



ENERGY STAR® Program Requirements Product Specification for Displays

Draft 2 Test Method Rev. August-2018

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.

Note: The U.S. Department of Energy (DOE) has published the Test Procedure for Television Sets Final Rule (78 FR 63823). 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 Rulemaking published by DOE in Appendix H to subpart B of 10 CFR 430.

3 DEFINITIONS

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

- A) Host Machine: The machine or device used as the source of video/audio signal for testing Displays. It may be a computer or any other device capable of providing a video signal.
- B) Tiled Display System: An array of individual Displays or panels tiled together contiguously and supported by single external controller and single external power supply to produce a single larger image.
- C) Maximum Tiled Configuration: At Tiled Display System with the maximum number of panels supported by the power supply and controller.

Note: Typical Maximum Tiled Configurations include a 2 x 2 configuration (four display panels). In this example, the minimum configuration would include a single panel operating with the power supply and controller rated for a total of four panels. For the purposes of the ENERGY STAR test, only the Maximum Tiled Configuration is considered.

Note: In response to Draft 1, EPA received feedback to create a specific product subcategory for tiled displays with On Mode power requirements similar to comparably sized single panel Signage Displays. In Draft 2, EPA and DOE are proposing the definition of Tiled Display System and Maximum Tiled Configuration. EPA and DOE welcome stakeholder feedback on this proposal.

4 TEST SETUP

- A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this method shall be in accordance with the requirements of International Electrotechnical Commission (IEC)

28 62301:2011, "Household electrical appliances - Measurement of standby power," Section 4, "General
 29 Conditions for Measurements," unless otherwise noted in this document. In the event of conflicting
 30 requirements, the ENERGY STAR Test Method shall take precedence.

31 B) Ac Input Power: Products capable of being powered from ac mains shall be connected to a voltage
 32 source appropriate for the intended market, as specified in Table 1. If an external power supply is
 33 shipped with the product, it shall be used to connect the product to the specified voltage source.

34 **Table 1: Input Power Requirements for Products**

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 %

35 C) Dc Input Power:

36 1) Products may be tested with a dc source (e.g., via network or data connection) only if dc is the
 37 only available source of power for the product (i.e., no ac plug or External Power Supply (EPS) is
 38 shipped with the product).

39 2) Dc-powered products shall be installed and powered as directed by the manufacturer, using a
 40 port with the full specifications recommended for the Display (e.g., Universal Serial Bus (USB) 3.1
 41 if applicable, even if backwards-compatible with USB 2.0).

42 3) The power measurement shall be made between the dc source (e.g., Host Machine) and the
 43 cable shipped with the product, including the losses introduced by the shipped cable. If no cable
 44 is shipped with the product, any cable between 2 and 6 feet long may be used in its place. The
 45 resistance of the cable used to connect the Display to the point of measurement shall be
 46 measured and reported.

47 **Note:** The measured resistance of dc power cables includes the sum of resistances of both the
 48 dc supply voltage wire and the ground wire.

49 4) A spliced cable may be used between the shipped cable and dc source in order to connect the
 50 power meter. If this method is used, the following requirements must be met:

51 a) The spliced cable shall be used in addition to the shipped cable described in Section 4.C)3.

52 b) The spliced cable shall be connected between the dc source and the shipped cable.

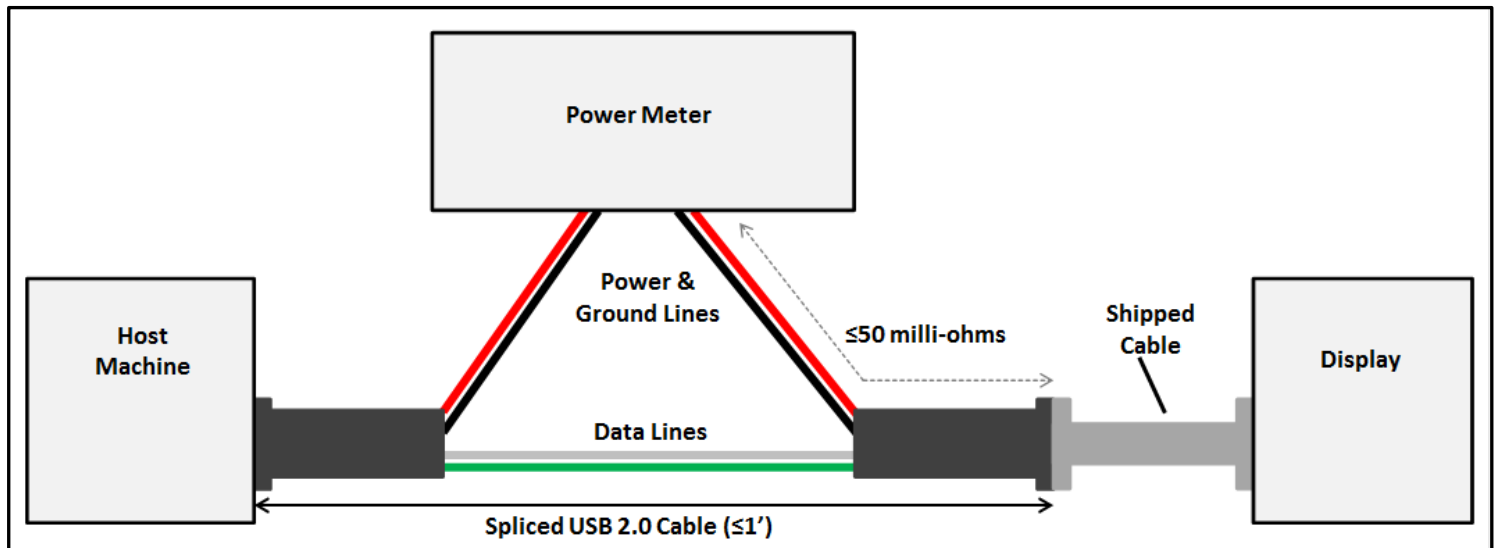
53 c) The spliced cable shall be no longer than 1 foot.

54 d) For measuring voltage, the total amount of wiring used between the voltage measurement
 55 and the shipped cable shall be less than 50 milliohms of resistance. This only applies to the
 56 wiring that is carrying load current.

57 **Note:** Voltage and current need not necessarily be measured at the same location, so long
 58 as the voltage is measured within 50 milliohms of the shipped cable.

59 e) The current measurement can be made either on the ground wire or the dc supply voltage
 60 wire.

61 f) Figure 1 depicts an example spliced cable setup using a USB 2.0-powered Display
 62 connected to the Host Machine.



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Figure 1: Example Spliced USB 2.0 Cable Arrangement

65 D) Ambient Temperature: Ambient temperature shall be $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

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

67 F) UUT Alignment:

- 68 1) All four corners of the face of the Unit Under Test (UUT) shall be equidistant from a vertical
69 reference plane (e.g., wall).
- 70 2) The bottom two corners of the face of the UUT shall be equidistant from a horizontal reference
71 plane (e.g., floor).

72 G) Light Source for On Mode Testing:

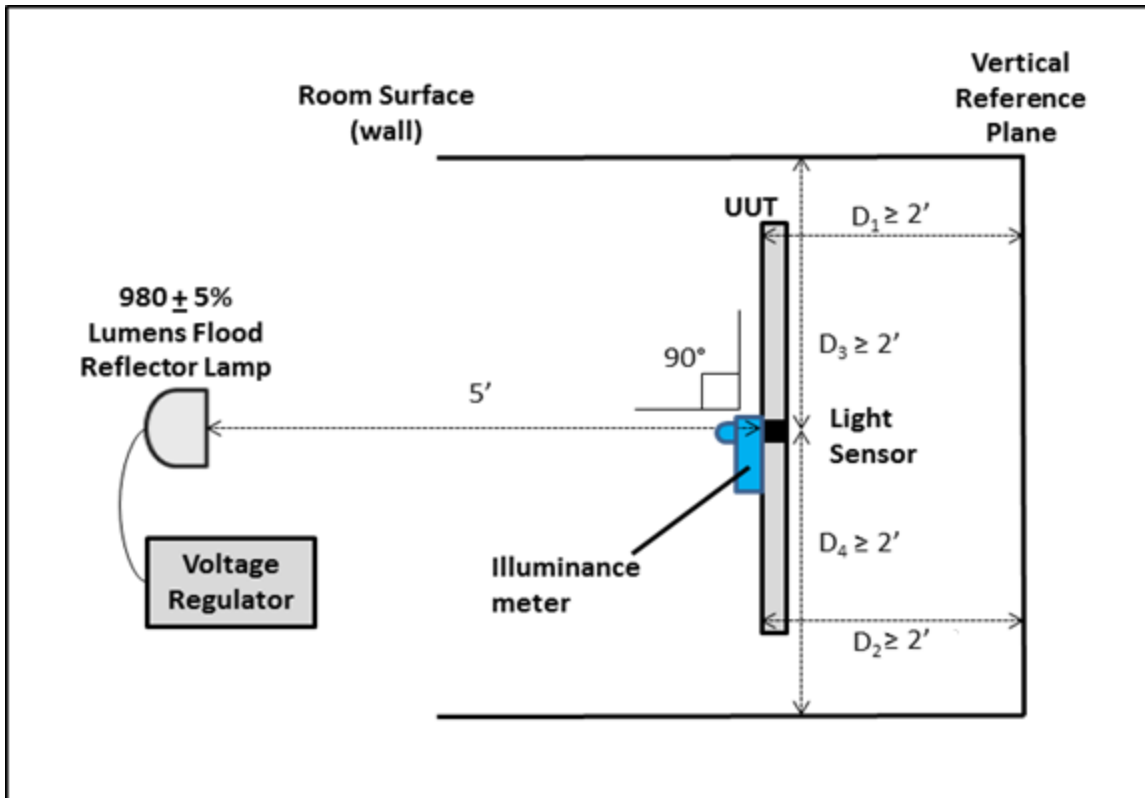
73 1) Lamp Type:

- 74 a) Standard spectrum halogen flood reflector lamp. The lamp shall not meet the definition of
75 "Modified spectrum" as defined in 10 CFR 430.2 - Definitions¹.
- 76 b) Rated Brightness: $980 \pm 5\%$ lumens.

77 2) Light Source Alignment For Testing Products With ABC Enabled By Default:

- 78 a) There shall be no obstructions between the lamp and the UUT's Automatic Brightness
79 Control (ABC) sensor (e.g., diffusing media, frosted lamp covers, etc.).
- 80 b) The center of the lamp shall be placed at a distance of 5 feet from the center of the ABC
81 sensor.
- 82 c) The center of the lamp shall be aligned at a horizontal angle of 0° with respect to the center
83 of the UUT's ABC sensor.
- 84 d) The center of the lamp shall be aligned at a height equal to the center of the UUT's ABC
85 sensor with respect to the floor (i.e. the light source shall be placed at a vertical angle of 0°
86 with respect to the center of the UUT's ABC sensor).
- 87 e) No test room surface (i.e., floor, ceiling, and wall) shall be within 2 feet of the center of the
88 UUT's ABC Sensor.
- 89 f) Illuminance values shall be obtained by varying the input voltage of the lamp.
- 90 g) Figure 2 and Figure 3 and provide more information on UUT and light source alignment.

¹ <http://www.gpo.gov/fdsys/pkg/CFR-2011-title10-vol3/pdf/CFR-2011-title10-vol3-sec430-2.pdf>

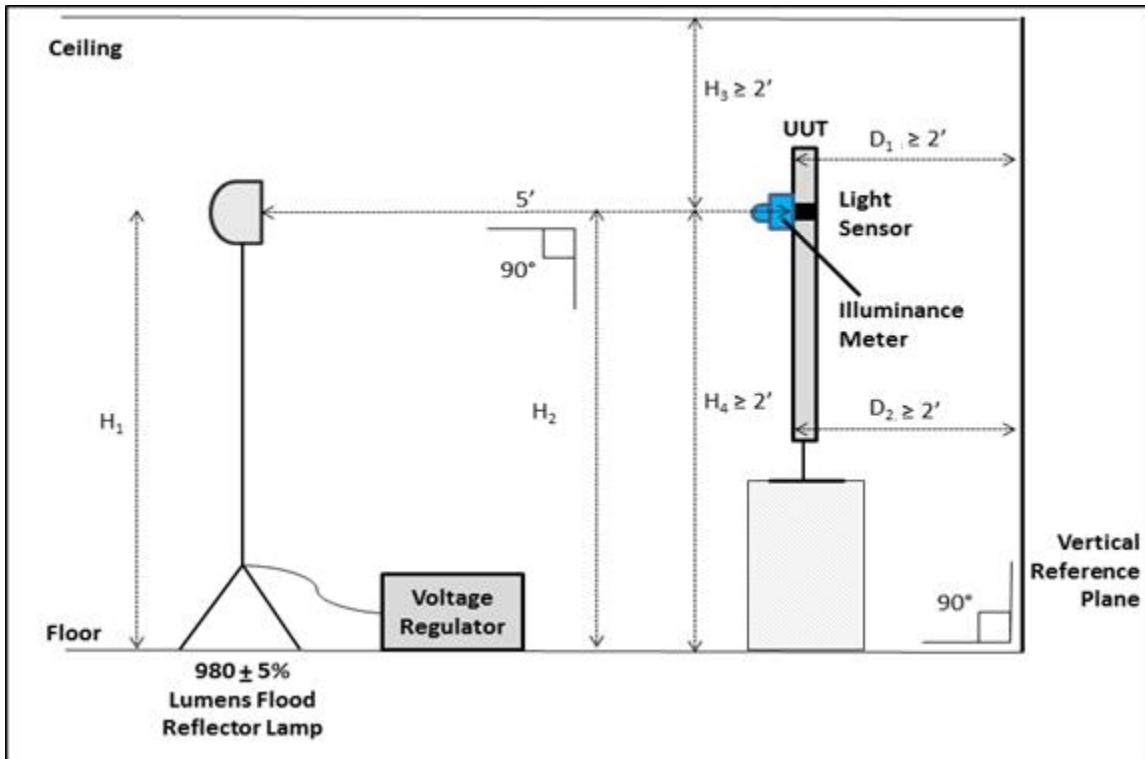


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Figure 2: Test Setup - Top View

Notes:

- $D_1 = D_2$ with respect to vertical reference plane
- D_1 and D_2 indicate that the corners of the face of the UUT shall be at least 2 feet from the vertical reference plane
- D_3 and D_4 indicate that the center of the light sensor shall be at least 2 feet from the room walls



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Figure 3: Test Setup - Side View

Notes:

- $D_1 = D_2$ with respect to vertical reference plane
- D_1 and D_2 indicate that the corners of the face of the UUT shall be at least 2 feet from the vertical reference plane
- Illuminance meter shall be removed for power measurements, after target illuminance achieved
- $H_1 = H_2$ with respect to horizontal reference plane (e.g. floor)
- H_3 and H_4 indicate that the center of the light sensor must be at least 2 feet from the floor and 2 feet from the ceiling
- Illuminance meter removed for power measurements, after target illuminance achieved

95 H) Power Meter: Power meters shall possess the following attributes

96 1) Crest Factor:

- 97 a) An available current crest factor of 3 or more at its rated range value; and
- 98 b) Lower bound on the current range of 10 mA or less.

99 2) Minimum Frequency Response: 3.0 kHz

100 3) Minimum Resolution:

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

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

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

104 I) Luminance and Illuminance Meters:

105 1) Luminance measurement shall be performed using either

106 a) A contact meter; or

107 b) A non-contact meter.

108 2) All luminance and illuminance meters shall have be accurate to $\pm 2\%$ (± 2 digits) of the digitally
109 displayed value.

110 3) Non-contact luminance meters shall have an acceptance angle of 3 degrees or less.

111 Note: The overall accuracy of a meter is found by taking (\pm) the absolute sum of 2% of the
112 measurement and a 2 digit tolerance of the displayed value least significant digit. For example, if an
113 illuminance meter displays "200.0" when measuring a screen brightness of 200 nits, 2% of 200 nits is
114 4.0 nits. The least significant digit is 0.1 nits. "Two digits" implies 0.2 nits. Thus, the displayed value
115 would be 200 ± 4.2 nits (4 nits + 0.2 nits). The accuracy is specific to the illuminance meter and shall
116 not be considered as tolerance during actual light measurements.

117 J) Measurement Accuracy:

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

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

122 3) All ambient light values (measured lux) shall be measured at the location of the ABC sensor on
123 the UUT with light entering directly into the sensor and with the main menu from the test signal
124 from IEC 62087:2011, "Methods of measurement for the power consumption of audio, video and
125 related equipment" displayed on the product. For products not compatible with the IEC test signal
126 format, ambient light values shall be measured with the Video Electronics Standard Association
127 (VESA) Flat Panel Display Measurements Standard version 2.0 (FPDM2) FK test signal being
128 displayed on the product.

129 4) Ambient light values shall be measured within the following tolerances:

130 a) At 12 lux, ambient lighting shall be within ± 1.0 lux; and

131 b) At 300 lux, ambient lighting shall be within ± 9.0 lux.

132 5 TEST CONDUCT

133 5.1 Guidance for Power Measurements

134 A) Testing at Factory Default Settings: Power measurements shall be performed with the product in its
135 as-shipped condition for the duration of Sleep Mode and On Mode testing, with all user-configurable
136 options set to factory defaults, except as otherwise specified by this test method.

137 1) Picture level adjustments shall be performed per the instructions in this test method.

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

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

144 C) Plug-in Modules: Optional Plug-in Modules shall be removed from the Display if the Display can be
145 tested according to the test method without the module installed.

146 D) Sleep Mode with Multiple Functionalities: If the product offers multiple options for device behavior in
147 Sleep Mode (e.g., quick start) or multiple methods by which Sleep Mode may be entered, the power
148 during all Sleep Modes shall be measured and recorded. All Sleep Mode testing shall be carried out
149 as per Section 6.5.

150 E) Tiled Display Systems: Products that meet the definition of Tiled Displays Systems shall be tested in
151 the Maximum Tiled Configuration which is considered the UUT. The power meter shall be placed
152 between the power source and external power supply supporting the maximum number of panels.

153 **Note:** In this draft, EPA and DOE are proposing new guidelines for testing the maximum configurations of
154 tiled displays that are being considered in the Draft 2 Version 8.0 ENERGY STAR specification. EPA and
155 DOE welcomes stakeholder feedback.

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157 **5.2 Conditions for Power Measurements**

158 A) Power measurements:

159 1) Power measurements shall be taken from a point between the power source and the UUT. No
160 Uninterruptible Power Supply (UPS) units may be connected between the power meter and the
161 UUT. The power meter shall remain in place until all On Mode, Sleep Mode and Off Mode power
162 data are fully recorded.

163 2) Power measurements shall be recorded in watts as directly measured (unrounded) values at a
164 rate of greater than or equal to 1 reading per second.

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

166 B) Dark Room Conditions:

167 1) Unless otherwise specified, the illuminance measured at the UUT screen with the UUT in Off
168 Mode shall be less than or equal to 1.0 lux. If the UUT does not have an Off Mode, the
169 illuminance shall be measured at the UUT screen with the UUT’s power cord disconnected.

170 C) UUT Configuration and Control:

171 1) Peripherals and Network Connections:

172 a) External peripheral devices (e.g. mouse, keyboard, external hard disk drive (HDD), speakers
173 etc.) shall not be connected to USB ports or other data ports on the UUT.

174 b) Bridging: If the UUT supports bridging per the definition in Section 1 of the ENERGY STAR
175 Eligibility Criteria for Displays Version 7.0, a bridge connection shall be made between the
176 UUT and the Host Machine. The connection shall be made in the following order of
177 preference. Only one connection shall be made and the connection shall be maintained for
178 the duration of the test.

179 i. Thunderbolt

180 ii. USB

- 181 iii. Firewire (IEEE 1394)
- 182 iv. Other

Note: Examples of bridging for Displays may include:

1. *A case where the Display converts data between two different port types (e.g. Thunderbolt and Ethernet). This can allow a device to use Thunderbolt as an Ethernet connection or vice versa.*
2. *Allowing a USB keyboard/mouse to be connected to another system (e.g. Host Machine) through the Display by a USB hub controller.*

- 183 c) Networking: If the UUT has networking capability (i.e., it has the ability to obtain an IP
184 address when configured and connected to a network) the networking capability shall be
185 activated, and the UUT shall be connected to a live physical network (e.g., Wi-Fi, Ethernet,
186 etc.). The physical network shall support the highest and lowest data speeds of the UUT's
187 network function. An active connection is defined as a live physical connection over the
188 physical layer of the networking protocol. In the case of Ethernet, the connection shall be via
189 a standard Cat 5e or better Ethernet cable to an Ethernet switch or router. In the case of Wi-
190 Fi the device shall be connected and tested in proximity to a wireless access point (AP). The
191 tester shall configure the address layer of the protocol, taking note of the following:
- 192 i. Internet Protocol (IP) v4 and IPv6 have neighbor discovery and will generally configure a
193 limited, non-routable connection automatically.
 - 194 ii. IP can be configured manually or by using Dynamic Host Configuration Protocol (DHCP)
195 with an address in the 192.168.1.x Network Address Translation (NAT) address space if
196 the UUT does not behave normally when autoIP is used. The network shall be configured
197 to support the NAT address space and/or autoIP.
 - 198 iii. The UUT shall maintain this live connection to the network for the duration of testing
199 unless otherwise specified in this Test Method, disregarding any brief lapses (e.g., when
200 transitioning between link speeds). If the UUT is equipped with multiple network
201 capabilities, only one connection shall be made in the following order of preference:
 - 202 a. Wi-Fi (Institution of Electrical and Electronics Engineers - IEEE 802.11- 2007²)
 - 203 b. Ethernet (IEEE 802.3). If the UUT supports Energy Efficient Ethernet (IEEE 802.3az-
204 2010³), then it shall be connected to a device that also supports IEEE 802.3az
 - 205 c. Thunderbolt
 - 206 d. USB
 - 207 e. Firewire (IEEE 1394)
 - 208 f. Other
- 209 d) Touchscreen Functionality: If the UUT features a touchscreen that requires a separate data
210 connection, this function shall be set up as directed by the manufacturer's instructions,
211 including connections to the Host Machine and installation of software drivers.
- 212 e) In the case of a UUT that has a single connection capable of performing multiple functions
213 (e.g. bridging, networking, and/or touchscreen functionality), a single connector can be used
214 to meet these functionalities provided it is the highest preferred connection the UUT supports

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 for each functionality.
- 216 f) In the case of a UUT that has no data/network capabilities, the UUT shall be tested as-
217 shipped.
- 218 g) Built-in speakers and other product features and functions not specifically addressed by the
219 ENERGY STAR eligibility criteria or test method must be configured in the as-shipped power
220 configuration.
- 221 h) Availability of other capabilities such as occupancy sensors, flash memory-card/smart-card
222 readers, camera interfaces, PictBridge shall be recorded.
- 223 2) Signal Interface:
- 224 a) If the UUT has multiple signal interfaces, the UUT shall be tested with the first available
225 interface from the list below:
- 226 i. Thunderbolt
- 227 ii. DisplayPort
- 228 iii. USB-C
- 229 iv. HDMI
- 230 v. DVI
- 231 vi. VGA
- 232 vii. Other Digital Interface
- 233 viii. Other Analog Interface

234 **Note:** Due to the increasing prevalence of Monitors and computers with USB-C, EPA and DOE are
235 proposing to add USB-C to the signal interface order of testing preference list above. Stakeholder
236 comments on the proposal are welcome.

- 237
- 238 3) Occupancy Sensor: If the UUT has an occupancy sensor, the UUT shall be tested with the
239 occupancy sensor settings in the as-shipped condition. For UUT's with an occupancy sensor
240 enabled as-shipped:
- 241 a) A person shall be within close proximity of the occupancy sensor for the entire warm up,
242 stabilization, luminance testing and On Mode to prevent the UUT from entering a lower power
243 state (e.g. Sleep Mode or Off Mode). The UUT shall remain in On Mode for the duration of
244 the warm up period, stabilization period, luminance test and On Mode test.
- 245 b) No person shall be within close proximity of the occupancy sensor for the duration of the
246 Sleep Mode and Off Mode tests to prevent the UUT from entering a higher power state (e.g.
247 On Mode). The UUT shall remain in Sleep Mode or Off Mode for the duration of the Sleep
248 Mode or Off Mode tests, respectively.
- 249 4) Orientation: If the UUT can be rotated into vertical and horizontal orientations, it shall be tested in
250 the horizontal orientation, with the longest dimension being parallel to the table surface.
- 251 D) Resolution and Refresh Rate:
- 252 1) Fixed-pixel Displays:
- 253 a) Pixel format shall be set to the native level as specified in the product manual.
- 254 b) For non-Cathode Ray Tube (CRT) Displays, refresh rate shall be set to 60 Hz, unless a
255 different default refresh rate is specified in the product manual, in which case the specified
256 default refresh rate shall be used.
- 257 c) For CRT Displays, pixel format shall be set to the highest resolution that is designed to be

258 driven at a 75 Hz refresh rate, as specified in the product manual. Typical industry standards
259 for pixel format timing shall be used for testing. Refresh rate shall be set to 75 Hz.

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

264 F) True Power Factor: Partners shall report the true power factor (PF) of the UUT during On Mode
265 measurement. The power factor values shall be recorded at the same rate at which the power value
266 (P_{ON}) are recorded. The reported power factor shall be averaged over the entire duration of the On
267 Mode testing.

268 G) Test Materials:

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

272 2) "VESA FPDM2" shall be used only for products that cannot display the IEC 62087:2011 Dynamic
273 Broadcast-Content Signal.

274 H) Host Machine and Video Input Signal:

275 1) The Host Machine shall generate the video input signal in the native resolution of the Display
276 such that the active area of the video fills the entire screen. This may require the playback
277 software to adjust the aspect ratio of the video.

278 2) The frame rate of the video input signal should match the frame rate most commonly used in the
279 region in which the product is sold (e.g., For the US and Japan a 60 Hz frame rate is used; for
280 Europe and Australia a 50 Hz frame rate is used).

281 3) The audio settings on the Host Machine shall be disabled so that no sound is produced alongside
282 the video input signal.

283 4) The Host Machine shall not have a battery and must operate on its own ac power source (e.g.
284 desktop computer, Blu-ray player, etc.). If a UUT must be used with a Host Machine that requires
285 a battery, ensure that the battery is fully charged and the Host Machine is connected to an ac
286 power source prior to connecting to the UUT.

287 **Note:** Stakeholders commented in response to the prior draft test method, that the host machine may
288 draw power from the UUT to charge its battery. EPA and DOE are proposing the above procedure to
289 ensure that any host machine does not have a battery, or, if a host machine with a battery is required
290 to operate the UUT, the battery is fully charged. The host machine must be connected to an ac
291 source prior to the test.

292 6 TEST PROCEDURES FOR ALL PRODUCTS

293 6.1 Pre-Test UUT Initialization

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

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

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

298 3) With the UUT off, set the ambient light level such that the measured screen illuminance is less
299 than 1.0 lux (see Section 5.2B)).

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

- 301 5) Ensure UUT settings are in their as-shipped configuration, unless otherwise specified in this test
302 method.
- 303 6) Warm up the UUT for 20 minutes, or the time it takes the UUT to complete initialization and
304 become ready for use, whichever is longer. The IEC 62087:2011 test signal format, as specified
305 in Section 5.2G)1), shall be displayed for the entire warm up period. Displays that cannot display
306 the IEC 62087:2011 test signal format shall have the VESA FPDM2 L80 test signal, as specified
307 in Section 5.2G)2), displayed on the screen.
- 308 7) Report the ac input voltage and frequency or dc input voltage.
- 309 8) Report the test room ambient temperature and relative humidity.

310 6.2 Luminance Testing

- 311 A) Luminance testing shall be performed immediately following the warm up period and in dark room
312 conditions. Product screen illuminance, as measured with the UUT in Off Mode, shall be less than or
313 equal to 1.0 lux.
- 314 B) Luminance shall be measured perpendicular to the center of the product screen using a luminance
315 meter in accordance with the meter's user manual.
- 316 C) The position of the luminance meter relative to the product screen shall remain fixed throughout the
317 duration of testing.
- 318 D) For products with ABC, luminance measurements shall be performed with ABC disabled. If ABC
319 cannot be disabled, luminance measurements shall be measured perpendicular to the center of the
320 product screen with light entering directly into the UUT's ambient light sensor at greater than or equal
321 to 300 lux.
- 322 E) Luminance measurements shall be performed as follows:
- 323 1) Verify that the UUT is in the default as-shipped luminance value or "Home" picture setting.
- 324 2) Display the test video signal for the specific product class, as described below:
- 325 a) **All products, except as specified in b):** Three-bar video signal specified in IEC
326 62087:2011, Section 11.5.5 (three bars of white (100%) over a black (0%) background).
- 327 b) **Products that cannot display signals from IEC 62087:2011:** VESA FPDM2 L80 test signal
328 for the maximum resolution supported by the product.
- 329 3) Display the test video signal for no less than 10 minutes to allow the UUT luminance to stabilize.
330 This 10 minute stabilization period may be reduced if luminance measurements are stable to
331 within 2% over a period of not less than 60 seconds.
- 332 4) Measure and record the luminance in default as-shipped setting $L_{As-shipped}$.
- 333 5) Set the brightness and contrast levels of the UUT to their maximum values.
- 334 6) Measure and record the luminance as $L_{Max_Measured}$.
- 335 7) Record the manufacturer-reported maximum luminance $L_{Max_Reported}$.
- 336 F) The contrast setting shall be left at the maximum level for the subsequent On Mode tests unless
337 otherwise specified.

338 6.3 On Mode Testing for Products without ABC Enabled by Default

- 339 A) After the Luminance Testing and prior to On Mode power measurement, the luminance of the UUT
340 shall be set according to the following:
- 341 1) **For Signage Displays**, the product shall be tested with luminance set at a value greater than or
342 equal to 65% of the manufacturer-reported maximum luminance ($L_{Max_Reported}$). Luminance values
343 shall be measured as per Section 6.2. This luminance value L_{On} shall be recorded.

- 344 2) **For all other products**, adjust appropriate luminance controls until the luminance of the screen is
345 **200 candelas per square meter (cd/m²)**. If the UUT cannot achieve this luminance, set the
346 product luminance to the nearest achievable value. Luminance values shall be measured as per
347 Section 6.2. This luminance value L_{On} shall be reported. Appropriate luminance controls refer to
348 any controls that adjust the brightness of the Display, but do not include contrast settings.
- 349 3) The luminance, as measured per Section 6.2 but without the 10 minute stabilization period, shall
350 meet the requirements above at any point during the On Mode test.
- 351 B) For a UUT capable of displaying the IEC signals, On Mode power (P_{ON}) shall be measured according
352 to IEC 62087:2011 Section 11.6.1 "Measurements using dynamic broadcast-content video signal."
353 For a UUT not capable of displaying the IEC signals, On Mode power (P_{ON}) shall be measured as
354 follows:
- 355 1) Ensure that the UUT has been initialized per Section 6.1.
- 356 2) Display the VESA FPDM2, A112-2F, SET01K test pattern (8 shades of gray from full black
357 (0 volts) to full white (0.7 volts)).
- 358 3) Verify that input signal levels conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev.
359 2.0, December 2002.
- 360 4) With the brightness and contrast controls at maximum, verify that the white and near-white grey
361 levels can be distinguished. If necessary, adjust contrast controls until the white and near-white
362 grey levels can be distinguished.
- 363 5) Display the VESA FPDM2, A112-2H, L80 test pattern (full white (0.7 volts) box that occupies 80%
364 of the image).
- 365 6) Ensure that the luminance measurement area falls entirely within the white portion of the test
366 pattern.
- 367 7) Adjust appropriate luminance controls until the luminance of the white area of the screen is set as
368 described in Section 6.3A).
- 369 8) Record the screen luminance (L_{On}).
- 370 9) Record On Mode power (P_{ON}) and total pixel format (horizontal x vertical). The On Mode power
371 shall be measured over a 10 minute period similar to the IEC 62087:2011 dynamic broadcast-
372 content test.
- 373 10) If the Host Machine draws power from the UUT then the power drawn shall be included in the On
374 Mode power measurement.

375 **6.4 On Mode Testing for Products with ABC Enabled by Default**

376 The average On Mode power consumption of the product shall be determined with the dynamic
377 broadcast-content as defined in IEC 62087:2011. If the product cannot display the IEC signal, then the
378 VESA FPDM2 L80 test pattern, as described in Section 6.3B)5), shall be used for all of the following
379 steps.

- 380 A) Stabilize the UUT for 30 minutes. This shall be done with three repetitions of the 10 minute IEC
381 dynamic broadcast-content video signal.
- 382 B) Set the light output of the lamp used for testing to 12 lux as measured at the face of the ambient light
383 sensor.
- 384 C) Display the 10 minute dynamic broadcast-content video signal. Measure and record the power
385 consumption, P_{12} , during the 10 minute dynamic broadcast-content video signal.
- 386 D) Repeat steps 6.4B) and 6.4C) for an ambient light level of 300 lux, to measure P_{300} .
- 387 E) Disable ABC and measure On Mode power (P_{ON}) per Section 6.3. If ABC cannot be disabled, power
388 measurements shall be conducted as follows:

- 389 1) If the brightness can be set to a fixed value as specified in Section 6.3, then On Mode power for
390 these products shall be measured as per Section 6.3 with light entering directly into the UUT's
391 ambient light sensor at greater than or equal to 300 lux.
- 392 2) If the brightness cannot be set to a fixed value, then On Mode power for these products shall be
393 measured as per Section 6.3 with light entering directly into the UUT's ambient light sensor at
394 greater than or equal to 300 lux and without modifying the screen brightness.

395 **6.5 Sleep Mode Testing**

- 396 A) Sleep Mode power (P_{SLEEP}) shall be measured according to IEC 62301:2011, with the additional
397 guidance in Section 5.
- 398 B) The Sleep Mode test shall be conducted with the UUT connected to the Host Machine in the same
399 manner as in the On Mode test. If possible, Sleep Mode shall be enacted by putting the Host Machine
400 to sleep. For a computer Host Machine, Sleep Mode is defined in the Version 6.1 ENERGY STAR
401 Computers specification.
- 402 C) If the product has a variety of Sleep Modes that may be manually selected, or if the product can enter
403 Sleep Mode via different methods (e.g., remote control or putting the Host Machine to sleep),
404 measurements shall be performed and recorded in all Sleep Modes.
- 405 If the product automatically transitions through its various Sleep Modes, the measurement time shall
406 be long enough to obtain an average of all Sleep Modes. The measurement shall still meet
407 requirements (e.g., stability, measurement period, etc.) outlined in Section 5.3 of IEC 62301:2011.

408 **6.6 Off Mode Testing**

- 409 A) For products having Off Mode capability, at the conclusion of the Sleep Mode test, initiate Off Mode
410 via the most easily accessible power switch.
- 411 B) Measure Off Mode power (P_{OFF}) according to Section 5.3.1 of the IEC 62301:2011. Document the
412 method of adjustment and sequence of events required to reach Off Mode.
- 413 C) Any input synchronizing signal check cycle may be ignored when measuring Off Mode power.

414 **6.7 Additional Testing**

- 415 A) For products with data/networking capabilities or a bridge connection, in addition to tests performed
416 with data/networking capabilities activated and a bridge connection established (see Section 5.2C)1)),
417 Sleep Mode Testing shall be performed with data/networking features deactivated and without any
418 bridge connection established, per Section 5.2C)1)b) and c).
- 419 B) The presence of Full Network Connectivity shall be determined by testing the Display for network
420 activity in Sleep Mode according to section 6.7.5.2 of CEA-2037-A, Determination of Television Set
421 Power Consumption, with the following guidance:
- 422 1) The Display shall be connected to a network per Section 5.2C)1)c) prior to the test.
- 423 2) The Display shall be placed into Sleep Mode in place of standby-active, low.