



ENERGY STAR® Program Requirements for Displays

Table of Contents

Partner Commitments	2
Commitment.....	2
Performance for Special Distinction.....	3
Eligibility Criteria	5
Definitions.....	5
Qualifying Products.....	6
Energy-Efficiency Specifications for Qualifying Products.....	6
Test Method.....	9
User Interface.....	14
Effective Date.....	14
Future Specification Revisions.....	15



ENERGY STAR® Program Requirements for Displays

Partner Commitments

Commitment

The following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacturing of ENERGY STAR qualified displays. The ENERGY STAR Partner must adhere to the following program requirements:

- comply with current ENERGY STAR Eligibility Criteria, defining the performance criteria that must be met for use of the ENERGY STAR certification mark on displays and specifying the testing criteria for displays. EPA may, at its discretion, conduct tests 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 EPA's request;
- comply with current ENERGY STAR Identity Guidelines, describing how the ENERGY STAR name and mark may be used. Partner is responsible for adhering to these guidelines and for ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance;
- qualify at least one ENERGY STAR qualified display model within six months of activating the display portion of the agreement. When Partner qualifies the product, it must meet the specification (e.g., Tier 1 or 2) in effect at that time;
- provide clear and consistent labeling of ENERGY STAR qualified displays. The ENERGY STAR label must be clearly displayed on the product packaging, in product literature (i.e., spec sheets), and on the manufacturer's Internet site where information about ENERGY STAR qualified models is displayed. In addition, ENERGY STAR qualified displays must be labeled according to one of the following three options: 1) permanent label on the top/front of the display; 2) temporary label on the top/front of the display; or 3) use of an electronic label so that the ENERGY STAR certification mark appears on the display's screen through software in a manner that ensures only qualified displays are labeled, such as a desktop folder, on-screen display, boot-up screen, or navigation screen.

Note: EPA has removed the 'labeling through advertising' option under this Draft 1 Version 5.0 specification because, to EPA's knowledge, no manufacturers have elected to use this option as a substitute for placing either a permanent, temporary, or electronic label on their product since the Version 4.0 specification took effect in January 2005. Additionally, EPA has removed language indicating that the labeling requirements were deferred until July 1, 2006.

- provide to EPA, on an annual basis, an updated list of ENERGY STAR qualifying display models. Once the Partner submits its first list of ENERGY STAR qualified display models, the Partner will be listed as an ENERGY STAR Partner. Partner must provide annual updates in order to remain on the list of participating product manufacturers;
- provide to EPA, on an annual basis, unit shipment data or other market indicators to assist in determining the market penetration of ENERGY STAR. Specifically, Partner must submit the total number of ENERGY STAR qualified displays shipped (in units by model) or an equivalent measurement as agreed to in advance by EPA and Partner. Partner is also encouraged to provide

ENERGY STAR qualified unit shipment data segmented by meaningful product characteristics (e.g., capacity, size, speed, or other as relevant), total unit shipments for each model in its product line, and percent of total unit shipments that qualify as ENERGY STAR. The data for each calendar year should be submitted to EPA, preferably in electronic format, no later than the following March and may be provided directly from the Partner or through a third party. The data will be used by EPA only for program evaluation purposes and will be closely controlled. If requested under the Freedom of Information Act (FOIA), EPA will argue that the data is exempt. Any information used will be masked by EPA so as to protect the confidentiality of the Partner;

- notify EPA of a change in the designated responsible party or contacts for displays within 30 days.

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:

- consider energy efficiency improvements in company facilities and pursue the ENERGY STAR label for buildings;
- 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;
- ensure the power management feature is enabled on all ENERGY STAR qualified displays 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 product models;
- feature the ENERGY STAR mark on Partner Web site and in other promotional materials. If information concerning ENERGY STAR is provided on the Partner Web site as specified by the ENERGY STAR Web Linking Policy (this document can be found in the Partner Resources section on the ENERGY STAR Web site at www.energystar.gov), EPA may provide links where appropriate to the Partner Web site;
- 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 Web pages, etc. The plan may be as simple as providing a list of planned activities or planned milestones that Partner would like EPA to be aware of. For example, activities may include: (1) increase the availability of ENERGY STAR qualified products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrate the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) provide information to users (via the Web site and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products, and (4) build awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event;
- 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.

Note: Note: EPA proposes the following additions to the “Performance for Special Distinction” section of the Partner Commitments for Display Partners:

- Join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. SmartWay Transport 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, visit <http://www.epa.gov/gmpower/>.



ENERGY STAR® Program Requirements for Displays

Eligibility Criteria (Version 5.0)

DRAFT 1

Below is the Draft 1 (Version 5.0) product specification for ENERGY STAR qualified Displays. A product must meet all of the identified criteria if it is to be labeled as ENERGY STAR by its manufacturer.

1) **Definitions:** Below is a brief description of an Electronic Display and other terms as relevant to ENERGY STAR.

- A. **Electronic Display (also referred to as “Display”):** A commercially-available, electronic product with a display screen and its associated electronics encased in a single housing that, as its primary function, displays visual information from (i) a computer, workstation or server via one or more inputs, such as VGA, DVI, HDMI, and/or IEEE 1394, or (ii) a USB flash drive, a memory card, or wireless Internet connection to obtain primary functionality. Common display technologies include liquid crystal display (LCD), light emitting diode (LED), cathode-ray tube (CRT), or other device. To qualify, the display must be capable of being powered by a separate AC wall outlet, a battery unit that is sold with an AC adapter, or from a data or network connection. Displays with a tuner may qualify as ENERGY STAR under this specification as long as they are marketed and sold to consumers as displays (i.e., focusing on electronic display as the primary function) or as dual function displays and televisions. However, products with a tuner and computer capability that are marketed and sold as televisions are not included in this specification.

Note: EPA has broadened the scope of the ‘computer monitor’ definition provided under the Version 4.1 computer monitor specification to now apply to a wider category of electronic display devices. It is EPA’s intent that when finalized, this Version 5.0 Displays specification will cover a variety of electronic displays, including digital photo frames, computer monitors, and professional signage. As such, EPA has modified all references to ‘computer monitors’ in the Version 4.1 specification to now read ‘displays’ in this Draft 1 Version 5.0 document. However, while broadening the scope, EPA wants to ensure that the intent of the ENERGY STAR displays program is maintained by only allowing products to qualify for which we have relevant power consumption test data. These product types include digital photo frames, computer monitors, and professional signage. **As such, EPA is considering including minimum and maximum viewable diagonal screen sizes for eligible products to the above definition and seeks stakeholder input on the appropriate size constraints.** For stakeholder reference, the smallest product in EPA’s current displays dataset has a viewable diagonal screen size of 7 inches and the largest has a viewable diagonal screen size of 84 inches.

Consistent with the Version 4.1 monitor specification, products with a tuner may continue to qualify under this proposed Version 5.0 set of requirements as long as they are marketed and sold as displays or as dual function displays and televisions. However, it is EPA’s intent that under Tier 2, only those products without tuners will be able to qualify under the proposed Version 5.0 displays specification. All displays products with tuners will have to qualify under Tier 2 of the Version 3.0 ENERGY STAR TV products specification.

- B. **External Power Supply:** A component contained in a separate physical enclosure external to the display casing and designed to convert line voltage ac input from the mains to lower dc voltage(s) for the purpose of powering the display. An external power supply must connect to the display via a removable or hard-wired male/female electrical connection, cable, cord or other wiring.

EPA has included a definition for external power supplies in this Draft 1 specification because of the inclusion of external power supply requirements under Section 3, Energy Efficiency Specifications for Qualifying Products.

- C. **On Mode:** The product is connected to a power source and produces an image. The power requirement in this mode is typically greater than the power requirement in Sleep and Off Modes.
 - D. **Sleep Mode:** The reduced power state that the display enters after receiving instructions from a computer, server, or via other functions. A blank screen and reduction in power consumption characterize this mode. The display returns to On Mode with full operational capability upon sensing a signal through the visual display input (e.g., user moves the mouse or presses a key on the keyboard).
 - E. **Off Mode:** The lowest power consumption (“minimum power”) mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when a display is connected to the main electricity supply and used in accordance with the manufacturer’s instructions. For purposes of this specification, Off Mode is defined as the power state when the product is connected to a power source, produces no images, and is waiting to be switched to On Mode by a direct signal from a use (e.g., user pushes power switch).
- 2) **Qualifying Products:** In order to qualify as ENERGY STAR, a display model must meet the definition in Section 1.A and the specification requirements provided in Section 3, below. As explained in Section 1, this specification does not cover products with computer capability that are marketed and sold as televisions.
- 3) **Energy-Efficiency Specifications for Qualifying Products:** Only those products listed in Section 2 that meet the following criteria may qualify as ENERGY STAR. Effective dates for Tiers 1 and 2 are provided in Section 6 of this specification.

A. **On Mode Requirements**

- 1. **Tier 1:** To qualify as ENERGY STAR, display models must not exceed the maximum On Mode power consumption (P) found from the equations provided in Table 1, based on the unit’s resolution and viewable screen area. The maximum On Mode power consumption is expressed in watts and rounded up to one decimal place. In the following equations, MP is the number of megapixels in decimal form (e.g., 1,920,000 pixels = 1.92 megapixels), and A is the viewable screen area of the product rounded to the nearest whole number, found by multiplying the viewable display width by the viewable display height.

Table 1: Tier 1 On Mode Power Consumption Requirements for Displays

Display Category	Maximum On Mode Power Consumption
Less than 30" viewable diagonal screen size and less than 1 MP resolution	$P = 6.5*(MP) + 0.06*(A) + 3$
Less than 30" viewable diagonal screen size and greater than or equal to 1 MP resolution	$P = 14*(MP) + 0.15*(A) - 19$
Greater than or equal to 30" viewable diagonal screen size	$P = 14*(MP) + 0.20*(A) - 44$

For example, the maximum power consumption for a display with 1440 x 900 resolution, or 1,296,000 pixels, a 19 inch viewable diagonal screen size and a viewable screen area of 161 inches², would be: $((14 \times 1.296) + (0.15 \times 161)) - 19 = 23.3$ watts when rounded to one decimal place. Under these metrics, maximum allowed power consumption for displays with various resolutions and screen sizes is provided below in Table 2.

Table 2: Sample Tier 1 On Mode Maximum Power Levels

Viewable Diagonal Screen Size (Inches)	Resolution	Total Megapixels	Viewable Screen Size in Inches	Screen Area in Square Inches	Maximum On Mode Power Use (Watts)
7	800 x 480	0.384	5.9 x 3.5	21	6.8
15	1024 x 768	0.786	12 x 9	108	14.6
19	1440 x 900	1.296	16.07 x 10.05	161	23.3
46	1366 x 768	1.049	40.1 x 22.5	902	151.1
54	1920 x 1080	2.074	47 x 26.4	1,241	233.3

Note: In conducting a statistical analysis on the data submitted by manufacturers, EPA found that both screen resolution and screen size play a role in determining a display's On Mode power consumption. For standard LCD displays, EPA found that On Mode power consumption (at default luminance setting) was most strongly correlated to resolution. However, for displays of the same resolution, screen size was clearly an important variable for determining On Mode power consumption. For very small screen models, EPA found On Mode power consumption to be most strongly correlated to resolution. For very large screen models, EPA found On Mode power consumption to be most strongly correlated to screen area. EPA determined it was feasible to integrate both variables into a single equation for determining On Mode performance levels. This approach allows us to address the power consumption of models with the same resolution but different viewable screen sizes and conversely, the power consumption of models with the same viewable screen size but different resolutions. The approach also creates more consistency with the Version 3.0 ENERGY STAR TV products specification, which will facilitate addressing convergence under Tier 2 for both televisions and displays. Including both resolution and screen area as independent variables explained over 70% of the variance in On Mode power consumption for LCD displays.

Per EPA's preliminary analysis of monitors unit shipment data collected for calendar year 2007, market penetration of ENERGY STAR qualified monitors is estimated to be at over 90%. Based on EPA's current dataset, approximately 28% of display models would be able to meet the Tier 1 On Mode requirements proposed in this Draft 1 Version 5.0 displays specification.

Similar to the Tier 2 requirements under the Version 4.1 ENERGY STAR monitor specification, On mode requirements proposed under this Draft 1 Version 5.0 specification differentiate based on resolution and screen size, with reduced power consumption levels for low resolution, smaller screen sizes and increased power consumption levels for higher resolution and/or larger screen sizes. Sample Tier 1 maximum on mode power consumption levels are provided in Table 1 for a variety of display resolutions/sizes.

2. Tier 2: To qualify as ENERGY STAR, display models must not exceed the following maximum active power consumption equations: TBD.

Note: EPA has left Tier 2 requirements under this Draft 1 Version 5.0 displays specification as TBD. However, it is EPA's intent to engage in dialogue with industry during the Draft 1 stakeholder meeting scheduled for September 25, 2008, to discuss development of Tier 2 requirements that take into account energy-saving features for displays, such as (i) modulating backlights, (ii) automatic brightness control, (iii) polarizing films, (iv) timers/occupancy sensors, etc. Approximately 24% of EPA's current displays dataset incorporates automatic brightness control and it is anticipated that this feature, along with the others listed here, will only increase in prevalence over the next several years.

For those products that already incorporate automatic brightness control, it is EPA's intent under Tier 1 of this proposed Version 5.0 specification to request manufacturers to submit On Mode power consumption data under both low and average ambient light conditions. EPA will subsequently use this data as part of the development process for determining Tier 2 levels. **During the Draft 1 stakeholder meeting, scheduled for September 25, 2008, EPA will seek stakeholder input on appropriate test conditions for 'low' and 'average' ambient light conditions, which are currently not provided in this proposed set of Version 5.0 requirements.**

EPA developed the proposed requirements for Tier 1 of this Draft 1 Version 5.0 specification to allow display models with added functionality such as built-in speakers, USB ports, etc to qualify. Similarly, when developing Tier 2 requirements EPA is committed to recognizing full-featured products.

EPA is beginning review of other energy and safety related impacts associated with this product category for discussion with stakeholders for possible inclusion in Tier 2 of this specification. EPA is interested in receiving input on means to address this interest in a way that aligns with ENERGY STAR's guiding principles and fully expects to engage significant stakeholders input during this process.

To qualify a display as ENERGY STAR, it must be tested according to the protocol outlined in Section 4, Test Method.

- B. Display Products Using an External Power Supply: To qualify, the external power supply must be ENERGY STAR qualified or meet the no-load and active mode efficiency levels provided in the ENERGY STAR Program Requirements for Single Voltage Ac-Ac and Ac-Dc External Power Supplies. The ENERGY STAR specification and qualified product list can be found at www.energystar.gov/powersupplies.

Note: EPA has incorporated external power supply requirements for displays in this Draft 1 Version 5.0 ENERGY STAR displays specification. The inclusion of external power supply requirements is consistent with EPA's approach to other electronics product specifications developed/revised since the launch of the ENERGY STAR specification for single voltage ac-ac and ac-dc external power supplies, e.g., computers, set-top boxes, and televisions, whereby products must meet their respective energy-efficiency requirements and when coupled with external power supplies, those power supplies must also meet ENERGY STAR requirements.

C. Sleep and Off Modes

1. Tiers 1 and 2: Maximum power consumption levels for Sleep and Off Modes are provided in Table 2 below. Displays capable of multiple Sleep Modes (i.e., Sleep and Deep Sleep) shall meet the Sleep Mode requirement below in all such modes. For example, a display tested at 4 watts in Sleep and 2 watts in Deep Sleep would not qualify because one of the Sleep Modes exceeds 2 watts. For products that meet the Off Mode power requirement in Sleep Mode, no further automatic power reductions are required to meet the Sleep Mode criterion.

Note: For simplicity, EPA has removed the section titled 'Sleep Mode Exception' that was previously included under the Version 4,1 monitor specification and instead, has included a statement clarifying that products able to meet the Off Mode requirements in Sleep Mode require no further automatic power reductions.

Table 3: Energy-Efficiency Criteria for Sleep and Off Modes (Tiers 1 and 2)

Mode	Tier 1	Tier 2
Sleep Mode	≤ 2 watts	≤ 1 watt
Off Mode	≤ 1 watt	≤ 1 watt

2. Sleep Mode Enabling: Energy savings from the display's Sleep Mode can only be achieved if this power-saving mode is enabled. EPA recognizes that enabling and default times are driven by the display input interface, e.g., computer, and, as such, has outlined these requirements in the Computer Agreement. However, where feasible (e.g., where display manufacturer has a business relationship with specific computer manufacturers or where display manufacturer also sells its own computers or bundled products), display manufacturer should ensure that ENERGY STAR qualified displays have their Sleep Modes enabled when shipped to the customer. Further, the display input interface shall activate the display's Sleep Mode within 15 minutes of user inactivity or as otherwise defined in future versions of the Computer Agreement (issued after current Version 4.0).

Note: Sleep and off Mode requirements under Tier 1 of this Draft 1 Version 5.0 specification are identical to the Tier 2 Sleep and Off mode requirements under the Version 4.1 specification. However, EPA has updated the specific reference to the amount of time after which the display's Sleep Mode must be activated based on the requirements in the latest Version 4.0 computer specification. Based on EPA's current displays dataset, approximately 26% of models can qualify across all modes under the Tier 1 requirements proposed in this Draft 1 Version 5.0 specification.

Under Tier 2, EPA is proposing to lower the Sleep Mode requirement to ≤ 1 watt. This proposal would allow consistency between the Tier 2 displays criteria and other ENERGY STAR specifications, such as televisions.

4) Test Method

Product Testing Set-up, Method, and Documentation: EPA utilizes, where possible, existing, widely-accepted industry practices for measuring product performance and power use under normal or typical operating conditions. The testing and measurement methods below reference published specifications from the Video Electronics Standards Association (VESA) Display Metrology Committee and the International Electrotechnical Commission (IEC), and supplement those guidelines where necessary with methods developed in cooperation with the display industry.

Manufacturers are required to perform tests and self-certify those product models that meet the ENERGY STAR guidelines. Families of display models that are built on the same chassis and are identical in every respect but housing and color may be qualified through submission of test data for a single, representative model. Likewise, models that are unchanged or that differ only in finish from those sold in a previous year may remain qualified without the submission of new test data, assuming the specification remains unchanged.

Power shall be measured from the outlet or power source to the product under test. The average true power consumption of the display shall be measured during the On Mode, the Sleep Mode, and the Off Mode. When performing measurements to self-certify a product model, the product being tested must initially be in the same condition (e.g., configuration and settings) as when shipped to the customer, unless adjustments need to be made pursuant to instructions below. If a product's electrical power comes from Mains, USB, IEEE1394, Power-over-Ethernet, telephone system, or any other means or combinations of means, the net AC electrical power consumed by the product (taking into account ac-to-dc conversion losses) must be used for qualification.

To ensure a consistent means for measuring the power consumption of electronics products, the following protocol must be followed, which has three main components:

- Product Testing Set-up and Conditions
- Product Testing Method

- **Product Testing Documentation**

This protocol ensures that outside factors do not adversely affect the test results and that the test results can be consistently reproduced. Manufacturers may elect to use an in-house or independent laboratory to provide the test results.

Product Testing Set-up and Conditions

A. Test Conditions:

Supply Voltage:	North America/Taiwan:	115 (± 1%) Volts AC, 60 Hz (± 1%)
	Europe/Australia/New Zealand:	230 (± 1%) Volts AC, 50 Hz (± 1%)
	Japan:	100 (± 1%) Volts AC, 50 Hz (± 1%)/60 Hz (± 1%)
		<i>Note:</i> For products rated for > 1.5 kW maximum power, the voltage range is ± 4%
Total Harmonic Distortion (THD) (Voltage):	< 2% THD (< 5% for products which are rated for > 1.5 kW maximum power)	
Ambient Temperature:	23°C ± 5°C	
Relative Humidity:	10 – 80 %	

(Reference IEC 62301 Ed 1.0: Household Electrical Appliances – Measurement of Standby Power, Sections 4.2, 4.3)

B. Models Capable of Operating at Multiple Voltage/Frequency Combinations: Manufacturers shall test their products based on the market(s) in which the models will be sold and promoted as ENERGY STAR qualified. For products that are sold as ENERGY STAR in multiple international markets and, therefore, rated at multiple input voltages, the manufacturer must test at and report the required power consumption or efficiency values at all relevant voltage/frequency combinations. For example, a manufacturer that is shipping the same model to the United States and Europe must measure, meet the specification, and report test values at both 115 Volts/60 Hz and 230 Volts/50 Hz in order to qualify the model as ENERGY STAR in both markets. If a model qualifies as ENERGY STAR at only one voltage/frequency combination (e.g., 115 Volts/60 Hz), then it may only be qualified and promoted as ENERGY STAR in those regions that support the tested voltage/frequency combination (e.g., North America and Taiwan).

Note: EPA has updated the Test Conditions in this Draft 1 Version 5.0 displays specification to be consistent with other recently developed/revised ENERGY STAR electronics specifications, e.g., computers, set-top boxes, and televisions. The test conditions are based on those provided in IEC 62301, Ed 1.0. Additionally, EPA has updated language related to qualifying display models capable of operating at multiple voltage/frequency combinations, again to be consistent with other recently developed/revised electronics specifications. The intent of this language is identical to the intent of the text included in the Version 4.1 specification under the heading ‘**Supply Voltage**,’ whereby models must be tested/qualified as ENERGY STAR at the voltage/frequency combination for each region where the manufacturer intends to sell the model as qualified.

C. Dark Room Conditions: When performing light measurements, the display shall be located in a dark room condition. The display screen illuminance measurement (E), when in Off Mode/Standby Power, must be 1.0 Lux or less. Measurements should be made at a point perpendicular to the center of the screen using a Light Measuring Device (LMD) with the display in Off Mode/Standby Power (Reference VESA FPDM Standard 2.0, Section 301-2F).

D. Color Controls and Peripherals: All color controls (hue, saturation, gamma, etc.) shall be placed at their factory default settings. No external devices shall be connected to any included Universal Serial Bus (USB) hubs or ports. Any built-in speakers, TV tuners, etc. may be placed in their minimum power configuration, as adjustable by the user, to minimize power use not associated

with the display itself. Circuit removal or other actions not under user control may not be taken to minimize power use.

- E. **Power Measurement Test Conditions:** For LCDs and other fixed pixel technologies, pixel format shall be set to the native level. LCD refresh rate shall be set to 60 Hz, unless a different refresh rate is specifically recommended by the manufacturer, in which case that rate shall be used. CRT pixel format shall be set at the preferred pixel format with the highest resolution that is intended to be driven at a 75 Hz refresh rate. A VESA Discrete Monitor Timing (DMT) or newer industry standard pixel format timing must be used for the test. The CRT display must be capable of meeting all its manufacturer-stated quality specifications in the tested format.
- F. **Power Measurement Protocols:** Display power consumption shall be measured in watts with an imposed test pattern. Warm-up time shall be a minimum of a 20-minute period (Reference VESA FPDM Standard 2.0, Section 301-2D or 305-3 for warm-up test). A true RMS power meter with a crest factor of at least five shall be used to measure the power use of each randomly chosen unit at one or more, as appropriate, of the voltage/frequency combinations provided in Section 4.A (Reference VESA Standard: Display Specifications and Measurement Procedures, Version 1.0, Revision 1.0, Section 8.1.3). Measurements shall be taken after wattage values are stable over a three-minute period. Measurements are considered stable if the wattage reading does not vary more than 1% over the three-minute period (Reference IEC 4.3.1). (Manufacturers shall ignore the input sync signal check cycle when metering the model in Sleep Mode/Low Power and Off Mode/Standby Power.) Manufacturers shall use calibrated measuring equipment capable of measurements accurate to one-tenth of a watt or better.

Borrowing from European Norm 50301 (Reference BSI 03-2001, BS EN 50301:2001, Methods of Measurement for the Power Consumption of Audio, Video, and Related Equipment, Annex A), EPA has established a test procedure where the number of units required for test depends on the test results for the first unit. If a tested display uses at least 15% less power (i.e., greater than or equal to 15%) than the ENERGY STAR specification in all three operating modes (On Mode/Active Power, Sleep Mode/Low Power, and Off Mode/Standby Power), then it only has to be tested once. However, if a tested display is within 15% (i.e., less than 15%) of the ENERGY STAR specification in any of the three operating modes, then two more units have to be tested. None of the test values may exceed the ENERGY STAR specification for the model to qualify as ENERGY STAR. All of the test results as well as the average values (based on the three or more data points) must be reported to EPA via the Online Product Submittal tool.

The following example further illustrates this approach:

EXAMPLE: For simplicity, assume the specification is **100 watts or less and only applies to one operational mode. 85 watts would represent the 15% threshold...**

- If the first unit is measured at **80 watts, no more testing** is needed and the model qualifies (80 watts is at least 15% more efficient than the specification and is “outside” the 15% threshold).
- If the first unit is measured at **85 watts, no more testing** is needed and the model qualifies (85 watts is exactly 15% more efficient than the specification).
- If the first unit is measured at **90 watts**, then **two more units** must be tested to determine qualification (90 watts is only 10% more efficient than the specification and is “within” the 15% threshold).
- If three units are tested at **90, 98, and 105 watts**, the model **does not qualify** as ENERGY STAR—even though the average is 98 watts—because one of the values (105) exceeds the ENERGY STAR specification.

- G. **Luminance Test Patterns and Procedures:** For all Fixed Pixel displays (e.g., LCDs and others), test pattern (VESA FPDM Standard 2.0, A112-2F, SET01K) shall be displayed that provides eight shades of gray from full black (0 volts) to full white (0.7 volts).¹ Input signal levels shall conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev. 2.0, December 2002. With the brightness and contrast controls at maximum, the technician shall check that, at a minimum, the white and near white gray levels can be distinguished. If white and near white gray levels cannot be

distinguished, then contrast shall be adjusted until they can be distinguished. The technician shall next display a test pattern (VESA FPDM Standard 2.0, A112-2H, L80) that provides a full white (0.7 volts) box that occupies 80% of the image. The technician shall then adjust the brightness control until the white area of the screen is set at the unit's default, as-shipped luminance setting, measured according to VESA FPDM Standard 2.0, Section 302-1. The luminance value shall be reported to EPA with other required testing documentation.

For CRT displays, the technician shall initiate the AT01P (Alignment Target 01 Positive Mode) pattern (VESA FPDM Standard 2.0, A112-2F, AT01P) for screen size and use it to set the display to the manufacturer's recommended image size, which is typically slightly smaller than maximum viewable screen size. Then, test pattern (VESA FPDM Standard 2.0, A112-2F, SET01K) shall be displayed that provides eight shades of gray from full black (0 volts) to full white (0.7 volts).¹ Input signal levels shall conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev. 2.0, December 2002. The technician shall adjust (where feasible) the display brightness control downward from its maximum until the lowest black bar luminance level is just slightly visible (VESA FPDM Standard 2.0, Section 301-3K). The technician shall then display a test pattern (VESA FPDM Standard 2.0, A112-2H, L80) that provides a full white (0.7 volts) box that occupies 80% of the image. The technician shall then adjust the contrast control until the white area of the screen is set at the unit's default, as-shipped luminance setting, measured according to VESA FPDM Standard 2.0, Section 302-1. The luminance value shall be reported to EPA with other required testing documentation.

Note: EPA has updated the luminance settings in this Draft 1 Version 5.0 specification to specify that manufacturers must test their displays at the unit's default, as-shipped luminance setting to determine ENERGY STAR qualification. EPA has made this change to capture savings associated with an estimated 30% difference in power consumption between luminance levels prescribed in the Version 4.1 specification and typical default, as-shipped luminance settings.

With this proposed change in luminance settings, it is EPA's intent that manufacturers continue to ship their display models at luminance settings that optimize display viewing for their consumers. It is not EPA's intent to encourage manufacturers to ship their display models at artificially low luminance levels in order to meet ENERGY STAR levels, as this will lead to consumer dissatisfaction and potentially a higher number of consumer complaints and returns.

- H. Light Measurement Protocols: When light measurements, such as illuminance and luminance, need to be made, a LMD shall be used with the display located in dark room conditions. The LMD shall be used to make measurements at the center of, and perpendicular to the display screen (Reference VESA FPDM Standard 2.0, Appendix A115). The screen surface area to be measured shall cover at least 500 pixels, unless this exceeds the equivalent of a rectangular area with sides of lengths equal to 10% of the visible screen height and width (in which case this latter limit applies). However, in no case may the illuminated area be smaller than the area the LMD is measuring (Reference VESA FPDM Standard 2.0, Section 301-2H).
- I. Display Set-up and Characterization: The display test sample characteristics shall be recorded prior to the test. The following information shall be recorded at a minimum:

¹ Corresponding voltage values for digital only interface displays that correspond to the brightness of the image (0 to 0.7 volts) are:

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

Please note that future digital interface specifications may widen this range, but in all cases, 0 volts shall correspond to black and the maximum value shall correspond to white, with 0.1 volts corresponding to one-seventh of the maximum value.

Product Description/Category (e.g., 17-inch computer monitor with white housing)
Display Technology (e.g., CRT, LCD, Plasma)
Brand Name/Manufacturer
Model Number
Serial Number
Rated Voltage (VAC) and Frequency (Hz)
Viewable Diagonal Size (inches)
Viewable Screen Area (square inches)
Aspect Ratio (e.g., 4:3)
Recommended Image Size (actual size tested) Width X Height
Viewing Angle (horizontal and vertical degrees)
Screen Refresh Rate (during test) (Hz)
Default Luminance Setting
Number of Pixels as Tested (horizontal)
Number of Pixels as Tested (vertical)
Maximum Claimed Resolution (horizontal)
Maximum Claimed Resolution (vertical)
Analog, Digital, or Both Interfaces
Instrumentation Information (e.g., type of signal generator)
Type of Power Supply (i.e., external or internal)

Note: EPA has added viewable screen area (square inches), default luminance setting, and type of power supply to the above list of display test sample characteristics that should be recorded prior to testing to account for the modified energy efficiency requirements proposed in this Draft 1 Version 5.0 specification.

Testing Method

- J. **Test Method:** Following are the test steps for measuring the true power requirements of the test unit in On Mode, Sleep Mode, and Off Mode. Manufacturers are required to test their displays using the analog interface, except in those cases where one is not provided (i.e., digital interface monitors, which are defined as only having a digital interface for purposes of this test method). For digital interface displays, please see Footnote 1 on page 12 for voltage information and then follow the test method below using a digital signal generator.

On Mode

1. Connect the test sample to the outlet or power source and test equipment. For displays shipped with an external power supply, the external power supply (as opposed to a reference power supply) must be used in the test.
2. Power on all test equipment and properly adjust power source voltage and frequency.
3. Check for normal operation of the test unit and leave all customer adjustments set to factory default settings.
4. Bring the test unit into On Mode either by using the remote control device or by using the ON/OFF switch on the test unit cabinet. Allow the unit under test to reach operating temperature (approximately 20 minutes).
5. Set the proper display mode. Refer to Section E, Power Measurement Test Conditions.
6. Provide dark room conditions. See Sections H, Light Measurement Protocols, and C, Dark Room Conditions.
7. Set size and luminance. Refer to Section G, Luminance Test Patterns and Procedures for CRT or Fixed Pixel displays. Once luminance is set, dark room conditions are no longer needed.
8. Either verify that the wall outlet power is within specifications or adjust the AC power source output as described in Section A (e.g., 115V ± 1%, 60Hz ± 1%).
9. Set the power meter current range. The full-scale value selected multiplied by the crest factor rating (I_{peak}/I_{rms}) of the meter must be greater than the peak current reading from the oscilloscope.

10. Allow the readings on the power meter to stabilize and then take the true power reading in watts from the power meter. Measurements are considered stable if the wattage reading does not vary more than 1% over the three-minute period. See Section F, Power Measurement Protocols.
11. Power consumption shall be recorded, as well as total pixel format (horizontal x vertical pixels displayed), to calculate pixels/watt.
12. Record the test conditions and test data.

Sleep Mode (Power Switch On, No Video Signal)

1. At the conclusion of the On Mode test, initiate the display's Sleep Mode. The method of adjustment shall be documented along with the sequence of events required to reach the Sleep Mode. Power on all test equipment and properly adjust operation range.
2. Allow the display to remain in Sleep Mode until stable power readings are measured. Measurements are considered stable if the wattage reading does not vary more than 1% over the three-minute period. Manufacturers shall ignore the input sync signal check cycle when metering the model in Sleep Mode.
3. Record the test conditions and test data. The measurement time shall be sufficiently long to measure the correct average value (i.e., not peak or instantaneous power). If the device has different Sleep Modes that can be manually selected, the measurement should be taken with the device in the most energy consumptive of those modes. If the modes are cycled through automatically, the measurement time should be long enough to obtain a true average that includes all modes.

Off Mode (Power Switch Off)

1. At the conclusion of the Sleep Mode test, initiate the display's Off Mode. If only one power switch is provided (i.e., a soft off or a hard off), press that switch; if two power switches are provided (i.e., a soft off AND a hard off), press the soft off switch. The method of adjustment shall be documented along with the sequence of events required to reach the Off Mode. Power on all test equipment and properly adjust operation range.
2. Allow the display to remain in Off Mode until stable power readings are measured. Measurements are considered stable if the wattage reading does not vary more than 1% over the three-minute period. Manufacturers shall ignore the input sync signal check cycle when metering the model in Off Mode.
3. Record the test conditions and test data. The measurement time shall be sufficiently long to measure the correct average value (i.e., not peak or instantaneous power).

Product Testing Documentation

- K. Submittal of Qualified Product Data to EPA: Partners are required to self-certify those product models that meet the ENERGY STAR guidelines and report information to EPA through the Online Product Submittal tool. ENERGY STAR qualifying product data, including information about new as well as discontinued models, must be provided on an annual basis, or more frequently if desired by the manufacturer.
- 5) **User Interface**: Manufacturers are strongly recommended to design products in accordance with the user interface standard IEEE P1621: Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments. This standard was developed by the Power Management Controls project to make power controls more consistent and intuitive across all electronic devices. For details on this project, see <http://eetd.LBL.gov/Controls>.
- 6) **Effective Date**: The date that manufacturers may begin to qualify products as ENERGY STAR, under the Version 5.0 specification, will be defined as the *effective date* of the agreement. Any previously executed agreement on the subject of ENERGY STAR qualified displays shall be terminated effective October 20, 2009.
 - A. Qualifying Products Under Tier 1 of the Version 5.0 Specification: Tier 1 of the Version 5.0 specification shall commence on **October 21, 2009**. All products, including models originally qualified under Version 4.1, with a **date of manufacture** on or after **October 21, 2009**, must meet the new (Version 5.0) requirements in order to qualify for ENERGY STAR (including additional

shipments of models originally qualified under Version 4.1). The **date of manufacture** is specific to each unit and is the date (e.g., month and year) of which a unit is considered to be completely assembled.

- B. Qualifying Products Under Tier 2 of the Version 5.0 Specification: The second phase of this specification, Tier 2, shall commence on **October 21, 2011**. Specifications for Tier 2 shall apply to products with a date of manufacture on or after **October 21, 2011**. For example, a unit with a date of manufacture of October 21, 2011 must meet the Tier 2 specification in order to qualify as ENERGY STAR.

Note: EPA anticipates finalizing the Version 5.0 ENERGY STAR displays specification in January 2009. The proposed effective date of October 21, 2009 would allow industry the typical nine months transition time prior to the revised specification taking effect. EPA has subsequently allowed two years prior to Tier 2 requirements taking effect in October 2011.

- C. Elimination of Grandfathering: EPA will not allow grandfathering under this Version 5.0 ENERGY STAR specification. **ENERGY STAR qualification under Version 4.1 is not automatically granted for the life of the product model.** Therefore, any product sold, marketed, or identified by the manufacturing partner as ENERGY STAR must meet the current specification in effect at the time of manufacture of the product.

- 7) **Future Specification Revisions**: EPA reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through stakeholder discussions.

EPA will periodically assess the market in terms of energy efficiency and new technologies. As always, stakeholders will have an opportunity to share their data, submit proposals, and voice any concerns. EPA will strive to ensure that the Tier 1 and 2 specifications recognize the most energy-efficient models in the marketplace and reward those manufacturers who have made efforts to further improve energy efficiency.