



ENERGY STAR® Program Requirements for Displays

Partner Commitments

Following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacture and labeling of ENERGY STAR qualified products. The ENERGY STAR Partner must adhere to the following partner commitments:

Qualifying Products

1. Comply with current ENERGY STAR Eligibility Criteria, which define performance requirements and test procedures for displays. A list of eligible products and their corresponding Eligibility Criteria can be found at www.energystar.gov/specifications.
2. Obtain certification of ENERGY STAR qualification from a Certification Body recognized by EPA for displays prior to associating the ENERGY STAR name or mark with any product. As part of this certification process, products must be tested in a laboratory recognized by EPA to perform display testing.

Using the ENERGY STAR Name and Marks

3. Comply with current ENERGY STAR Identity Guidelines, which define how the ENERGY STAR name and marks may be used. Partner is responsible for adhering to these guidelines and ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance. The ENERGY STAR Identity Guidelines are available at www.energystar.gov/logouse.
4. Use the ENERGY STAR name and marks only in association with qualified products. Partner may not refer to itself as an ENERGY STAR Partner unless at least one product is qualified and offered for sale.
5. Provide clear and consistent labeling of ENERGY STAR qualified displays.
 - 5.1. Partner shall adhere to the following product-specific commitments regarding use of the ENERGY STAR certification mark on qualified products:
 - 5.1.1. Partner must use the ENERGY STAR mark in one of the following ways:
 - 1) Via permanent or temporary label on the top or front of the product. All temporary labeling must be affixed to the product with an adhesive or cling-type application; or
 - 2) Via electronic labeling. Electronic labeling must meet the following requirements:
 - a. The ENERGY STAR mark in cyan, black, or white must appear at system start-up, and must display for a minimum of 5 seconds;
 - b. The ENERGY STAR mark must be at least 10% of the screen by area, must not be smaller than 76 pixels x 78 pixels, and must be legible.EPA will consider alternative proposals for electronic labeling on a case-by-case basis.
 - 5.1.2. If additional information about the ENERGY STAR program or other products is provided by the Partner on its website, Partner must comply with the ENERGY STAR Web Linking Policy, which can be found at www.energystar.gov/partners;

Verifying Ongoing Product Qualification

6. Participate in third-party verification testing through a Certification Body recognized by EPA for displays.
7. Comply with tests that EPA/DOE may conduct at its discretion on products that are referred to as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily supplied by Partner at the government's request.

Providing Information to EPA

8. Provide unit shipment data or other market indicators to EPA annually to assist with creation of ENERGY STAR market penetration estimates, as follows:
 - 8.1. Partner must submit the total number of ENERGY STAR qualified displays shipped in the calendar year or an equivalent measurement as agreed to in advance by EPA and Partner. Partner shall exclude shipments to organizations that rebrand and resell the shipments (unaffiliated private labelers).
 - 8.2. Partner must provide unit shipment data segmented by meaningful product characteristics (e.g., type, capacity, presence of additional functions) as prescribed by EPA.
 - 8.3. Partner must submit unit shipment data for each calendar year to EPA or an EPA-authorized third party, preferably in electronic format, no later than March 1 of the following year.Submitted unit shipment data will be used by EPA only for program evaluation purposes and will be closely controlled. Any information used will be masked by EPA so as to protect the confidentiality of the Partner;
9. Report to EPA any attempts by laboratories or Certification Bodies (CBs) to influence testing or certification results or to engage in discriminatory practices.
10. Notify EPA of a change in the designated responsible party or contacts within 30 days using the My ENERGY STAR Account tool (MESA) available at www.energystar.gov/mesa.

Training and Consumer Education

11. Partner shall comply with the following, product-specific requirements concerning training and education:
 - 11.1. For products that are intended for use with computers, agree to complete steps to educate users of their products about the benefits of power management for both displays and computers by including the following information with each ENERGY STAR qualified display in the user manual or as part of a printed box insert:
 - 11.1.1. Energy and cost savings potential;
 - 11.1.2. Environmental benefits; and
 - 11.1.3. The ENERGY STAR logo, plus information on ENERGY STAR and a link to www.energystar.gov; and
 - 11.2. Include a link to www.energystar.gov/powermanagement from product web pages, product specifications, and related content pages.
 - 11.3. At the Partner's request, EPA will supply suggested facts and figures related to the above criteria, template elements, or a complete template suitable for use in user guides or box inserts.

Performance for Special Distinction

In order to receive additional recognition and/or support from EPA for its efforts within the Partnership, the ENERGY STAR Partner may consider the following voluntary measures, and should keep EPA informed on the progress of these efforts:

- Provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.
- Consider energy efficiency improvements in company facilities and pursue benchmarking buildings through the ENERGY STAR Buildings program.
- Purchase ENERGY STAR qualified products. Revise the company purchasing or procurement specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA for periodic updates and coordination. Circulate general ENERGY STAR qualified product information to employees for use when purchasing products for their homes.
- Feature the ENERGY STAR mark(s) on Partner website and other promotional materials. If information concerning ENERGY STAR is provided on the Partner website as specified by the ENERGY STAR Web Linking Policy (available in the Partner Resources section of the ENERGY STAR website), EPA may provide links where appropriate to the Partner website.
- Ensure the power management feature is enabled on all ENERGY STAR qualified displays and computers in use in company facilities, particularly upon installation and after service is performed.
- Provide general information about the ENERGY STAR program to employees whose jobs are relevant to the development, marketing, sales, and service of current ENERGY STAR qualified products.
- Provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, communicate, and/or promote Partner's activities, provide an EPA representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR website, etc. The plan may be as simple as providing a list of planned activities or milestones of which Partner would like EPA to be aware. For example, activities may include: (1) increasing the availability of ENERGY STAR qualified products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrating the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) providing information to users (via the website and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products; and (4) building awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event.
- Join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. The SmartWay Transport Partnership works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway.
- Join EPA's Climate Leaders Partnership to inventory and reduce greenhouse gas emissions. Through participation, companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders. For more information on Climate Leaders, visit www.epa.gov/climateleaders.
- Join EPA's Green Power Partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities. For more information on Green Power, visit www.epa.gov/greenpower.



ENERGY STAR® Program Requirements Product Specification for Displays

Eligibility Criteria Draft Version 5.1

1 Following is the Version 5.1 ENERGY STAR Product Specification for Displays. A product shall meet all of
2 the identified criteria if it is to earn the ENERGY STAR.

3 **1 DEFINITIONS**

4 A) Product Types:

5 1) Electronic Display (Display): A commercially-available product with a display screen and
6 associated electronics, often encased in a single housing, that as its primary function displays
7 visual information from (1) a computer, workstation or server via one or more inputs (e.g., VGA,
8 DVI, HDMI, IEEE 1394), (2) a USB flash drive, (3) a memory card, or (4) a wireless Internet
9 connection.

10 B) External Power Supply (EPS): Also referred to as External Power Adapter. A component contained in
11 a separate physical enclosure external to a display, designed to convert line voltage AC input from the
12 mains to lesser DC voltage(s) in order to provide power to the display. An EPS connects to the display
13 via a removable or hard-wired male/female electrical connection, cable, cord or other wiring.

14 C) Operational Modes:

15 1) On Mode: The operational mode of a display that (1) is connected to a power source, (2) has all
16 mechanical (hard) power switches turned on, and (3) is producing an image.

17 2) Sleep Mode: The operational mode of a display that (1) is connected to a power source, (2) has all
18 mechanical (hard) power switches turned on, and (3) is in a reduced-power state after receiving a
19 signal from a connected device (e.g., computer, game console, set-top box) or by cause of an
20 internal function (e.g., sleep timer, occupancy sensor). Sleep Mode is considered a “soft” low-
21 power condition, in that the product may exit Sleep Mode upon receiving a signal from a
22 connected device or by cause of an internal function.

23 3) Off Mode: The operational mode of a display that (1) is connected to a power source, (2) has one
24 or more manual power switches turned off, and (3) is not providing any function. The product may
25 only exit Off Mode by cause of direct user actuation of a manual power switch.

26 D) Luminance: The photometric measure of the luminous intensity per unit area of light travelling in a
27 given direction, expressed in units of candelas per square meter (cd/m²).

28 E) Screen Area: The viewable screen area of a product, calculated by multiplying the viewable image
29 width by the viewable image height.

30 F) Automatic Brightness Control (ABC): The self-acting mechanism that controls the brightness of a
31 display as a function of ambient light.

32 G) **Product Family:** A group of product models that are (1) made by the same manufacturer, (2) subject to
33 the same ENERGY STAR qualification criteria, and (3) of a common basic design. Product models
34 within a family differ from each other according to one or more characteristics or features that either
35 (1) have no impact on product performance with regard to ENERGY STAR qualification criteria, or (2)
36 are specified herein as acceptable variations within a product family. For Displays, acceptable
37 variations within a product family include:

38 1) Color, and

39 2) Housing.

40 **2 SCOPE**

41 **2.1 Included Products**

42 2.1.1 Products that meet the definition of a Display as specified herein and are powered directly from ac
43 mains, via an external power supply, or via a data or network connection, are eligible for ENERGY
44 STAR qualification, with the exception of products listed in Section 2.2.

45 **2.2 Excluded Products**

46 2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for
47 qualification under this specification. The list of specifications currently in effect can be found at
48 www.energystar.gov/products.

49 2.2.2 The following products are not eligible for qualification under this specification:

- 50 i. Products with a viewable diagonal screen size greater than 60 inches,
- 51 ii. Under Tier 1 eligibility criteria, products with an integrated television tuner that are marketed
52 and sold exclusively as televisions,
- 53 iii. Under Tier 2 eligibility criteria, all products with an integrated television tuner.

54 **3 QUALIFICATION CRITERIA**

55 **3.1 Significant Digits and Rounding**

56 3.1.1 All calculations shall be performed with actual measured or observed values. Only the final result
57 of a calculation shall be rounded. Calculated results shall be rounded to the nearest significant
58 digit as expressed in the corresponding specification limit.

59 3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using exact
60 values without any benefit from rounding.

61 **3.2 General Requirements**

62 3.2.1 **External Power Supply:** If the product is shipped with an EPS, the EPS shall meet the level V
63 performance requirements under the International Efficiency Marking Protocol and include the
64 level V marking. Additional information on the Marking Protocol is available
65 at www.energystar.gov/powersupplies.

66 3.2.2 Power Management:

- 67 i. Products shall offer at least one power management feature that is enabled by default, and
68 that can be used to automatically transition from On Mode to Sleep Mode or Off Mode (e.g.,
69 support for VESA Display Power Management Signaling [DPMS], enabled by default).
70 ii. Products that generate content for display from one or more internal sources shall have a
71 sensor or timer enabled by default to automatically engage Sleep or Off Mode.

72 **3.3 On Mode Requirements**

- 73 3.3.1 For products with Automatic Brightness Control (ABC) enabled by default, On Mode power (P_{ON}),
74 as calculated per Equation 1, shall be less than or equal to the Maximum On Mode Power
75 Requirement (P_{ON_MAX}), as calculated per Table 1.

76 **Equation 1: Calculation of On Mode Power for**
77 **Products with ABC Enabled by Default**

78
$$P_{ON} = (0.8 \times P_H) + (0.2 \times P_L)$$

79 *Where:*

- 80
 - 81 P_{ON} is the calculated On Mode power
 - 82 P_H is the measured On Mode power in high ambient lighting
 - 83 conditions (300 lux),
 - 84 P_L is the measured On Mode power in low ambient lighting
 - conditions (0 lux).

- 85 3.3.2 For products that do not offer ABC, or for which ABC is not enabled by default, On Mode power
86 (P_{ON}), as calculated per Equation 2, shall be less than or equal to the Maximum On Mode Power
87 Requirement (P_{ON_MAX}), as calculated per Table 1.

88 **Equation 2: Calculation of On Mode Power for**
89 **Products without ABC Enabled by Default**

90
$$P_{ON} = P_L$$

91 *Where:*

- 92
 - 93 P_{ON} is the calculated On Mode power
 - 94 P_L is the measured On Mode power in low ambient lighting
 - conditions (0 lux).

95

Table 1: Calculation of Maximum On Mode Power Requirements (P_{ON_MAX})

| Product Type | | P_{ON_MAX} Tier 1 (watts) | P_{ON_MAX} Tier 2 (watts) |
|---------------------------------------|--|--|------------------------------------|
| Diagonal Screen Size, d (inches) | Screen Resolution, r (megapixels) | | |
| | | <i>Where:</i> <ul style="list-style-type: none"> ▪ r = Screen resolution in megapixels ▪ A = Viewable screen area, rounded to the nearest 0.1 square inches. | |
| $d < 30.0$ | $r \leq 1.1$ | $(6.0 \times r) + (0.05 \times A) + 3.0$ | TBD |
| | $r > 1.1$ | $(9.0 \times r) + (0.05 \times A) + 3.0$ | TBD |
| $30.0 \leq d \leq 60.0$ | Any | $(0.27 \times A) + 8.0$ | TBD |

96 **3.4 Sleep Mode Requirements**

97 3.4.1 Measured Sleep Mode power (P_{SLEEP}) shall be less than or equal to the Maximum Sleep Mode
98 Power Requirement (P_{SLEEP_MAX}), as specified in Table 2.

99 **Table 2: Maximum Sleep Mode Power Requirements (P_{SLEEP_MAX})**

| P_{SLEEP_MAX} Tier 1 (watts) | P_{SLEEP_MAX} Tier 2 (watts) |
|---------------------------------------|---------------------------------------|
| 2.0 | 1.0 |

100 3.4.2 For products that offer more than one Sleep Mode (e.g., “Sleep” and “Deep Sleep”), measured
101 Sleep Mode power (P_{SLEEP}) in any Sleep Mode shall not exceed the Maximum Sleep Mode Power
102 Requirement (P_{SLEEP_MAX}).

103 **3.5 Off Mode Requirements**

104 3.5.1 Measured Off Mode power (P_{OFF}) shall be less than or equal to the Maximum Off Mode Power
105 Requirement (P_{OFF_MAX}) specified in Table 3.

106 **Table 3: Maximum Off Mode Power Requirements (P_{OFF_MAX})**

| P_{OFF_MAX} Tier 1 (watts) | P_{OFF_MAX} Tier 2 (watts) |
|-------------------------------------|-------------------------------------|
| 1.0 | 1.0 |

107 **4 TEST REQUIREMENTS**

108 **4.1 Test Methods**

109 4.1.1 When testing Display products, the test methods identified in Table 4 shall be used to determine
110 ENERGY STAR qualification.

111

Table 4: Test Methods for ENERGY STAR Qualification

| Diagonal Screen Size, <i>d</i> (inches) | Test Method |
|--|--|
| $d < 30.0$ | ENERGY STAR Test Method for Displays Rev. Aug 2010. VESA Flat Panel Display Measurements (FPDM) Standard, Version 2.0 |
| $30.0 \leq d \leq 60.0$ | ENERGY STAR Test Method for Displays Rev. Aug 2010. IEC 62087, Ed 2.0: Methods of Measurement for the Power Consumption of Audio, Video and Related Equipment |
| All Screen Sizes | IEC 62301 Ed 1.0: Household Electrical Appliances – Measurement of Standby Power |

112 **4.2 Number of Units Required for Testing**

113 4.2.1 Representative Models shall be selected for testing per the following requirements:

- 114 i. For qualification of an individual product model, a product configuration equivalent to that
115 which is intended to be marketed and labeled as ENERGY STAR is considered the
116 Representative Model;
- 117 ii. For qualification of a product family, any product configuration within the family may be
118 considered the Representative Model.

119 4.2.2 A single unit of each Representative Model shall be selected for testing. If test results for any
120 operational mode power measurement are within 10% of ENERGY STAR requirements, two
121 additional units of the same Representative Model with an identical configuration shall be tested.

122 4.2.3 All tested units shall meet ENERGY STAR qualification requirements.

123 **4.3 International Market Qualification**

124 4.3.1 Products shall be tested for qualification at the relevant input voltage/frequency combination for
125 each market in which they will be sold and promoted as ENERGY STAR.

126 **5 USER INTERFACE**

127 5.1.1 Partners are encouraged to design products in accordance with the user interface standard IEEE
128 P1621: Standard for User Interface Elements in Power Control of Electronic Devices Employed in
129 Office/Consumer Environments. For details, see <http://eetd.LBL.gov/Controls>.

130

131 **6 EFFECTIVE DATE**

132 6.1.1 Effective Date: The Version 5.1 ENERGY STAR Displays specification shall take effect on the
133 dates specified in Table 5. To qualify for ENERGY STAR, a product model shall meet the
134 ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is
135 specific to each unit and is the date (e.g., month and year) on which a unit is considered to be
136 completely assembled.

137 6.1.2 Future Specification Revisions: EPA reserves the right to change this specification should
138 technological and/or market changes affect its usefulness to consumers, industry, or the
139 environment. In keeping with current policy, revisions to the specification are arrived at through
140 stakeholder discussions. In the event of a specification revision, please note that the ENERGY
141 STAR qualification is not automatically granted for the life of a product model.

142 **Table 5: Specification Effective Dates**

| Diagonal Screen Size, <i>d</i> (inches) | Tier 1 Effective Date | Tier 2 Effective Date |
|--|-----------------------|-----------------------|
| $d < 30.0$ | October 30, 2009 | October 30, 2011 |
| $30.0 \leq d \leq 60.0$ | January 30, 2010 | October 30, 2011 |

143 **7 CONSIDERATIONS FOR FUTURE REVISIONS**

144 **7.1 Greenhouse Gas Emissions**

145 7.1.1 EPA is interested in working with LCD industry stakeholders through the ENERGY STAR program
146 to reduce the emission of high global warming potential gases associated with LCD production,
147 specifically NF₃, SF₆, and CF₄. EPA recognizes the opportunity to significantly reduce emissions
148 beyond product use-phase, and to engage partners in achieving significant, measurable
149 greenhouse gas and energy reductions from other phases of the product lifecycle.

150 **7.2 Harmonization of Displays**

151 7.2.1 EPA is committed to continuing to develop performance levels for displays and televisions in a
152 similar and convergent manner, as reflected in industry and market trends. Under Tier 2, EPA will
153 explore testing all displays for On Mode power using the IEC 62087 test procedure. Issues such
154 as luminance boundary levels, mode requirements, test conditions, power saving features, and
155 other energy related attributes will be explored with stakeholders during the Tier 2 specification
156 development process.

157

158

APPENDIX A: Example Calculations

159

| Diagonal Screen Size (inches) | Resolution (pixel count) | Resolution (MP) | Screen Dimensions (inches) | Screen Area (sq. inches) | P _{ON MAX} (watts) |
|-------------------------------|--------------------------|-----------------|----------------------------|--------------------------|-----------------------------|
| 7 | 800 x 480 | 0.384 | 5.9 x 3.5 | 20.7 | 6.4 |
| 19 | 1440 x 900 | 1.296 | 16.1 x 10.1 | 162.6 | 22.8 |
| 26 | 1920 x 1200 | 2.304 | 21.7 x 13.5 | 293.0 | 38.4 |
| 42 | 1360 x 768 | 1.044 | 36.0 x 20.0 | 720.0 | 202.4 |
| 50 | 1920 x 1080 | 2.074 | 44.0 x 24.0 | 1056.0 | 293.1 |

160



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 30 inches.

2) Test procedures in Section 9 shall be performed on all products with viewable diagonal screen size from 30 to 60 inches, inclusive.

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

A) 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. 1.0, "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.

B) Input Power:

1) 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.

25
26

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 % |
| China | 220 Vac | +/- 1.0 % | 2.0 % | 50 Hz | +/- 1.0 % |
| Japan | 100 Vac | +/- 1.0 % | 2.0 % | 50 Hz and 60 Hz | +/- 1.0 % |

27
28

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 % |
| China | 220 Vac | +/- 4.0 % | 5.0 % | 50 Hz | +/- 1.0 % |
| Japan | 100 Vac | +/- 4.0 % | 5.0 % | 50 Hz and 60 Hz | +/- 1.0 % |

29 C) Low-voltage DC Input Power:

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

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

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

40

- 41 F) Power Meter: Power meters shall possess the following attributes:
- 42 1) Crest Factor: Capability to measure the current waveform without clipping.
- 43 i) The peak of the current waveform measured during Sleep Mode and On Mode shall
44 determine the crest factor rating requirement and the appropriate current range setting.
- 45 ii) The full-scale value of the selected current range multiplied by the crest factor for that range
46 shall be at least 15% greater than the peak current.
- 47 2) Bandwidth: Minimum bandwidth as determined by an analysis of current and voltage to determine
48 the highest frequency component (harmonic) with a magnitude greater than 1% of the
49 fundamental frequency under the test conditions.
- 50 3) Minimum Frequency Response: 3.0 kHz
- 51 4) Minimum Sampling Frequency: 60 Hz
- 52 5) Minimum Resolution:
- 53 i) 0.01 W for measurement values less than 10 W;
- 54 ii) 0.1 W for measurement values from 10 W to 100 W; and
- 55 iii) 1.0 W for measurement values greater than 100 W.
- 56 G) Measurement Accuracy:
- 57 1) Power measurements with a value greater than or equal to 0.5 W shall be made with an
58 uncertainty of less than or equal to 2% at the 95% confidence level.
- 59 2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less than
60 or equal to 0.01 W at the 95% confidence level.

61 **5 TEST CONDUCT**

- 62 A) Power Measurements:
- 63 1) Power measurements shall be taken from a point between the power source and the unit under
64 test (UUT).
- 65 2) Power measurements shall be recorded in watts and rounded to the nearest tenth of a watt.
- 66 3) Power measurements shall be recorded after instrument readings are stable to within 1% over a
67 three-minute period.
- 68 B) Dark Room Conditions:
- 69 1) Unless otherwise specified, the display screen illuminance measured with the UUT in Off Mode
70 shall be less than or equal to 1.0 lux.

71 C) Light Measurements:¹

72 1) Light measurements shall be performed with the Light Measurement Device (LMD) located at the
73 center of, and perpendicular to, the display screen.²

74 2) The LMD shall measure a rectangular area that is the greater of (1) an area each side of which is
75 10% as long as the corresponding side of the viewable screen area, or (2) 500 pixels.

76 3) The LMD measurement area shall be no larger than the illuminated screen area.

77 D) UUT Configuration and Control:

78 1) As-shipped Condition: The UUT shall be tested in its “as-shipped” configuration. For products that
79 offer a choice of user-configurable options, all options, including color controls, shall be set to their
80 default conditions.

81 2) Peripherals:

82 i) External devices shall not be connected to Universal Serial Bus (USB) ports.

83 ii) Built-in speakers, TV tuners, and other product features and functions not specifically
84 addressed by the ENERGY STAR eligibility criteria or test method may be configured in a
85 minimum power configuration, as adjustable by the user.

86 3) Signal Interface: Displays that offer both an analog and a digital interface shall be tested with the
87 analog interface.

88 E) Resolution and Refresh Rate:

89 1) Fixed-pixel Displays:

90 i) Pixel format shall be set to the native level.

91 ii) Refresh rate shall be set to 60 Hz, unless a different default refresh rate is specified in the
92 product manual, in which case the specified default refresh rate shall be used.

93 2) CRT Displays:

94 i) Pixel format shall be set to the highest resolution that is designed to be driven at a 75 Hz
95 refresh rate, as specified in the product manual. VESA Discrete Monitor Timing (DMT) or
96 other industry standard pixel format timing shall be used for testing.

97 ii) Refresh rate shall be set to 75 Hz.

98 F) Battery Operated Products: For products designed to operate using batteries when not connected to
99 the mains, the battery shall be fully charged before the start of testing and shall be left in place for the
100 test.

101 **6 LOW-VOLTAGE DC SOURCE MEASUREMENT**

102 1) Connect the DC source to the power meter and relevant AC supply as specified in Table 1.

¹ VESA FPDM Standard 2.0, Section 301-2H

² VESA FPDM Standard 2.0, Appendix A115

- 103 2) Verify that the DC source is unloaded.
- 104 3) Allow the DC source to warm up for a minimum of 30 minutes.
- 105 4) Measure and record the unloaded DC source power (P_S) according to IEC 62301 Ed. 1.0.

106 **7 PRE-TEST UUT INITIALIZATION FOR ALL PRODUCTS**

- 107 A) Prior to the start of testing, the UUT shall be initialized as follows:
- 108 1) Set up the UUT per the instructions in the supplied operating manual.
- 109 2) Connect the power meter to the power source and connect the UUT to the power outlet on the
110 power meter.
- 111 3) Set the ambient light level such that the measured display screen illuminance is less than 1 lux.
- 112 4) Power on the UUT and perform initial system configuration, as applicable.
- 113 5) Ensure that UUT settings are in their as-shipped configuration.
- 114 6) Warm up the UUT for at least 20 minutes, or until the unit has completed initialization and is ready
115 for use.³
- 116 7) Measure and record the ac input voltage and frequency.
- 117 8) Measure and record the test room ambient temperature.

118 **8 TEST PROCEDURES FOR PRODUCTS WITH VIEWABLE**

119 **DIAGONAL SCREEN SIZE LESS THAN 30 INCHES**

120 **8.1 On Mode Test for CRT Displays**

- 121 1) Ensure that the UUT has been initialized per Section 6.
- 122 2) Display the VESA FPDM AT01P test pattern.
- 123 3) Set the UUT image size to the manufacturer's recommended image size (typically slightly smaller
124 than maximum viewable screen size).
- 125 4) Display the VESA FPDM SET01K test pattern (8 shades of gray from full black (0 volts) to full
126 white (0.7 volts)).⁴
- 127 5) Verify that input signal levels conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev.
128 2.0, December 2002.

³ VESA FPDM Standard 2.0, Section 301-2D or 305-3 for warm-up test.

⁴ For digital-interface displays, image brightness shall correspond to voltage as follows:

- 0.0 V (black) = a setting of 0
- 0.1 V (darkest shade of gray analog) = 36 digital gray
- 0.7 V (full white analog) = 255 digital gray

- 129 6) If possible, adjust display brightness control until the lowest black-bar luminance level is just
130 slightly visible, per VESA FPDM Section 301-3K.
- 131 7) Display the VESA FPDM L80 test pattern (full white (0.7 volts) box that occupies 80% of the
132 image).
- 133 8) Ensure that the LMD measurement area falls entirely within the illuminated portion of the test
134 pattern.
- 135 9) Adjust the contrast control until the measured luminance of the white area of the screen is 100
136 cd/m² or nearest achievable value.
- 137 10) Measure and record display luminance. Note: Following this point in the test procedure, dark
138 room conditions are no longer required.
- 139 11) Measure and record On Mode power (P_{ON}) and total pixel format (horizontal x vertical).

140 **8.2 On Mode Test for Fixed-pixel Displays**

- 141 1) Ensure that the UUT has been initialized per Section 6.
- 142 2) Display the VESA FPDM SET01K test pattern (8 shades of gray from full black (0 volts) to full
143 white (0.7 volts)).
- 144 3) Verify that input signal levels conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev.
145 2.0, December 2002.
- 146 4) With the brightness and contrast controls at maximum, verify that the white and near-white-grey
147 levels can be distinguished. If necessary, adjust contrast controls until the white and near-white-
148 grey levels can be distinguished
- 149 5) Display the VESA FPDM L80 test pattern (full white (0.7 volts) box that occupies 80% of the
150 image).
- 151 6) Ensure that the LMD measurement area falls entirely within the white portion of the test pattern.
- 152 7) Adjust the contrast control until the luminance of the white area of the screen is as specified in
153 Table 3. If the UUT cannot achieve the specified luminance, set display luminance to the nearest
154 achievable value.

155 **Table 3: Luminance Settings for On Mode Testing of Fixed-Pixel Displays**

| Screen Resolution | Luminance (Cd/m ²) |
|---|--------------------------------|
| Less than or equal to 1.1 MP resolution | 175 |
| Greater than 1.1 MP resolution | 200 |

- 156 8) Measure and record display luminance.
- 157 9) If the UUT does not have ABC Enabled by Default:
 - 158 i) Measure and record On Mode power (P_{ON}) and total pixel format (horizontal x vertical).
- 159 10) If the UUT has ABC Enabled by Default:

- 160 i) Set the ambient light level to 300 lux, as measured at the face of the product's ambient light
161 sensor.
- 162 ii) Measure and record On Mode power in high ambient lighting conditions (P_H) and total pixel
163 format (horizontal x vertical).
- 164 iii) Set the ambient light level to 0 lux, as measured at the face of the product's ambient light
165 sensor.
- 166 iv) Measure and record On Mode power in low ambient lighting conditions (P_L).

167 **8.3 Sleep Mode**

- 168 1) At the conclusion of the On Mode test, initiate Sleep Mode.
- 169 2) Document the method of adjustment and sequence of events required to reach Sleep Mode.
- 170 3) If the product has a variety of Sleep Modes that can be manually selected, measurements shall be
171 performed in the most energy consumptive Sleep Mode. If the product automatically cycles
172 through its various Sleep Modes, measurement time shall be long enough to obtain a true average
173 of all Sleep Modes.
- 174 4) Measure and record Sleep Mode power (P_{SLEEP}).

175 **8.4 Off Mode**

- 176 1) At the conclusion of the Sleep Mode test, initiate Off Mode via the most easily accessible power
177 switch.
- 178 2) Document the method of adjustment and sequence of events required to reach Off Mode.
- 179 3) Any input sync signal check cycle may be ignored when measuring Off Mode power.
- 180 4) Measure and record Off Mode power (P_{OFF}).

181 **9 TEST PROCEDURES FOR PRODUCTS WITH VIEWABLE**
182 **DIAGONAL SCREEN SIZE FROM 30 TO 60 INCHES, INCLUSIVE**

183 **Table 4: Test Procedures**

| Requirement | Test Protocol |
|---------------|---|
| On Mode Power | IEC 62087, Ed 2.0: Methods of Measurement for the Power Consumption of Audio, Video and Related Equipment, Section 11, "Measuring conditions of television sets for On (average) mode." |

184 **9.1 On Mode**

- 185 A) Products shall be tested in On Mode according to the method specified in Table 4, subject to the
186 following guidance:

- 187 1) Accuracy of Input Signal Levels: Video inputs shall be within $\pm 2\%$ of reference white and black
188 levels.
- 189 2) Signal Input: HDMI inputs should be used for testing wherever possible.
- 190 3) True Power Factor: True power factor shall be measured over the duration of On Mode testing.
191 The average true power factor shall be recorded.
- 192 4) Test Materials: "Dynamic Broadcast Content" shall be used for testing, as specified in IEC-62087
193 Ed. 2.0, Section 11.6.1, "On mode (average) testing with dynamic broadcast-content video signal."
- 194 5) As-shipped Conditions: The UUT shall be tested in its as-shipped factory-default condition. All
195 picture adjustments required for On Mode testing shall be performed per IEC-62087, Ed. 2.0,
196 11.4.8, "Picture level adjustments."
- 197 6) Forced Menu: If the product includes a "forced menu" upon initial start-up for user selection of a
198 picture mode, "standard" or "home" picture mode shall be selected.
- 199 7) Automatic Brightness Control: On Mode power shall be measured and recorded under both low-
200 ambient (0 lux) and high-ambient (300 lux) lighting conditions, as measured at the face of the
201 product's ambient light sensor.
- 202 8) Luminance: Luminance measurements shall be performed in accordance with the test conditions
203 specified in IEC 62087, Ed. 2.0. Luminance measurements shall be conducted with picture
204 settings in their "as-shipped" condition. For products with a forced menu, measurements shall be
205 conducted in "standard" or "home" mode.

206 9.2 Luminance

- 207 9) At the conclusion of the On Mode test, display a three bar (L_t) static video signal per section 11.5
208 of IEC 62087.
- 209 10) Measure and record the center point, axial luminance of the display (per VESA FPDM Version 2.0,
210 section 301-2H).

211 9.3 Sleep Mode

- 212 1) At the conclusion of the Luminance test, initiate Sleep Mode.
- 213 2) Document the method of adjustment and sequence of events required to reach Sleep Mode.
- 214 3) If the product has a variety of Sleep Modes that can be manually selected, measurements shall be
215 performed in the most energy consumptive Sleep Mode. If the product automatically cycles
216 through its various Sleep Modes, measurement time shall be long enough to obtain a true average
217 of all Sleep Modes.
- 218 4) Measure and record Sleep Mode power (P_{SLEEP}).

219 9.4 Off Mode

- 220 1) At the conclusion of the Sleep Mode test, initiate Off Mode via the most easily accessible power
221 switch.

- 222 2) Document the method of adjustment and sequence of events required to reach Off Mode.
- 223 3) Any input sync signal check cycle may be ignored when measuring Off Mode power.
- 224 4) Measure and record Off Mode power (P_{OFF}).