



ENERGY STAR® Program Requirements for Computer Monitors

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ENERGY STAR® Program Requirements for Computer Monitors

Partner Commitments

Commitment

The following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacturing of ENERGY STAR qualified computer monitors. 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 computer monitors and specifying the testing criteria for computer monitors. 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 computer monitor model within six months of activating the computer monitor 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 computer monitors. 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 computer monitors must be labeled according to one of the following four options: 1) permanent label on the top/front of the computer monitor; 2) temporary label on the top/front of the computer monitor; 3) use of an electronic label so that the ENERGY STAR certification mark appears on the computer monitor screen through software in a manner that ensures only qualified computer monitors are labeled, such as a desktop folder, on-screen display, boot-up screen, or navigation screen; or 4) the ENERGY STAR label incorporated into advertising so that the number of impressions that result are roughly equivalent to the impressions that would have resulted from consumer exposure to the label on qualified computer monitors. While Partner is expected to fulfill all other commitments listed under this Partner Commitments section of the Partnership Agreement for Computer Monitors as of the specification effective date, the labeling requirements are deferred until January 2006;

Note: After considering stakeholder comments, EPA has removed Section 6.D, Fulfillment of Partner Commitments, from the Eligibility Criteria and inserted the relevant text in the bullet above. With this change, all Partner Commitments language is maintained in one place or section of the Partnership Agreement.

The language above allows additional time for partners to implement the labeling requirements. Partners must display the label on product packaging, in product literature, on their Internet sites, and on qualifying models according to one of four options (i.e., permanent label, temporary label, electronic label, or labeling via advertising) by January 2006; this date was specifically selected to coincide with the Tier 2 effective date and the anticipated adoption of the new ENERGY STAR label by the European Commission.

- provide to EPA, on an annual basis, an updated list of ENERGY STAR qualifying computer monitor models. Once the Partner submits its first list of ENERGY STAR qualified computer monitor 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 computer monitors 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 computer monitors 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 computer monitors 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.



ENERGY STAR® Program Requirements for Computer Monitors

DRAFT 3 Eligibility Criteria (Version 4.0)

Below is the DRAFT 3 product specification (Version 4.0) for ENERGY STAR qualified Computer Monitors. 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 a Computer Monitor and other terms as relevant to ENERGY STAR.
 - A. **Computer Monitor (also referred to as "Monitor"):** A commercially-available, electronic product with a display screen and its associated electronics encased in a single housing that is capable of displaying output information from a computer via one or more inputs, such as VGA, DVI, and/or IEEE 1394. The monitor usually relies upon a cathode-ray tube (CRT), liquid crystal display (LCD), or other display device. This definition is intended primarily to cover standard monitors designed for use with computers. To qualify, the computer monitor must have a viewable diagonal screen size greater than 12 inches and must be capable of being powered by a separate AC wall outlet or a battery unit that is sold with an AC adapter. Computer monitors with a tuner/receiver may qualify as ENERGY STAR under this specification as long as they are marketed and sold to consumers as computer monitors (i.e., focusing on computer monitor as the primary function) or as dual function computer monitors and televisions. However, products with a tuner/receiver and computer capability that are marketed and sold as televisions are not included in this specification.
- Note:** In this draft, EPA has clarified the screen size reference to include viewable diagonal size in inches.
- B. **On Mode/Active Power:** 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.
 - C. **Sleep Mode/Low Power:** The reduced power state that the computer monitor enters after receiving instructions from a computer or via other functions. A blank screen and reduction in power consumption characterize this mode. The computer monitor returns to On Mode with full operational capability upon sensing a request from a user/computer (e.g., user moves the mouse or presses a key on the keyboard).
 - D. **Off Mode/Standby Power:** The lowest power consumption mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when a computer monitor 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 user/computer (e.g., user pushes power switch).¹
 - E. **Hard Off Mode:** A condition where the product is still plugged into the mains, but has been disconnected from an external power source. This mode is usually engaged by the consumer via a "hard off switch." While in this mode, a product will not draw any electricity and will usually measure 0 watts when metered.

¹ This definition is consistent with IEC 62301: Household Electrical Appliances – Measurement of Standby Power. IEC 62301 is still in draft form, as of the writing of this specification. While significant changes to the relevant portions of the IEC document are not envisioned by its authors, EPA will review the final version, when available, to ensure that no material changes have been made to the applicable sections of the document.

Note: For additional clarity, EPA has 1) removed the sentence regarding IEC 62301 from the Off Mode/Standby Power definition and incorporated it into Footnote 1 and 2) deleted the term “operating” from the Hard Off Mode definition.

EPA anticipates that many computer monitors will be designed such that they enter Off Mode when the user pushes the “soft off” power switch. Monitors operating in this manner are eligible for the ENERGY STAR, provided that they meet the power requirements. Similarly, a Hard Off Mode/Switch is not required for ENERGY STAR qualification. EPA added a Hard Off Mode definition in Draft 2.5 at the request of manufacturers and in order to better differentiate the various modes.

F. Disconnect: The product has been unplugged from the mains and therefore is disconnected from all external power sources.

- 2) **Qualifying Products**: In order to qualify as ENERGY STAR, a computer monitor 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.

Widescreen Models: Widescreen (e.g., 16:9, 15:9, etc.) models are eligible to earn the ENERGY STAR, provided that they meet EPA’s energy-efficiency requirements. There are no separate specifications for widescreen models and as such, they must comply with Sections 3.A and 3.B, below. For Tier 2, future revisions or clarifications for widescreen models will be evaluated and considered, when adequate energy consumption data is readily available to EPA.

Note: In this draft, EPA has indicated that 16:9, 15:9, etc. are examples of wide screen formats and not the only available formats.

Under Tiers 1 and 2 of this specification, widescreen models may qualify as ENERGY STAR if they meet the energy-efficiency requirements. EPA’s data analysis has shown that some currently-available widescreen models will qualify as ENERGY STAR under the Tier 1 specification, and hence a separate widescreen specification is not required. However, given the relatively recent introduction of widescreen models and the lack of significant energy consumption data available for them, EPA did not have the data to properly evaluate widescreen models relative to the Tier 2 specification. Further evaluation of Tier 2 and widescreens may be needed at a later date, if widescreen models garner additional market share as forecasted.

A. On Mode/Active Power

1. Tier 1: To qualify as ENERGY STAR, computer monitor models must not exceed the following maximum active power consumption equation: $Y = 38X + 30$. Y is expressed in watts and rounded up to the nearest whole number and X is the number of megapixels in decimal form (e.g., 1,920,000 pixels = 1.92 megapixels). For example, the maximum power consumption for a computer monitor with 1800 x 1440 resolution, or 2,592,000 pixels, would be: $38(2.592) + 30 = 128.49$ or 129 watts when rounded up. Under this metric, maximum allowed power consumption for computer monitors with various standard resolutions is provided below in Table 1.
2. Tier 2: To qualify as ENERGY STAR, computer monitor models must not exceed the following maximum active power consumption equation: If $X < 1$ megapixel, then $Y = 23$; if $X \geq 1$ megapixel, then $Y = 28X$. Y is expressed in watts and rounded up to the nearest whole number and X is the number of megapixels in decimal form (e.g., 1,920,000 pixels = 1.92 megapixels). For example, the maximum power consumption for a computer monitor with

1024 x 768 resolution (or .78 megapixels) would be $Y = 23$ watts and for a computer monitor with 1600 x 1200 resolution would be $28(1.92) = 53.76$ or 54 watts when rounded up.

Table 1: Sample Tier 1 On Mode Maximum Power Levels

Resolution	Total Pixels	Maximum Power Use for Tier 1
640 x 480	307,200	42 watts
800 x 600	480,000	49 watts
1024 x 768	786,432	60 watts
1280 x 768	983,040	68 watts
1280 x 1024	1,310,720	80 watts
1600 x 1024	1,638,400	93 watts
1600 x 1200	1,920,000	103 watts
1920 x 1200	2,304,000	118 watts
1800 x 1440	2,592,000	129 watts
2048 x 1440	2,949,120	143 watts
2048 x 1536	3,145,728	150 watts

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

B. Sleep and Off Modes

1. Tiers 1 and 2: Maximum power consumption levels for Sleep and Off Modes are provided in Table 2 below. Computer monitors capable of multiple Sleep Modes (i.e., Sleep and Deep Sleep) shall meet the Sleep Mode requirement below in all such modes. For example, under Tier 1, a computer monitor tested at 7 watts in Sleep and 3 watts in Deep Sleep would not qualify because one of the Sleep Modes exceeds 4 watts.
2. Sleep Mode Exception: Computer monitors that have the capability to proceed automatically from On Mode/Active Power to an Off Mode/Standby Power of 2 watts or less in Tier 1 and 1 watt or less in Tier 2 comply with these energy consumption requirements. The computer monitor's Off Mode/Standby Power must be activated within 30 minutes of user inactivity or as otherwise defined in future versions of the Computer Agreement (issued after current Version 3.0). Upon resumption of user activity (e.g., user moves the mouse or presses a key on the keyboard), the computer monitor must return to full operational capability. In other words, a Sleep Mode is not necessary if the computer monitor can proceed from On Mode/Active Power to Off Mode/Standby Power and meet the ENERGY STAR requirements in the Off Mode/Standby Power.

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

	Tier 1	Tier 2
Sleep Mode	≤ 4 watts	≤ 2 watts
Off Mode	≤ 2 watts	≤ 1 watt

3. Sleep Mode Enabling: Energy savings from the computer monitor'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 computer, and as such, has outlined these requirements in the Computer Agreement. However, where feasible (e.g., where monitor manufacturer has a business relationship with specific computer manufacturers or where monitor manufacturer also sells its own computers or bundled products), monitor manufacturer should ensure that ENERGY STAR qualified computer monitors have their Sleep Modes enabled when shipped to the customer. Further, the computer shall activate the computer monitor's Sleep Mode within 30 minutes of user inactivity or as otherwise defined in future versions of the Computer Agreement (issued after current Version 3.0). **If a computer monitor has the capability to proceed automatically from On Mode/Active Power to Off Mode/Standby Power, then, consistent with the Sleep Mode requirements, the computer monitor's Off**

Mode/Standby Power must be activated within 30 minutes of user inactivity or as otherwise defined in future versions of the Computer Agreement (issued after current

Note: Regarding the Draft 3 performance levels, please note the following:

- For Tier 2, the proposed levels are based on test data submitted to EPA by monitor manufacturers and represent the top 25% of LCDs in All Modes and the top 38% in On Mode/Active Power.
- The proposed Tier 2 levels today represent the top 11.7% of computer monitors in EPA's expanded data set in All Modes.
- The changes to Tier 2 reduce the performance level for low resolution/smaller screen size models without affecting the larger screen sizes.
- Tier 2 levels accommodate larger screen sizes; sufficient data is not currently available to evaluate widescreens under Tier 2.
- Tier 1 levels have not changed and remain consistent with Draft 2.5. The levels represent the top 17% of CRTs and 69% of LCDs from the data set.
- Tier 1 levels accommodate larger screen sizes (20 inches and above) and widescreen models, as suggested by manufacturers.
- Tier 1 and 2 Sleep and Off Mode levels have not changed and remain consistent with Drafts 1, 2 and 2.5.

Version 3.0).

4) **Test Methodology**

Product Testing Set-up, Methodology, 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 computer monitor industry.

Manufacturers are required to perform tests and self-certify those product models that meet the ENERGY STAR guidelines. Families of computer monitor 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.

The power requirement shall be measured from the outlet or power source to the product under test. The average true power consumption of the computer monitor shall be measured during the On Mode/Active Power, the Sleep Mode/Low Power, and the Off Mode/Standby Power. 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.

Note: Based on a stakeholder comment, EPA revised the language in the above paragraph to avoid any specific references to the partner, as the partner may not be conducting the tests.

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: Outlined below in Sections A through H are the ambient test conditions and measurement protocols that must be respected when performing power measurements.

Product Testing Methodology: The actual test steps for measuring power in On Mode/Active Power, Sleep Mode/Low Power, and Off Mode/Standby Power are provided in Section I, below.

Product Testing Documentation: Documentation requirements for submittal of qualified product data to EPA are detailed in Section J, below.

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. A sample of test facilities and recommended test equipment will be provided in the near future on the ENERGY STAR Web site at www.energystar.gov.

Product Testing Set-up and Conditions

A. Test Conditions:

General Criteria

Supply Voltage*:	North America: Europe: Australia/New Zealand: Japan:	115 (± 1%) Volts AC, 60 Hz (± 1%) 230 (± 1%) Volts AC, 50 Hz (± 1%) 230 (± 1%) Volts AC, 50 Hz (± 1%) 100 (± 1%) Volts AC, 50 Hz (± 1%)/60 Hz (± 1%)
Total Harmonic Distortion (Voltage):	< 2% THD	
Ambient Temperature:	21°C ± 3°C	
Relative Humidity:	40 – 60 %	
Line Impedance:	< 0.25 ohm	

(Reference IEC 62301: Household Electrical Appliances – Measurement of Standby Power, Sections 3.2, 3.3 and VESA Flat Panel Display Measurements (FPDM) Standard 2.0, Section 301-2)

***Supply Voltage:** Manufacturers shall test their computer monitors based on the market in which the models will be sold. Manufacturers must ensure that qualifying products marketed and sold in any region as ENERGY STAR do not exceed the power levels declared on the Qualifying Product Information (QPI) form (and stored in the ENERGY STAR database) at the standard mains voltage and frequency conditions of that region. For equipment that is sold in multiple international markets and therefore rated at multiple input voltages, the manufacturer must test at and report all relevant voltages and power consumption levels if it intends to register the product as ENERGY STAR in the respective markets. For example, a manufacturer that is shipping the same computer monitor model to the United States and Europe must measure and report the On, Sleep, and Off power consumption at both 115 Volts/60 Hz and 230 Volts/50 Hz.

Note: Based on feedback from international stakeholders, EPA has added language in Section 4.A requiring manufacturers to submit test values at local voltage/frequency conditions. While EPA considered limiting testing to 115 volts at 60 Hz, various concerns were raised about the potential variations in tested values across markets. Subsequent discussions with the Information Technology Industry Council (ITI) and other individual manufacturers indicated that testing at market-specific voltage and frequency values would be acceptable.

Finally, EPA has made three additional changes in response to stakeholder feedback:

- The ambient temperature range has been reduced from 15-25°C to 18-24°C;
- A relative humidity test range has been added; and
- To help ensure consistent power measurements, line impedance (less than 0.25 ohm) has been incorporated into the test conditions.

- B. **Dark Room Conditions:** When performing light measurements, the computer monitor shall be located in a dark room condition. The computer monitor 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

computer monitor in Off Mode/Standby Power (Reference VESA FPDM Standard 2.0, Section 301-2F).

Note: For clarity in Section 4.B, EPA has used the term “Off Mode/Standby Power” instead of “when the screen is switched off” or “with the power to the computer monitor off.”

- C. 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.
- D. Power Measurement Test Conditions: 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 monitor must be capable of meeting all its manufacturer-stated quality specifications in the tested format. 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.
- E. Power Measurement Protocols: Computer monitor 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. For the purposes of ENERGY STAR, if a tested computer monitor 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 computer monitor 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 on an ENERGY STAR QPI form.

Note: Two minor changes have been made to Section 4.E. In the first paragraph, any mention of specific voltage/frequency combinations has been removed and replaced with a reference to Section 4.A. In the second paragraph, the text has been corrected to reflect power measurements as opposed to efficiency measurements.

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.

- F. **Luminance Test Patterns and Procedures:** For **CRT monitors**, 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 computer monitor 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).² 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 computer monitor 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 provides at least 100 candelas per square meter of luminance, measured according to VESA FPDM Standard 2.0, Section 302-1.

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).² 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 provides at least 175 candelas per square meter of luminance, measured according to VESA FPDM Standard 2.0, Section 302-1. [If computer monitor’s maximum luminance is less than 175 candelas per square meter (e.g., 150), then technician shall use the maximum luminance (e.g., 150) and report the value to EPA with other required testing documentation. Similarly, if the computer monitor’s minimum luminance is greater than 175 candelas per square meter (e.g.,

² Corresponding voltage values for digital only interface monitors 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.

200), then technician shall use the minimum luminance (e.g., 200) and report the value to EPA.]

Note: High-resolution test patterns are available through VESA. However, because the test pattern files are very large for resolutions over 1600 x 1200, VESA is currently not able to upload them to www.vesa.org/public/Fpdm2/Test%20Patterns/ for download by the public. For high-resolution test patterns on a CD-ROM, please contact Bill Lempesis, Executive Director, at (408) 957-9270 or bill@vesa.org.

- G. **Light Measurement Protocols:** When light measurements, such as illuminance and luminance, need to be made, a LMD shall be used with the computer monitor located in dark room conditions. The LMD shall be used to make measurements at the center of, and perpendicular to the computer monitor 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).
- H. **Display Set-up and Characterization:** The computer monitor test sample characteristics shall be recorded prior to the test. The following information shall be recorded at a minimum:

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)
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)
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)

Product Testing Methodology

- I. **Test Method:** Following are the test steps for measuring the true power requirements of the test unit in On Mode/Active Power, Sleep Mode/Low Power, and Off Mode/Standby Power. Manufacturers are required to test their computer monitors 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 monitors, please see Footnote 2 on page 11 for voltage information and then follow the test method below using a digital signal generator.

On Mode/Active Power

1. Connect the test sample to the outlet or power source and test equipment. For computer monitors 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/Active Power 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 D, Power Measurement Test Conditions.
 6. Provide dark room conditions. See Sections G, Light Measurement Protocols, and B, Dark Room Conditions.
 7. Set size and luminance. Refer to Section F, 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 ($115V \pm 1\%$, $60Hz \pm 1\%$).
 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 E, 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/Low Power (Power Switch On, No Video Signal)

1. At the conclusion of the On Mode/Active Power test, initiate the computer monitor's Sleep Mode/Low Power. The method of adjustment shall be documented along with the sequence of events required to reach the Sleep Mode/Low Power. Power on all test equipment and properly adjust operation range.
2. Allow the computer monitor to remain in Sleep Mode/Low Power 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/Low Power.
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/Standby Power (Power Switch Off)

1. At the conclusion of the Sleep Mode/Low Power test, initiate the computer monitor's Off Mode/Standby Power. 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/Standby Power. Power on all test equipment and properly adjust operation range.
2. Allow the computer monitor to remain in Off Mode/Standby Power 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/Standby Power.
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).

Note: Manufacturers may meet the Off Mode/Standby Power requirements by employing a soft off or a hard off power switch on their computer monitors. A hard off switch is not required for ENERGY STAR qualification. Computer monitors with both a hard off and a soft off switch must be tested after pressing the soft off switch to determine ENERGY STAR qualification.

Product Testing Documentation

- J. 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 on a QPI form. ENERGY STAR qualifying product lists, 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 standards being 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 4.0 specification, will be defined as the *effective date* of the agreement. Any previously executed agreement on the subject of ENERGY STAR qualified computer monitors shall be terminated effective December 31, 2004.
- A. Qualifying Products Under Tier 1 of the Version 4.0 Specification: Tier 1 of the Version 4.0 specification shall commence on **January 1, 2005**. All products, including models originally qualified under Version 3.0, with a **date of manufacture** on or after **January 1, 2005**, must meet the new (Version 4.0) requirements in order to qualify for ENERGY STAR (including additional shipments of models originally qualified under Version 3.0). 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 and Labeling Products Under Tier 2 of the Version 4.0 Specification: The second phase of this specification, Tier 2, shall commence on **January 1, 2006**. Specifications for Tier 2 shall apply to products with a date of manufacture on or after **January 1, 2006**. For example, a unit with a date of manufacture of January 1, 2006 must meet the Tier 2 specification in order to qualify as ENERGY STAR.
- C. Elimination of Grandfathering: EPA will not allow grandfathering under this Version 4.0 ENERGY STAR specification. **ENERGY STAR qualification under Version 3.0 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.