ENERGY STAR® Program Requirements
Product Specification for Televisions

Test Method

1 OVERVIEW

The following test method shall be used for determining product compliance with requirements in the ENERGY STAR Eligibility Criteria for Televisions.

2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the feature set of the product under evaluation. The following guidelines shall be used to determine the applicability of each section of this document:

1) Test procedures in section 6 shall be performed on all products;

2) Test procedures in section 6.3 shall be performed on products without automatic brightness control (ABC) enabled by default;

3) Test procedures in section 6.4 shall be performed on products with ABC enabled by default;

4) Test procedures in section 6.5 shall be performed on products with download acquisition mode (DAM).

3 DEFINITIONS

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

4 TEST SETUP

A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this procedure 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, the ENERGY STAR test method shall take precedence.

B) Input Power: Input power shall be as specified in Table 1 or Table 2.

**Table 1: Input Power Requirements for Products with
Nameplate Rated Power Less Than or Equal to 1500 W**

Market	Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
North America, Taiwan	115 Vac	+/- 1.0 %	2.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 Vac	+/- 1.0 %	2.0 %	50 Hz	+/- 1.0 %
Japan	100 Vac	+/- 1.0 %	2.0 %	50 Hz/ 60 Hz	+/- 1.0 %

**Table 2: Input Power Requirements for Products with
Nameplate Rated Power Greater Than 1500 W**

Market	Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
North America, Taiwan	115 Vac	+/- 4.0 %	5.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 Vac	+/- 4.0 %	5.0 %	50 Hz	+/- 1.0 %
Japan	100 Vac	+/- 4.0 %	5.0 %	50 Hz/60 Hz	+/- 1.0 %

C) Ambient Temperature: Ambient temperature shall be from 18 °C to 28 °C.

D) Relative Humidity: Relative humidity shall be from 10% to 80%.

Note: EPA has revised all references to IEC 62301 to refer to Edition 1.0. References to Edition 2.0 were included in previous versions of this specification, but as of this writing Edition 2.0 remains in draft status with IEC and has recently undergone substantial changes. EPA will revisit the use of references to IEC 62301 Ed. 2.0 in future versions of this specification.

E) Power Meter: Power meters shall possess the following attributes[1]:

1) Crest Factor:

    i) 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.

2) Minimum Frequency Response: 3.0 kHz

3) Minimum Resolution:

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[1]Characteristics of approved meters taken from IEC 62301 Ed 1.0: Household Electrical Appliances – Measurement of Standby Power.

i) 0.01 W for measurement values less than 10 W;

ii) 0.1 W for measurement values from 10 W to 100 W; and

iii) 1.0 W for measurement values greater than 100 W.

F) Measurement Accuracy:

1) Power measurements with a value greater than or equal to 0.5 W shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level.

2) Power measurements with a value 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.

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

5   TEST CONDUCT

5.1   Guidance for Implementation of IEC 62301

A) Testing at Factory Default Settings: Power measurements shall be performed with the product in its as-shipped condition for the duration of Sleep Mode testing, with all user-configurable options set to factory defaults, except as otherwise specified by the test procedure.

B) POD Modules: Optional POD modules shall not be installed.

C) Network Connection: Products that offer networking capability (e.g., Ethernet, WiFi) shall be configured with networking features deactivated.

D) Multiple Sleep Modes: If the product offers multiple Sleep Modes, the power during all Sleep Modes shall be measured and recorded.

5.2   Guidance for Implementation of IEC 62087 and CEA-2037

A) Testing at Factory Default Settings:

1) Power measurements shall be performed with the product in its as-shipped condition for the duration of On Mode testing, with all user-configurable options set to factory defaults, except as otherwise specified by the test procedure.

2) Picture level adjustments shall be performed per the instructions in IEC 62087, Ed. 2.0, Section 11.4.8.

3) Products that include a "forced menu" upon initial start-up shall be tested in "standard" or "home" picture mode. Products that do not include a forced menu shall be tested in the default picture mode. In the case that no "standard" mode or equivalent exists, the first mode listed in the on-screen menus shall be used for testing and noted in the test report.

B) Input Signal Accuracy: Follow guidance provided in Section 4.3 of CEA-2037.

C) Broadcast Test Materials: Follow guidance provided in Section 4.1 of CEA-2037.

D) <u>True Power Factor</u>: Due to increased awareness of the importance of power quality on the part of EPA and electric utilities, manufacturers shall indicate the true power factor of their sets during On Mode measurement.

E) <u>Signal Input</u>: If the UUT has an HDMI input, the HDMI input shall be used for display of test signals during testing. If HDMI is not available, then the component interface shall be used. The VGA interface shall not be used.

Note: EPA has added additional detail about the use of various signal inputs for testing.

F) <u>Automatic Brightness Control</u>: Follow guidance provided in Section 4.4.3.2 of CEA-2037.

G) <u>Network Connection</u>: Products that offer networking capability (e.g., Ethernet, WiFi) shall be configured with networking features deactivated.

5.3   Guidance for Implementation of CEA: Procedure for DAM Testing

A) The "Ideal" CEA: Procedure for DAM Testing is the preferred protocol for ENERGY STAR DAM testing, though the "Practical" protocol may also be used.

B) Energy consumption for all DAM functionalities, both frequent and infrequent, shall be declared on the data collection sheet.

C) Energy consumption from DAM functionalities meeting the definition of "infrequent" may be excluded from the calculation of total DAM energy consumption.

6   TEST PROCEDURES FOR ALL PRODUCTS

6.1   Sleep Mode Testing

A) Sleep Mode power (P_{SLEEP}) shall be measured according to IEC 62301, Ed 1.0: Household Electrical Appliances – Measurement of Standby Power, with the additional guidance in section 5.

6.2   Luminance Testing

A) Luminance testing shall be performed in dark room conditions. Display screen illuminance (E) as measured with the UUT in Off Mode shall be less than or equal to 1.0 lux.

B) Luminance shall be measured perpendicular to the center of the display screen using a Light Measuring Device (LMD). A 500 mm measurement distance is recommended for LMDs that cannot be operated in close proximity to the screen.

C) The position of the LMD relative to the display screen shall remain fixed throughout the duration of testing.

D) For products with Automatic Brightness Control, luminance measurements shall be performed with ABC disabled. If ABC cannot be disabled, luminance measurements shall be performed with light entering directly into the television's ambient light sensor at greater than or equal to 300 lux.

E) Luminance measurements shall be performed per the following procedure:

1) Verify that the product is in the "home" picture mode, or the default as-shipped picture mode.

2) Immediately following the conclusion of On Mode power testing, begin to display the three-bar video signal specified in IEC 62087 Ed. 2.0, Section 11.5.5 (three bars of white (100%) over a black (0%) background).

3) Display the three-bar video signal for not less than 10 minutes to allow the display luminance to stabilize. This 10-minute stabilization period may be reduced if luminance measurements are stable to within 2% over a period of not less than 60 seconds.

4) Measure and record luminance in the home, or default as-shipped picture mode (L_{HOME}).

5) Within 1 minute of performing the measurement, set the television to "retail" picture mode, or the brightest-selectable preset picture mode.

6) Display the three-bar video signal for not less than 10 minutes to allow the display luminance to stabilize. This 10-minute stabilization period may be reduced if luminance measurements are stable to within 2% over a period of not less than 60 seconds.

7) Measure and record luminance in the retail, or brightest-selectable, preset picture mode (L_{RETAIL}).

6.3 On Mode Testing for Products without ABC Enabled by Default

A) On mode power (P_{ON}) shall be measured according to IEC 62087, Ed 2.0: Methods of Measurement for the Power Consumption of Audio, Video and Related Equipment; Section 11: Measuring Conditions for Television Sets in On (average) Mode; with the additional guidance in section 5.

6.4 On Mode Testing for Products with ABC Enabled by Default

A) On mode power in various lighting conditions for TVs with ABC enabled ($P_{o\_BROADCAST}$ and $P_{ABC\_BROADCAST}$) shall be measured according to IEC 62087, Ed 2.0: Methods of Measurement for the Power Consumption of Audio, Video and Related Equipment; Section 11: Measuring Conditions for Television Sets in On (average) Mode; with the additional guidance in section 5.

6.5 Download Acquisition Mode Testing

A) Energy consumption in Download Acquisition Mode (E_{DAM}) shall be measured per the CEA: Procedure for DAM Testing, with the additional guidance in Section 5.

1 SCOPE

This is the CEA Test Method for the determination of Download Acquisition Mode (DAM) energy consumption (E_DAM), as applicable to the ENERGY STAR Program Requirements for Televisions. The test procedure herein is applicable to any television using a DAM as defined in the ENERGY STAR Program Requirements document.

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3   REFERENCE DOCUMENTS

1. Energy Star TV Program Requirements – Procedure for DAM Testing
2. ENERGY STAR® Program Requirements for Televisions Eligibility Criteria Versions 4.2 and 5.1

4   Definition of DAM mode

In Energy Star 4.2, the EPA defines the following:

Download Acquisition Mode (DAM): Where the product is connected to a mains power source, is not producing a sound or a picture, and is actively downloading data, to include but not limited to, channel listing information according to a defined schedule for use by the electronic programming guide, TV setup data, channel map updates, TV firmware updates, monitoring for emergency messaging/communications and/or otherwise communicating through a network protocol. The power use in this mode is typically greater than the power requirement in Sleep and less than that in On Mode.

This test procedure introduces the following definitions:

Infrequent Download: Any DAM download that occurs no more than four times per year and has a duration of less than six hours per instance (i.e., total of less than 24 hours/year or 0.27%). Some examples of infrequent downloads are TV firmware updates, TV setup data downloads, and the Rovi EPG Setup State.

Frequent Download: Any DAM download that does not meet the definition of an Infrequent Download.

5   Qualifications to the DAM mode power usage

5.1   All frequent downloads must be included in the DAM mode power measurement. Note: All DAM functionalities, both frequent and infrequent must be declared, but those meeting the definition of infrequent can be excluded from the calculation of total DAM energy consumption (This declaration is so that the EPA is made aware of, and thereby has the option to evaluate the validity of, and test for the occurrences of, those downloads defined as infrequent.)

    5.1.1. Downloads that happen at a frequency of less than once per day, but do not meet the definition of infrequent , must be averaged to come up with an equivalent daily value for the DAM measurement.

5.2   There are also various triggers for the initiation of a DAM sequence. It may be a daily trigger at a certain time of day (as an EPG download), or a TV power state trigger (as a clock update that is performed each time the TV "turned off" before it actually enters Sleep mode.) There are also other asynchronous external triggers possible. Daily triggers need no further discussion, a TV power state trigger will be assumed to happen five times per day. Asynchronous triggers must be estimated in good faith, conservatively towards the high side of expected occurrence. (Significant underestimation is clearly grounds for de-listing.)

6 DAM mode power measurement

To test for the power consumed in DAM, the Ideal or the Practical test method may be used.

6.1 Ideal

6.1.1 To ideally measure the DAM mode power consumption, the TV should be connected to power meter that measures the total energy consumed (E_TOTAL) and a signal source that can provide a signal containing the same type and amount or duration of data that the TV will acquire in its actual application DAM use. The following procedure should be followed:

1. UUT shall be connected to a power meter that will measure the total energy consumed over duration of the test.
2. A signal source shall be prepared that can provide a signal containing the same type and amount or duration of data that the TV will acquire over the course of an average 24 hour period. This signal shall include representative segments from all Frequent Downloads.
3. The energy consumption of the UUT shall be measured over a 24 hour period (E_TOTAL), during which the TV is turned on for 1 hour then turned off for 1.5 hours 4 times then turned on for 1 hour and off for 13 hours.
4. The following equation shall be used to derive the energy used in DAM (E_DAM):

$$E\_DAM = E\_TOTAL - (P\_ON * 5 \text{ Hours}) - (P\_SLEEP * 19 \text{ Hours})$$

Where:
E_TOTAL – Total energy used by the UUT over a 24 hour period
P_ON – On mode power consumption
P_SLEEP – Sleep mode power consumption
Time_DAM – Average time spent in DAM per day

6.2 Practical

6.2.1 For practical measurement of DAM mode power consumption, it can be verified that the E_DAM can be calculated by simply multiplying the instantaneous (P_DAM - P_SLEEP) by the time in DAM mode. The following steps should be followed:

1. The TV shall be connected to a power meter and power source.
2. The TV shall be connected to an appropriate signal source for communicating with the DAM function being tested.
3. The signal which causes the TV to activate the DAM function should be applied.

4. Confirm that the TV has activated the DAM function and is communicating with the DAM signal source as appropriate for the DAM function being tested.
5. Record "P_DAM" (watts) power consumption in DAM using the power meter.
6. Confirm "Time_DAM" (hours) time of DAM per day, and calculate "E_DAM" by
   the following equation:
   $E\_DAM = (P\_DAM - P\_SLEEP) \times Time\_DAM$
7. If there are different DAM functions for the same TV, repeat steps 1 through 6 for each DAM function. In this case, the total E_DAM is calculated:

   $E\_DAM = SUM((P\_DAM - P\_SLEEP) \times Time\_DAM)$

   Where:
   P_SLEEP – Sleep mode power consumption
   P_DAM – DAM power consumption for each DAM function
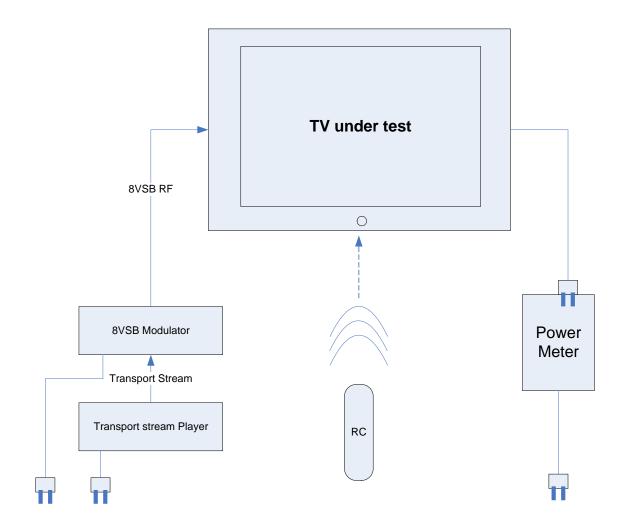   Time_DAM - Time spent per day in DAM for each DAM function

6.3   Verification

6.3.1   The average time per day spent in DAM mode is easily estimated and easily verified by connecting the TV into its intended application and monitoring the energy usage. It is self evident when the TV is in On mode. When the TV is off and drawing less than 1W it must be in Sleep mode, and when it is off and drawing more than 1W, it must be in DAM mode. The verification should be repeated for several days in case a less frequent download occurs on one day.

7   Connection Diagram

8 Templates

8.1 Data Declaration

8.1.1 As stated above, all DAM functions both frequent and infrequent must be declared. For each function all appropriate columns must be completed. The total E_DAM will be compared against the ENERGY STAR limit for DAM.

8.2 Blank DAM Declaration Template

DAM Declarations					P_DAM	P_DAM - P_Sleep	Time_DAM	E_DAM*	
	Function	Trigger	Duration(s)	Frequency	Estimate	Power (W)		Hrs:Min	(W-hrs)	Notes
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
				Total						

8.3   Example DAM Declaration Template

DAM Declarations					P_DAM	P_DAM - P_Sleep	Time_DAM	E_DAM*	
Function	Trigger	Duration(s)	Frequency	Estimate	Power (W)		Hrs:Min	(W-hrs)	Notes
1 Firmware Update	availability detected by Check	1 hr 45 min	Infrequent	2x / year	26.5	26			only if required for feature update/fix
2 Download Setup data	new installation	5 min	Infrequent	Once	26.5	26			
3 Update Setup/Channel Map	availability detected by check	5 min	Infrequent	2x / year	26.5	26			if now channels added or room setup change required
4 Check for new version of 1,2, or 3	Turn off + 15 minutes	3 min	Frequent	5x / day	26.5	26	0:15	6.5	Check for new version - downloads only if new version available
5 Initialize EPG setup	new installation	3 hrs	Infrequent	Once	26.5	26			
6 Update EPG data	daily	15 min	Frequent	4x / day	26.5	26	2:22	62.4	
		2 hrs			26.5	26			
		5 min			26.5	26			
		2 min			26.5	26			
7 Weekly Download	weekly	1 hr	Frequent	1x / week	26.5	26	0:09	3.9	
8									
9									
10									
				Total			2:46	72.8	
									*E_DAM = (P_DAM - P_Sleep) x Time_DAM

* $E\_DAM = (P\_DAM - P\_Sleep) \times Time\_DAM$