



# ENERGY STAR<sup>®</sup> Audio/Video V2.0 Preliminary Test Procedure Draft // 26 February 2009

## 1. Overview

This document represents a key step in the process of developing an updated ENERGY STAR test procedure for Audio/Video equipment. During the revision of the ENERGY STAR Audio/Video specification, EPA will work to refine this test procedure based on an analysis of available data and feedback from stakeholders.

The test procedures that follow are based on existing ENERGY STAR test procedures and on information that has been made available to EPA to date; the low-power mode, video, and removable media test procedures are derived from the ENERGY STAR Set-top Box test procedure, and the amplifier test procedure is based on comments received from stakeholders during conference calls and in-person meetings. EPA understands that these test procedures are not comprehensive at this time, and that revisions and additions may be required before the final product specification is complete.

Participation is critical to the success of this project at this early stage. By performing as much preliminary testing on as many products as possible, and by critically examining the proposed test procedures to identify areas for improvement, stakeholders can make significant contributions to the development of a high-quality, equitable, and accurate ENERGY STAR test program for this product category.

## 2. Applicability

The test procedures in sections in this document are intended for use with all Audio/Video products being considered for eligibility under the Version 2.0 specification. In order to obtain the most complete and useful power consumption data, EPA has prepared the following guidelines for testing of Audio/Video products:

- 1) the idle and sleep power mode tests described in Section 5 should be performed on every product,
- 2) the video device tests (Section 6) should be performed on any product that offers storage for recording and playback of video,
- 3) the removable media player device tests (Section 7) should be performed on any product with an integrated removable media device (e.g. CD, DVD, or Blu-ray Disc player/recorder), and
- 4) the amplifier tests (Section 8) should be performed on any product that offers audio amplification.

Following is a list of products under consideration at this time: Home Theater AV Receiver, Web Video Device (i.e. Vudu, AppleTV), Digital Media Server, Blu-ray Disc

Player, DVD Player, CD/SACD Player, Audio Power Amplifier, Audio Tuner, Audio Pre-amp, Self-powered Subwoofer, Wireless Speaker System, Home Theater in a Box (HTIB), Compact & Portable Audio Systems, Compact Audio Shelf System, Clock Radio, Boombox, Home Radio, Karaoke Machine, Wireless Microphone System, Video Conference System, and Building PA System.

Under the guidelines, a HTIB system with an integrated DVD player/recorder and audio amplifiers would likely be subject to the low-power tests in Section 5, several of the removable media player tests in Section 7, and the amplifier tests in Section 8. In contrast, a stand-alone rack-mount audio amplifier would only be subject to the low-power tests in Section 5 and the amplifier tests in Section 8.

### 3. Definitions

#### 3.1. General

- Unit Under Test (UUT): The device being tested.
- Total Harmonic Distortion (THD): The ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency of a signal.

#### 3.2. Device Power Modes

- On/Active Mode: An operational state in which the device is actively delivering one or more of its principal functions and some or all of its applicable secondary functions.
- Idle Mode: An operational state in which the device is powered on but is not delivering any of its principal functions and may only be delivering basic secondary functions that are enabled by default. In the Idle state, the device is ready to deliver one or more of its principal functions without direct user intervention.
- Sleep Mode: An operational state in which the device has less capability and responsiveness than in the On/Active or Idle states. The device may enter a Sleep state from the On/Active or Idle states after:
  - the device receives a notification from the user to enter a sleep state via a power button press on a remote control or front panel of the unit, or through an electronic signal or data packet received via a digital interface on the device; or
  - the device auto powers down to a Sleep state. The energy consumption after auto power down to Sleep and after a user initiated power down to Sleep may, or may not be, equivalent.
- Off Mode: An operational state in which the device is either disconnected from the mains, or is connected to the mains and offers no Sleep, Idle, or Active/On mode functionality.
- Auto-Power Down (APD): The capability to automatically switch a component from the On state to a Sleep state after a period of time without user input, generally based on the amount of time the component has remained “idle”

from last active use, i.e., user input such as channel change, volume change, menu access, etc.

### 3.3. *Noise Signals*

- Pink Noise ( $A=1/f$ ): Pink noise is a random signal within the audible frequency range, whose amplitude decreases as frequency increases, maintaining constant audio power per frequency increment.
- Brownian Noise ( $A=1/f^2$ ): Brownian noise (also known as brown or red noise) is similar to pink noise, but with a power density decrease of 6 dB per octave with increasing frequency.
- Grey Noise (inverted A-weighting): Grey noise is random pink noise within the audible frequency range subjected to inverted A-weighting psychoacoustic equal loudness curve per IEC61672:2003.

## 4. Test Setup

### 4.1. *Test Equipment*

The following test equipment is recommended for performing ENERGY STAR power consumption tests:

- Oscilloscope or Power Analyzer, with a current probe, to monitor AC line current waveform, amplitude, and frequency;
- True RMS volt meter, to measure voltage at the input of the unit being tested (optional if AC source output is sufficiently accurate);
- Frequency counter, to measure frequency at the input of the unit being tested (optional if AC source output is sufficiently accurate);
- Digital Signal Generator, to produce sine wave and noise spectrum inputs for amplifier testing; and
- Timer, for measuring test durations.

### 4.2. *Calibration*

All test equipment shall be annually calibrated to an industry-accepted standard by a laboratory with ISO/IEC 17025:2005 accreditation, or equivalent.

### 4.3. *General Requirements*

#### **(a) Power Measurement**

All power measurements shall be made at a point between the AC power source and the UUT.

#### **(b) System Control**

The UUT shall be controlled with the factory-supplied remote control (I/R or RF) to the extent possible. For units that do not ship with a remote control, or for functions that cannot be accessed from the supplied remote control, control mechanisms on the face or body of the UUT may be used.

#### **(c) Source Signals**

All source signals shall be from live sources (i.e. broadcast TV, cable TV, radio) of the type used under typical device operation.

The following reference channels shall be used as inputs when video signals are required:

- Reference Channel A: SD Network TV channel. This channel shall be at least 480i format.
- Reference Channel B: SD/HD Sports channel. If the UUT is HD-capable, this channel shall be at least 720p format. If the UUT is not HD-capable, this channel shall be at least 480i format.
- Reference Channel C: SD 24-hour News channel. This channel shall be at least 480i format.

When tuning to a broadcast video source, this is defined as one tuner acquiring an encrypted digital video service, where the video service is rendered on all analog audio/video output (e.g. RF modulated, S-Video, composite and component) and on all SPDIF audio outputs (if equipped).

#### ***(d) Output Volume***

The UUT output volume should be set to zero for the duration of all tests except as noted in the Amplifier test procedures in Section 8.

#### ***(e) Component-level Data Collection***

In the case of products that include many sub-components (e.g. a home theater system may include a receiver, powered subwoofer, and wireless speakers), all components shall be connected together in a typical end-use configuration. All components may be tested simultaneously, but each power-consuming device must be metered separately. Power consumption data for each sub-component may then be summed to determine the total power consumption of the product.

#### ***(f) Optional Hardware***

If the UUT uses Smart card or POD technology for conditional access system control, then insert the applicable card into the UUT prior to applying power.

### ***4.4. Pre-test UUT Configuration***

Prior to the start of testing, the UUT must be configured as follows:

- 1) Connect the UUT to external devices per instructions in the product operating manual. If the product manual contains several example configurations, select the most basic configuration that will allow for completion of the test procedure. External devices typical of a normal customer installation shall be used, and these shall be attached to the UUT via standard AV connectors.
- 2) Connect the UUT to the power source.
- 3) Power on the UUT and perform initial system configuration, as applicable.
  - a. Disable any wireless networking functionality (WiFi), unless wireless networking is the UUT's primary means of accessing a network.
  - b. Disable any VOIP and Data services that are exposed to the user for external use such as broadband services.

- 4) Connect the UUT to the signal source. The input signal shall comply to the requirements in Section 2.3(a), above.
- 5) Let the UUT sit for at least 15 minutes, or until the unit has completed initialization and is ready for use.

## 5. Test Procedures for All Products

The following tests shall be performed on all Audio/Video products, as applicable.

### 5.1. *Auto Power-down (APD) Function (Test time: 5 minutes)*

- 1) Configure the UUT in a typical Active or Idle mode operational state.
- 2) Allow the UUT to automatically power-down.
- 3) Verify that the device is in the expected APD low-power state.
- 4) Begin power consumption measurement and start timer.
- 5) Record the net power consumption at time = 5 minutes.
- 6) Calculate the average power consumption over the full 5 minute test period.

### 5.2. *Idle Mode (Test time: 5 minutes)*

- 1) Configure the UUT in a typical Sleep or Off mode operational state.
- 2) Press the Power button to bring the unit into an Active mode operational state.
- 3) Record the net power consumption at time = 5 minutes.
- 4) Calculate the average power consumption over the full 5 minute test period.

### 5.3. *Sleep Mode (Test time: 5 minutes)*

- 1) Configure the UUT in a typical Active or Idle mode operational state.
- 2) Press the Power button to bring the unit into a Sleep mode low-power operational state.
- 3) Begin power consumption measurement and start timer.
- 4) Record the net power consumption at time = 5 minutes.
- 5) Calculate the average power consumption over the full 5 minute test period.

## 6. Test Procedures for Video Devices

The following tests shall be performed on any product that offers storage for recording and playback of video, as applicable.

### 6.1. *Live Video Playback Test (Test time: 6 minutes)*

- 1) Turn on the UUT and tune to a live TV signal.
- 2) Begin power consumption measurement and start timer.
- 3) Tune to Reference Channel A.
- 4) Record the net power consumption at time = 2 minutes.
  - a. If the UUT has DVR functionality, the DVR shall be in Pause for 5% of the test period, Fast Forward for 10% of the test period, and Rewind for 10% of the test period.
- 5) Tune to Reference Channel B.

- 6) Record the net power consumption at time = 4 minutes.
  - a. If the UUT has DVR functionality, the DVR shall be in Pause for 5% of the test period, Fast Forward for 10% of the test period, and Rewind for 10% of the test period.
- 7) Tune to Reference Channel C.
  - a. If the UUT has one or more Additional Tuners, tune the primary tuner to Reference Channel C, and the secondary tuner to Reference Channel A.
    - i. If the UUT has PIP functionality, render the secondary image in a PIP window as near to  $\frac{1}{4}$  of the total screen area as possible.
    - ii. If the UUT does not have PIP functionality, display the primary tuner image on the screen and record the secondary signal in the background.
- 8) Record the net power consumption at time = 6 minutes.
  - a. If the UUT has DVR functionality, the DVR shall be in Pause for 5% of the test period, Fast Forward for 10% of the test period, and Rewind for 10% of the test period.
- 9) Calculate the average power consumption over the full 6 minute test period.

### 6.2. *Live Video Recording Test (Test time: 6 minutes)*

- 1) Turn on the UUT and tune to Reference Channel A.
- 2) Begin power consumption measurement and start test timer.
- 3) Begin DVR recording of Reference Channel A.
  - a. If the UUT has one or more Additional Tuners, record Reference Channel A with the secondary tuner for the duration of the test.
- 4) Record the net power consumption at time = 2 minutes.
- 5) Begin DVR recording of Reference Channel B.
- 6) Record the net power consumption at time = 4 minutes.
- 7) Begin DVR recording of Reference Channel C.
- 8) Record the net power consumption at time = 6 minutes.
- 9) Calculate the average power consumption over the full 6 minute test period.
- 10) If the UUT is capable of recording HD signals, repeat the test with an HD input signal (Reference Channel B) and record the average power consumption from both tests.
- 11) Save all DVR recordings for the Recorded TV Playback Test.

### 6.3. *Recorded Video Playback Test (Test time: 5 minutes)*

- 1) Turn on the UUT and tune to Reference Channel A.
- 2) Begin power consumption measurement and start timer.
- 3) Using the on-screen menus, begin playback of a recorded program.
- 4) Play back the recorded video for the duration of the test period. The playback shall be in Pause for 5% of the test period, Fast Forward for 10% of the test period, and Rewind for 10% of the test period.
- 5) Record the net power consumption at time = 5 minutes.
- 6) Calculate the average power consumption over the full 5 minute test period.

- 7) If the UUT is capable of recording HD signals, repeat the test with an HD input signal (Reference Channel B) and record the average power consumption from both tests.

## **7. Test Procedures for Removable Media Players**

The following tests shall be performed on any product that contains a removable media player (e.g. optical drive, USB drive, etc.), as applicable.

### **7.1. Playback Test (Test time: 5+ minutes)**

- 1) Turn on the UUT and tune to Reference Channel A.
- 2) Begin power consumption measurement and start timer.
- 3) Activate the UUT removable media playback function.
- 4) Insert the removable media. Close the door, if applicable.
- 5) Begin playback of the removable media, if applicable.
- 6) Play back the recording for until 5 minutes have elapsed on the timer.
- 7) Stop playback and eject the removable media.
- 8) Record the net power consumption over the duration of the test.
- 9) Calculate the average power consumption over the full test period.
- 10) If the UUT is capable of recording HD signals, repeat the test with an HD input signal (Reference Channel B) and record the average power consumption from both tests.

### **7.2. Record Test (Test time: 5+ minutes)**

- 1) To begin the media record test, tune to Reference Channel A.
- 2) Begin power consumption measurement and start timer.
- 3) Activate the UUT removable media recording function.
- 4) Insert the removable media. Close the door, if applicable.
- 5) Begin recording to the removable media.
- 6) Record to the removable media until 5 minutes have elapsed on the timer.
- 7) Stop recording and eject the removable media.
- 8) Record the net power consumption over the duration of the test.
- 9) Calculate the average power consumption over the full test period.
- 10) If the UUT is capable of recording HD signals, repeat the test with an HD input signal (Reference Channel B) and record the average power consumption from both tests.

## **8. Test Procedures for Amplifiers**

The following tests shall be performed on any product that contains an audio power amplifier, as applicable.

### **8.1. Active Mode Test**

- 1) Connect the UUT to the output of the digital signal generator.
- 2) Generate a sine wave input signal.

- 3) Increase the amplifier power until the THD of the output is 1% or greater. This is considered the maximum undistorted volume.
- 4) Measure & record the amplifier input and output power. Calculate the amplifier efficiency at 100% of the maximum undistorted volume.
- 5) Turn down the amplifier until the output is 30% of the maximum undistorted volume.
- 6) Measure & record the amplifier input and output power. Calculate the amplifier efficiency at 30% of the maximum undistorted volume.
- 7) Turn down the amplifier until the output is 12.5% of the maximum undistorted volume.
- 8) Measure & record the amplifier input and output power. Calculate the amplifier efficiency at 12.5% of the maximum undistorted volume.
- 9) Generate a grey noise input signal and repeat the test procedure.
- 10) Generate a pink noise input signal and repeat the test procedure.
- 11) Generate a Brownian noise signal and repeat the test procedure.