ENERGY STAR Test Procedure for Determining the Power Use of Computers in Off, Sleep, and Idle

The following protocol should be followed when measuring power consumption levels of computers for compliance with the Off, Sleep, and Idle levels provided in the ENERGY STAR Version 5.0 Computer Specification. Partners must measure a representative sample of the configuration as shipped to the customer. However, the Partner does not need to consider power consumption changes that may result from component additions, BIOS and/or software settings made by the computer user after sale of product. *This procedure is intended to be followed in order and the mode being tested is labeled where appropriate.*

I. Definitions

Unless otherwise specified, all terms used in this document are consistent with the definitions contained in the Version 5.0 ENERGY STAR Eligibility Criteria for Computers.

UUT
UUT is an acronym for "unit under test," which in this case refers to the computer being tested.

UPS
UPS is an acronym for "Uninterruptible Power Supply," which refers to a combination of converters, switches and energy storage means, for example batteries, constituting a power supply for maintaining continuity of load power in case of input power failure.

II. Testing Requirements

Approved Meter
Approved meters will include the following attributes[1]:

- Power resolution of 1 mW or better;
- An available current crest factor of 3 or more at its rated range value; and
- Lower bound on the current range of 10mA or less.

The following attributes in addition to those above are suggested:

- Frequency response of at least 3 kHz; and
- Calibration with a standard that is traceable to the U.S. National Institute of Standards and Technology (NIST).

It is also desirable for measurement instruments to be able to average power accurately over any user selected time interval (this is usually done with an internal math's calculation dividing accumulated energy by time within the meter, which is the most accurate approach). As an alternative, the measurement instrument would have to be capable of integrating energy over any user selected time interval with an energy resolution of less than or equal to 0.1 mWh and integrating time displayed with a resolution of 1 second or less.

Accuracy
Measurements of power of 0.5 W or greater shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level. Measurements of power of less than 0.5 W shall be made with an uncertainty of less than or equal to 0.01 W at the 95% confidence level. The power measurement instrument shall have a resolution of:

[1] *Characteristics of approved meters taken from IEC 62301 Ed 1.0: Measurement of Standby Power*

- 0.01 W or better for power measurements of 10 W or less;
- 0.1 W or better for power measurements of greater than 10 W up to 100 W; and
- 1 W or better for power measurements of greater than 100 W.

All power figures should be in watts and rounded to the second decimal place. For loads greater than or equal to 10 W, three significant figures shall be reported.

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%)
		Note: 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: Household Electrical Appliances – Measurement of Standby Power, Sections 3.2, 3.3)

Test Configuration
Power consumption of a computer shall be measured and tested from an ac source to the UUT.

The UUT must be connected to an Ethernet network switch capable of the UUT's highest and lowest network speeds. The network connection must be live during all tests.

III. Test Procedure for Off, Sleep and Idle for All Products

Measurement of ac power consumption of a computer should be conducted as follows:

UUT Preparation
1. Record the manufacturer and model name of the UUT.
2. Ensure that the UUT is connected to a live Ethernet (IEEE 802.3) network switch as specified in Section II., "Test Configuration," above, and that the connection is live. The computer must maintain this live connection to the switch for the duration of testing, disregarding brief lapses when transitioning between link speeds.
3. Connect an approved meter capable of measuring true power to an ac line voltage source set to the appropriate voltage/frequency combination for the test.
4. Plug the UUT into the measurement power outlet on the meter. No power strips or UPS units should be connected between the meter and the UUT. For a valid test to take place the meter should remain in place until all Off, Sleep, and Idle power data is recorded.
5. Record the ac voltage.
6. Boot computer and wait until the operating system has fully loaded.
7. If necessary, run the initial operating system setup and allow all preliminary file indexing and other one-time/periodic processes to complete.

8. Record basic information about the computer's configuration – computer type, operating system name and version, processor type and speed, and total and available physical memory, etc.[2]
9. Record basic information about the video card - video card name, resolution, amount of onboard memory, and bits per pixel.[3]
10. Ensure that the UUT is configured as shipped including all accessories, power management settings, WOL enabling and software shipped by default. UUT should also be configured using the following requirements for all tests:
    a. Desktop systems shipped without accessories should be configured with a standard mouse, keyboard and external monitor.
    b. Notebooks and tablets should include all accessories shipped with the system, and need not include a separate keyboard or mouse when equipped with an integrated pointing device or digitizer.
    c. Notebooks and tablets should have the battery pack(s) removed for all tests. For systems where operation without a battery pack is not a supported configuration, the test may be performed with fully charged battery pack(s) installed, making sure to report this configuration in the test results.
    d. Power to wireless radios should be turned off for all tests. This applies to wireless network adapters (e.g., 802.11) or device-to-device wireless protocols.
11. The following guidelines should be followed to configure power settings for displays (adjusting no other power management settings):
    a. For computers with external displays (most desktops): use the monitor power management settings to prevent the monitor from powering down to ensure it stays on for the full length of the Idle test as described below.
    b. For computers with integrated monitors (notebooks, tablets and integrated systems): use the power management settings to set the monitor to power down after 1 minute.
12. Shut down the UUT.

Off Mode Testing

13. With the UUT shut down and in Off, set the meter to begin accumulating true power values at an interval of 1 reading per second. Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period.[4]

Idle Mode Testing

14. Switch on the computer and begin recording elapsed time, starting either when the computer is initially switched on, or immediately after completing any log in activity necessary to fully boot the system. Once logged in with the operating system fully loaded and ready, close any open windows so that the standard operational desktop screen or equivalent ready screen is displayed. Exactly 15 minutes after the initial boot or log in, set the meter to begin accumulating true power values at an interval of 1 reading per second. Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period.

Sleep Mode Testing

15. After completing the Idle measurements, place the computer in Sleep mode. Reset the meter (if necessary) and begin accumulating true power values at an interval of 1 reading per second. Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period.

[2] On Windows-based machines, much of this information can be found by selecting the following window: Start / Programs / Accessories / System Tools / System Information.

[3] On Windows-based machines, this can be found by selecting the following window: Start / Programs / Accessories / System Tools / Components / Display.

[4] Laboratory-grade, full-function meters can integrate values over time and report the average value automatically. Other meters would require the user to capture a series of changing values every 5 seconds for a five minute period and then compute the average manually.

16. If testing both WOL enabled and WOL disabled for Sleep, wake the computer and change the WOL from Sleep setting through the operating system settings or by other means. Place the computer back in Sleep mode and repeat step 15, recording Sleep power necessary for this alternate configuration.

Reporting Test Results

17. The test results must be reported to EPA or the European Commission, as appropriate, taking care to ensure that all required information has been included.

IV. Continuing Verification

This testing procedure describes the method by which a single unit may be tested for compliance. An ongoing testing process is highly recommended to ensure that products from different production runs are in compliance with ENERGY STAR.