



ENERGY STAR® Program Requirements Product Specification for Displays

Test Method

1 OVERVIEW

The following test method shall be used for determining product compliance with requirements in the ENERGY STAR Eligibility Criteria for Displays.

2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the feature set of the product under evaluation. The following guidelines shall be used to determine the applicability of each section of this document:

- 1) Test procedures in Section 8 shall be performed on all products with viewable diagonal screen size less than 60 inches.

Note: The test method has been modified to clarify issues with the test procedure and to accommodate testing using the IEC 62087, Ed 2.0: Methods of Measurement for the Power Consumption of Audio, Video and Related Equipment. EPA is referencing the IEC 62087 test method to harmonize testing between the ENERGY STAR Displays and TV specifications and other national and international standards.

EPA invites stakeholders to comment on any clarifications needed in using IEC 62087 to test all display products and on the applicability of this test method by June 14, 2011.

3 DEFINITIONS

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

4 TEST SETUP

- Test Setup and Instrumentation: Test setup and instrumentation for all portions of this procedure shall be in accordance with the requirements of IEC 62301, Ed. 2.0 , "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.
- AC Input Power: Products intended to be powered from AC mains shall be connected to an external power supply shipped with the unit (if applicable) and then connected to a voltage source appropriate for the intended market, as specified in Table 1 and Table 2.

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

Market	Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
North America, Taiwan	115 Vac	+/- 1.0 %	2.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 Vac	+/- 1.0 %	2.0 %	50 Hz	+/- 1.0 %
Japan	100 Vac	+/- 1.0 %	2.0 %	50 Hz/60 Hz	+/- 1.0 %

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

Market	Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
North America, Taiwan	115 Vac	+/- 4.0 %	5.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 Vac	+/- 4.0 %	5.0 %	50 Hz	+/- 1.0 %
Japan	100 Vac	+/- 4.0 %	5.0 %	50 Hz/ 60 Hz	+/- 1.0 %

33 C. Low-voltage Dc Input Power:

- 34 1) Products may only be powered with a low-voltage dc source (e.g., via network or data
35 connection) if the dc source is the only available source of power for the product (e.g., no ac plug
36 or EPS is available).
- 37 2) Products powered by low-voltage dc shall be configured with an ac source of the dc power for
38 testing (e.g., an ac-powered USB hub).
- 39 3) Reported UUT power shall be equal to the ac power consumption of the low-voltage dc source
40 with the UUT as the load, minus the ac power consumption of the low-voltage dc source with no
41 load (P_s), as measured per Section 6 of this procedure.

42 D. Ambient Temperature: Ambient temperature shall be from 18 °C to 28 °C.

43 E. Relative Humidity: Relative humidity shall be from 10% to 80%.

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- 45 F. Power Meter: Power meters shall possess the following attributes¹:
- 46 1) Crest Factor:
- 47 i) An available current crest factor of 3 or more at its rated range value; and
- 48 ii) Lower bound on the current range of 10mA or less.
- 49 2) Minimum Frequency Response: 3.0 kHz
- 50 3) Minimum Resolution:
- 51 iii) 0.01 W for measurement values less than 10 W;
- 52 iv) 0.1 W for measurement values from 10 W to 100 W; and
- 53 v) 1.0 W for measurement values greater than 100 W.
- 54 G. Measurement Accuracy:
- 55 1) Power measurements with a value greater than or equal to 0.5 W shall be made with an
- 56 uncertainty of less than or equal to 2% at the 95% confidence level.
- 57 2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less than
- 58 or equal to 0.01 W at the 95% confidence level.

59 **5 TEST CONDUCT**

60 **5.1 Guidance for Implementation of IEC 62301 Ed. 2.0**

- 61 A. Testing at Factory Default Settings: Power measurements shall be performed with the product in its
- 62 as-shipped condition for the duration of Sleep Mode and On Mode testing, with all user-configurable
- 63 options set to factory defaults, except as otherwise specified by the test procedure.
- 64 1) Picture level adjustments shall be performed per the instructions in IEC 62087, Ed. 2.0, Section
- 65 11.4.8.
- 66 2) Products that include a “forced menu” upon initial start-up shall be tested in “standard” or “home”
- 67 picture mode. Products that do not include a forced menu shall be tested in the default picture
- 68 mode. In the case that no “standard” mode or equivalent exists, the first mode listed in the on-
- 69 screen menus shall be used for testing and noted in the test report.
- 70 B. Point of Deployment (POD) Modules: Optional POD modules shall not be installed.
- 71 C. Multiple Sleep Modes: If the product offers multiple Sleep Modes, the power during all Sleep Modes
- 72 shall be measured and recorded.

73 **5.2 Conditions for Power Measurements**

- 74 A. Power measurements: shall be taken from a point between the power source and the unit under test
- 75 (UUT).
- 76 1) Power measurements shall be recorded in watts and rounded to the nearest tenth of a watt.
- 77 2) Power measurements shall be recorded after instrument readings are stable to within 1% over a
- 78 three-minute period.
- 79 B. Dark Room Conditions:
- 80 1) Unless otherwise specified, the display screen illuminance measured with the UUT in Off Mode
- 81 shall be less than or equal to 1.0 lux.

¹ Characteristics of approved meters taken from IEC 62301 Ed 2.0: Household Electrical Appliances – Measurement of Standby Power.

82 C. UUT Configuration and Control:

83 1) Peripherals and Network Connections:

84 i) External peripheral devices shall not be connected to the Universal Serial Bus (USB) ports on
85 the UUT.

86 ii) In the case of a UUT that has Data and Network capabilities (e.g. Wi-Fi, Ethernet), the
87 product shall be configured with networking features activated. A bridge connection should be
88 made between the UUT and the host machine connected to the UUT for testing. The
89 connections should be made in the following order of preference and only one connection
90 should be made.

91 (1) Wi-fi (IEEE 802.11)

92 (2) Ethernet (IEEE 802.3). If the UUT supports Energy Efficient Ethernet (IEEE 802.3az)
93 then it shall be connected to a device that also supports IEEE 802.3az.

94 (3) Thunderbolt

95 (4) USB

96 (5) Firewire (IEEE 1394)

97 (6) Other

98 iii) In the case of a UUT that has Data capabilities only and no Network capabilities, a bridge
99 connection should be made between the UUT and the host machine connected to the UUT
100 for testing. The connections should be made in the following order of preference and only one
101 connection should be made.

102 (1) Thunderbolt

103 (2) USB

104 (3) Firewire (IEEE 1394)

105 (4) Other

106 iv) In the case of a UUT that has no Data/Network capabilities, the unit should be tested as is.

107 v) Built-in speakers, and other product features and functions not specifically addressed by the
108 ENERGY STAR eligibility criteria or test method must be configured in the as shipped power
109 configuration.

110 **Note:** EPA has an interest in ensuring that testing for ENERGY STAR qualification resembles intended
111 product usage. In doing so, EPA is best able to ensure real consumer savings when ENERGY STAR
112 products are used.

113 EPA proposes that manufacturers engage the USB/Firewire/Thunderbolt hub controller (or similar) in the
114 display when testing for ENERGY STAR qualification, which will reflect a more accurate depiction of the
115 state of hardware when in use by the end user.

116 EPA welcomes stakeholder input on the prevalence of network connectivity for display products and the
117 associated power consumption in On, Off and Sleep Mode when a network connection is activated. In the
118 longer term, EPA seeks to work with stakeholders to develop a testing approach that mirrors more closely
119 how home and business users configure and employ their Displays. As such, EPA recognizes that in
120 many cases peripherals, e.g., speakers, mice, cameras, smartphones, may be connected to a display in
121 home or office settings, and, therefore, seeks additional data and feedback pertaining to:

122 1. The connection of peripherals to displays. In particular, how widespread is the connection of
123 peripherals, in both home and office settings, and what is the typical duration of this connection?

124 2. The energy impact associated with peripherals' connection to displays during On, Off and Sleep mode
125 testing.

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127 2) Signal Interface: Displays that offer both an analog and a digital interface shall be tested with the
128 digital interface.

129 i. If a product has multiple digital interfaces, the product shall be tested with the first available
130 interface from the list below:

131 (1) Thunderbolt

132 (2) DisplayPort

133 (3) HDMI

134 (4) DVI

135 ii. If they product only has analog interfaces, analog composite should take precedence over
136 analog component.

137 **Note:** Currently qualified ENERGY STAR display products exhibit the increasing adoption of digital
138 interfaces, as the majority of qualified products have digital interfaces. Therefore, in efforts to standardize
139 and enhance the repeatability of the test method, EPA has indicated the sequence for testing display
140 interfaces. EPA welcomes stakeholder feedback on this sequence.

141 3) Resolution and Refresh Rate:

142 i. Fixed-pixel Displays:

143 (1) Pixel format shall be set to the native level.

144 (2) Refresh rate shall be set to 60 Hz, unless a different default refresh rate is specified in
145 the product manual, in which case the specified default refresh rate shall be used.

146 (3) For CRT Displays, pixel format shall be set to the highest resolution that is designed to
147 be driven at a 75 Hz refresh rate, as specified in the product manual. Typical industry
148 standards for pixel format timing shall be used for testing.

149 (a) Refresh rate shall be set to 75 Hz.

150 D. Battery Operated Products: For products designed to operate using batteries when not connected to
151 the mains, the battery shall be fully charged before the start of testing and shall be left in place for the
152 test.

153 E. Accuracy of Input Signal Levels: Video inputs shall be within $\pm 2\%$ of reference white and black levels.

154 F. True Power Factor: Due to increased awareness of the importance of power quality on the part of
155 EPA and electric utilities, Partners shall indicate the true power factor of their displays during On
156 Mode measurement.

157 G. Test Materials:

158 1) "Dynamic Broadcast Content" shall be used for testing, as specified in IEC 62087 Ed. 2.0, Section
159 11.6, "On (average) mode testing using dynamic broadcast-content video signal."

160 2) "Internet Video Content" shall be used for testing, as specified in IEC 62087 Ed. 2.0, Section
161 11.7, "On (average) mode testing using Internet-content video signal."

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163 **6 LOW-VOLTAGE DC SOURCE MEASUREMENT**

- 164 A. Connect the dc source to the power meter and relevant ac supply as specified in Table 1.
165 1) Verify that the dc source is unloaded.
166 2) Allow the dc source to warm up for a minimum of 30 minutes.
167 3) Measure and record the unloaded dc source power (PS) according to IEC 62301 Ed. 1.0².

168 **7 PRE-TEST UUT INITIALIZATION FOR ALL PRODUCTS**

- 169 A. Prior to the start of testing, the UUT shall be initialized as follows:
170 1) Set up the UUT per the instructions in the supplied operating manual.
171 2) Connect the power meter to the power source and connect the UUT to the power outlet on the
172 power meter.
173 3) Set the ambient light level such that the measured display screen illuminance is less than 1 lux.
174 4) Power on the UUT and perform initial system configuration, as applicable.
175 5) Ensure that UUT settings are in their as-shipped configuration.
176 6) Warm up the UUT for at least 20 minutes and until the unit has completed initialization and is
177 ready for use.
178 7) Measure and record the ac input voltage and frequency.
179 8) Measure and record the test room ambient temperature.

180 **8 TEST PROCEDURES FOR ALL PRODUCTS**

181 **8.1 Luminance Testing**

- 182 A. Luminance testing shall be performed in dark room conditions. Display screen illuminance (E) as
183 measured with the UUT in Off Mode shall be less than or equal to 1.0 lux.
184 B. Luminance shall be measured perpendicular to the center of the display screen using a Light
185 Measuring Device (LMD). A 500 mm measurement distance is recommended for LMDs that cannot
186 be operated in close proximity to the screen.
187 C. The position of the LMD relative to the display screen shall remain fixed throughout the duration of
188 testing.
189 D. For products with Automatic Brightness Control, luminance measurements shall be performed with
190 ABC disabled. If ABC cannot be disabled, luminance measurements shall be performed with light
191 entering directly into the displays ambient light sensor at greater than or equal to 300 lux.
192 E. Luminance measurements shall be performed per the following procedure:
193 1) Verify that the product is in the default as-shipped luminance value or 'Home' picture mode.
194 2) Immediately following the conclusion of On Mode power testing, begin to display the three-bar
195 video signal specified in IEC 62087 Ed. 2.0, Section 11.5.5 (three bars of white (100%) over a
196 black (0%) background).

2 Considering that IEC62301 Ed. 2.0 does not include dc powered products in its scope, EPA is referencing IEC62301 Ed. 1.0.

- 197 3) Display the three-bar video signal for not less than 10 minutes to allow the display luminance to
198 stabilize. This 10-minute stabilization period may be reduced if luminance measurements are
199 stable to within 2% over a period of not less than 60 seconds.
- 200 4) Measure and record luminance in default as-shipped luminance value or 'Home' picture mode
201 (L_{HOME}).
- 202 5) Within 1 minute of performing the measurement, set the luminance of the UUT to a value at least
203 65% of the maximum luminance, $L_{65\%}$.
- 204 6) Display the three-bar video signal for not less than 10 minutes to allow the display luminance to
205 stabilize. This 10-minute stabilization period may be reduced if luminance measurements are
206 stable to within 2% over a period of not less than 60 seconds.
- 207 7) Measure and record luminance, $L_{65\%}$. This luminance value should be at least 65% of the UUT's
208 maximum luminance.

209 **Note:** Stakeholders are invited to comment on the proposed procedure for testing luminance. In
210 particular, EPA is interested in obtaining stakeholder input regarding the applicability of the test procedure
211 and the positioning of the LMD.

212 **8.2 On Mode Testing for Products without ABC Enabled by Default**

- 213 A. Set the luminance to a value at least 65% of the UUT's maximum luminance, ($L_{65\%}$).
- 214 B. On mode power (PON) shall be measured according to IEC 62087, Ed 2.0: Methods of Measurement
215 for the Power Consumption of Audio, Video and Related Equipment; Section 11: Measuring
216 Conditions for Television Sets in On (average) Mode; with the additional guidance in section 5. On
217 Mode power tests must be repeated using the Internet-content video signal as defined in IEC 62087
218 Ed 2.0 Section 11.7.

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220 **8.3 On Mode Testing for Products with ABC Enabled by Default**

- 221 A. On mode power in various lighting conditions, $P_{broadcast_10lux}$, $P_{broadcast_100lux}$,
222 $P_{broadcast_150lux}$, and $P_{broadcast_300lux}$, for displays with ABC enabled shall be measured
223 according to IEC 62087, Ed 2.0: Methods of Measurement for the Power Consumption of Audio,
224 Video and Related Equipment; Section 11: Measuring Conditions for Television Sets in On (average)
225 Mode; with the additional guidance in section 5. On Mode power tests must be repeated using the
226 Internet-content video signal as defined in IEC 62087 Ed 2.0 Section 11.7.

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228 **Note:** EPA and DOE are interested in improving the measurement associated with ABC enabled by
229 default. Both EPA and DOE believe that the test conditions for room illuminance should be representative
230 of consumer use. EPA is proposing testing conditions for ABC enabled by default that have been
231 recommended by DOE for televisions in order to further harmonize this draft specification for Displays with
232 the Version 6.0 draft specification for Televisions. EPA also welcomes feedback on testing ABC at three
233 room illuminance levels instead of four and whether the proposed room illuminance levels are appropriate
234 for displays 30"-60" in diagonal screen size intended for non-household applications, such as professional
235 signage. EPA intends to adopt the DOE test procedure once it is finalized.

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238 **Note:** IEC 62087 defines testing for On Mode power with either static content, dynamic broadcast-
239 content, or Internet-content video signals. In efforts to harmonize with the ENERGY STAR Televisions
240 specification, EPA is proposing to test On Mode power using both, the **dynamic broadcast content**
241 **video signal and the Internet-content video signals for all product sizes.**
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243 EPA believes that the Internet-content video signal is pertinent for testing displays, considering that a
244 significant percentage of ENERGY STAR qualified displays are computer monitors, where one of their
245 main functions is to use the Internet. On a similar note, taking into account recent market data
246 demonstrating the increasing number of television shipments with Internet connectivity enabled, in the
247 draft Version 6.0 ENERGY STAR Televisions Test Method, EPA is proposing that manufacturers provide
248 data for On Mode power consumption using the Internet-content video signal, as it will demonstrate the
249 typical energy a television consumes when viewing Internet-based content.

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251 In special cases where products may not be able to display moving images, and therefore, may neither
252 be able to use the dynamic nor Internet-content video signals, EPA proposes testing using the static
253 content video signal. EPA requests stakeholder input regarding what type of display products would
254 necessitate the use of static content and feedback on this proposed approach.

255
256 **EPA invites stakeholders to comment on any clarifications needed in using IEC 62087 to test all**
257 **display products and on the applicability of this test method by June 14, 2011.**
258 **EPA encourages stakeholders to test displays less than 30" in diagonal screen size using the IEC**
259 **62087 test method and to share the test data for EPA consideration no later than July 18, 2011. In**
260 **addition, EPA encourages feedback from stakeholders on the most appropriate method for**
261 **weighting or averaging the two video signals, dynamic broadcast and Internet, in order to best**
262 **represent how the product will be used by consumers.**

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264 **8.4 Sleep Mode Testing**

- 265 A. Sleep Mode power (P_{SLEEP}) shall be measured according to IEC 62301, Ed 2.0: Household Electrical
266 Appliances – Measurement of Standby Power, with the additional guidance in section 5.
- 267 B. If the product has a variety of Sleep Modes that can be manually selected, measurements shall be
268 performed in the most energy consumptive Sleep Mode. If the product automatically cycles through
269 its various Sleep Modes, measurement time shall be long enough to obtain a true average of all
270 Sleep Modes.

271 **8.5 Off Mode Testing**

- 272 A. At the conclusion of the Sleep Mode test, initiate Off Mode via the most easily accessible power
273 switch.
- 274 B. Document the method of adjustment and sequence of events required to reach Off Mode.
- 275 C. Any input sync signal check cycle may be ignored when measuring Off Mode power.

276 **8.6 Additional Testing**

- 277 A. For data collection purposes, where applicable, EPA is requiring the following tests found in Section
278 8.1- 8.5 to be performed with networking features deactivated and without any bridge connection, in
279 addition to tests performed with networking capabilities activated and a bridge connection
280 established, per section 5.2.C) ii and iii, above:

- 281 1) On Mode
282 2) Sleep Mode

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