



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

## Final Draft Test Method Rev. Apr-2016

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### 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.

### 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 Technology Association (CTA) standard, CTA-2043, "Set-top Box (STB) Power Measurement", Rev. Aug-2013 (CTA-2043).

**Note:** DOE has updated references to the CTA standard to CTA-2043 from CEA-2043 to be consistent with the trade organization's name change.

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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22 C) Dc Input Power:

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

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

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

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

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

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

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

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

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

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

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

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

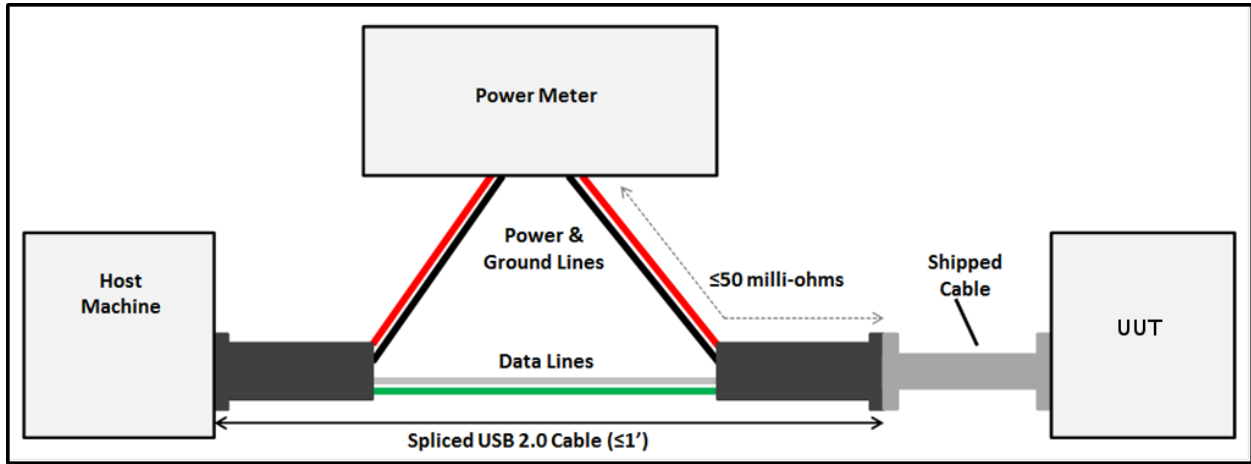


Figure 1: Example Spliced USB 2.0 Cable Arrangement

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## 4.2 UUT Connections

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

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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

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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.

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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

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- 63 C) STBs offering concurrent operation of integrated HNIs at time of installation must be tested with the  
 64 HNIs providing video content.
- 65 D) STBs and Clients that are connected using a wireless connection shall be placed within 10 feet of  
 66 each other during testing. Ensure that there are no walls or other obstructions between the STB and  
 67 Client.

68 **Note:** In response to the above requirement for testing wirelessly connected devices, DOE received a  
 69 stakeholder comment that the 10 foot distance is too short to exercise high power transmission. DOE  
 70 clarifies that the 10 foot distance between the STB and Client is proposed to ensure repeatability of the  
 71 test. To exercise the high power transmission of MIMO equipment, a much more complicated test setup is  
 72 required, which would add unnecessary burden for testing STBs. Therefore, DOE has kept this  
 73 requirement as is in this Final Draft Test Method.

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

76 **Table 4: Output Connections**

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

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### 78 **4.3 Voice and Data Setup**

79 Unlike as specified in CTA-2043, the UUT shall be provisioned to provide data and/or voice services  
 80 where applicable.

- 81 A) Voice: UUTs with Public Switched Telephone Network (PSTN) technology shall be configured and  
 82 provisioned for VOIP services to allow incoming and outgoing calls. Connect an analog single-line  
 83 telephone to the UUT via the RJ-14 jack on the unit using a 1.8 meter, 4 wire telephone extension  
 84 with RJ-14 connectors.
- 85 B) Data: Configure and provision data services such that there is a live, usable connection to the head  
 86 end and a live, usable local area network via either MoCA, Ethernet, or Wi-Fi interfaces on the UUT,  
 87 following the precedence list in Table 2 above. Follow the configuration directives in the ENERGY  
 88 STAR Version 1.0 Small Network Equipment (SNE) Specification in Sections 6.3 through 6.4.7) of the  
 89 SNE Test Procedure. Ignore the WAN portion of Section 6.4.
- 90 C) In the case of an Ethernet network, a switch capable of the same maximum link speed as the UUT  
 91 shall be connected via a 1 meter Ethernet Cat 5a or Cat 6 cable.
- 92 D) In the case of MoCA, a compatible MoCA bridge shall be connected via the appropriate COAX/Cat5e  
 93 (or better) cable and provisioned for data services.
- 94 E) Additional devices shall not otherwise be connected to the local area network unless the connected  
 95 Clients utilize this network for video transmission.

## 96 **5 TEST CONDUCT**

### 97 **5.1 Implementation of CTA-2043 for STB Testing**

98 The Test Conduct shall be carried out according to the requirements in CTA-2043 reference with the  
 99 following guidance.

100 A) Required Test Results

101 1) Tests shall be performed using a live or simulated Service Provider or streaming video provider  
 102 environment per Section 8.1.11 of CTA-2043.

103 2) The minimum required CTA-2043 tests test parameters, and reported results are specified in  
 104 Table 5. Parameters used in this section are defined in Appendix A of the ENERGY STAR  
 105 Specification for Set-top Boxes or CTA-2043.

106 **Note:** EPA has updated some of the terminology used for describing the different variables associated  
 107 with the STB modes of operation. Accordingly, DOE has updated the above requirement to specify that  
 108 some of the parameter terms are described in the specification.

109 3) Scheduled Sleep test is not required if the STB does not support this mode.

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

115 B) Special Function Configuration

116 1) If at any time during setup or on mode operation a message prompt is displayed requesting the  
 117 configuration of special functions, such as automatic power down (APD), deep sleep, or  
 118 scheduled sleep, the most power consumptive configuration shall be selected, except as noted  
 119 below:

120 a) If scheduled sleep mode is enabled by default and a prompt is displayed that asks for the  
 121 scheduled sleep duration (i.e. start time and end time), input the duration as specified in  
 122 section 5.3C).

123 **Note:** In response to the Draft 2 Specification and Test Method, some commenters expressed concern  
 124 that manufacturer's may present a user-accessible way to alter the default deep sleep or APD setting. To  
 125 address this scenario, DOE is proposing the above requirement, which specifies that if special functions  
 126 such as deep sleep, scheduled sleep, or APD can be configured via an automatic menu once the STB is  
 127 setup, then these functions must be configured to be in their most power consumptive state. This  
 128 approach will ensure that these features are not changed as soon as the STB is setup. Manufacturers  
 129 can still provide an option to configure these settings through other menu options.

130  
 131 The only difference is with respect to scheduled sleep mode. If schedule sleep mode is enabled by  
 132 default but there isn't a default scheduled sleep time, then inputting the start and end time as noted  
 133 elsewhere in this test method is allowed.

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135 **Table 5: CTA-2043 Required Tests and Test Parameters**

CTA-2043 (Test Number: Test Name)	Test Parameters	Reported Result
<b>ON Mode</b>		
8.2.2.1 ON (Watch TV)*	$T_{WATCH\_TV} \geq 5 \text{ min}$	$P_{WATCH\_TV}$
<b>SLEEP Mode</b>		
8.3.4 SLEEP**	$T_{SLEEP} \geq 1 \text{ h}$	$P_{SLEEP}$

	(Use CTA-2043 Section 8.3.2 (a) for SLEEP determination method <sup>***</sup> )	
<b>SCHEDULED SLEEP Mode</b>		
8.3.4 SLEEP (for SCHEDULED SLEEP mode)	$T_{\text{SCHED\_SLEEP}} \geq 1 \text{ h}$ $T_{\text{SLEEP\_WAIT}} = 5 \text{ min}$	$P_{\text{SCHED\_SLEEP}}$ $T_{\text{SCHED\_SLEEP}}$
<b>Power Mode Transitions</b>		
8.5.1 APD initiated ON to SLEEP	$T_{\text{SLEEP\_MAX}} = 4.25 \text{ h}$	$P_{\text{APD}}$ $T_{\text{APD\_TIMEOUT}}$
8.5.3 Reenter SLEEP after RECORD	$T_{\text{SLEEP\_MAX}} = 20 \text{ min}$	$T_{\text{REC\_to\_SLEEP}}$
8.5.4 Reenter SLEEP after MAINT	$T_{\text{SLEEP\_MAX}} = 20 \text{ min}$	$T_{\text{MAINT\_to\_SLEEP}}$
8.5.5 SLEEP to ON	$T_{\text{SLEEP\_to\_ON\_WAIT}} = 1 \text{ min}$	$T_{\text{SLEEP\_to\_ON}}$

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

140 \*\* Assure no SCHEDULED SLEEP is scheduled over the entire duration of the SLEEP test. The STB may  
141 enter DEEP SLEEP over the duration of the SLEEP test.

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

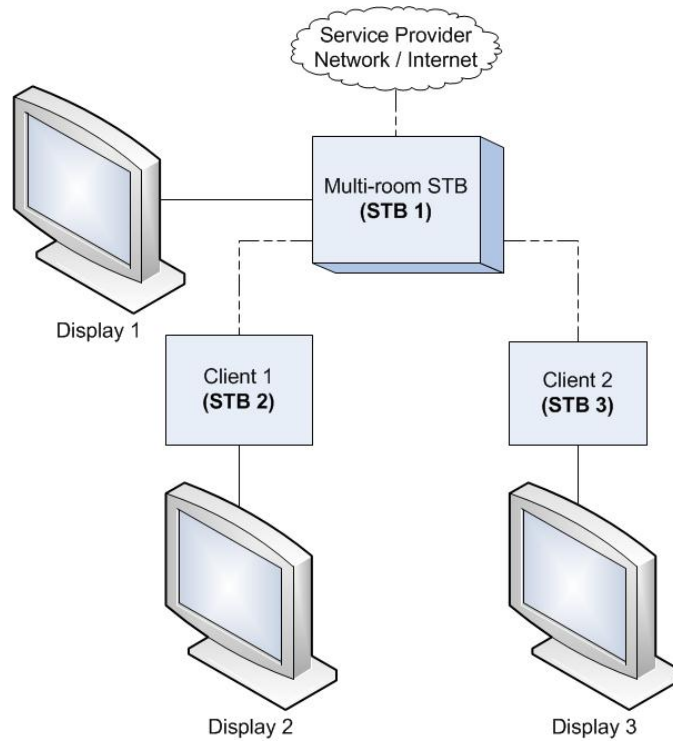
144 **Note:** DOE has updated some of the terminology for test parameters and reported results in this table to  
145 be consistent with those used in the specification. Additionally, previous versions of the test method  
146 specified that deep sleep must not engage during the sleep mode tests. However, this version of the  
147 specification specifies that  $P_{\text{SLEEP}}$  may also include deep sleep. That is, if an STB automatically transitions  
148 to a deeper sleep state from sleep mode, the power draw of sleep mode can include the reduced power  
149 draw of deep sleep state. Therefore, DOE has updated the requirement to specify that deep sleep may  
150 engage during sleep mode.

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## 152 5.2 Implementation of CTA-2043 for Multi-room STB Testing

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

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

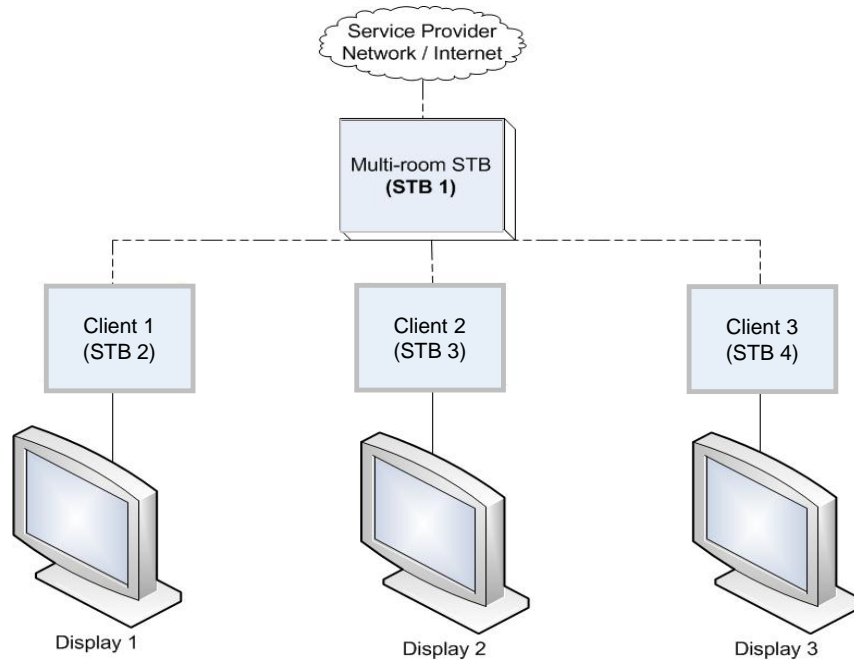


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**Figure 2: Multi-room STB Configuration for STBs that Support Connection to a Display Device**

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

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B) Multi-Room STB On Mode Test Conduct: The following instructions describe the measurement of On Mode for Multi-Room STBs for the purposes of calculating TEC.

- 173 1) The Multi-Room STB under test and the connected Clients shall be running the CTA-2043 tests  
 174 specified in Table 6 concurrently, with the Thin Client/Remote STBs serving as a background  
 175 condition for the testing of the Multi-Room STB.
- 176 2) When testing On Mode for Multi-Room STBs, video traffic shall be sent to all connected Clients.  
 177 Regardless of the internal state of the Multi-Room STBs, this configuration shall be considered  
 178 the On Mode for the STB.

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

Device in Figure 2 or Figure 3	CTA-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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- 181 C) Multi-Room STB Sleep Mode Test Conduct: The following instructions describe the measurement of  
 182 Sleep Mode for Multi-Room STBs for the purposes of calculating TEC.
- 183 1) The Multi-Room STB under test and the connected Clients shall be running the CTA-2043 tests  
 184 specified in Table 7 concurrently, with the Thin-client/Remote STBs serving as a background  
 185 condition for the testing of the Multi-Room STB.
- 186 2) When testing Sleep Mode for Multi-Room STBs, no video traffic shall be sent to the Clients.  
 187 Regardless of the internal state of the Multi-Room STB, this configuration shall be considered the  
 188 Sleep Mode for the STB.

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

Device in Figure 2 or Figure 3	CTA-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



191 **Note:** DOE has removed the Multi-Room Client-Only Incentive Test from the test method because EPA  
192 has removed the associated adder from the specification.

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### 194 **5.3 Implementation of CTA-2043 for Scheduled Sleep Mode**

195 A) Test Setup: Units for test shall be set up per the following requirements.

- 196 1) All devices shall be configured per CTA-2043.  
197 2) The number of Clients, Display Devices, or Recording Devices connected to the UUT is  
198 unspecified; however, all devices shall be in Sleep Mode.

199 B) Test Conduct:

- 200 1) All requirements in section 8.3.1 of CTA-2043 shall be followed.  
201 2) The time period for the test,  $T_{\text{SCHED\_SLEEP}}$ , shall be equal to the duration of the default sleep  
202 schedule or 6 hours, whichever is smaller. If there is no default scheduled sleep time, then input  
203 the start and end time such that the total scheduled sleep duration ( $T_{\text{SCHED\_SLEEP}}$ ) is exactly 4  
204 hours (e.g. scheduled sleep hours are set to be 1:00 am to 5:00 am).  
205 a) 30 minutes before the beginning of the scheduled sleep time, place the STB in the On (Watch  
206 TV) configuration.  
207 b) Do not use (or move) the STB remote control.  
208 c) Place all connected client devices into Sleep Mode.  
209 d) Ensure the STB is in On Mode before scheduled sleep time begins.  
210 e) Begin power draw measurement at the start of the scheduled sleep time. Record the average  
211 power drawn as  $P_{\text{SCHED\_SLEEP}}$  and the duration of the test as  $T_{\text{SCHED\_SLEEP}}$ .

212 **Note:** DOE has removed the user-enabled deep sleep test from this section because the specification  
213 allows STBs to transition (and capture the associated power draw) to deep sleep during the sleep mode  
214 measurement. Further, DOE and EPA have not identified any STBs in the US market that utilize a 'user-  
215 enabled' deep sleep state.

216 DOE has also updated the terminology for the variables associated with the scheduled sleep mode test.  
217

218

### 219 **5.4 Verifying No Network Initiated Actions**

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

- 223 1) Repeat the Sleep Mode test 2 more times on the same unit.  
224 2) Use the median value of all 3 tests as the Sleep Mode power measurement.

## 225 **6 TEST PROCEDURES FOR ALL PRODUCTS**

### 226 **6.1 UUT and Test Preparation**

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

230

231 **6.2 On Mode Testing**

232 On Mode power shall be measured according to Section 8.2.1 of CTA-2043, with additional guidance  
233 from Section 5 of this document.

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235 **6.3 Sleep Mode Testing**

236 Sleep Mode power shall be measured according to Section 8.3.1 of CTA-2043, with additional guidance  
237 from Section 5 of this document.

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239 **6.4 Scheduled Sleep Mode Testing**

240 Scheduled Sleep power shall be measured according to Section 8.3.1 of CTA-2043, with additional  
241 guidance from Section 5 of this document.

242

243 **6.5 Power Mode Transitions**

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

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

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

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

255 **7 REFERENCES**

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