ENERGY STAR® Audio/Video V2.0
Draft Test Procedure
20 April 2009

1. Overview

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.

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) Power mode tests described in Section 5 should be performed on every product,
2) Video device tests (Section 6) should be performed on any product that offers storage for recording and playback of live video,
3) Removable media player device tests (Section 7) should be performed on any product capable of playback or recording of audio and/or video stored on removable media (e.g. Flash drive, CD, DVD, Blu-ray Disc), and
4) 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, Internet Media Player (Audio and/or Video), Digital Media Server, Optical Disc Player/Recorder (Blu-ray Disc, DVD, CD, SACD), Audio Power Amplifier, Audio Tuner, Audio Pre-amp, Self-powered Speaker, 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 / Telepresence 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 likely only be subject to the low-power tests in Section 5 and the amplifier tests in Section 8.

3. Definitions

3.1. General

- 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.
- Unit Under Test (UUT): The device being tested.

3.2. Device Power Modes

- ON Mode: Where the product is connected to a mains power source, has been activated and is providing one or more of its principal functions. The common terms “active”, “in-use” and “normal operation” also describe this mode.
- SLEEP Mode: The common term “standby” may also describe this mode, where the product is connected to a mains power source, is not providing a principal function, and offers one or more of the following user oriented or protective functions which may persist for an indefinite time:
    - To facilitate the activation of other modes (including activation or deactivation of ON mode) by remote switch (including remote control), internal sensor, timer;
    - Continuous function: information or status displays including clocks;
    - Continuous function: sensor-based functions.
- OFF Mode: Where the product is connected to a mains power source and is not providing any ON mode or SLEEP mode functions, and where the mode may persist for an indefinite time. An indicator that only shows the user that the product is in the off position is included within the classification of an off mode.
- Auto-Power Down (APD): The capability to automatically switch a component from the On state to a Sleep state after a period of inactivity, 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) while not actively performing a primary function.

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);

- Signal Generator(s), Analog or Digital, to produce signal inputs for amplifier testing, as appropriate; and
- Timer, for measuring test durations.

4.2. Calibration

All test equipment shall be annually calibrated by a laboratory accredited to ISO/IEC 17025:2005 by an ILAC recognized accreditation body.

4.3. Power Measurement Test Conditions

(a) Test Setup

Test setup shall be in accordance with the requirements of IEC 62301, Ed. 1.0, "Measurement of Household Appliance Standby Power", Section 4, "General Conditions for Measurements", unless otherwise noted in this document. In the event of conflicting requirements, this test procedure shall take precedence.

(b) Measurement Location

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

(c) Component-level Measurement

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 (e.g. power consumption must be measured at each plug connection to mains power). Power consumption data for each sub-component shall be summed to determine the total power consumption of the product.

(d) Measurement Methods [1]

Average power consumption shall be determined in accordance with the requirements of IEC 62301, Ed. 1.0, "Measurement of Household Appliance Standby Power", Section 5.3.2, using either the average power or accumulated energy approaches outlined below.

- Average Power Approach: where the instrument can record a true average power over a user selected period, the period selected shall not be less than 10 minutes.
- Accumulated Energy Approach: where the instrument can accumulate energy over a user selected period, the period selected shall not be less than 10 minutes. The integrating period shall be such that the total recorded value for energy and time is more than 200 times the resolution of the meter for energy and time. Determine the average power by dividing the accumulated energy by the time for the monitoring period.

[1] NOTE: Test durations in Sections 5 through 8 have been reduced for purposes of this draft test procedure. The final test procedure will require individual test durations of 10 minutes or more to ensure that test results are representative of real world power consumption.

4.4. Source Signals

(a) Signal Input Location

If the UUT does not have accessible signal input terminals, test signal input shall be through the device antenna or other accessible means typical of customer use.

(b) Audio Sources

The following noise profiles shall be used for all audio testing:

- Pink Noise (A=1/f): Pink noise is a random signal within the audible frequency range, whose amplitude is inversely proportional to frequency, maintaining constant audio power per logarithmic frequency increment.

(c) Video Sources

All video source signals shall be from live sources (i.e. broadcast TV, cable TV, radio, streaming Internet content, etc.) of the type used under typical device operation. If the UUT does not have a tuner, a video signal input with equivalent content and resolution shall be provided.

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.

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

(d) Option to Test with Only HD Video Sources

The video test procedures in Sections 6 and 7 are performed with both SD and HD video sources for devices capable of processing both SD and HD content. The overall average power consumption for the UUT is the average of the power consumption measurements from the SD and HD video source tests. This average is intended to reward devices that can scale back power consumption when processing SD video signals.

If the UUT is found to have negligible differences in power consumption when processing SD versus HD sources, the manufacturer may choose to perform and report results from only HD video source tests (per the definition of Reference Channel B), in order to expedite testing.

4.5. UUT Operation

(a) UUT 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.

(b) Output Volume

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

(c) Battery Powered Devices

If the UUT contains rechargeable batteries, or can be integrated with another device that contains rechargeable batteries, all batteries should be in a fully charged state for the duration of testing.

(d) 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.

4.6. UUT Pre-test Configuration

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

1) Set up the UUT per the 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.
2) If the UUT includes speaker outputs, connect a resistive load across each pair of output terminals equivalent to the nominal rated load impedance. The same resistive load must be used for all amplifier tests.
    a. For self-powered or internal speakers with no accessible output terminals, output power shall be measured across the speaker input leads, using the attached speaker as a resistive load.
3) Connect the UUT to the power source.
4) 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.
5) Connect the UUT to the signal source. The input signal shall comply to the requirements in Section 4.4, above.
6) Let the UUT sit for at least 15 minutes, or until the unit has completed initialization and is ready for use.
7) Measure and record the AC mains input voltage and frequency.
8) Measure and record the test room ambient temperature.

5. Test Procedures for All Products

The following tests shall be performed on all Audio/Video products, as applicable[2].

5.1. Auto Power-down (APD) Function (Test time: 10 minutes)

1) Configure the UUT in a typical Active mode operational state.
2) Stop any active content from playing on the UUT.
3) Measure the average power consumption before APD over a 5 minute period.
4) Allow the UUT to automatically power-down.
5) Verify that the device is in the expected APD low-power state.
6) Measure the average power consumption after APD over a 5 minute period.

5.2. Idle Condition (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, such that no active content is playing.
3) Measure the average power consumption over a 5 minute 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) Measure the average power consumption over a 5 minute 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) Tune to Reference Channel A.
2) Measure the average power consumption over a 2 minute period.
    - Note: 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.
3) Tune to Reference Channel B.
4) Measure the average power consumption over a 2 minute period.
    - Note: 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 C. 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.

[2] NOTE: The APD test (5.1) is not required for products that do not offer an APD function. The Sleep Mode test (5.3) is not required for products that do not offer a Sleep mode.

- Note: If the UUT has PIP functionality, render the secondary image in a PIP window as near to ¼ of the total screen area as possible. If the UUT does not have PIP functionality, display the primary tuner image on the screen and record the secondary signal in the background.

6) Measure the average power consumption over a 2 minute period.
    - Note: 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) Calculate the average power consumption over the full test duration.

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

1) Tune to and begin DVR recording of Reference Channel A.
    - Note: If the UUT has one or more Additional Tuners, record Reference Channel A with the secondary tuner for the duration of the test.
2) Measure the average power consumption over a 2 minute period.
3) Tune to and begin DVR recording of Reference Channel B.
4) Measure the average power consumption over a 2 minute period.
5) Tune to and begin DVR recording of Reference Channel C.
6) Measure the average power consumption over a 2 minute period.
7) Calculate the average power consumption over the full test duration.
8) 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.
9) Save all DVR recordings for the Recorded Video Playback Test.

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

1) Tune to Reference Channel A.
2) Using the on-screen menus, begin playback of a recorded program. 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.
3) Measure the average power consumption over a 5 minute period.
4) 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 capable of playback or recording of audio and/or video stored on removable media (e.g. Flash drive, CD, DVD, Blu-ray Disc), as applicable.

7.1. Video Playback Test (Test time: 5+ minutes)

1) Insert / install the removable media and begin playback of SD video content equivalent to Reference Channel A.
2) Measure the average power consumption over a 5 minute period.
3) If the UUT is capable of playing HD content, repeat the test with HD video content equivalent to Reference Channel B and record the average power consumption from each test.

7.2. Video Recording Test (Test time: 5+ minutes)

1) Insert / install the removable media and begin recording of SD video content equivalent to Reference Channel A.
2) Measure the average power consumption over a 5 minute period.
3) If the UUT is capable of recording HD content, repeat the test with HD video content equivalent to Reference Channel B and record the average power consumption from each test.

7.3. Audio Playback Test (Test time: 5+ minutes)

1) Insert / install the removable media and begin playback of a pink noise signal.
2) Measure the average power consumption over a 5 minute period.

7.4. Audio Recording Test (Test time: 5+ minutes)

1) Insert / install the removable media and begin recording of a pink noise signal.
2) Measure the average power consumption over a 5 minute period.

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 signal generator.
2) Generate a 1 kHz sine wave input signal. For devices that accept only digital input signals, generate an appropriate representation of a 1 kHz sine wave.[3]
3) Increase the amplifier volume until the THD of the output is 1% or greater. This is considered the maximum undistorted power.[4]
4) Turn down the amplifier until the output is 1/3 of the maximum undistorted power.
5) Measure & record the amplifier input and output power. Calculate the amplifier efficiency at 1/3 of the maximum undistorted power.
6) Turn down the amplifier until the output is 1/8 of the maximum undistorted power.
7) Measure & record the amplifier input and output power. Calculate the amplifier efficiency at 1/8 of the maximum undistorted power.
8) Generate a pink noise input signal and repeat the test procedure beginning at Section 8.1, Step 6.

[3] If 1 kHz is outside of the range of the UUT, the signal frequency shall be the geometric mean of the upper and lower -3 dB response points of the device.

[4] If the UUT performs signal processing such that the amplifier output does not clip at 1% THD, maximum undistorted power shall be obtained by monitoring input signal amplitude and output power simultaneously to identify the point at which input signal amplitude is increased and output power remains constant.