
45 the analyzer shall equal the reading interval. Data averaging interval is defined as the time period
46 over which all samples captured by the high-speed sampling electronics of the analyzer are
47 averaged to provide the measurement set.
- 48 7) Measurement Accuracy: Power measurements shall be reported by the analyzer with an overall
49 accuracy of 1% or better for all measured power values.
- 50 E) Temperature Sensor: The temperature sensor shall possess the following attributes:
- 51 1) Compliance: The temperature sensor shall be chosen from the list of temperature measuring
52 devices specified in the most current¹ SERT Design Document³.
- 53 2) Logging: The sensor shall have a minimum reading rate of 4 samples per minute.
- 54 3) Measurement Accuracy: Temperature must be measured no more than 50mm in front of (upwind
55 of) the main airflow inlet of the Unit Under Test (UUT) and reported by the sensor with an overall
56 accuracy of ± 0.5 °C or better.
- 57 F) Active State Test Tool: The most current¹ version of SERT, provided by Standard Performance
58 Evaluation Corporation (SPEC)⁴.
- 59 G) Controller System: The Controller System may be a Server, a desktop computer, or a laptop and shall
60 be used to record power and temperature data.

¹ For the purposes of this document, the most current SERT version is listed in the most recently published Servers 3.0 Clarification Memo, located on the Enterprise Servers Specification Version 3.0 website (https://www.energystar.gov/products/spec/enterprise_servers_specification_version_3_0_pd)

² <http://www.spec.org/sert/>

³ http://www.spec.org/sert/docs/SERT-Design_Document.pdf

⁴ <http://www.spec.org/>

61 1) The power analyzer and the temperature sensor shall be connected to the Controller System.

62 **Note:** DOE and EPA have updated the Version 2.1 references to Version 3.0 in the footnotes on page
63 3.

64

65 2) The Controller System and the UUT shall be connected to each other via an Ethernet network
66 switch.

67 H) General SERT Requirements: Any additional requirements specified in any SPEC, or the most
68 current¹ SERT supporting documents shall be followed, unless otherwise specified in this test
69 method. Supporting documents from SPEC include:

70 1) SPEC Power and Performance Methodology

71 2) SPEC Power Measurement Setup Guide

72 3) SPEC PTDaemon Design Document

73 4) SERT Design Document

74 5) SERT Run and Reporting Rules

75 6) SERT User Guide

76 7) SERT JVM Options

77 8) SERT Result File Fields

78 **5 TEST CONDUCT**

79 **5.1 Test Configuration**

80 Power and efficiency shall be tested and reported for the Computer Servers being tested. Testing shall be
81 conducted as follows:

82 A) As-shipped Condition: Products shall be tested in their “as-shipped” configuration, which includes
83 both hardware configuration and system settings, unless otherwise specified in this test method.
84 Where relevant, all software options shall be set to their default condition.

85 B) Measurement Location: All power measurements shall be taken at a point between the ac power
86 source and the UUT. No Uninterruptible Power Supply (UPS) units may be connected between the
87 power meter and the UUT. The power meter shall remain in place until all Idle and Active State power
88 data are fully recorded. When testing a Blade System, power shall be measured at the input of the
89 Blade Chassis (i.e., at the power supplies that convert data center distribution power to Chassis
90 distribution power).

91 C) Air Flow: Purposefully directing air in the vicinity of the measured equipment in a way that would be
92 inconsistent with normal data center practices is prohibited.

93 D) Power Supplies: All PSUs shall be connected and operational.

94 1) UUTs with Multiple PSUs: All power supplies shall be connected to the ac power source and
95 operational during the test. If necessary, a Power Distribution Unit (PDU) may be used to connect
96 multiple power supplies to a single source. If a PDU is used, any overhead electrical use from the
97 PDU shall be included in the power measurement of the UUT. When testing Blade Servers with
98 half-populated Chassis configurations, the power supplies for the unpopulated power domains
99 can be disconnected (see section 5.2.D)2) for more information).

- 100 E) Power Management and Operating System: The as-shipped operating system or a representative
101 operating system shall be installed. Products that are shipped without operating systems shall be
102 tested with any compatible operating system installed. For all tests, the power management
103 techniques and/or power saving features shall be left as-shipped. Any power management features
104 which require the presence of an operating system (i.e. those that are not explicitly controlled by the
105 Basic Input Output System (BIOS) or management controller) shall be tested using only those power
106 management features enabled by the operating system by default.
- 107 F) Storage: Products shall be tested for qualification with at least one Hard Disk Drive (HDD) or one
108 Solid State Drive (SSD) installed. Products that do not include pre-installed hard drives (HDD or SSD)
109 shall be tested using a storage configuration used in an identical model for sale that does include pre-
110 installed hard drives. Products that do not support installation of hard drives (HDD or SSD) and,
111 instead, rely exclusively on external storage solutions (e.g. storage area network) shall be tested
112 using external storage solutions.
- 113 G) Blade System and Dual/Multi-Node Servers: A Blade System or Dual/Multi-Node Server shall have
114 identical configurations for each node or Blade Server including all hardware components and
115 software/power management settings. These systems shall also be measured in a way that ensures
116 all power from all tested nodes/Blade Servers is captured by the power meter during the entire test.
- 117 H) Blade Chassis: The Blade Chassis, at a minimum, shall have power, cooling, and networking
118 capabilities for all the Blade Servers. The Chassis shall be populated as specified in section 5.2.D).
119 All power measurements for Blade Systems shall be made at the input of the Chassis.
- 120 I) BIOS and UUT System Settings: All BIOS settings shall remain as-shipped unless otherwise
121 specified in the test method.
- 122 J) Input/Output (I/O) and Network Connection: The UUT shall have at least one port connected to an
123 Ethernet network switch. The switch shall be capable of supporting the UUT's highest and lowest
124 rated network speeds. The network connection shall be live during all tests, and, although the link
125 shall be ready and able to transmit packets, no specific traffic is required over the connection during
126 testing. For the purpose of testing ensure the UUT offers at least one Ethernet port (using a single
127 add-in card only if no onboard Ethernet support is offered).
- 128 1) Ethernet Connections: Products shipped with support for Energy Efficient Ethernet (compliant
129 with IEEE 802.3az) shall be connected only to Energy Efficient Ethernet compliant network
130 equipment during testing. Appropriate measures shall be taken to enable EEE features on both
131 ends of the network link during all tests.

132 **5.2 UUT Preparation**

- 133 A) The UUT shall be tested with the processor sockets populated as specified in Section 6.1.2 of
134 ENERGY STAR Eligibility Criteria Version 3.0.
- 135 B) Install the UUT in a test rack or location. The UUT shall not be physically moved until testing is
136 complete.
- 137 C) If the UUT is a Multi-node system, the UUT shall be tested for per node power consumption in the
138 fully-populated Chassis configuration. All Multi-node Servers installed in the Chassis shall be
139 identical, sharing the same configuration.
- 140 D) If the UUT is a Blade System, the UUT shall be tested for Blade Server power consumption in the
141 half-populated Chassis configuration with an additional option of testing the UUT in the fully-
142 populated Chassis configuration. For Blade Systems, populate the Chassis as follows:

- 143 1) Individual Blade Server Configuration
- 144 a) All Blade Servers installed in the Chassis shall be identical, sharing the same configuration
- 145 (homogeneous).
- 146 2) Half Chassis Population (Required)
- 147 a) Calculate the number of Blade Servers required to populate half the number of Single-wide
- 148 Blade Server slots available in the Blade Chassis.
- 149 b) For Blade Chassis having multiple power domains, choose the number of power domains
- 150 that is closest to filling half of the Chassis. In a case where there are two choices that are
- 151 equally close to filling half of the Chassis, test with the domain or combination of domains
- 152 which utilize a higher number of Blade Servers.
- 153 *Example 1: A certain Blade Chassis supports up to 7 Single-wide Blade Servers on two*
- 154 *power domains. One power domain supports 3 Blade Servers and the other supports 4*
- 155 *Blade Servers. In this example, the power domain which supports 4 Blade Servers would*
- 156 *be fully populated during testing, while the other power domain would remain*
- 157 *unpopulated.*
- 158 *Example 2: A certain Blade Chassis supports up to 16 Single-wide Blade Servers on four*
- 159 *power domains. Each of the four power domains supports 4 Blade Servers. In this*
- 160 *example, two of the power domains would be fully populated during testing, while the*
- 161 *other two power domains would remain unpopulated.*
- 162 c) Follow all user manual or manufacturer recommendations for partially populating the Chassis,
- 163 which may include disconnecting some of the power supplies and cooling fans for the
- 164 unpopulated power domains.
- 165 d) If user manual recommendations are not available or are incomplete, then use the following
- 166 guidance:
- 167 i. Completely populate the power domains.
- 168 ii. If possible, disconnect the power supplies and cooling fans for unpopulated power
- 169 domains.
- 170 iii. Fill all empty bays with blanking panels or an equivalent airflow restriction for the duration
- 171 of testing.
- 172 3) Full Chassis Population (Optional)
- 173 a) Populate all available Chassis bays. All power supplies and cooling fans shall be connected.
- 174 Proceed with all required tests in the test procedure as specified in Section 6.
- 175 E) Connect the UUT to a live Ethernet (IEEE 802.3) network switch. The live connection shall be
- 176 maintained for the duration of testing, except for brief lapses necessary for transitioning between link
- 177 speeds.
- 178 F) The Controller System required to provide SERT workload harness control, data acquisition, or other
- 179 UUT testing support shall be connected to the same network switch as the UUT and satisfy all other
- 180 UUT network requirements. Both the UUT and Controller System shall be configured to communicate
- 181 via the network.
- 182 G) Connect the power meter to an ac voltage source set to the appropriate voltage and frequency for the
- 183 test, as specified in Section 4.

- 184 H) Plug the UUT into the measurement power outlet on the power meter following the guidelines in
185 5.1.B).
- 186 I) Connect the data output interface of the power meter and the temperature sensor to the appropriate
187 input of the Controller System.
- 188 J) Verify that the UUT is configured in its as-shipped configuration.
- 189 K) Verify that the Controller System and UUT are connected on the same internal network via an
190 Ethernet network switch.
- 191 L) Use a normal *ping* command to verify that the Controller System and UUT can communicate with
192 each other.
- 193 M) Install the most current¹ SERT on the UUT and the Controller System as specified in the most
194 current¹ SERT User Guide⁵.

195 **6 TEST PROCEDURES FOR ALL PRODUCTS**

196 **6.1 Idle and Active State Testing Using SERT**

- 197 A) Power on the UUT, either by switching it on or connecting it to mains power.
- 198 B) Between 5 and 15 minutes after the completion of initial boot or log in, follow the most current SERT
199 User Guide⁵ to engage SERT.
- 200 C) Follow all steps outlined in the most current¹ SERT User Guide to successfully run SERT.
- 201 1) Manual intervention or optimization to the Controller System, UUT, or its internal and external
202 environment is prohibited during the execution of SERT.
- 203 D) Once SERT is completed, include the following output files with all testing results:
- 204 1) Results.xml
- 205 2) Results.html
- 206 3) Results.txt
- 207 4) All results-chart png files (e.g. results-chart0.png, results-chart1.png, etc.)
- 208 5) Results-details.html
- 209 6) Results-details.txt
- 210 7) All results-details-chart png files (e.g. results-details-chart0.png, results-details-chart1.png, etc.)
- 211 E) When testing a Multi-node or Blade System, proceed as follows to derive single node or single Blade
212 Server power:
- 213 1) Divide the measured total idle power in Section 6.1.C) by the number of nodes/Blade Servers
214 installed for the test;
- 215 2) Record the measured total and per-node/per-Blade Server idle power values as calculated in
216 6.1.E)1) for each measurement.

217 **Note:** DOE and EPA are proposing to remove the manual idle state test found in Version 2 and have
218 revised the previous *Active State Testing Using SERT* section to also incorporate the idle
219 measurements gathered during SERT testing. Stakeholders should take the same approach when
220 calculating per blade/per-node idle power values using the idle state power measured in SERT.

⁵ http://www.spec.org/sert/docs/SERT-User_Guide.pdf