

ENERGY STAR® Computer Monitor 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 (henceforth referred to as “monitor”) industry.

Manufacturers are required to perform tests and self-certify those product models that meet the ENERGY STAR guidelines. Families of monitor models that are built on the same chassis and 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 Partner shall measure the average true power consumption of the monitor 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.

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

Product Testing Set-up and Conditions: Outlined 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.

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

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:	100 (± 1%) Volts AC, 50 Hz (± 0.5Hz) 115 (± 1%) Volts AC, 60 Hz (± 0.5Hz) 230 (± 1%) Volts AC, 50 Hz (± 0.5Hz)
Total Harmonic Distortion (Voltage):	< 2% THD
Ambient Temperature:	20°C ± 5°C

(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)

Note: The above table provides the proper test voltage/frequency combinations. See Section E for additional details.

B. Dark Room Conditions: When performing light measurements, the monitor shall be located in a dark room condition. The monitor screen illuminance measurement (E), when screen is switched off, 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 power to the monitor off (Reference VESA FPDM Standard 2.0, Section 301-2F).

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 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 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: 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 of five or more randomly chosen units from the production line at each of the three following voltage/frequency combinations: 100 Volts AC at 50 Hz, 115 Volts AC at 60 Hz, and 230 Volts AC at 50 Hz (Reference VESA Standard: Display Specifications and Measurement Procedures, Version 1.0, Revision 1.0, Section 8.1.3). If any of the voltage/frequency combinations is outside of the monitor model's rating, the manufacturer is not required to test at that particular voltage/frequency combination. Measurements shall be taken after wattage values are stable over a 3-minute period. Measurements are considered stable if the wattage reading does not vary more than 1% over the 3-minute period (Reference IEC 4.3.1). Manufacturers shall use calibrated measuring equipment capable of measurements accurate to one tenth of a watt or better. Manufacturers shall report all values on an ENERGY STAR qualified product information form as well as computing a mean value for the 15 or more data points, which shall be used as the reported On Mode/Active Power consumption of the monitor. **EPA appreciates manufacturers' concerns about the volume of data requested; accordingly, EPA agrees to analyze those data for variability and consider possible reductions of voltage/frequency combinations or sample size as warranted by that analysis.**

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 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 8 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 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

¹ 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.

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 8 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 provides at least 175 candelas per square meter of luminance, measured according to VESA FPDM Standard 2.0, Section 302-1. (If 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 monitor's minimum luminance is greater than 175 candelas per square meter (e.g., 200), then technician shall use the minimum luminance (e.g., 200) and report the value to EPA.)

G. Light Measurement Protocols: When light measurements, such as illuminance and luminance, need to be made, a Light Measuring Device (LMD) shall be used with the monitor located in darkroom conditions. The LMD shall be used to make measurements at the center of, and perpendicular to the monitor screen. 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 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)
Manufacturer/Brand Name
Model Number
Serial Number
Rated Voltage and Frequency
Viewable Diagonal Size (inches)
Aspect Ratio
Recommended Image Size (actual size tested) Width X Height
Viewing Angle (horizontal and vertical degrees)
Screen Refresh Rate (during test)
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 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 1 on page 2 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 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 (ex. $115V_{rms} \pm 1V_{rms}$, $60Hz \pm 0.5Hz$).
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 3-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 monitor 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 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 3-minute period.
3. Record the test conditions and test data. The measurement time shall be sufficiently long to measure the correct average value. 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 monitor Off Mode/Standby Power. 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 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 3-minute period.
3. Record the test conditions and test data. The measurement time shall be sufficiently long to measure the correct average value.

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 Qualified Product Information (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.