



ENERGY STAR for Set-top Boxes Test Procedure

This document is an addendum to C380-07: *Test procedure for the measurement of energy consumption of set-top boxes (STBs)* for purposes of testing and qualifying products under:

- (1) ENERGY STAR Program Requirements for Set-Top Boxes - Version 2.0; and
- (2) ENERGY STAR Program Requirements for Cable, Satellite, and Telecom Service Providers – Version 1.0.

All requirements for qualifying to the ENERGY STAR requirements are contained herein.

Note: *These test procedures may not be an exact fit for devices such as place-shifters (e.g., Slingbox[®]) and IP STBs provided outside of a Service Provider contract. As such, below is a list of assumptions testers should follow in order to complete testing of non-traditional STB devices.*

- *Input Source signals – Use an input source format appropriate for your device. It should be of equivalent size and aspect ratio as the source listed. The file should be encrypted if the device normally uses encrypted files.*
 - *Place Shifting – If your product only does place-shifting, then perform the Live TV test in Section 5.3.1 (P_{TV}) only once. If place-shifting is an option, test twice to measure power consumption with the feature both on and off.*
 - *Download-only STBs. The Live TV test in Section 5.3.1 should be performed with simultaneous playback and download of the video source file. The Playback test in Section 5.3.2 should be performed with playback from disk storage only, with no simultaneous file download.*
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5 Duty Cycle Workload Testing Procedure

5.1 Background

The purpose of this section is to provide a workload-based test procedure centered on the actions of the user and the practical output of STBs when placed in situ. These are meant to mimic general actions and general conditions of STBs when used by the average user and are not meant to represent all conditions for all possible box functions and user scenarios.

5.1.1. Definitions

For purposes of this section (5 Duty Cycle Workload Testing Procedure), the definitions contained in (1) ENERGY STAR Program Requirements for Set-Top Boxes - Version 2.0, and (2) ENERGY STAR Program Requirements for Cable, Satellite, and Telecom Service Providers – Version 1.0 supersede those in section “3 Definitions and abbreviations” of *C380-07 Test procedure for the measurement of energy consumption of set-top boxes (STBs)*.

5.2 Preparation

5.2.1 Measurement of Energy Consumption

For purposes of this workload-based test procedure, the following portions of section 4 of C380-07 as amended, shall be followed.

4.1 General

Average power shall be measured from the AC power source to the equipment being tested.

4.2 Test Conditions

4.2.1 General

Unless otherwise specified, measurements shall be made under test conditions and with equipment specified below.

4.2.3 Test room

The tests shall be carried out in a room that has an air speed close to the UUT of ≤ 0.5 m/s, and the ambient temperature shall be maintained at $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ throughout the test. The UUT shall be tested on a thermally non-conductive surface

4.2.4 Test voltage

An AC power source shall be used to provide input voltage and frequency of $115 \pm 1\%$ at 60 Hz to the UUT.

The Total Harmonic Distortion (THD) of the supply voltage when supplying the UUT in the specified mode shall not exceed 2%, up to and including the 13th harmonic. The peak value of the test voltage shall be within 1.34 and 1.49 times its RMS value.

4.2.5 Test leads

All leads used in the test set-up shall be of a sufficient gauge and length in order to avoid the introduction of errors in the testing process.

Note: For further guidance, see Table B.2, "Commonly used values for wire gages and related voltage drops" in IEEE 1515.

4.4 Test Equipment

4.4.1 General

The following should be considered when selecting test equipment:

- (a) an oscilloscope with a current probe, to monitor AC line current waveform, amplitude, and frequency;
- (b) a true rms volt meter, to verify voltage at the input of the unit being tested (optional if AC source output is sufficiently accurate); and
- (c) a frequency counter, to verify frequency at the input of the unit being tested (optional if AC source output is sufficiently accurate).

4.4.2 Calibration

Test instruments shall be calibrated annually to traceable national standards to ensure limits of error in measurement no greater than $\pm 0.5\%$ of the measured value over the required bandwidth of the output.

4.4.3 True power watt meter

4.4.3.1 Crest Factor

A true power watt meter, with accuracy and, resolution in accordance with 4.4.2, and 4.4.3.4 and sufficient bandwidth, and crest factor rating appropriate for the waveforms being measured, shall be used.

The selected watt meter's crest factor rating shall be capable of reading the available current waveform without clipping the waveform.

The peak of the current waveform measured during SLEEP and ON states for the UUT shall determine the crest factor rating requirement and the appropriate current range setting.

The full-scale value of the selected current range multiplied by the crest factor for that range shall be at least 15% greater than the peak current to prevent any measurement error.

4.4.3.2 Bandwidth

The current and voltage signal shall be analyzed to determine the highest frequency component (harmonic) with a magnitude greater than 1% of the fundamental frequency under the test conditions. This shall determine the minimum bandwidth of the test instruments.

The meter shall be capable of sampling at a minimum of one second intervals.

4.4.3.3 Frequency response

A watt meter with a frequency response of at least 9 kHz shall be used, which accounts for harmonics up to the 50th.

Note: Electronic equipment can cause harmonic waveforms that lead to inaccuracies in power measurements.

4.4.3.4 Resolution

The power measurement instrument shall have a resolution of:

- 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.

5.2.2 General

The box and test conditions should be prepared according to section 5.2.1 above.

- a. Begin the test by connecting all relevant A/V connectors.
- b. Next plug the box into the power source and let the unit sit for 15 minutes as the unit initializes and comes to a ready state.
- c. Do not attach external devices that are not required for operation and/or that will not be used with the device under normal operation.
- d. For signal source input, ensure that the box is connected to the input source and the input source conforms to the source signal requirements below
- e. Connect the UUT to a display device (e.g. TV) via the applicable interface(s) supported by the UUT (e.g. composite video output).
- f. If the UUT supports conditional access system control, then provision the UUT as applicable for the UUT type (e.g. Cable, Satellite, Telcocom, or IP STB).
- g. Functions to Disable: WiFi (unless WiFi is the primary network connection), VOIP and Data services (those exposed to the user for external use such as broadband services)
- h. Source Signals
 - a. All Cable STBs interacting with Conditional Access (CA) system data via DOCSIS Set-top Gateway (DSG) or SCTE-55 as applicable for the product
 - b. All Telcocom QAM/IP STBs interacting with CA system data via SCTE-55 and/or via an applicable LAN technology (e.g. Multimedia Over Coax - MoCA).
 - c. All IP STBs interacting with CA system data via applicable LAN technology (e.g. IEEE-802.3, Multimedia Over Coax - MoCA)
 - d. STBs with POD/CableCard - encrypted content is decrypted by POD/CableCard
 - e. All Satellite STBs - interacting with CA system via LNB and POTS modem
 - f. All Terrestrial STBs – ATSC signal from a live source.

5.2.3 Duty Cycle Specific Test Conditions

- a. Remote: In all cases, user input should be accomplished with the remote in cases where the unit ships with one, otherwise the unit's face controls should be utilized. In cases where the functionality needed is not on the remote, then for that particular function the face mounted controls should be utilized.
- b. Reset the meter after each test.
- c. 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. 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.
- i. Reference Channels:
 - a. [A] Standard Definition network TV (minimum 480i)

- b. [B] Live/Recorded Sporting channel. When the box is HD capable this channel should be the HD version. (minimum 480i in SD, 720p in HD).
- c. [C] Standard Definition news channel. I.e; 24 hours news channel. (minimum 480i)

5.2.4 Other Specific Test Conditions

The following additional test conditions apply.

- a. Satellite Low Noise Block (LNB): incremental power required to operate the LNB(s), if drawn from the STB, may be subtracted from the power measurements. It is preferable that all LNB power drawn be supplied separately. Otherwise, the amount subtracted must be clearly noted on the Qualified Product Information (QPI) form.
- b. Functions to Disable: WiFi (unless WiFi is the primary network connection), VOIP and Data services (those exposed to the user for external use such as broadband services)

5.3 Active Tests

5.3.1 Live TV (P_{TV})

- a. To begin the active portion of the test, press the button on the remote, if one is shipped with the unit, responsible for turning on the tuner and/or tuning to a live TV signal. If there is no "on" button and the unit's tuner is designed to be on continuously, then ensure that the tuner is in a state where it is tuned to live TV.
- b. Proceed to change the channel on the tuner, to Reference Channel A as a starting point.
- c. Begin to measure average power at this point and continue for 5 minutes.
- d. After 5 minutes, switch the channel to Reference Channel B and continue to measure average power. If the device is an HD device, select an HD stream for Reference Channel B
- e. After ten minutes, switch the channel to Reference Channel C. If the UUT has one or more Additional Tuners as defined in the ENERGY STAR specification then with the second tuner acquire Channel A and render in a window embedded in the primary window while the primary tuner displays in the primary picture window Channel C In the case of multiple sizes available to the user, the one closest to the size of $\frac{1}{4}$ the screen size will be chosen. In the case where no picture-in-picture capability exists, simply record the second channel in the background instead.
- f. Wait 5 minutes and note the average power used during the test. Total test time should be twenty minutes.
- g. When testing a DVR or unit with similar functionality, the video must be paused 5% of the time, in fast forward 10% and in rewind 10% during each Channel test above, all the while the raw video feed is being buffered. However, this does not increase the overall test times.

5.3.2 Recording Live TV (P_{Record})

- a. Tune to the Reference Channel.
- b. Begin the test by starting the meter
- c. Begin recording Channel A for 5 minutes.
 - a. Note that for certain devices it may be more accurate to create a series of programmed back-to-back recording sessions to avoid HID prompts. This is allowed.
- d. Switch to Channel B for 10 minutes.
- e. Switch to Channel C for 5 minutes.
- f. Stop the meter and note the average power value for the past 20 minutes of recording time.
- g. Save the recordings for the Playback test.
- h. In the case of a DVR or unit with similar functionality, a second tuner, if available on the UUT, must be engaged in recording during the entire time.

5.3.3 Playing Back Recorded TV (P_{Playback})

- a. Tune to Reference Channel A.
- b. Begin the test by starting the meter
- c. Press the button on the remote to bring the menu containing previously recorded recordings onto the screen.
- d. Begin watching the first recording from Channel A.
- e. When done delete the recording (if prompted to do so simply select the affirmative prompt).
- f. Proceed to the recordings menu and select the second recording.
- g. Begin watching the second recording from Channel B.
- h. When done delete the recording (if prompted to do so simply select the affirmative prompt).
- i. Begin watching the second recording from Channel C.
- j. When done delete the recording (if prompted to do so simply select the affirmative prompt).
- k. Stop the meter and note the average power value for the playback time.
- l. When testing a DVR or unit with similar functionality, the video playback must be paused 5% of the time, in fast forward 10% and in rewind 10% during each Channel test above, all the while the raw video feed is being buffered. However, this does not increase the overall test times.
- m. In the case of a DVR or unit with similar functionality, a second tuner, if available on the UUT, must be engaged in recording during the entire time.

5.3.4 Removable Media Playback Test (P_{Playback})

- a. To begin the media playback test, tune to Reference Channel A.
- b. Start the meter.
- c. Press the button to activate the media playback functionality.
 - a. Note that if the playback function is automatically started when the door for the removable media is opened, this is sufficient.
- d. If applicable, open the media door, insert the media and if applicable, close the media door.
- e. Either allow the media to automatically begin playback or begin playback by using the menu or "play" button on the remote.
- f. Playback the recording for 20 minutes.
- g. Press "stop" on the remote.
- h. Eject the media if applicable.
- i. Stop the meter and note the average power for the test.

5.3.5 Removable Media Record Test (P_{Record})

- a. To begin the media record test, tune to Reference Channel A.
- b. Start the meter.
- c. If applicable, open the media door, insert the media and if applicable, close the media door.
- d. Press the button to activate the media record functionality.
- e. Either begin recording by using the menu or "play" button on the remote.
- f. Record the recording for 20 minutes.
- g. Press "stop" on the remote.
- h. Eject the media if applicable.
- i. Stop the meter and note the average power for the test.
- j. If the unit is HD recording capable, perform the test with an HD stream and average the value of both tests.

5.4 Inactive Tests

5.4.1 Sleep Test (P_{Sleep})

- a. To begin the inactive system tests, run through at least the Watching Live TV test in 5.3.1.
- b. Press the power/standby button on the remote to place the system into its lower power state.
- c. Soon thereafter start the meter.
- d. After 20 minutes take the reading of average power off of the meter.

5.4.2 Auto Power Down (P_{AutoPD})

- a. Place the unit in a state where it is tuned to live TV.
- b. Allow the STB to auto power down.
- c. Verify that the device went into the expected lower power state.
- d. Soon thereafter start the meter.
- e. After 20 minutes take the reading of average power off of the meter.