



# ENERGY STAR® Program Requirements Product Specification for Set-Top Boxes

## Draft 2 Test Method Rev. Feb-2016

### 1 OVERVIEW

The following test method shall be used for determining product compliance with requirements in the ENERGY STAR Specification for Set-top Boxes.

### 2 APPLICABILITY

The following test method is applicable to all products eligible for qualification under the ENERGY STAR Specification for Set-top Boxes.

**Note:** In the Draft 1 Test Method for ENERGY STAR Set-top Boxes, Rev. Dec-2015 (Draft 1 Test Method), DOE had discussed that it may consider combining the test requirements for displayless video gateways (DVGs) and set-top boxes (STBs) if EPA combines the categories in the specification. Because EPA has revised the STB definition such that it includes both DVGs and STBs, DOE has revised this Draft 2 Test Method to align with the specification.

### 3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Specification for Set-top Boxes.

### 4 TEST SETUP

#### 4.1 Test Setup and Instrumentation

A) Unless otherwise specified within this Test Method, the test setup and instrumentation for all portions of this method shall be in accordance with Section 7 of the Consumer Electronics Association (CEA) standard, CEA-2043, "Set-top Box (STB) Power Measurement", Rev. Aug-2013 (CEA-2043).

**Note:** DOE received a stakeholder comment that a newer CEA-2043 version from August 2013 is available. This version is the same as the June 2013 version and DOE has updated all references to the August version.

B) **Ac Input Power:** 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 1.

Table 1: Ac 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 %

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28 C) Dc Input Power:

29 1) Products may be tested with a dc source (e.g., via network or data connection) only if dc is the  
30 only available source of power for the product (i.e., no ac plug or External Power Supply (EPS) is  
31 shipped with the product).

32 2) Dc-powered products shall be installed and powered as directed by the manufacturer, using a  
33 port with the full specifications recommended for the STB (e.g., Universal Serial Bus (USB) 3.1 if  
34 applicable, even if backwards-compatible with USB 2.0).

35 3) The power measurement shall be made between the dc source (e.g., Host Machine) and the  
36 cable shipped with the product, including the losses introduced by the shipped cable. If no cable  
37 is shipped with the product, any cable between 2 and 6 feet long may be used in its place. The  
38 resistance of the cable used to connect the UUT to the point of measurement shall be measured  
39 and reported.

40 **Note:** The measured resistance of dc power cables includes the sum of resistances of both the  
41 dc supply voltage wire and the ground wire.

42 4) A spliced cable may be used between the shipped cable and dc source in order to connect the  
43 power meter. If this method is used, the following requirements must be met:

44 a) The spliced cable shall be used in addition to the shipped cable described in Section 4.1C)3).

45 b) The spliced cable shall be connected between the dc source and the shipped cable.

46 c) The spliced cable shall be no longer than 1 foot.

47 d) For measuring voltage, the total amount of wiring used between the voltage measurement  
48 and the shipped cable shall be less than 50 milli-ohms of resistance. This only applies to the  
49 wiring that is carrying load current.

50 **Note:** Voltage and current need not necessarily be measured at the same location, so long  
51 as the voltage is measured within 50 milli-ohms of the shipped cable.

52 e) The current measurement can be made either on the ground wire or the dc supply voltage  
53 wire.

54 f) Figure 1 depicts an example spliced cable setup using a USB 2.0-powered UUT connected to  
55 the Host Machine.

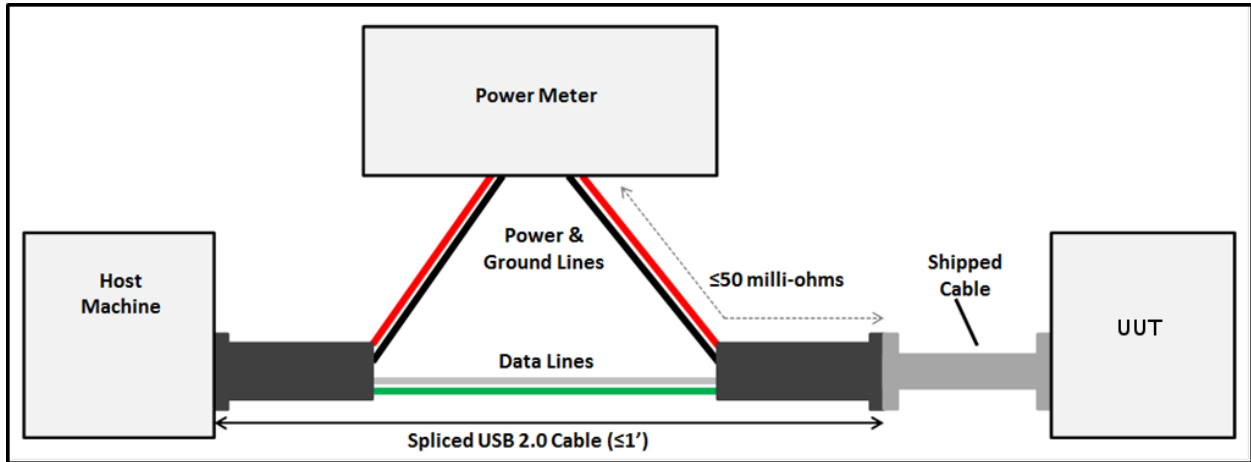


Figure 1: Example Spliced USB 2.0 Cable Arrangement

## 4.2 UUT Connections

A) The UUT shall be connected to the first applicable input connection specified in Table 2.

Table 2: 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

B) If the UUT is intended for operation on a Home Network or with Clients or Multi-room STBs and the input connection specified in Section 4.2A), above, is insufficient to permit this operation, the UUT shall be further connected to the Home Network, Clients, or Multi-room STB through a second connection specified in Table 3.

Table 3: 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

69 C) STBs offering concurrent operation of integrated HNIs at time of installation must be tested with the  
70 HNIs providing video content.

71 **Note:** DOE included the above text in the Draft 1 Test Method to align with the Tier 2 Program  
72 Requirements of the Industry Voluntary Agreement for Ongoing Improvement to the Energy Efficiency of  
73 Set-top Boxes (the VA), which specifies this requirement. In the Draft 1 Test Method, DOE had  
74 additionally included that this requirement is applicable when multiple streams are needed for testing,  
75 such as for Multi-Room STBs. However, during the webinar held to discuss the Draft 1 Specification and  
76 Test Method, stakeholders commented that the VA includes this requirement to explain that the HNI  
77 connection used for testing must be the one that supports video content streaming. That is, a Wi-Fi  
78 connection is used only if video content can be streamed over Wi-Fi. Otherwise, the next available HNI  
79 connection that supports video streaming should be used. DOE's intent is to align with the VA where  
80 feasible. Accordingly, DOE has updated the above text to be the same as that specified in the VA.

81  
82 DOE further requests feedback on whether it is common to use different HNI connections to stream video  
83 content. That is, is it more common for a Multi-Room STB to stream content to different Clients over the  
84 same HNI connection or use two different connections if both of them support video streaming?

85 D) STBs and Clients that are connected using a wireless connection shall be placed within 10 feet of  
86 each other during testing. Ensure that there are no walls or other obstructions between the STB and  
87 Client.

88 **Note:** DOE received some comments regarding the setup of wirelessly connected devices. Therefore,  
89 DOE is proposing to include the above requirement to provide clarity that wireless UUTs and Clients are  
90 placed next to each other during testing to ensure repeatability of the test.

91 E) If the UUT supports connection to a Display Device, it shall be connected to a Display Device with the  
92 first applicable output connection specified in Table 4.

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**Table 4: Output Connections**

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

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### 95 **4.3 Voice and Data Setup**

96 A) Unlike as specified in CEA 2043, the UUT shall be provisioned to provide data and/or voice services  
97 where applicable.

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

102 2) Data: Configure and provision data services such that there is a live, usable connection to the  
103 head end and a live, usable local area network via either MoCA, Ethernet, or Wi-Fi interfaces on  
104 the UUT, following the precedence list in Table 2 above. Follow the configuration directives in the  
105 ENERGY STAR Version 1.0 Small Network Equipment (SNE) Specification in Sections 6.3  
106 through 6.4.7) of the SNE Test Procedure. Ignore the WAN portion of Section 6.4.

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

- 109 4) In the case of MoCA, a compatible MoCA bridge shall be connected via the appropriate  
 110 COAX/Cat5e (or better) cable and provisioned for data services.
- 111 5) Additional devices shall not otherwise be connected to the local area network unless the  
 112 connected Clients utilize this network for video transmission.

113 **5 TEST CONDUCT**

114 **5.1 Implementation of CEA-2043 for STB Testing**

115 The Test Conduct shall be carried out according to the requirements in CEA-2043 reference with the  
 116 following guidance.

117 A) Required Test Results

- 118 1) Tests shall be performed using a live or simulated Service Provider or streaming video provider  
 119 environment per Section 8.1.11 of CEA-2043.
- 120 2) The minimum required CEA-2043 tests, test parameters, and reported results are specified in  
 121 Table 5. Parameters used in this section are defined in CEA-2043.
- 122 3) CEA-2043 Special Sleep test is not required if the STB does not support a Deep Sleep State or a  
 123 Scheduled Sleep Mode.

124 **Note:** As explained in the Draft 2 V. 5.0 ENERGY STAR Specification for Set-top Boxes, EPA has  
 125 redefined Deep Sleep State and the state formerly known as Deep Sleep has been renamed to  
 126 Scheduled Sleep. Accordingly, DOE has updated the terminology in the Draft 2 Test Method to be  
 127 consistent with the requirements in the specification.

- 128 4) As specified in section 8.1.3 of CEA-2043, all tests shall use source test streams that match the  
 129 output capability of the UUT. However, UltraHD output capable STBs shall use an UltraHD Test  
 130 Stream only if claiming the UltraHD adder. Otherwise, they shall use an HD Test Stream. The  
 131 output resolution from the UUT shall be the same as the input resolution (e.g. 720p or 1080i for  
 132 an HD STB).

133 **Note:** In the Draft 1 Test Method DOE requested feedback on the transition to UltraHD and the  
 134 prevalence of UltraHD STBs in the market. DOE also requested feedback on what changes would be  
 135 required to the test method if UltraHD streams are used for testing UltraHD STBs. DOE received one  
 136 written comment, which specified that a standard test mechanism that specifies resolution, bitrates, etc.  
 137 should be defined for the UltraHD and HEVP allowances.

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139 Additionally, DOE received some feedback during the webinar meeting. Stakeholders commented that  
 140 upscaling to UltraHD can happen at multiple places, such as within the STB or within the TV. A  
 141 stakeholder also commented that one option is to specify that the test is performed using a stream at the  
 142 highest resolution supported by the UUT and the UUT is connected to a TV that supports the highest  
 143 output resolution of the UUT.

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145 DOE is not making it mandatory to test UltraHD STBs with an UltraHD Test Stream in this version of the  
 146 test method. Additionally, DOE has clarified that an UltraHD stream should be used only if claiming the  
 147 adder and the output resolution must be the same as that of the input.

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**Table 5: CEA-2043 Required Tests and Test Parameters**

CEA-2043 <small>(Test Number: Test Name)</small>	Test Parameters	Reported Result
<b>ON Mode</b>		

8.2.2.1 ON (Watch TV)*	$T_{ON} \geq 5 \text{ min}$	$P_{WATCH TV_n}$ ( $n = DD + Clients$ )
<b>SLEEP Mode</b>		
8.3.4 SLEEP**	$T_{SLEEP} \geq 1 \text{ h}$ (Use CEA 2043 Section 8.3.2 (a) for SLEEP determination method***)	$P_{SLEEP}$
<b>SPECIAL SLEEP Mode</b>		
8.3.4 SLEEP (for DEEP SLEEP and SCHEDULED SLEEP mode)	$T_{SLEEP} \geq 1 \text{ h}$ $T_{SLEEP\_WAIT} = 5 \text{ min}$	$P_{SLEEP\_SP\_1}$ OR $P_{SLEEP\_SP\_2}$
<b>Power Mode Transitions</b>		
8.5.1 APD initiated ON to SLEEP	$T_{SLEEP\_MAX} = 4.25 \text{ h}$	$P_{APD\_ON\_to\_SLEEP}$ $T_{APD\_ON\_to\_SLEEP}$
8.5.3 Reenter SLEEP after RECORD	$T_{SLEEP\_MAX} = 20 \text{ min}$	$T_{REC\_to\_SLEEP}$
8.5.4 Reenter SLEEP after MAINT	$T_{SLEEP\_MAX} = 20 \text{ min}$	$T_{MAINT\_to\_SLEEP}$
8.5.5 SLEEP to ON	$T_{SLEEP\_to\_ON\_WAIT} = 1 \text{ min}$	$T_{SLEEP\_to\_ON}$

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

154 \*\* Assure no DEEP SLEEP or SCHEDULED SLEEP mode is scheduled over the entire duration of the  
155 SLEEP test.

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

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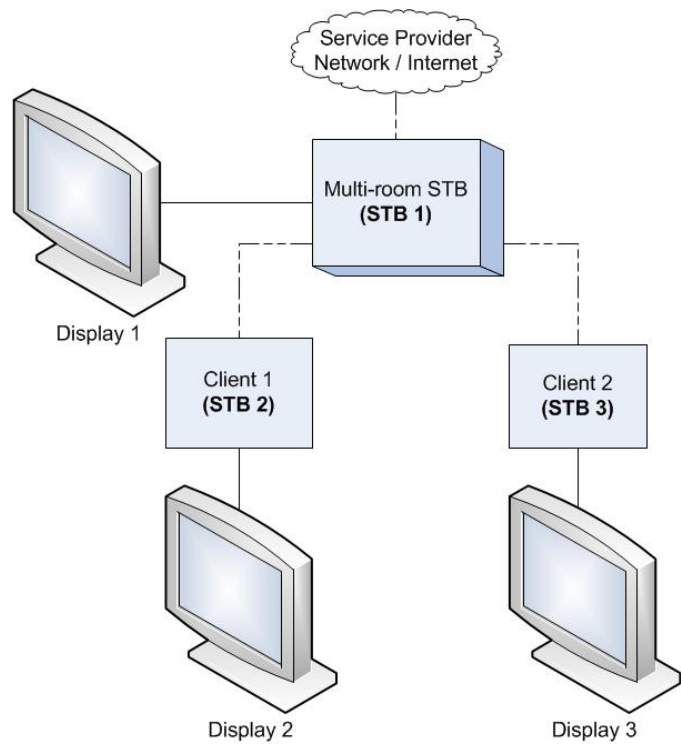
## 159 5.2 Implementation of CEA-2043 for Multi-room STB Testing

160 A) Multi-room STB Test Set-Up: Multi-room STBs that support connection to a Display Device shall be  
161 set up per Figure 2 using the connections specified in Section 4.2. Multi-room STBs that do not  
162 support connection to a Display Device shall be set up per Figure 3 using the connections specified in  
163 Section 4.2. Additionally, all STBs shall be subject to the following requirements.

- 164 1) The Clients connected to the Multi-room STB shall be configured per CEA-2043.
- 165 2) STBs claiming the Multi-Room (MR) allowance must be tested with three (3) live video streams  
166 with two Clients (receiving live video) and a locally connected Display Devices, if supported. If a  
167 locally connected Display Device is not supported, the STB must be tested with three Clients  
168 (receiving live video). If three live streams are not supported the MR allowance may not be used.
- 169 3) All other testing conditions shall be taken from the sections above.

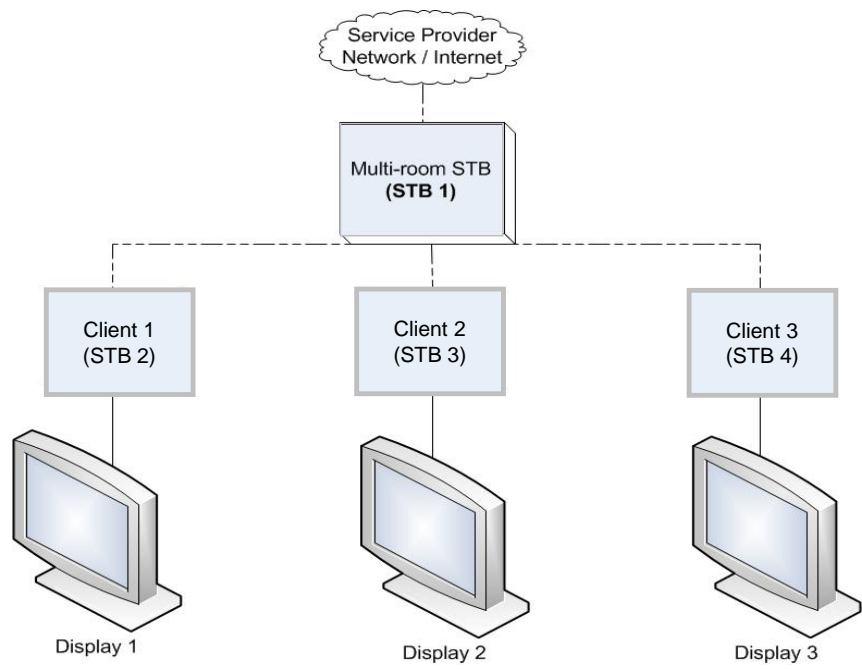
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**Note:** DOE has combined the requirements for testing STBs and DVGs as discussed in the Draft 1 Test Method. The test conduct and test requirements for testing DVGs continue to be the same as before.



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**Figure 2: Multi-room STB Configuration for STBs that Support Connection to a Display Device**



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**Figure 3: Multi-room STB Configuration for STBs that do not Support Connection to a Display Device**

- 180 A) Multi-Room STB On Mode Test Conduct: The following instructions describe the measurement of On  
 181 Mode for Multi-Room STBs for the purposes of calculating TEC.
- 182 1) The Multi-Room STB under test and the connected Clients shall be running the CEA-2043 tests  
 183 specified in Table 6 concurrently, with the Thin Client/Remote STBs serving as a background  
 184 condition for the testing of the Multi-Room STB.
- 185 2) When testing On Mode for Multi-Room STBs, video traffic shall be sent to all connected Clients.  
 186 Regardless of the internal state of the Multi-Room STBs, this configuration shall be considered  
 187 the On Mode for the STB.

188 **Table 6: On Mode Test Setup for Multi-Room STBs**

Device in Figure 2 or Figure 3	CEA-2043 Test	Result	Notes
STB 1 (UUT)	8.2.2.1: ON (Watch TV)	P <sub>WATCH_TV</sub>	Multi-Room STB in On Mode
STB 2	8.2.2.1: ON (Watch TV)	Not Measured	Thin Client/Remote STB in On Mode over a home network
STB 3	8.2.2.1: ON (Watch TV)	Not Measured	Thin Client/Remote STB in On Mode over a home network
STB 4	8.2.2.1: ON (Watch TV)	Not Measured	Thin Client/Remote STB in On Mode over a home network

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- 190 B) Multi-Room STB Sleep Mode Test Conduct: The following instructions describe the measurement of  
 191 Sleep Mode for Multi-Room STBs for the purposes of calculating TEC.
- 192 1) The Multi-Room STB under test and the connected Clients shall be running the CEA-2043 tests  
 193 specified in Table 7 concurrently, with the Thin-client/Remote STBs serving as a background  
 194 condition for the testing of the Multi-Room STB.
- 195 2) When testing Sleep Mode for Multi-Room STBs, no video traffic shall be sent to the Clients.  
 196 Regardless of the internal state of the Multi-Room STB, this configuration shall be considered the  
 197 Sleep Mode for the STB.



**Table 7: Sleep Mode Test Setup for Multi-Room STBs**

Device in Figure 2 or Figure 3	CEA-2043 Test	Result	Notes
STB 1 (UUT)	8.3.4 SLEEP	P <sub>SLEEP</sub>	Multi-Room STB in Sleep Mode
STB 2	8.3.4 SLEEP	Not Measured	Thin Client/Remote STB in Sleep Mode
STB 3	8.3.4 SLEEP	Not Measured	Thin Client/Remote STB in Sleep Mode
STB 4	8.3.4 SLEEP	Not Measured	Thin Client/Remote STB in Sleep Mode

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200 B) **Multi-room STB Client-Only Incentive Test Conduct:** Multi-room STBs that support connection to a  
 201 Display Device may be tested to measure the Client Only Power, P<sub>CLIENT\_ONLY</sub>, and obtain the Client  
 202 Only Incentive specified in the ENERGY STAR Specification for Set-top Boxes, per the below  
 203 requirements.

204 **Note:** Consistent with the Draft 2 Specification, DOE has clarified in the test method that the Multi-Room  
 205 Client-Only Incentive Test is only applicable to STBs that support connection to a Display Device.

206 1) The devices in the configuration shall concurrently run all of the applicable CEA-2043 tests  
 207 specified in CEA-2043 section listed in Table 8, with the Thin Client/Remote STBs serving as a  
 208 background condition for the testing of the Multi-room STB (UUT).

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**Table 8: Multi-room STB Client Only Test**

STB in Figure 2	CEA-2043 Test	Result	Notes
STB 1 (UUT)	8.3 SLEEP*	P <sub>CLIENT_ONLY</sub>	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

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

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215 **5.3 Implementation of CEA-2043 for STBs with a Deep Sleep State and**  
 216 **Scheduled Sleep Mode**

- 217 A) Deep Sleep State and Scheduled Sleep Mode Test Setup: Units for test shall be set up per the  
218 following requirements.
- 219 1) All devices shall be configured per CEA-2043.
- 220 2) The number of Clients, Display Devices, or Recording Devices connected to the UUT is  
221 unspecified; however, all devices shall be in Sleep Mode.
- 222 B) User-enabled Deep Sleep State Test Conduct:
- 223 1) The tester shall enable Deep Sleep State per manufacturer instructions and report the process for  
224 enabling Deep Sleep State.
- 225 2) Record the average power drawn as  $P_{\text{SLEEP\_SP\_1}}$  over the time period  $T_{\text{SLEEP}}$ .
- 226 C) Scheduled Sleep Mode Test Conduct:
- 227 1) All requirements in section 8.3.1 of CEA-2043 shall be followed.
- 228 2) The time period for the test,  $T_{\text{SLEEP}}$ , shall be equal to the duration of the default sleep schedule or  
229 6 hours, whichever is smaller. If there is no default scheduled sleep time, then input the start and  
230 end time such that the total scheduled sleep duration ( $T_{\text{SLEEP}}$ ) is exactly 4 hours (e.g. scheduled  
231 sleep hours are set to be 1:00 am to 5:00 am).
- 232 a) 30 minutes before the beginning of the scheduled sleep time, place the STB in the On (Watch  
233 TV) configuration.
- 234 b) Do not use (or move) the STB remote control.
- 235 c) Place all connected client devices into Sleep Mode.
- 236 d) Ensure the STB is in On Mode before scheduled sleep time begins.
- 237 e) Begin power draw measurement at the start of the scheduled sleep time and record the  
238 average power drawn as  $P_{\text{SLEEP\_SP\_2}}$  and the duration of the test as  $T_{\text{SCHED\_SLEEP}}$ .

239 **Note:** DOE has made minor updates to this section to reflect the updated Deep Sleep State and  
240 Scheduled Sleep Mode terminology used in the specification.

241

## 242 5.4 Verifying No Network Initiated Actions

- 243 A) According to section 8.3.1(c) of CEA-2043, no network initiated actions shall occur during the Sleep  
244 Mode, Deep Sleep State, or Scheduled Sleep Mode tests. If a network initiated action cannot be  
245 prevented, or if it is unclear whether network initiated actions are occurring during the tests, then use  
246 the following steps:
- 247 1) Repeat the Sleep Mode test 2 more times on the same unit.
- 248 2) Use the median value of all 3 tests as the Sleep Mode power measurement.

## 249 6 TEST PROCEDURES FOR ALL PRODUCTS

### 250 6.1 UUT and Test Preparation

251 UUT and test preparation shall be performed according to Section 8.1.1 to Section 8.1.12 of CEA-2043,  
252 with additional guidance from Section 5 of this document and the ENERGY STAR Specification for Set-  
253 top Boxes.

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### 255 6.2 On Mode Testing

256 On Mode power shall be measured according to Section 8.2.1 of CEA-2043, with additional guidance  
257 from Section 5 of this document.

258

### 259 **6.3 Sleep Mode Testing**

260 Sleep Mode power shall be measured according to Section 8.3.1 of CEA-2043, with additional guidance  
261 from Section 5 of this document.

262

### 263 **6.4 Special Sleep Mode Testing**

264 A) User-enabled Deep Sleep State: User-enabled Deep Sleep power shall be measured according to  
265 Section 8.3.1 of CEA-2043 along with the additional instructions in Section 8.3.3 of CEA-2043 and  
266 with additional guidance from Section 5 of this document.

267 B) Scheduled Sleep Mode: Scheduled Sleep power shall be measured according to Section 8.3.1 of  
268 CEA-2043, with additional guidance from Section 5 of this document.

269

### 270 **6.5 Power Mode Transitions**

271 A) APD Initiated On to Sleep: APD initiated on to sleep mode power and transition time shall be  
272 measured according to Section 8.5.1 of CEA-2043, with additional guidance from Section 5 of this  
273 document.

274 B) Reenter Sleep after Record Event: The transition time to reenter Sleep Mode after a recording event  
275 shall be measured according to Section 8.5.3 of CEA-2043, with additional guidance from Section 5  
276 of this document.

277 C) Reenter Sleep after Maintenance Event: The transition time to reenter Sleep Mode after a  
278 maintenance event shall be measured according to Section 8.5.4 of CEA-2043, with additional  
279 guidance from Section 5 of this document.

280 D) Sleep to On Mode Transition: The Sleep to On Mode transition time shall be measured according to  
281 Section 8.5.5 of CEA-2043, with additional guidance from Section 5 of this document.

## 282 **7 REFERENCES**

283 A) CEA-2043, Set-top Box (STB) Power Measurement, Rev. August 2013.