

ENERGY STAR Program Requirements for Displays

Annex 1: Test Procedures for Displays less than (<) 30 inches diagonal

When to use this document

This document describes the test procedures for displays with a viewable screen area measuring less than (<) 30 inches diagonal for the ENERGY STAR Program Requirements for Displays Version 5.0. The procedures are to be used to determine the On, Sleep, and Off Mode power consumption of the unit under test (UUT). Note this annex includes separate procedures for the following product types:

- CRT displays;
- Fixed pixel displays without Automatic Brightness Control (ABC) enabled by default; and,
- Fixed pixel displays with ABC enabled by default.

1) **Test Method for CRT displays:**

A. Testing conditions, instrumentation, and setup: Before testing the UUT, ensure the proper testing conditions, instrumentation, and setup are in place as outlined in the Product Test Conditions and Instrumentation, and Product Test Setup sections of the Displays specification.

B. On Mode:

1. Connect the test sample to the outlet or power source and test equipment.
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.
5. Allow the UUT to reach operating temperature (approximately 20 minutes).
6. Set the proper display mode. (Refer to Product Test Setup, Section G, Resolution and Refresh Rate.)
7. Provide dark room conditions. (Refer to Product Test Conditions and Instrumentation, Section F, Light Measurement Protocols, and Section E, Dark Room Conditions.)
8. Set size and luminance as follows:
 - a. 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 Partner's recommended image size, which is typically slightly smaller than maximum viewable screen size.
 - b. 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.
 - c. 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,

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.

Section 301-3K).

- d. 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.
- e. Adjust the contrast control until the white area of the screen is set at the following luminance:

$$100 \text{ cd/m}^2$$

measured according to VESA FPDM Standard 2.0, Section 302-1.

- f. The luminance value shall be reported to EPA with other required testing documentation.
9. Once luminance is set, dark room conditions are no longer needed.
10. Set the power meter current range. The full-scale value selected multiplied by the crest factor rating ($I_{\text{peak}}/I_{\text{rms}}$) of the meter must be greater than the peak current reading from the oscilloscope.
11. 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 once the wattage reading does not vary more than 1% over a three-minute period. (Refer to Product Test Setup, Section I, Stability.)
12. Record power consumption and total pixel format (horizontal x vertical pixels displayed), to calculate pixels/watt.

C. 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 once the wattage reading does not vary more than 1% over a three-minute period. Tester shall ignore the input sync signal check cycle when metering the unit 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.

D. Off Mode (Power Switch Off):

1. At the conclusion of the Sleep Mode test, initiate the display's Off Mode using the power switch that is most easily accessed by the user. 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 once the wattage reading does not vary more than 1% over a three-minute period. Tester 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).

E. Reporting results: Upon completion of this test procedure, please refer to the Product Test Documentation section of the specification for guidance on how to report your test results to EPA.

2) **Test Method for fixed pixel displays *without* ABC enabled by default:**

A. Testing conditions, instrumentation, and setup: Before testing the UUT, ensure the proper testing conditions, instrumentation, and setup are in place as outlined in the Product Test Conditions and

Instrumentation, and Product Test Setup sections of the Displays specification.

B. On Mode:

1. Connect the test sample to the outlet or power source and test equipment.
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.
5. Allow the UUT to reach operating temperature (approximately 20 minutes).
6. Set the proper display mode (Refer to Product Test Setup, Section G, Resolution and Refresh Rate).
7. Provide dark room conditions (Refer to Product Test Conditions and Instrumentation, Section F, Light Measurement Protocols, and Section E, Dark Room Conditions).
8. Set size and luminance as follows:
 - a. 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.
 - b. 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.
 - c. 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.
 - d. The technician shall then adjust the brightness until the white area of the screen is set at the following luminance:

Product	Cd/m²
Less than or equal to 1.1 MP resolution	175
Greater than 1.1 MP resolution	200

measured according to VESA FPDM Standard 2.0, Section 302-1.

- e. The luminance value shall be reported to EPA with other required testing documentation.
9. Once luminance is set, dark room conditions are no longer needed.
10. 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.
11. 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 once the wattage reading does not vary more than 1% over a three-minute period. (Refer to Product Test Setup, Section I, Stability.)
12. Record power consumption and total pixel format (horizontal x vertical pixels displayed), to calculate pixels/watt.

C. 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 once the wattage reading does not vary more than 1% over a three-minute period. Tester shall ignore the input sync signal check cycle when metering the unit 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.

D. Off Mode (Power Switch Off):

1. At the conclusion of the Sleep Mode test, initiate the display's Off Mode using the power switch that is most easily accessed by the user. 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 once the wattage reading does not vary more than 1% over a three-minute period. Tester 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).

E. Reporting results: Upon completion of this test procedure, please refer to the Product Test Documentation section of the specification for guidance on how to report your test results to EPA.

3) **Test Method for fixed pixel displays with ABC enabled by default:**

A. Testing conditions, instrumentation, and setup: Before testing the UUT, ensure the proper testing conditions, instrumentation, and setup are in place as outlined in the Product Test Conditions and Instrumentation, and Product Test Setup sections of the Displays specification.

B. On Mode:

1. Connect the test sample to the outlet or power source and test equipment.
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.
5. Allow the UUT to reach operating temperature (approximately 20 minutes).
6. Set the proper display mode (Refer to Product Test Setup, Section G, Resolution and Refresh Rate).
7. 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.
8. The following alternate calculation is used to calculate maximum On Mode power consumption for displays shipped with Automatic Brightness Control enabled by default:

$$Po_1 = (0.8 * P_h) + (0.2 * P_l)$$

where Po_1 is the average On Mode power consumption in watts, rounded to the nearest tenth of a watt, P_h is the On Mode power consumption in high ambient lighting conditions, and P_l is the On Mode power consumption in low ambient lighting conditions. The formula assumes the display will be in high ambient lighting conditions 80% of the time, and in low ambient lighting conditions 20% of the time. For this test procedure, high ambient lighting is to be set at 300 lux, while low ambient lighting is to be set at 0 lux, as follows:

- a. Set the ambient light level to 300 lux as measured at the face of an ambient light sensor.
- b. 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 once the wattage reading does not vary more than 1% over a three-minute period. (Refer to Product Test Setup, Section I, Stability.)
- c. Set the ambient light level to 0 lux as measured at the face of an ambient light sensor.

- d. Allow the readings on the power meter to stabilize, and then take the true power reading in watts from the power meter.
 9. Record power consumption and total pixel format (horizontal x vertical pixels displayed), to calculate pixels/watt.
- C. 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 once the wattage reading does not vary more than 1% over a three-minute period. Tester shall ignore the input sync signal check cycle when metering the unit 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.
- D. Off Mode (Power Switch Off):
1. At the conclusion of the Sleep Mode test, initiate the display's Off Mode using the power switch that is most easily accessed by the user. 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 once the wattage reading does not vary more than 1% over a three-minute period. Tester 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).
- E. Reporting results: Upon completion of this test procedure, please refer to the Product Test Documentation section of the specification for guidance on how to report your test results to EPA.