ENERGY STAR® Product Specification for Set-top Boxes

Eligibility Criteria
Final Draft Version 4.1

Following is the Version 4.1 ENERGY STAR product specification for Set-top Boxes (STBs). A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1 DEFINITIONS

A) Set-top Box (STB): A device combining hardware components with software programming designed for the primary purpose of receiving television and related services from terrestrial, cable, satellite, broadband, or local networks and providing video output using at least one direct video connection.

B) Displayless Video Gateway (DVG): A device combining hardware components with software programming designed for the primary purpose of receiving television and related services from terrestrial, cable, satellite, broadband, or local networks and providing video without any direct video connection.

		Primary purpose is receiving television and related services?		
		Yes		**No**
		Local Video Connection?		
		Yes	**No**	
Direct Service Provider Source Input?	**Yes**	STB	Displayless Video Gateway(DVG)	Small Network Equipment (covered in separate ENERGY STAR Specification)
	No	Thin Client/ Remote STB	Excluded from Scope	

C) Product Type (Base Type): The means of access to video content for a STB or DVG.

1) Cable: A STB or DVG that can receive television signals from a broadband, hybrid fiber/coaxial, or community cable distribution system with Conditional Access (CA) or a STB or DVG capable of receiving cable service after installation of a CableCARD or other type of Conditional Access system.

2) Satellite: A STB or DVG that can receive and decode video content as delivered from a MVPD satellite network.

3) Cable Digital Transport Adapter (DTA): A minimally-configured STB that can receive television signals from a broadband, hybrid fiber/coaxial, or community cable distribution system.

4) Internet Protocol (IP): A STB or DVG that can receive television/video signals encapsulated in IP packets.

i) Over-the-top (OTT) Internet Protocol (IP): An IP STB that cannot receive signals from a Multichannel Video Programming Distributor (MVPD) as defined in Title 47 USCS § 522.

ii) Multichannel Video Programming Distributor (MVPD) Internet Protocol (IP): An IP STB or DVG that can receive signals from a MVPD.

Note: EPA has updated the references to "Service Provider" to MVPD, to avoid confusion with any video services that can be accessed through Over-the-top (OTT) IP STBs

5) Terrestrial: A STB that can receive television signals over the air (OTA) or via community cable distribution system without Conditional Access (CA).

6) Thin-client / Remote: A STB that can receive content over an HNI from another STB or a DVG, but is unable to interface directly to the MVPD network.

D) Additional Functionality:

1) CableCARD: The capability to decrypt premium audio/video content and services and provide other network control functions via a plug-in Conditional Access module that complies with the ANSI/SCTE 28 HOST-POD Interface Standard[1].

2) Digital Video Recorder (DVR): A feature that records television signals on a hard disk drive (HDD) or other non-volatile storage device integrated into the STB or DVG. A DVR often includes features such as: Play, Record, Pause, Fast Forward (FF), and Fast Rewind (FR). STBs or DVGs that support a Service Provider network-based "DVR" service are not considered DVR STBs or DVGs for purposes of this specification. The presence of DVR functionality does not mean the device is defined to be a STB or DVG.

3) DOCSIS®: The capability to distribute data and audio/video content over cable television infrastructure in accordance with the CableLabs® Data Over Cable Service Interface Specification[2].

4) Home Network Interface (HNI): An interface with external devices over a local area network (example: Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wireless-Fidelity or Wi-Fi), Multimedia over Coax Alliance (MoCA), HomePNA alliance (HPNA), IEEE 802.3, HomePlug AV) that is capable of transmitting video content.

i) Multi-Input Multi-Output (MIMO) Wireless HNI: IEEE 802.11n/ac and related MIMO enabled Wi-Fi functionality that supports more than one spatial stream in both send and receive. (Antenna support is not relevant, thus the device must be 2 x n : 2[3] or better to fall under this definition.)

5) Multi-room: The capability to provide independent live audio/video content to multiple devices (2 or more Clients) or support pause/time-shifting capability for otherwise standalone IP or Thin-client STBs within a single family living unit. This definition does not include the capability to manage gateway services for multi-subscriber scenarios.

Note: the Agency proposes in this draft to expand the definition of multi-room to include Service Provider IP STBs that have a functionality somewhere between true Multi-room and shared-DVR—but may be more efficient than true multi-room.

6) Multi-stream: A STB or DVG feature that allows the device to read multiple independent streams of video content for use with one or more Clients, one or more directly connected Display Devices, or a DVR, etc. This definition does not include the capability to manage gateway services for multi-subscriber scenarios.

7) Ultra HD (4k) Resolution: The capability to transmit or display video signals with a minimum output resolution of 3840×2160 pixels in progressive scan mode at minimum frame rate of 24 fps (abbreviated 2160p24).

1 http://www.scte.org/standards/
2 http://www.cablelabs.com/specifications/
3 The description "2 x n : 2" means 2 send streams x n antennas : 2 receive streams, where n will always be the same or larger as the largest number of streams (in this case 2).

8) High Efficiency Video Processing: Video decoding providing compression efficiency significantly higher than H.264/AVC, for example HEVC (H.265).

9) Three-dimensional (3D) Capability: The capability to transmit or display video signals with 3D depth information for stereoscopic display.

10) Access Point: The capability to provide wireless network connectivity to multiple clients. For the purposes of this specification, Access Point functionality includes only IEEE 802.11 (Wi-Fi) connectivity.

11) Router: The capability to determine the optimal path along which network traffic should be forwarded. Routers forward packets from one network to another based on network layer information. Router functionality includes Access Point functionality.

12) Telephony: The ability to provide analog telephone service through one or more RJ11 or RJ14 jacks.

E) Auto Power Down (APD): A STB or DVG feature that monitors parameters correlated with the user activity or viewing. If the parameters collectively indicate that no user activity or viewing is occurring, the APD feature enables the STB or DVG to transition to Sleep Mode.

F) Principal Function: Functions necessary for selecting, receiving, decoding, decompressing, or delivering live or recorded audio/video content to a Display Device, local/remote recording device, or Client. Monitoring for user or network requests is not considered a Principal Function for STBs or DVGs.

G) Secondary Function: Functions that enable, supplement, or enhance a Primary Function including the activation or deactivation of a Primary Function by remote switch (e.g., remote control, internal sensor, and timer).

H) Operational Modes:

1) On Mode: The STB or DVG is connected to a mains power source. At least one Principal Function is activated and all Principal Functions are provisioned for use. The power consumption in On Mode may vary based on specific use and configuration.

2) Sleep Mode: A range of reduced power states where the STB or DVG is connected to a mains power source and is not providing any Principal Function. The STB or DVG may transition to On Mode due to user action, internal signal, or external signal. The power consumed in this mode may vary based on specific use or configuration. If any Principal Function is activated while operating in this mode, the STB or DVG is assumed to transition to On Mode. Monitoring for user or network requests is not considered a Principal Function. The STB or DVG shall be able to transition from this mode to On Mode within 30 seconds to be considered in Sleep Mode.

3) Deep Sleep State: A power state characterized by reduced power consumption that provides additional energy savings.

Note: EPA removed Deep Sleep State from being "within Sleep Mode" to permit recovery time to be greater than 30 seconds, as is anticipated under current implementations of Deep Sleep State.

I) Other Definitions

1) Display Device (DD): A device (e.g., TV, Computer Monitor, or Portable TV) that receives its content directly from a STB through a video interface (example: High-Definition Multimedia Interface (HDMI), Component Video, Composite Video, or S-Video), not through a HNI, and displays it for viewing.

2) Client: A device (e.g., STB, Thin-Client STB, Smart TV, Mobile Phone, Tablet, PC, etc.) that can receive content over a HNI from another STB or DVG .

3) External Power Supply (EPS): Also referred to as External Power Adapter. An external power supply circuit that is used to convert household electric current into dc current or lower-voltage ac current to operate a consumer product.

4) Service Provider: A business entity that provides video content, a delivery network, and associated installation or support services to subscribers with whom it has an ongoing contractual relationship.

5) Conditional Access: The encryption, decryption, and authorization techniques employed to protect content from unauthorized viewing. CableCARD and Downloadable Conditional Access System (DCAS) are examples of Conditional Access technology.

6) Typical Energy Consumption (TEC): A means for evaluating energy efficiency through a calculation of expected energy consumption for a typical household over a one year period, expressed in units of kWh/year.

Note: EPA has replaced Annual Energy Consumption (AEC) with Typical Energy Consumption (TEC) to reflect that testing for both STBs and DVGs will be based on the CEA 2043 test procedure.

7) Unit Under Test (UUT): The STB or DVG being tested.

Note: EPA has modified the UUT definition to include Displayless Video Gateway (DVG) and updated other references to STB to "STB or DVG" throughout.

J) Product Family: A group of product models that are (1) made by the same manufacturer, (2) subject to the same ENERGY STAR qualification criteria, and (3) of a common basic design. Product models within a family differ from each other according to one or more characteristics or features that either (1) have no impact on product performance with regard to ENERGY STAR qualification criteria, or (2) are specified herein as acceptable variations within a product family. For Set-top Boxes, acceptable variations within a product family include aesthetic housing changes that do not affect the thermal characteristics of the device (e.g., color, labeling, or other cosmetic modifications).

2 SCOPE

2.1 Included Products

2.1.1 Products that meet the definition of Set-top Box or Displayless Video Gateway, and a Set-top Box Base Type as specified herein are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.2.

2.2 Excluded Products

2.2.1 Products that are covered under existing ENERGY STAR product specifications are not eligible for qualification under the STB specification. The list of specifications currently in effect can be found at www.energystar.gov/specifications.

3 QUALIFICATION CRITERIA

3.1 Significant Digits and Rounding

3.1.1 All calculations shall be carried out with directly measured (unrounded) values.

3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using directly measured or calculated values without any benefit from rounding.

3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

Note: The rounding requirements have been updated for consistency with other ENERGY STAR

specifications.

3.2 General Qualification Criteria

3.2.1 External Power Supplies (EPSs): Single- and Multiple-voltage EPSs shall meet the level V performance requirements under the International Efficiency Marking Protocol when tested according to the Uniform Test Method for Measuring the Energy Consumption of External Power Supplies, Appendix Z to Subpart B of 10 CFR Part 430.

i. Single-voltage EPSs shall include the level V marking.

ii. Additional information on the Marking Protocol is available at www.energystar.gov/powersupplies.

3.2.2 Maintenance Activities:

i. Products may automatically exit Sleep Mode and/or Deep Sleep State on a regular schedule to download content, scan for program and schedule information, and perform maintenance activities. The total time spent performing maintenance activities shall not exceed an average of two hours in any 24-hour period, exclusive of activities scheduled by the end-user (e.g., video recording of a regularly scheduled program). Video downloads that are not user-requested (e.g., "speculative recording", or "push") shall be counted against the two hour average per day requirement.

ii. Products that have exited Sleep Mode or Deep Sleep State and completed maintenance or other user-requested activities shall automatically return to Sleep Mode or Deep Sleep State in less than 15 minutes.

iii. Products that provide a speculative recording function shall provide a user-accessible menu option to permit users to disable the functionality. Instructions for disabling speculative recording shall be included in printed and/or electronic product manuals.

3.2.3 Auto Power Down (APD): To apply "YES" in Table 1 Operational Mode Durations for Column 1 "APD Enabled by Default," products shall meet the following requirements:

i. Products shipped with software from the manufacturer shall ship with APD enabled by default, with APD timing set to engage after a period of inactivity less than or equal to 4 hours.

ii. Otherwise, the default software download from the Service Provider shall set APD timing to engage after a period of inactivity less than or equal to 4 hours.

iii. All energy-related default settings shall persist until an end-user chooses to manually either (1) disable APD, or (2) modify the default settings.

3.2.4 Deep Sleep State: To apply "YES" in Table 1 Operational Mode Durations for Column 2 "Automatic Deep Sleep," products shall meet the following requirements:

i. A means of activating Deep Sleep shall be present and may include clearly marked button(s) or switch(es) on the remote control that shall begin activation of Deep Sleep within 2 seconds of being pressed and within two button presses. Alternatively, Deep Sleep shall be activated via a timer or network stimulus. Alternative button configurations or methods of reaching Deep Sleep will be acceptable with written approval from EPA.

ii. Deep Sleep functionality shall be enabled by default

iii. Deep Sleep functionality shall not prevent a device from performing a user-scheduled DVR recording or other function.

iv. Conversely, a user-scheduled DVR recording or other function shall not prevent a device from entering and remaining in Deep Sleep, except during the time required to perform the DVR recording or other function, and 15 minutes before and after the time required.

v. An override function may be provided to allow the end-user to disable Deep Sleep functionality; however, users shall first be offered an explanation of the Deep Sleep feature and provided the opportunity to change the schedule to better suit their needs.

vi. After the end of deep/scheduled sleep time, the STB must resume Sleep Mode functionality including the ability to transition to On Mode in 30 seconds or less.

Note: EPA has removed the Deep Sleep Incentive proposed in the August 29 memo because power decreases in a Deep Sleep State are now recognized in the TEC calculation. In order to apply the Deep Sleep State in the TEC equation, EPA is maintaining the above proposed requirements so that Deep Sleep State is more likely to realize energy saving benefits above and beyond Sleep Mode once the product is deployed in consumers' homes.

Since the last draft, EPA has included the override function requirement to allow a user to set their optimal schedule rather than disabling the feature outright as one Deep Sleep schedule will not suit all users.

3.3 Typical Energy Consumption (TEC) Requirements

3.3.1 For STBs, TEC as determined per the test procedure , multiplied by a factor relating to the client-only incentive, shall be less than or equal to the Maximum TEC Specification Requirement (TEC_{MAX}), as illustrated in Equation 1.

Equation 1: TEC Requirement for STBs

$$\left(1 - Incentive_{CLIENT\_ONLY}\right) \times TEC \leq TEC_{MAX} = TEC_{BASE} + \sum_{1}^{n} TEC_{ADDL\_i},$$

Where:

- *TEC is the Typical Energy Consumption, as calculated in Equation 3;*
- *$Incentive_{CLIENT\_ONLY}$ is an incentive for Multi-room STBs, as specified in Section 3.3.4;*
- *TEC_{MAX} is the maximum TEC Specification Requirement—the level for ENERGY STAR qualification;*
- *TEC_{BASE} is the topmost applicable Base Type TEC Allowance (kWh), as specified in Equation 3; and*
- *TEC_{ADDL_i} is each applicable Additional Functionality TEC Allowance (kWh), as specified in Table 3, applied once per functionality and subject to the requirements in Section 3.3.3, below.*

3.3.2 For Displayless Video Gateways (DVGs), TEC as determined per the test procedure shall be less than or equal to the Maximum TEC Specification Requirement (TEC_{MAX}), as illustrated in Equation 2.

Equation 2: TEC Requirement for Displayless Video Gateways (DVGs)

$$TEC \leq TEC_{MAX} = TEC_{BASE} + \sum_{1}^{n} TEC_{ADDL\_i},$$

Where:

- *TEC is the Typical Energy Consumption, as calculated in Equation 3;*
- *TEC_{MAX} is the maximum TEC Specification Requirement—the level for ENERGY STAR qualification;*

- *TEC_{BASE} is the topmost applicable Base Type TEC Allowance (kWh), as specified in Table 1; and*
- *TEC_{ADDL_i} is each applicable Additional Functionality TEC Allowance (kWh), as specified in Table 3, applied once per functionality and subject to the requirements in Section 3.3.3, below.*

Equation 3: TEC Calculation

$$TEC = 0.365\left[\left(T_{WATCH\_TV} \times P_{WATCH\_TV}\right) + \left(T_{SLEEP} \times P_{SLEEP}\right) + \left(T_{APD} \times P_{APD\_ON\_to\_SLEEP}\right) + \left(T_{DEEP\ SLEEP} \times P_{SLEEP\_SP\_2}\right)\right]$$

Where:

- *T_{WATCH_TV} is the time coefficient for On Mode, as determined per Table 1*
- *P_{WATCH_TV} is the measured power in On Mode (W);*
- *T_{SLEEP} is the time coefficient for Sleep Mode, as determined per Table 1;*
- *P_{SLEEP} is the measured power in Sleep Mode (W);*
- *T_{APD} is the time coefficient for APD, as determined per Table 1;*
- *$P_{APD\_ON\_to\_SLEEP}$ is the measured power after an APD timeout (W);*
- *T_{DEEP_SLEEP} is the time operating in Deep Sleep State (maximum of 4h); and*
- *$P_{SLEEP\_SP\_2}$ is the measured power in the automatically scheduled Deep Sleep State (W).*

Table 1: Operational Mode Durations

APD Enabled by Default	Auto-matic Deep Sleep	T_{WATCH_TV}	T_{SLEEP}	T_{APD}	T_{DEEP_SLEEP}
NO	NO	14	10	0	0
NO	YES	14	$10 - T_{DEEP\ SLEEP}$	0	Deep Sleep as-deployed duration
YES	NO	$7 - \frac{4 - T_{APD\ ON\ to\ SLEEP}}{2}$	10	$7 + \frac{4 - T_{APD\ ON\ to\ SLEEP}}{2}$	0
YES	YES	$7 - \frac{4 - T_{APD\ ON\ to\ SLEEP}}{2}$	$10 - T_{DEEP\ SLEEP}$	$7 + \frac{4 - T_{APD\ ON\ to\ SLEEP}}{2}$	Deep Sleep as-deployed duration

Table 2: Base Type TEC Allowance (TEC_{BASE_MAX})

Base Type (Use Topmost if Multiple Apply)	Version 4.1 Allowance (kWh/year)
1. Cable DTA	40
2. Cable	60
3. Satellite	65
4. Multichannel Video Programming Distributor (MVPD) Internet Protocol (IP)	65
5. Over-the-top (OTT) Internet Protocol (IP)	10
6. Terrestrial	18

Base Type (Use Topmost if Multiple Apply)	Version 4.1 Allowance (kWh/year)
7. Thin-client / Remote	30

Note: As proposed in the August 29 memo to stakeholders, EPA increased many of the base allowances to reflect re-analysis of the ENERGY STAR dataset and to ensure adequate selection of each base type.

3.3.3 Additional Functionality TEC Allowances (TEC_{ADDL_i}) shall be as specified in Table 3, subject to the following requirements:

i. No additional functionality allowances may be applied to STBs or DVGs with CABLE DTA base functionality.

ii. The HOME NETWORK INTERFACE, and MIMO Wi-Fi HNI allowances are the only additional functionality allowances that may be applied to STBs with THIN CLIENT / REMOTE base functionality.

iii. The CableCARD allowance may only be applied once per STB or DVG, regardless of the number of CableCARDs installed in the STB or DVG.

iv. The DOCSIS allowance may only be applied to STBs or DVGs that are installed in a Service Provider network with DOCSIS capability.

v. The MULTI-ROOM allowance may only be applied once per STB or DVG, regardless of the number of remote outputs served by the STB or DVG.

vi. The MULTI-ROOM allowance may only be applied to STBs or DVGs that can provide live audio/video content to multiple devices (2 or more Clients) or support pause/time-shifting capability for otherwise standalone IP or Thin-client STBs.

Note: EPA updated the above MULTI-ROOM allowance rule for consistency with the changed definition.

vii. The MULTI-ROOM allowance may not be combined with the HOME NETWORK INTERFACE allowance on a single STB or DVG.

viii. The MIMO Wi-Fi HNI allowance can only be combined with HOME NETWORK INTERFACE or MULTI-ROOM allowance and only when the device is tested with Wi-Fi as the HOME NETWORK INTERFACE providing the primary video transport for the device. It cannot be used at any other time and must be used in conjunction with the HOME NETWORK INTERFACE or MULTI-ROOM allowance.

ix. The MULTI-STREAM allowances may only be applied once per STB or DVG, regardless of the number of simultaneous streams supported by the STB or DVG.

x. Either the ROUTER or ACCESS POINT allowance may be applied once per STB or DVG, and must be combined with the HOME NETWORK INTERFACE or MULTI-ROOM allowance.

Table 3: Additional Functionality TEC Allowance (TEC_{ADDL_i})

Additional Functionality	Version 4.1 Allowance (kWh/year)
CableCARD	15
Digital Video Recorder (DVR)	45
DOCSIS®	20

Additional Functionality	Version 4.1 Allowance (kWh/year)
DOCSIS® 3 (Applicable until December 1, 2015)	11
High Efficiency Video Processing	15
Home Network Interface (HNI)	17
MIMO Wi-Fi HNI: 2.4 GHz Stream	3
MIMO Wi-Fi HNI: 5 GHz Stream	10
Multi-room	56
Multi-stream – Cable/Satellite	16
Multi-stream – Terrestrial/IP	6
UltraHD Resolution	5
Access Point	8
Router	27
Telephony	4

Note: Based on stakeholder feedback that STBs shipping with DOCSIS 3 will not be able to take advantage of the 1×1 energy saving mode until the head-end equipment is deployed, EPA is proposing an additional, but time-limited, DOCSIS 3 allowance of 11 kWh/yr (to be combined with the DOCSIS allowance, yielding a total of 31 kWh/yr). This additional allowance will be in place until 2015, when upgrades to the head-end equipment are expected.

Also, following the webinar to discuss the memo to stakeholders published on August 29, EPA amended the presentation slides to reflect the consensus on the webinar that some of the proposed 20 kWh/yr UltraHD Resolution allowance should be allocated to High Efficiency Video Processing. However the balance between UltraHD and HEVP was recorded incorrectly. Table 3**,** above, reflects the correct distribution, with UltraHD receiving 5 kWh/yr and HEVP receiving 15 kWh/yr.

Lastly, also in response to the discussion of the August 29 memo on September 16, EPA increased the allowances for HNI (from 15 kWh/yr to 17 kWh/yr), 2.4 GHz MIMO Wi-Fi HNI streams (from 2 kWh/yr to 3 kWh/yr), and 5 GHz MIMO Wi-Fi HNI streams (from 7 kWh/yr to 10 kWh/yr) to more accurately reflect the energy requirements of current technologies.

3.3.4 Client Only Incentive: Multi-room STBs can receive an incentive for use in Equation 1 by going into a lower-power state while continuing to provide video to their connected clients, as calculated in Equation 4. Note, because DVGs lack a connected Display Device, they always operate in Client Only mode (measured in Section 4.7.3). Therefore, this incentive applies only to STBs and not DVGs.

Equation 4: Calculation of Client Only Incentive for Multi-room STBs

$$Incentive_{CLIENT\_ONLY} = \frac{P_{WATCH\_TV} - P_{CLIENT\_ONLY}}{P_{WATCH\_TV}},$$

Where:

- $Incentive_{CLIENT\_ONLY}$ *is the Client Only Incentive applicable to Multi-room STBs;*
- P_{WATCH_TV} *is the measured power in On Mode (W) for Multi-room STBs; and*
- P_{CLIENT_ONLY} *is the Sleep Mode Power as measured in Section 4.6.2.*

Note: EPA changed the explanation of P_{CLIENT_ONLY} to reference Sleep Mode as the test is based on the CEA-2043 Sleep Mode test.

Note: Products intended for sale in the US market are subject to minimum toxicity requirements. Please see ENERGY STAR® Program Requirements for Set-top Boxes: Partner Commitments for details.

4 TESTING

4.1 Test Methods

4.1.1 Test methods identified in Table 4 shall be used to determine energy consumption.

Table 4: Test Methods for ENERGY STAR Qualification and Additional Incentives

Product Type	Test Method
STBs and Displayless Video Gateways (DVGs)	CEA-2043, Set-top Box (STB) Power Measurement, Rev, June-2013, subject to the clarifications in Sections 4.2–4.9.

Note: The table of test methods has been updated to reference the final CEA-2043 test procedure.

4.2 Number of Units Required for Testing

4.2.1 For qualification of an individual product model, the Representative Model shall be equivalent to that which is intended to be marketed and labeled as ENERGY STAR.

4.2.2 For qualification of a Product Family, the highest energy using model within that Product Family can be tested and serve as the Representative Model. Any subsequent testing failures (e.g., as part of verification testing) of any model in the family will have implications for all models in the family.

Note: The number of units for test has been updated for consistency with other ENERGY STAR specifications.

4.3 International Market Qualification

4.3.1 Products shall be tested for qualification at the relevant input voltage/frequency combination for each market in which they will be sold and promoted as ENERGY STAR, as specified in Table 5.

Table 5: Input Power Requirements

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

4.4 UUT Connections

4.4.1 The UUT shall be connected to the first applicable input connection specified in Table 6.

Table 6: Input Connections

Connection (Protocol)
1. Coax (QAM/DOCSIS)
2. Coax (Satellite/MoCA)
3. Coax (QAM/MoCA)
4. Wi-Fi
5. Coax (HPNA)
6. Ethernet (802.3)
7. Other

Note: The priority of network connections in Table 6, above, has been updated to reflect the testing order in the Voluntary Agreement.

4.4.2 If the UUT is intended for operation on a Home Network or with Clients or Multi-room STBs or DVGs and the input connection specified in Section 4.4.1, above, is insufficient to permit this operation, the UUT shall be further connected to the Home Network, Clients, or Multi-room STB or DVG through a second connection specified in Table 7.

Table 7: Network Connections

Connection (Protocol)
1. MIMO Wi-Fi HNI
2. Wi-Fi
3. Coax (MoCA)
4. Coax (HPNA)
5. HomePlug AV
6. Ethernet (802.3)
7. Other

Note: The priority of network connections in Table 7, above, has been updated to reflect the testing order in the Voluntary Agreement.

4.4.3 If the UUT is a STB, it shall be connected to a Display Device with the first applicable output connection specified in Table 8.

Table 8: Output Connections

Connection (Protocol)
1. HDMI/DVI
2. Component
3. S-Video
4. Composite

5. Coax
6. Other

4.4.4 STBs claiming the Multi-Room (MR) allowance must be tested with three (3) live video streams with at least one Client (receiving live video) in addition to locally connected Display Devices, if supported. If three live streams are not supported the MR allowance may not be used.

4.4.5 Voice and Data Setup: Unlike as specified in CEA 2043, the UUT shall be provisioned to provide data and/or voice services where applicable.

i. Voice: DVGs with Public Switched Telephone Network (PSTN) technology shall be configured and provisioned for VOIP services to allow incoming and outgoing calls. Connect an analog single-line telephone to the UUT via the RJ-14 jack on the unit using a 1.8 meter, 4 wire telephone extension with RJ-14 connectors.

ii. Data: Configure and provision data services such that there is a live, usable connection to the head end and a live, usable local area network via either MoCA, Ethernet, or Wi-Fi interfaces on the UUT, following the precedence list in Table 6 above. Follow the configuration directives in the ENERGY STAR Version 1.0 Small Network Equipment (SNE) Specification in Sections 6.3 through 6.4.7) of the SNE Test Procedure. Ignore the WAN portion of Section of 6.4.

iii. In the case of an Ethernet network, a switch capable of the same maximum link speed as the UUT shall be connected via a 1 meter Ethernet Cat 5a or Cat 6 cable.

iv. In the case of MoCA, a compatible MoCA bridge shall be connected via the appropriate COAX/Cat5e (or better) cable and provisioned for data services.

v. Additional devices shall not otherwise be connected to the local area network unless the connected Clients utilize this network for video transmission.

4.5 Implementation of CEA-2043 for STB Testing

4.5.1 Required Test Results

1) The minimum required CEA-2043 tests, test parameters, and reported results are specified in Table 9. Parameters used in this section are defined in CEA-2043.

2) CEA-2043 Special Sleep test is not required if the STB does not support a Deep Sleep State.

3) STBs claiming the UltraHD Resolution allowance must be tested using UltraHD Resolution stream(s) if supported. If UltraHD Resolution streams are not supported the UltraHD Resolution allowance may not be used.

Note: EPA added the above requirement for testing with UltraHD Resolution streams, extending the CEA-2043 practice of testing STBs with streams that match their capabilities.

Table 9: CEA-2043 Required Tests and Test Parameters

CEA-2043 (Test Number: Test Name)	Test Parameters	Reported Result
ON Mode		
8.2.2.1 ON (Watch TV)*	$T_{ON} \geq 5$ m	$P_{WATCH\ TV\_n}$ (n = DD + Clients)
SLEEP Mode		
8.3.4 SLEEP***	$T_{SLEEP} \geq 1$ h (Use CEA 2043 Section 8.3.2 (a) for SLEEP determination method**)	P_{SLEEP}
SPECIAL SLEEP Mode		
8.3.4 SLEEP (for DEEP SLEEP mode)	$T_{SLEEP} \geq 1$ h $T_{SLEEP\_WAIT} = 30$ s	$P_{SLEEP\_SP\_1}$ or $P_{SLEEP\_SP\_2}$
Power Mode Transitions		
8.5.1 APD initiated ON to SLEEP	$T_{SLEEP\_MAX} = 4.25$ h	$P_{APD\_ON\_to\_SLEEP}$ $T_{APD\_ON\_to\_SLEEP}$
8.5.3 Reenter SLEEP after RECORD	$T_{SLEEP\_MAX} = 20$ m	$T_{REC\_to\_SLEEP}$
8.5.4 Reenter SLEEP after MAINT	$T_{SLEEP\_MAX} = 20$ m	$T_{MAINT\_to\_SLEEP}$
8.5.5 SLEEP to ON	$T_{SLEEP\_to\_ON\_WAIT} = 1$ m	$T_{SLEEP\_TO\_ON}$

* CEA-2043 ON Mode test may be tested in the configurations specified above and without the requirement, as seen in CEA-2043 Section 8.2.2.1 to measure and record each iteration of adding another Display Device until the maximum supported is connected. Only the power consumption of the specified number of Display Devices and Client configurations need be reported.

** SLEEP determination method from CEA-2043 Section 8.3.2 (a) is "No channel viewing or recording is supported on a UUT or Client".

*** Assure no DEEP SLEEP mode is scheduled over the entire duration of the SLEEP test.

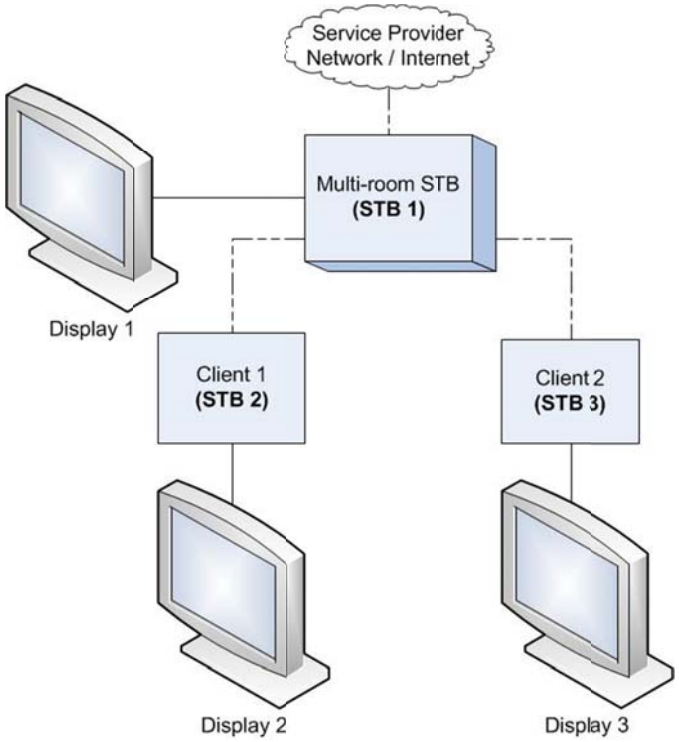
Note: The above additional requirements were included from the Voluntary Agreement Tier 2 Program Requirements to permit harmonization of testing. The requirements are taken verbatim, with the exceptions of clarifications to the first footnote and the addition of a wait time parameter (T_{SLEEP_WAIT}) for Deep Sleep State power measurement, to permit its differentiation from Sleep Mode.

4.6 Implementation of CEA-2043 for Multi-room STB Testing

4.6.1 Multi-room STB Test Set-Up: Multi-room STBs shall be set up per Figure 1, using the connections specified in Section 4.4 and per the following requirements.

i. The Clients connected to the Multi-room STB shall be configured per CEA-2043.
ii. All other testing conditions shall be taken from the sections above.

Figure 1: Multi-room STB Configuration[4]



4.6.2 Multi-room STB Test Conduct: Multi-room STBs may be tested to measure the Client Only Power, P_{CLIENT_ONLY}, and obtain the Client Only Incentive specified in Section 3.3.4, per the below requirements.

i. The devices in the configuration shall concurrently run all of the applicable CEA-2043 tests specified in CEA-2043 section listed in Table 10, with the Thin Client/Remote STBs serving as a background condition for the testing of the Multi-room STB (UUT).

Note: EPA has removed the additional requirements for the duration of Sleep Mode power measurement and the wait time for models entering Sleep Mode as these are now specified in Table 9, above. The measurement duration is greater than or equal to 1 hour, while there is no longer a wait time (T_{SLEEP_WAIT}). Instead, entry into Sleep Mode is indicated by the inability to view or record channels in the UUT or Clients.

Table 10: Multi-room STB Client Only Test

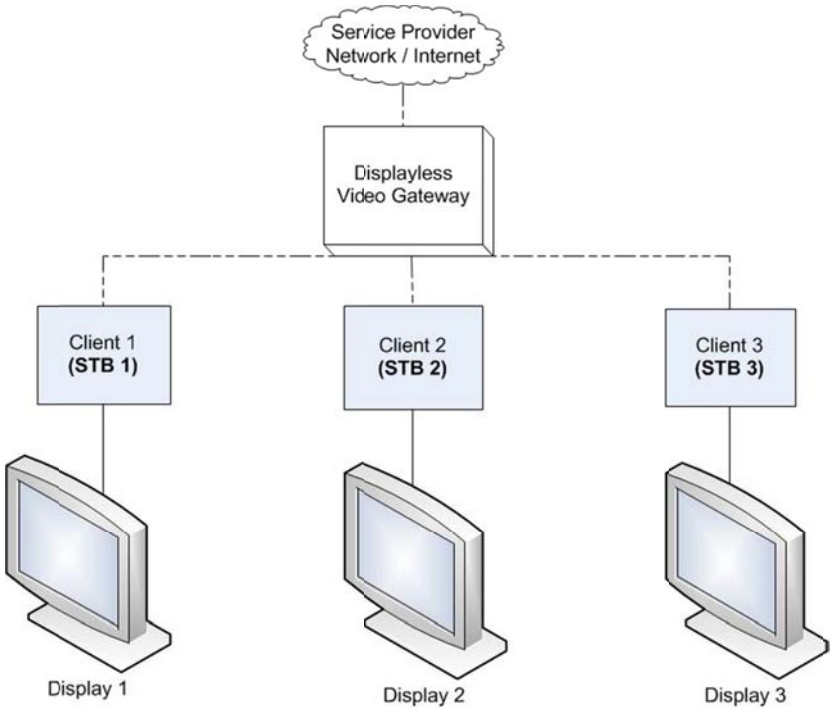
STB in Figure 1	CEA-2043 Test	Result	Notes
STB 1 (UUT)	8.3 SLEEP*	P_{CLIENT_ONLY}	Multi-room STB not being used locally for viewing or recording
STB 2	8.2.2.2: ON (Play)	Not Measured	Thin Client in On Mode over a home network
STB 3	8.2.2.2: ON (Play)	Not Measured	Thin Client in On Mode over a home network

* NOTE: Although the UUT is being tested per the CEA-2043 Sleep Mode test and should start the test in that mode, the STB may actually change to a different Mode in order to provide video content to Clients, though the tester should do nothing to the UUT except switch the two Clients to On Mode.

4.7 Implementation of CEA-2043 for Displayless Video Gateway (DVG) Testing

4.7.1 Displayless Video Gateway (DVG) Test Set-Up: Displayless Video Gateways shall be set up per Figure 2, using the connections specified in Section 4.4, and subject to the requirements below.

Figure 2: Displayless Video Gateway (DVG) Configuration



i. DVGs shall be configured per the setup in CEA-2043 for multi-room devices.

ii. The Clients connected to the DVG shall be configured per CEA-2043.

4.7.2 Displayless Video Gateway (DVG) Sleep Mode Test Conduct: The following instructions describe the measurement of Sleep Mode for DVGs for the purposes of calculating TEC.

i. The DVG under test and the connected Clients shall be running the CEA-2043 tests specified in Table 11 concurrently, with the Thin-client/Remote STBs serving as a background condition for the testing of the DVG.

ii. When testing Sleep Mode for DVGs, no video traffic shall be sent to the Clients. Regardless of the internal state of the DVG, this configuration shall be considered the Sleep Mode for the DVG.

Table 11: All Sleep Scenario 1

Device in Figure 2	CEA-2043 Test	Result	Notes
Displayless Video Gateway (UUT)	8.3.4 SLEEP	P_{SLEEP}	All Clients in SLEEP mode
STB 1	8.3.4 SLEEP	Not Measured	Thin Client/Remote STB in SLEEP mode over a home network
STB 2	8.3.4 SLEEP	Not Measured	Thin Client/Remote STB in SLEEP mode over a home network
STB 3	8.3.4 SLEEP	Not Measured	Thin Client/Remote STB in SLEEP mode over a home network

4.7.3 Displayless Video Gateway (DVG) On Mode Test Conduct: The following instructions describe the measurement of On Mode for DVGs for the purposes of calculating TEC.

i. The DVG under test and the connected Clients shall be running the CEA-2043 tests specified in Table 12 concurrently, with the Thin Client/Remote STBs serving as a background condition for the testing of the DVG.

ii. When testing On Mode for DVGs, video traffic shall be sent to all connected Clients. Regardless of the internal state of the DVG, this configuration shall be considered the On Mode for the DVG.

Note: EPA has removed the additional requirement for the duration of On Mode power measurement as this is now specified in Table 9, above. The measurement duration is greater than or equal to 5 minutes.

475 **Table 12: All On Scenario 2**

Device in Figure 2	CEA-2043 Test	Result	Notes
Displayless Video Gateway (UUT)	8.2.2.1: ON (Watch TV)	P_{MULTI_STREAM}	All Clients in On Mode
STB 1	8.2.2.1: ON (Watch TV)	Not Measured	Watching TV on a Display Device connected to Thin Client/Remote STB over a home network
STB 2	8.2.2.1: ON (Watch TV)	Not Measured	Watching TV on a Display Device connected to Thin Client/Remote STB over a home network
STB 3	8.2.2.1: ON (Watch TV)	Not Measured	Watching TV on a Display Device connected to Thin Client/Remote STB over a home network

476

477 ## 4.8 Implementation of CEA-2043 for STBs and DVGs with a Deep Sleep State

478 4.8.1 Deep Sleep State Test Setup: Units for test shall be set up per the following requirements.

479 i. All devices shall be configured per CEA-2043.

480 ii. The number of Clients, Display Devices, or Recording Devices connected to the UUT is
481 unspecified; however, all devices shall be in Sleep Mode.

482 4.8.2 User-enabled Deep Sleep State Test Conduct: Test per Section 8.3 of CEA-2043, following the
483 additional instructions in Section 8.3.3 of CEA-2043 and per the following requirements.

484 i. The tester shall enable Deep Sleep State per manufacturer instructions and report the
485 process for enabling Deep Sleep State.

486 ii. Record the average power consumed as $P_{SLEEP\_SP\_1}$ over the time period $T_{SLEEP.}$

487 **Note:** EPA has removed the additional requirement for the duration of Deep Sleep State power
488 measurement and the wait time for models entering Deep Sleep State as these are now specified in
489 Table 9, above. The measurement duration is greater than or equal to 1 hour, while the wait time
490 (T_{SLEEP_WAIT}) is 30 seconds.

491

492 4.8.3 Scheduled Deep Sleep State Test Conduct:

493 i. All requirements in section 8.3.1 of CEA-2043 shall be followed.

494 ii. The time period for the test, T_{SLEEP}, shall be equal to the duration of the default sleep
495 schedule or 6 hours, whichever is smaller. If there is no default scheduled sleep time, then
496 input the start and end time such that the total scheduled sleep duration (T_{SLEEP}) is exactly 4
497 hours (e.g. scheduled sleep hours are set to be 1:00 am to 5:00 am).

498 iii. 30 minutes before the beginning of the scheduled sleep time, place the STB or DVG in the
499 On (Watch TV) configuration.

500 iv. Do not use (or move) the STB remote control.

501 v. Place all connected client devices into Sleep Mode.

502 vi. Ensure the STB is in On Mode before scheduled sleep time begins.

Note: EPA clarified the above timing requirement per stakeholder feedback.

vii. Begin power consumption measurement at the start of the scheduled sleep time and record the average power consumed as $P_{SLEEP\_SP\_2}$ and the time period of the test as T_{DEEP_SLEEP}.

4.9 Verifying No Network Initiated Actions

4.9.1 According to section 8.3.1(c) of CEA-2043, no network initiated actions shall occur during the Sleep Mode or Deep Sleep State tests. If a network initiated action cannot be prevented, or if it is unclear whether network initiated actions are occurring during the tests, then use the following steps:

i. Repeat the Sleep Mode test 3 times on the same unit, and

ii. Use the median value of all 3 tests as the Sleep Mode power measurement.

5 USER INTERFACE

5.1.1 Partners are encouraged to design products in accordance with the user interface standard IEEE P1621: Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments. For details, see http://eetd.LBL.gov/Controls.

6 EFFECTIVE DATE

6.1.1 Effective Date: The Version 4.1 ENERGY STAR Set-top Box specification shall take effect on **December 1, 2014**. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is specific to each unit and is the date on which a unit is considered to be completely assembled.

6.1.2 Future Specification Revisions: EPA reserves the right to change this specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through stakeholder discussions. In the event of a specification revision, please note that the ENERGY STAR qualification is not automatically granted for the life of a product model.

7 FUTURE SPECIFICATION REVISIONS

7.1.1 EPA intends to include the following topics in the next revision of the STB specification:

i. Implement a mandatory Deep Sleep requirement for all qualifying STBs or DVGs, where Deep Sleep State power shall be significantly lower than that for Sleep Mode and On Mode.