



ENERGY STAR® Program Requirements Product Specification for Displays

Test Method –Draft 4.0 Rev. Apr-2012

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

The following test method is applicable to all products eligible for qualification under the ENERGY STAR Product Specification for Displays.

Products must be tested with hardware and software features and capabilities in the default, or “as-shipped” configuration, unless otherwise specified in this document.

Note: DOE has published the Test Procedure for Television Sets Notice of Proposed Rulemaking (77 FR 2830). Any product that is included in DOE’s scope of coverage for TVs shall ultimately be tested according to the Test Procedure for Television Sets Final Rulemaking published by DOE.

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 ACRONYMS

- A) °C: Celsius
- B) A: Ampere
- C) ABC: Automatic Brightness Control
- D) AC: Alternating Current
- E) DBC: Dynamic Broadcast Content
- F) DC: Direct Current
- G) DOE: U.S. Department of Energy

- 20 H) DVI: Digital Visual Interface
- 21 I) EPA: Environmental Protection Agency
- 22 J) EPS: External Power Supply
- 23 K) FPDM: Flat Panel Display Measurement
- 24 L) HDMI: High Definition Multimedia Interface
- 25 M) Hz: Hertz
- 26 N) IEC: International Electrotechnical Commission
- 27 O) IEEE: Institute of Electrical and Electronics Engineers
- 28 P) IP: Internet Protocol
- 29 Q) LMD: Light Measuring Device
- 30 R) POD: Point of Deployment
- 31 S) UPS: Uninterruptible Power Supply
- 32 T) USB: Universal Serial Bus
- 33 U) UUT: Unit Under Test
- 34 V) V: Voltage
- 35 W) VESA: Video Electronics Standard Association
- 36 X) W: Watts

37 **5 TEST SETUP**

- 38 A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this method shall
- 39 be in accordance with the requirements of IEC 62301, Ed. 2.0, "Measurement of Household
- 40 Appliance Standby Power," Section 4, "General Conditions for Measurements," unless otherwise
- 41 noted in this document. In the event of conflicting requirements, the ENERGY STAR test method
- 42 shall take precedence.

- 43 B) Ac Input Power: Products capable of being powered from ac mains shall be connected to an external
- 44 power supply, if one is shipped with the unit, and then connected to a voltage source appropriate for
- 45 the intended market, as specified in Table 1.

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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 V ac	+/- 1.0 %	5.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 V ac	+/- 1.0 %	5.0 %	50 Hz	+/- 1.0 %
Japan	100 V ac	+/- 1.0 %	5.0 %	50 Hz or 60 Hz	+/- 1.0 %

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53 C) Low-voltage Dc Input Power:

54 1) Products may be powered with a low-voltage dc source (e.g., via network or data connection)
55 only if the dc source is the only available source of power for the product (i.e., no ac plug or
56 External Power Supply (EPS) is available).

57 2) Products powered by low-voltage dc shall be configured with an ac source of the dc power for
58 testing (e.g., an ac-powered Universal Serial Bus (USB) hub).

59 3) The USB hub power adapter must have the following attributes:

60 a) Voltage Rating: 5 V

61 b) Current Range: 2 A to 3 A

Note: DOE and EPA are interested in understanding the characteristics of other dc powered display technology present in the market and as such welcome comments and test data on Power over Ethernet (PoE) displays.

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63 4) Power for the unit under test (UUT) shall include the following, as measured per Section 6.3 of
64 this method:

65 a) Ac power consumption of the low-voltage dc source with the UUT as the load (P_L).

66 b) Ac power consumption of the low-voltage dc source with no load (P_S).

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68 D) Ambient Temperature: Ambient temperature shall be $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$.
- 69 E) Relative Humidity: Relative humidity shall be from 10% to 80%.
- 70 F) UUT Alignment:
- 71 1) All four corners of the face of the Unit Under Test (UUT) shall be placed at a maximum distance
72 of 2.5 feet from a vertical reference plane (e.g., wall) and shall be equidistant from the vertical
73 reference plane.
- 74 2) The bottom two corners of the face of the UUT shall be equidistant from a horizontal reference
75 plane (e.g., floor).
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Note: During testing, DOE observed inconsistencies among test runs with minor variations in the UUT's position. To ensure test consistency, DOE has specified that all four corners of the UUT face shall be aligned to a reference vertical plane at a maximum of 2.5 feet from the UUT. The distance of 2.5 feet was chosen to account for TVs with rear projection technology, if the same test method is utilized for TVs. In addition, DOE has specified that the bottom two corners of the UUT face shall be aligned to a horizontal reference plane.

DOE and EPA welcome comments on this requirement.

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- 78 G) Light Source:
- 79 1) Lamp Type:
- 80 a) Halogen flood reflector lamp.
- 81 b) Rated Brightness: $980 \pm 5\%$ lumens.

Note: DOE's "Energy Efficiency Standards for General Service Incandescent Lamps" rule in section 321(a)(3)(A) of the Energy Independence and Security Act of 2007 (EISA 2007) set forth more stringent standards for incandescent halogen bulbs that could impact the lamp type specified in the previous draft. Consequently, DOE has specified that all testing shall be conducted with a halogen reflector lamp having a specified brightness of 980 lumens. DOE testing revealed that a 980 lumen halogen incandescent lamp was sufficient to obtain all illuminance targets of 10, 100, 300 and 500 lux, in addition to providing repeatable results. DOE also believes that specifying the light source by lumens will ensure a consistent light source for testing, regardless of the wattage. Specifying a flood reflector will minimize the light scatter during testing to ensure that light shines directly into the UUT's ABC sensor. More information on EISA 2007 can be found here:

<http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf>

DOE and EPA welcome feedback and comments on the lamp type specifications.

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- 83 2) Light Source Alignment:
- 84 a) There shall be no obstructions between the lamp and the UUT's Automatic Brightness
85 Control (ABC) sensor (e.g., diffusing media, lamp frosted covers, etc.).
- 86 b) The center of the lamp shall be placed at a distance of 5 feet from the center of the ABC
87 sensor.

- 88 c) The center of the lamp shall be aligned at a horizontal angle of 0° with respect to the center
89 of the UUT's ABC sensor.
- 90 d) The center of the lamp shall be aligned at a height equal to the center of the UUT's ABC
91 sensor with respect to the floor (i.e. the light source shall be placed at a vertical angle of 0°
92 with respect to the center of the UUT's ABC sensor).
- 93 e) Illuminance values shall be obtained by varying the input voltage of the lamp.
- 94 f) Figure 1 and Figure 2 provide more information on UUT and light source alignment.

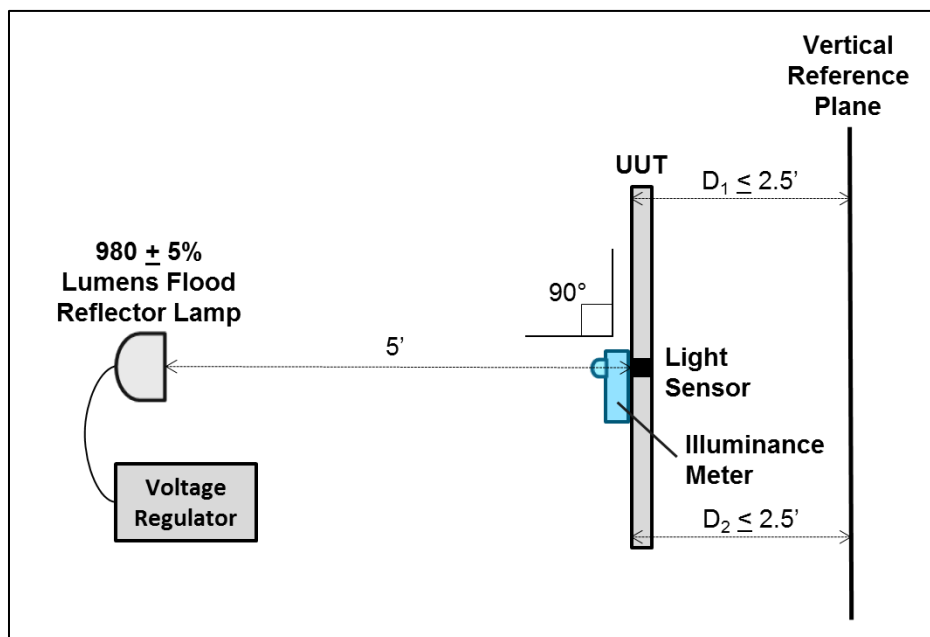


Figure 1: UUT and Light Source Alignment (Top View)

Notes:

- $D_1 = D_2$ with respect to vertical reference plane
- Illuminance meter removed for power measurements, after target illuminance achieved

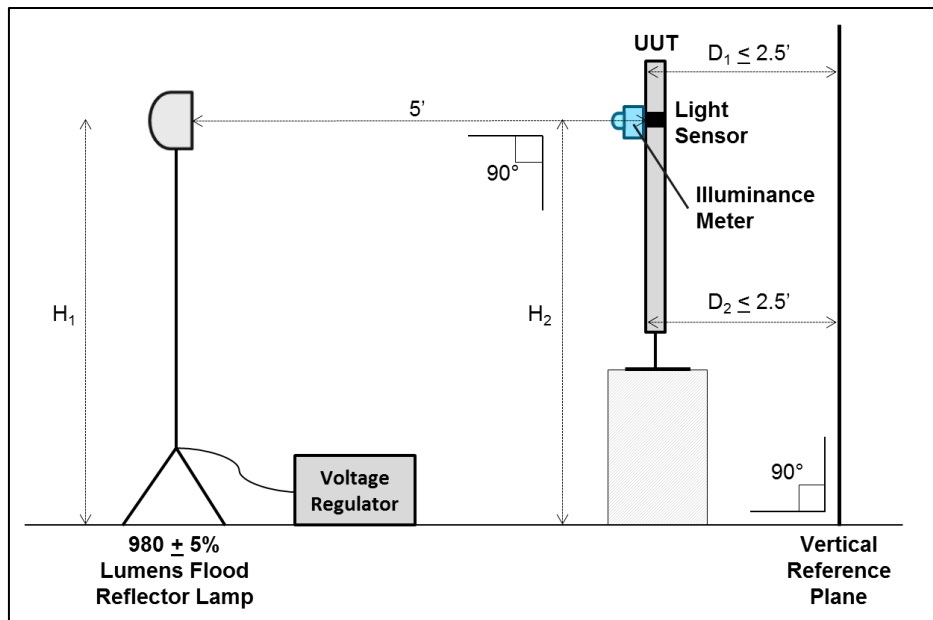


Figure 2: UUT and Light Source Alignment (Side View)

Notes:

- $D_1 = D_2$ with respect to vertical reference plane
- $H_1 = H_2$ with respect to vertical reference plane
- Illuminance meter removed for power measurements, after target illuminance achieved

Note: DOE's testing of products with ABC enabled by default revealed that different diffusing media provided different average On Mode power consumption values. In addition, requiring a means for diffusing/scattering the light increases the complexity of the test method. DOE also observed that the UUT's light sensor is most sensitive to incident light with no obstructing medium. As such, DOE has specified that no obstructions, such as frosted lamps or light diffusing material, be placed between the light source and UUT light sensor.

DOE's testing also revealed that power consumption is most sensitive to the lamp when the lamp is placed at a vertical and horizontal angle of 0° with respect to the UUT's ABC sensor. During testing, DOE observed large variations in On Mode power with small changes in the horizontal angle of the lamp with respect to the UUT's light sensor. For example, shifting the lamp by 5° resulted in a decrease in power of up to 26% at a given illuminance point, compared to testing at 0°. As such, DOE has specified that the center of the lamp be aligned at a height equal to the center of the UUT's ABC sensor, with respect to the floor (0° vertical angle) and that the center of the lamp shall be aligned with the UUT's ABC sensor at a 0° horizontal angle.

Further testing by DOE revealed that the On Mode power consumed by the UUT at a given illuminance level decreased as the light was moved away from the sensor. DOE observed a steep decrease in On Mode average power of the UUT up to 4 feet from the sensor. However, On Mode power decreased more gradually at distances greater than 4 feet. For example, at 100 lux DOE observed a 6% decrease in On Mode power when moving the lamp from 3 feet to 4 feet from the sensor, while no differences in power consumption were observed when the lamp was moved from 4 feet to 5 feet from the sensor. Based on these findings, DOE has specified that the light source shall be placed at a distance of 5 feet from the UUT's light sensor. The desired illuminance will need to be achieved by adjusting the voltage provided to the light source.

DOE and EPA welcome comments on these clarifications and the need to specify tolerance limits for the vertical and horizontal angles.

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102 H) Power Meter: Power meters shall possess the following attributes¹:

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1) Crest Factor:

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a) An available current crest factor of 3 or more at its rated range value; and

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b) Lower bound on the current range of 10 mA or less

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2) Minimum Frequency Response: 3.0 kHz

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3) Minimum Resolution:

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a) 0.01 W for measurement values less than or equal to 10 W;

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

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

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I) Light Measuring Device (LMD):

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1) Luminance measurement shall be performed using either

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a) A contact meter; or

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

- 114 b) A distance meter
- 115 2) All LMDs shall meet the following specifications:
- 116 a) Accuracy: $\pm 2\%$ (± 2 digits) of the digitally displayed value
- 117 b) Repeatability: Within 0.4% (± 2 digits) of the digitally displayed value
- 118 c) Acceptance Angle: 3 degrees or less
- 119 The overall accuracy of LMDs is found by taking (+/-) the absolute sum of 2% of the targeted
120 illuminance and a 2 digit tolerance of the displayed value least significant digit. For example, if the
121 LMD displays "200.0" when measuring a screen brightness of 200 nits, 2% of 200 nits is 4.0 nits. The
122 least significant digit is 0.1 nits. "Two digits" implies 0.2 nits. Thus, the displayed value would be 200
123 ± 4.2 nits (4 nits + 0.2 nits). The accuracy and repeatability are specific to the LMD and shall not be
124 considered as tolerance during actual light measurements. Light measured shall be within the
125 tolerance specified in 5J)4).
- 126 J) Measurement Accuracy:
- 127 1) Power measurements with a value greater than or equal to 0.5 W shall be made with an
128 uncertainty of less than or equal to 2% at the 95% confidence level.
- 129 2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less than
130 or equal to 0.01 W at the 95% confidence level.
- 131 3) All ambient light values (measured lux) shall be measured at the location of the Automatic
132 Brightness Control (ABC) sensor on the UUT with light entering directly into the sensor and with
133 the IEC 62087 Ed. 3.0 test signal main menu displayed on the product. For products not
134 compatible with the IEC 62087 test signal format, ambient light values shall be measured with the
135 VESA FPDM2 FK test signal being displayed on the product.
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- 137 4) Ambient light values shall be measured within the following tolerances:
- 138 a) At 10 lux, ambient lighting shall be within ± 1.0 lux;
- 139 b) At 100 lux, ambient lighting shall be within ± 5.0 lux; and
- 140 c) At 300 lux and 500 lux, ambient lighting shall be within ± 9.0 lux.

141 6 TEST CONDUCT

142 6.1 Guidance for Implementation of IEC 62087 Ed. 3.0

- 143 A) Testing at Factory Default Settings: Power measurements shall be performed with the product in its
144 as-shipped condition for the duration of Sleep Mode and On Mode testing, with all user-configurable
145 options set to factory defaults, except as otherwise specified by this test method.
- 146 1) Picture level adjustments shall be performed per the instructions in this test method.

- 2) Products that include a “forced menu” upon initial start-up shall be tested in “standard” or “home” picture setting. In the case that no “standard” setting or equivalent exists, the default setting recommended by the manufacturer shall be used for testing, and recorded in the test report. Products that do not include a “forced menu” shall be tested in the default picture setting.

B) Point of Deployment (POD) Modules: Optional POD modules shall not be installed.

C) Multiple Sleep Modes: If the product offers multiple Sleep Modes, the power during all Sleep Modes shall be measured and recorded. All Sleep Mode Testing shall be carried out as per Section 7.5.

6.2 Conditions for Power Measurements

A) Power measurements:

- 1) Power measurements shall be taken from a point between the power source and the 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 On Mode, Sleep Mode and Off Mode power data are fully recorded.

2) Power measurements shall be recorded in watts as directly measured (unrounded) values.

3) Power measurements shall be recorded after voltage measurements are stable to within 1%.

B) Dark Room Conditions:

- 1) Unless otherwise specified, the illuminance measured at the UUT screen with the UUT in Off Mode shall be less than or equal to 1.0 lux.

2) The dark room shall be free of all reflective surfaces.

C) UUT Configuration and Control:

1) Peripherals and Network Connections:

a) External peripheral devices shall not be connected to USB ports or other data ports on the UUT.

b) UUT connections shall be set up as follows:

- i. If the UUT has both data and network capabilities (e.g., USB, Wi-Fi, Ethernet), the UUT shall be configured and connected to a single active data source or a single network source, while maintaining a video signal connection.
- ii. If the UUT has data bridging capability (e.g., USB, Firewire), another device shall be capable of bridging the data connection, while active and powered with a live bridge i.e., the two devices shall act as bridged USB hub controllers.
- iii. If the UUT has network capabilities, the capabilities shall be activated and the UUT shall be connected to a live physical network (e.g., WiFi, Ethernet, etc.) and the physical network shall support the highest and lowest data speeds of the UUT’s network function. An active connection is defined as a live physical connection over the physical layer of the networking protocol. In the case of Ethernet, the connection shall be via a standard Cat 5e or better Ethernet cable to an Ethernet switch or router. In the case of WiFi the device shall be connected and tested in proximity to a wireless access point (AP). The tester shall configure the address layer of the protocol, taking note of the following:

- 185 a. Internet Protocol (IP) v4 and IPv6 have neighbor discovery and will generally
186 configure a limited, non-routable connection automatically.
- 187 b. IP can be configured manually or using Dynamic Host Configuration Protocol (DHCP)
188 with an address in the 192.168.1.x Network Address Translation (NAT) address
189 space if the UUT does not behave normally when autoIP is used. The network shall
190 be configured to support the NAT address space and/or autoIP.

Note: Based on stakeholder comments DOE has included clarifying language to better define an active physical network connection.

- 191 c) The UUT shall maintain this live connection to the network for the duration of testing,
192 disregarding any brief lapses, (e.g., when transitioning between link speeds). If the UUT is
193 equipped with multiple network capabilities, only one connection shall be made in the
194 following order of preference:
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- 196 i. Wi-Fi (Institution of Electrical and Electronics Engineers - IEEE 802.11- 2007²)
- 197 ii. Ethernet (IEEE 802.3). If the UUT supports Energy Efficient Ethernet (IEEE 802.3az-
198 2010³), then it shall be connected to a device that also supports IEEE 802.3az
- 199 iii. Thunderbolt
- 200 iv. USB
- 201 v. Firewire (IEEE 1394)
- 202 vi. Other
- 203 d) A bridge connection shall be made between the UUT and the host machine. The connection
204 shall be made in the following order of preference. Only one connection shall be made and
205 the connection shall be maintained for the duration of the testing.
- 206 i. Thunderbolt
- 207 ii. USB
- 208 iii. Firewire (IEEE 1394)
- 209 iv. Other
- 210 e) In the case of a UUT that has no data/network capabilities, the UUT shall be tested as-
211 shipped.
- 212 f) Built-in speakers and other product features and functions not specifically addressed by the
213 ENERGY STAR eligibility criteria or test method must be configured in the as-shipped power
214 configuration.

² IEEE 802 – Telecommunications and information exchange between systems—Local and metropolitan area networks – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications

³ Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications - Amendment 5: Media Access Control Parameters, Physical Layers, and Management Parameters for Energy-Efficient Ethernet

215 g) Availability of other capabilities such as occupancy sensors, flash memory-card/smart-card
216 readers, camera interfaces, PictBridge shall be recorded.

217 2) Signal Interface:

218 a) If the UUT has multiple digital interfaces, the UUT shall be tested with the first available
219 interface from the list below:

220 i. Thunderbolt

221 ii. DisplayPort

222 iii. HDMI

223 iv. DVI

224 v. Other Digital Interface

225 vi. Analog Component

226 vii. Analog Composite

227 viii. Other Analog Interfaces

228 D) Resolution and Refresh Rate:

229 1) Fixed-pixel Displays:

230 a) Pixel format shall be set to the native level as specified in the product manual.

231 b) For non-Cathode Ray Tube (CRT) Displays, refresh rate shall be set to 60 Hz, unless a
232 different default refresh rate is specified in the product manual, in which case the specified
233 default refresh rate shall be used.

234 c) For CRT Displays, pixel format shall be set to the highest resolution that is designed to be
235 driven at a 75 Hz refresh rate, as specified in the product manual. Typical industry standards
236 for pixel format timing shall be used for testing. Refresh rate shall be set to 75 Hz.

237 E) Battery Operated Products:

238 1) For products designed to operate using batteries when not connected to the mains, the battery
239 shall be removed for all tests. For UUTs where operation without a battery pack is not a
240 supported configuration, the batteries shall be fully charged before the start of testing and shall be
241 left in place for the test. To ensure the battery is fully charged, perform the following steps:

242 a) For products that have an indicator to show that the battery is fully charged, continue
243 charging for an additional 5 hours after the charged indicator is present.

244 b) If there is no charge indicator, but the manufacturer's instructions provide a time estimate for
245 when charging this battery or this capacity of battery should be complete, continue charging
246 for an additional 5 hours after the manufacturer's estimate.

247 c) If there is no indicator and no time estimate in the instructions, but the charging current is
248 stated on the UUT or in the instructions, terminate charging 1 hour after the calculated test
249 duration or, if none of the above applies, the duration shall be 24 hours.

F) Accuracy of Input Signal Levels: When using analog interfaces, video inputs shall be within $\pm 2\%$ of referenced white and black levels. When using digital interfaces, the source video signal shall not be adjusted for color, or modified by the tester for any purpose other than to compress/inflate and encode/decode for transmission, as required.

G) True Power Factor: Partners shall report the true power factor (PF) of the UUT during On Mode measurement. The reported power factor shall be averaged over the entire duration of the On Mode testing.

H) Test Materials:

1) "IEC 62087-2011 Dynamic Broadcast-Content Signal" shall be used for testing, as specified in IEC 62087, Ed. 3.0, Section 11.6, "On (average) mode testing using dynamic broadcast-content video signal."

2) "Video Electronics Standard Association (VESA) Flat Panel Display Measurements (FPDM) Standard version 2.0 test patterns" (shall be used only for products that cannot be tested using the dynamic broadcast-content video signal.)

6.3 Low-Voltage Dc Source Measurement

A) Connect the dc source to the power meter and relevant ac supply as specified in Table 1.

1) Verify that the dc source is unloaded.

2) Allow the dc source to warm up for a minimum of 30 minutes.

3) Measure and record the unloaded dc source power (P_S) according to IEC 62301 Ed. 2.0

4) Record the brand name, model number, voltage and current rating of the dc source.

7 TEST METHOD FOR ALL PRODUCTS

7.1 Pre-Test UUT Initialization

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

1) Set up the UUT per the instructions in the supplied product manual.

2) Connect an acceptable watt meter to the power source and connect the UUT to the power outlet on the watt meter.

3) With the UUT off, set the ambient light level such that the measured screen illuminance is less than 1.0 lux (see Section 6.2B)).

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

5) Ensure UUT settings are in their as-shipped configuration.

6) Warm up the UUT for 20 minutes, or the time it takes the UUT to complete initialization and become ready for use, whichever is longer. The IEC 62087 test signal format, as specified in section 6.2H)1), shall be displayed for the entire warm up period. Displays that are not compatible with the IEC 62087 test signal format shall have the VESA FPDM2 L80 test signal, as specified in section 6.2H)2), displayed on the screen.

- 285 7) Report the ac input voltage and frequency.
- 286 8) Report the test room ambient temperature and relative humidity.

287 **7.2 Luminance Testing**

- 288 A) Luminance testing shall be performed immediately following the warm-up period and in dark room
289 conditions. Product screen illuminance, as measured with the UUT in Off Mode, shall be less than or
290 equal to 1.0 lux.
- 291 B) Luminance shall be measured perpendicular to the center of the product screen using a Light
292 Measuring Device (LMD). Following the LMD manufacturer's instructions, it is recommended that the
293 LMD either be used as close to the screen as possible, or measure an area of at least 500 pixels.
- 294 C) The position of the LMD relative to the product screen shall remain fixed throughout the duration of
295 testing.
- 296 D) For products with ABC, luminance measurements shall be performed with ABC disabled. If ABC
297 cannot be disabled, luminance measurements shall be measured perpendicular to the center of the
298 product screen with light entering directly into the UUT's ambient light sensor at greater than or equal
299 to 500 lux.
- 300 E) Luminance measurements shall be performed as follows:
- 301 1) Verify that the UUT is in the default as-shipped luminance value or "Home" picture setting.
- 302 2) Display the test video signal for the specific product class, as described below:
- 303 a) All products: IEC 62087-2011 Three-bar video signal specified in IEC 62087, Ed. 3.0, Section
304 11.5.5 (three bars of white (100%) over a black (0%) background).
- 305 b) Products that cannot be tested with signals from IEC 62087: VESA FPDM2 L80 test signal for
306 the maximum resolution supported by the product.
- 307 3) Display the test video signal for no less than 10 minutes to allow the UUT luminance to stabilize.
308 This 10 minute stabilization period may be reduced if luminance measurements are stable to
309 within 2% over a period of not less than 60 seconds.
- 310 4) Measure and record the luminance in default as-shipped setting $L_{As-shipped}$.
- 311 5) Set the brightness and contrast level of the UUT to its maximum value.
- 312 6) Measure and record the luminance as $L_{Max_Measured}$.
- 313 7) Record the manufacturer-reported maximum luminance $L_{Max_Reported}$.

314 **7.3 On Mode Testing for Products without ABC Enabled by Default**

- 315 A) Prior to On Mode power measurement, the luminance of the UUT shall be set according to the
316 following:

1) For products with viewable diagonal screen size **less than 30 inches and any Computer Monitors 30 inches or more**, adjust appropriate controls until the luminance of the screen is **200 candelas per square meter (cd/m^2)**. If the UUT cannot achieve this luminance, set the product luminance to the nearest achievable value. Luminance values shall be measured as per section 7.2. This luminance value L_{On} shall be reported.

2) For products with viewable diagonal screen size of **30 inches or more that are Signage Displays**, the product shall be tested with luminance set at a value greater than or equal to 65% of the manufacturer-reported maximum luminance ($L_{\text{Max_Reported}}$). Luminance values shall be measured as per section 7.2. This luminance value L_{On} shall be recorded.

B) For a UUT capable of displaying the IEC signals, On Mode power (P_{ON}) shall be measured according to IEC 62087 Ed 3.0 Section 11: Measuring Conditions for Television Sets in On (average) Mode; with the additional guidance in Section 6.

1) Section 11.6 "On (average) Mode testing using dynamic broadcast-content video signal" for products capable of playing video.

C) For a UUT not capable of displaying the IEC signals, On Mode power (P_{ON}) shall be measured as follows:

1) Ensure that the UUT has been initialized per Section 7.1.

2) Display the VESA FPDM2, A112-2F, SET01K test pattern (8 shades of gray from full black (0 volts) to full white (0.7 volts)).

3) Verify that input signal levels conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev. 2.0, December 2002.

4) With the brightness and contrast controls at maximum, verify that the white and near-white grey levels can be distinguished. If necessary, adjust contrast controls until the white and near-white grey levels can be distinguished.

5) Display the VESA FPDM2, A112-2H, L80 test pattern (full white (0.7 volts) box that occupies 80% of the image).

6) Ensure that the LMD measurement area falls entirely within the white portion of the test pattern.

7) Adjust appropriate controls until the luminance of the white area of the screen is **200 Cd/m^2** . If the UUT cannot achieve the specified luminance, set product luminance to the nearest achievable value.

8) Record the screen luminance (L_{On}).

9) Record On Mode power (P_{ON}) and total pixel format (horizontal x vertical).

7.4 On Mode Testing for Products with ABC Enabled by Default

The average On Mode power consumption of the product shall be tested with the dynamic broadcast-content as defined in IEC 62087 Ed. 3.0.

A) Stabilize the UUT for 30 minutes. This shall be done with three repetitions of the 10 minute IEC dynamic broadcast-content video signal.

B) Set the ambient light to 10 lux as measured at the face of the ambient light sensor.

C) Display the 10 minute dynamic broadcast-content video signal. Measure and record the power consumption, P_{10} , during the 10 minute dynamic broadcast-content video signal.

- 358 D) Repeat steps 7.4B) and 7.4C) for ambient light levels of 100 lux, 300 lux, and 500 lux to measure
359 P_{100} , P_{300} , and P_{500} .
- 360 E) Disable ABC and measure On Mode power (P_{ON}) per Section 7.3. If ABC cannot be disabled, power
361 measurements shall be conducted as follows:
- 362 1) If the brightness can be set to a fixed value as specified in Section 7.3, then On Mode power
363 for these products shall be measured as per Section 7.3 with light entering directly into the
364 UUT's ambient light sensor at greater than or equal to 500 lux.
- 365 2) If the brightness cannot be set to a fixed value, then On Mode power for these products shall
366 be measured as per Section 7.3 with light entering directly into the UUT's ambient light
367 sensor at greater than or equal to 500 lux and without modifying the screen brightness.

368 **7.5 Sleep Mode Testing**

- 369 A) Sleep Mode power (P_{SLEEP}) shall be measured according to IEC 62301-2011: Household Electrical
370 Appliances – Measurement of Standby Power, with the additional guidance in Section 5.
- 371 B) The Sleep Mode test shall be conducted with the UUT connected to the host machine. Sleep Mode
372 shall also be initiated in the host machine to which the UUT is connected to.
- 373 C) If the product has a variety of Sleep Modes that can be manually selected, measurements shall be
374 performed and recorded in all Sleep Modes. If the product automatically cycles through its various
375 Sleep Modes, measurement time shall be long enough to obtain a true average of all Sleep Modes,
376 which will be the Sleep Mode power used for qualification.

377 **7.6 Off Mode Testing**

- 378 A) At the conclusion of the Sleep Mode test, initiate Off Mode via the most easily accessible power
379 switch.
- 380 B) Measure Off Mode power (P_{OFF}) according to Section 5.3.1 of the IEC 62301 off mode test. Document
381 the method of adjustment and sequence of events required to reach Off Mode.
- 382 C) Any input synchronizing signal check cycle may be ignored when measuring Off Mode power.
- 383 D) Off Mode power for products without a physical power switch shall be measured with the UUT
384 connected to the host machine, with the host machine in the power Off Mode

385 **7.7 Additional Testing**

- 386 A) For products with data/networking capabilities, in addition to tests performed with data/networking
387 capabilities activated and a bridge connection established (see Section 6.2C)1)), Sleep Mode Testing
388 shall be performed with data/networking features deactivated and without any bridge connection
389 established, per Section 6.2.C)1) Peripherals and Network Connections: b) and c).