



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

Draft 1 Test Method Rev. Dec-2015

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, including:

- Set-top Boxes (STBs); and
- Displayless Video Gateways (DVGs).

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. June-2013 (CEA-2043).
- 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.

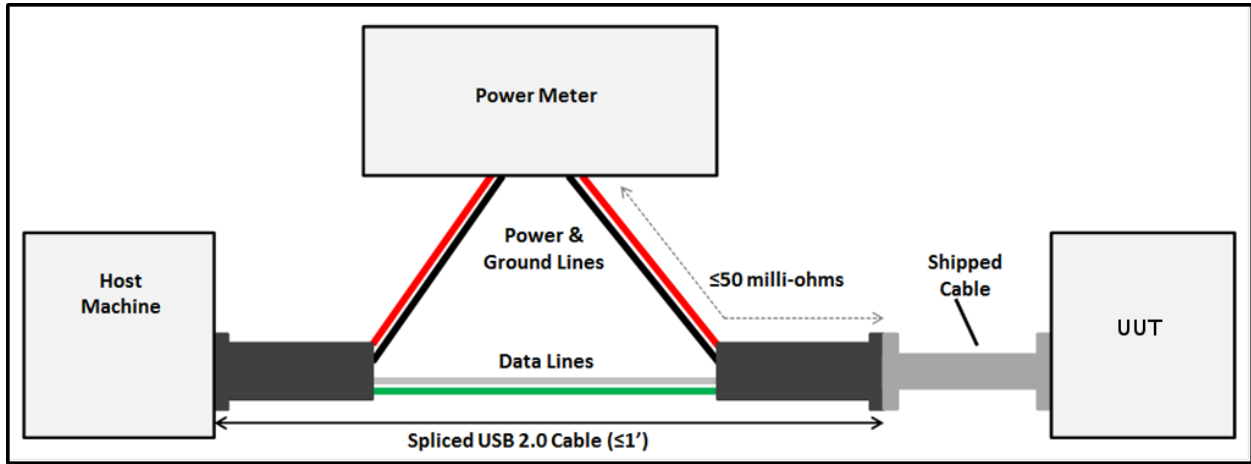


Figure 1: Example Spliced USB 2.0 Cable Arrangement

Note: DOE has provided instructions for testing products that are powered only through standard dc power and welcomes feedback on this proposal.

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 or DVGs 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 or DVG 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

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66 C) STBs or DVGs offering concurrent operation of integrated HNIs at time of installation must be tested
67 with the HNIs providing video content when multiple streams are needed for testing.

68 **Note:** DOE has modified the above text taken from the Tier 2 Program Requirements of the Industry
69 Voluntary Agreement for Ongoing Improvement to the Energy Efficiency of Set-top Boxes (the VA). DOE
70 believes that this requirement only impacts products that are tested with multiple simultaneous video
71 streams, such as Multi-Room STBs and all DVGs. DOE interprets this language to mean that if a STB or
72 DVG has multiple HNI connections that provide video content simultaneously, then different connections
73 must be used to stream the different live streams that are required for the Multi-Room test or DVG test.
74 For example, if a STB uses both Wi-Fi and MoCA simultaneously to stream live content, for the Multi-
75 Room test both Wi-Fi and MoCA connections must be used to stream content to the two connected
76 Clients. While DOE is proposing to include the above requirement to harmonize with the VA, it requests
77 comment on whether this setup is implemented commonly in the field. That is, would consumers with a
78 Multi-Room STB use both Wi-Fi and MoCA, if available, to stream content to the different Clients or would
79 both Clients receive content over the same HNI connection?

80 D) If the UUT is a STB, it shall be connected to a Display Device with the first applicable output
81 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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84 **4.3 Voice and Data Setup**

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

- 87 1) Voice: DVGs with Public Switched Telephone Network (PSTN) technology shall be configured
88 and provisioned for VOIP services to allow incoming and outgoing calls. Connect an analog
89 single-line telephone to the UUT via the RJ-14 jack on the unit using a 1.8 meter, 4 wire
90 telephone extension with RJ-14 connectors.
- 91 2) Data: Configure and provision data services such that there is a live, usable connection to the
92 head end and a live, usable local area network via either MoCA, Ethernet, or Wi-Fi interfaces on
93 the UUT, following the precedence list in Table 2 above. Follow the configuration directives in the
94 ENERGY STAR Version 1.0 Small Network Equipment (SNE) Specification in Sections 6.3
95 through 6.4.7) of the SNE Test Procedure. Ignore the WAN portion of Section 6.4.
- 96 3) In the case of an Ethernet network, a switch capable of the same maximum link speed as the
97 UUT shall be connected via a 1 meter Ethernet Cat 5a or Cat 6 cable.
- 98 4) In the case of MoCA, a compatible MoCA bridge shall be connected via the appropriate
99 COAX/Cat5e (or better) cable and provisioned for data services.

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

102 **5 TEST CONDUCT**

103 **5.1 Implementation of CEA-2043 for STB and DVG Testing**

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

106 A) Required Test Results

- 107 1) Tests shall be performed using a live or simulated Service Provider or streaming video provider
 108 environment per Section 8.1.11 of CEA-2043.
- 109 2) The minimum required CEA-2043 tests, test parameters, and reported results are specified in
 110 Table 5. Parameters used in this section are defined in CEA-2043.
- 111 3) CEA-2043 Special Sleep test is not required if the STB or DVG does not support a Deep Sleep
 112 State.
- 113 4) UltraHD output capable STBs or DVGs may use either an HD or UltraHD Test Stream.

114 **Note:** DOE welcomes feedback on the transition to UltraHD and whether today's STBs upscale HD
 115 content for UltraHD-capable/4k TVs. What further test method changes should be made to reflect current
 116 usage of UltraHD, including differences between receiving, recording, and transmitting (represented by
 117 the UltraHD Resolution functional adder) and decoding (represented by the HEVP functional adder).

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Table 5: 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)*	$T_{ON} \geq 5 \text{ min}$	$P_{WATCH\ TV_n}$ (n = DD + Clients)
SLEEP Mode		
8.3.4 SLEEP**	$T_{SLEEP} \geq 1 \text{ h}$ (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)	$T_{SLEEP} \geq 1 \text{ h}$ $T_{SLEEP_WAIT} = 5 \text{ min}$	$P_{SLEEP_SP_1}$ or $P_{SLEEP_SP_2}$
Power Mode Transitions		
8.5.1 APD initiated ON to SLEEP	$T_{SLEEP_MAX} = 4.25 \text{ h}$	$P_{APD_ON_to_SLEEP}$ $T_{APD_ON_to_SLEEP}$
8.5.3 Reenter SLEEP after RECORD	$T_{SLEEP_MAX} = 20 \text{ min}$	$T_{REC_to_SLEEP}$

8.5.4 Reenter SLEEP after MAINT	$T_{\text{SLEEP_MAX}} = 20 \text{ min}$	$T_{\text{MAINT_to_SLEEP}}$
8.5.5 SLEEP to ON	$T_{\text{SLEEP_to_ON_WAIT}} = 1 \text{ min}$	$T_{\text{SLEEP_to_ON}}$

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

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

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

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128 **5.2 Implementation of CEA-2043 for Multi-room STB Testing**

129 A) Multi-room STB Test Set-Up: Multi-room STBs shall be set up per Figure 2 using the connections
 130 specified in Section 4.2 and per the following requirements.

- 131 1) The Clients connected to the Multi-room STB shall be configured per CEA-2043.
- 132 2) STBs claiming the Multi-Room (MR) allowance must be tested with three (3) live video streams
 133 with two Clients (receiving live video) in addition to locally connected Display Devices, if
 134 supported. If three live streams are not supported the MR allowance may not be used.

135 **Note:** DOE proposes to change the requirement to ‘must be tested with three (3) live video streams with
 136 **two Clients**’. Previously, the requirement specified ‘at least one Client’ but DOE is proposing to change it
 137 to be consistent with Figure 2 that specifies the Multi-Room setup as well as the definition of Multi-Room
 138 both of which require two Client connections.

139 3) All other testing conditions shall be taken from the sections above.

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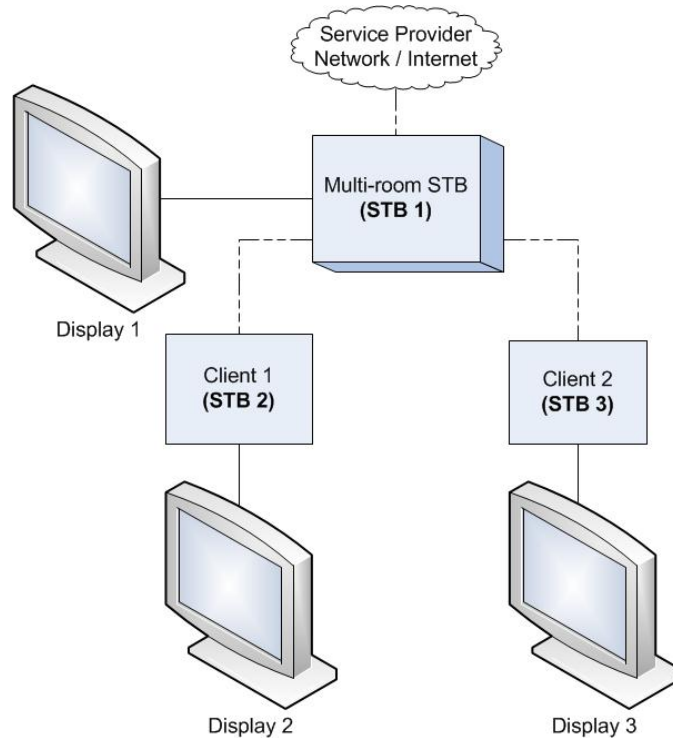


Figure 2: Multi-room STB Configuration

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

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

Device in Figure 2	CEA-2043 Test	Result	Notes
STB 1 (UUT)	8.2.2.1: ON (Watch TV)	P _{WATCH_TV}	Multi-Room STB in On Mode
STB 2	8.2.2.1: ON (Watch TV)	Not Measured	Thin Client in On Mode over a home network
STB 3	8.2.2.1: ON (Watch TV)	Not Measured	Thin Client in On Mode over a home network

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- B) Multi-Room STB Sleep Mode Test Conduct: The following instructions describe the measurement of Sleep Mode for Multi-Room STBs for the purposes of calculating TEC.
- 1) The Multi-Room STB under test and the connected Clients shall be running the CEA-2043 tests specified in Table 7 concurrently, with the Thin-client/Remote STBs serving as a background condition for the testing of the Multi-Room STB.

- 159 2) When testing Sleep Mode for Multi-Room STBs, no video traffic shall be sent to the Clients.
 160 Regardless of the internal state of the Multi-Room STB, this configuration shall be considered the
 161 Sleep Mode for the STB.

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

Device in Figure 2	CEA-2043 Test	Result	Notes
STB 1 (UUT)	8.3.4 SLEEP	P _{SLEEP}	Multi-Room STB in Sleep Mode
STB 2	8.3.4 SLEEP	Not Measured	Thin Client in Sleep Mode
STB 3	8.3.4 SLEEP	Not Measured	Thin Client in Sleep Mode

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164 **Note:** DOE has included tables to add specificity to the test setup and test conduct for testing Multi-Room
 165 STBs. The testing requirements itself have not changed but DOE believes the inclusion of tables makes it
 166 easier to follow the testing instructions.

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- 168 B) Multi-room STB Client-Only Incentive Test Conduct: Multi-room STBs may be tested to measure the
 169 Client Only Power, P_{CLIENT_ONLY}, and obtain the Client Only Incentive specified in the ENERGY STAR
 170 Specification for Set-top Boxes, per the below requirements.

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

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

STB in Figure 2	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

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

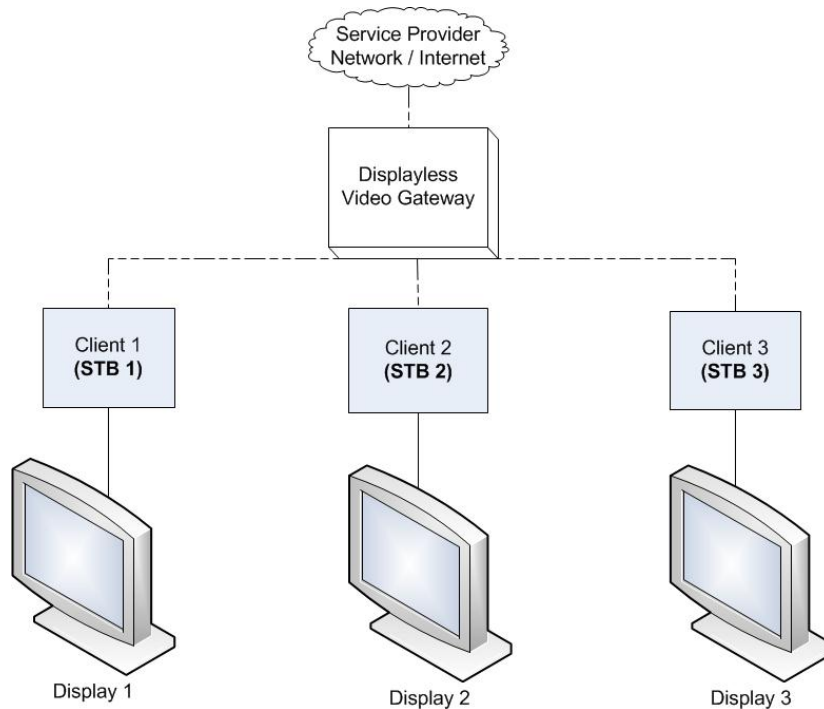
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179 **Note:** DOE requests comment on whether the ON (Play) tests from CEA-2043 are the appropriate tests
 180 to use for the Client Only Incentive or whether the ON (Watch TV) tests should be used instead to be
 181 consistent with the Multi-Room test, which requires live streams for testing. DOE also requests feedback
 182 if there are STBs that only share DVR content and cannot share live streaming with clients.

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184 **5.3 Implementation of CEA-2043 for Displayless Video Gateway (DVG) Testing**

- 185 A) Displayless Video Gateway (DVG) Test Set-Up: DVGs shall be set up per Figure 3 using the
186 connections specified in Section 4.2, and subject to the requirements below.
187 1) The Clients connected to the DVG shall be configured per CEA-2043.



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Figure 3: Displayless Video Gateway (DVG) Configuration

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- 191 B) Displayless Video Gateway (DVG) On Mode Test Conduct: The following instructions describe the
192 measurement of On Mode for DVGs for the purposes of calculating TEC.
- 193 3) The DVG under test and the connected Clients shall be running the CEA-2043 tests specified in
194 Table 9 concurrently, with the Thin Client/Remote STBs serving as a background condition for the
195 testing of the DVG.
- 196 4) When testing On Mode for DVGs, video traffic shall be sent to all connected Clients. Regardless
197 of the internal state of the DVG, this configuration shall be considered the On Mode for the DVG.

Table 9: On Mode Test Setup for Displayless Video Gateways (DVGs)

Device in Figure 3	CEA-2043 Test	Result	Notes
Displayless Video Gateway (UUT)	8.2.2.1: ON (Watch TV)	P_{WATCH_TV}	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

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

202 3) The DVG under test and the connected Clients shall be running the CEA-2043 tests specified in
203 Table 10 concurrently, with the Thin-client/Remote STBs serving as a background condition for
204 the testing of the DVG.

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

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Table 10: Sleep Mode Test Setup for Displayless Video Gateways (DVGs)

Device in Figure 3	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

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210 **Note:** As mentioned in the Draft 1 V. 5.0 ENERGY STAR Specification for Set-top Boxes, published on
 211 November 16, EPA is considering combining the DVG and STB definitions and replacing it with a single
 212 STB product category, for simplicity. Currently, the test method has separate test setup and test conduct
 213 requirements for DVGs as presented in this section. If EPA combines the DVG and STB categories into a
 214 single category in a future draft, DOE may consider combining the DVG test setup and test conduct
 215 requirements with the Multi-Room STB requirements in Section 5.2, since these requirements are similar.
 216 DOE will ensure that the requirements for testing DVGs remain the same even if the Sections themselves
 217 are combined.

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219 Additionally, while DOE may consider combining the test requirements for STBs and DVGs, it notes that
 220 some of the requirements specified for DVGs are different from those specified in the VA. The ENERGY
 221 STAR test method requires DVGs to be connected to three Clients for all testing. The VA does not specify
 222 this explicitly but requires a DVG to be connected to three Clients if it is claiming the Multi-Room
 223 allowance. DOE expects that all DVG units should be capable of supporting at least three Clients and are
 224 most likely tested while connected and streaming to three Clients for ENERGY STAR as well as the VA to
 225 claim the Multi-Room allowance. Therefore, DOE expects that while not specified explicitly, DVGs would
 226 still be tested in the same manner for both ENERGY STAR and the VA. Similarly, the ENERGY STAR
 227 test method requires DVGs to be connected to three Clients for the Sleep Mode power measurement,
 228 while the VA does not explicitly state if connection to the Clients' needs to be maintained for the Sleep
 229 Mode test. However, DOE is maintaining its proposed requirement in the test method because it is more
 230 realistic for a DVG to always be connected to its Client when deployed in the field.

231

232 **5.4 Implementation of CEA-2043 for STBs and DVGs with a Deep Sleep State**

233 A) Deep Sleep State Test Setup: Units for test shall be set up per the following requirements.

234 1) All devices shall be configured per CEA-2043.

235 2) The number of Clients, Display Devices, or Recording Devices connected to the UUT is
 236 unspecified; however, all devices shall be in Sleep Mode.

237 B) User-enabled Deep Sleep State Test Conduct:

- 238 1) The tester shall enable Deep Sleep State per manufacturer instructions and report the process for
239 enabling Deep Sleep State.
- 240 2) Record the average power drawn as $P_{\text{SLEEP_SP_1}}$ over the time period T_{SLEEP} .
- 241 C) Scheduled Deep Sleep State Test Conduct:
- 242 1) All requirements in section 8.3.1 of CEA-2043 shall be followed.
- 243 2) The time period for the test, T_{SLEEP} , shall be equal to the duration of the default sleep schedule or
244 6 hours, whichever is smaller. If there is no default scheduled sleep time, then input the start and
245 end time such that the total scheduled sleep duration (T_{SLEEP}) is exactly 4 hours (e.g. scheduled
246 sleep hours are set to be 1:00 am to 5:00 am).
- 247 a) 30 minutes before the beginning of the scheduled sleep time, place the STB or DVG in the
248 On (Watch TV) configuration.
- 249 b) Do not use (or move) the STB or DVG remote control.
- 250 c) Place all connected client devices into Sleep Mode.
- 251 d) Ensure the STB or DVG is in On Mode before scheduled sleep time begins.
- 252 e) Begin power draw measurement at the start of the scheduled sleep time and record the
253 average power drawn as $P_{\text{SLEEP_SP_2}}$ and the duration of the test as $T_{\text{DEEP_SLEEP}}$.
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255 5.5 Verifying No Network Initiated Actions

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

261 6 TEST PROCEDURES FOR ALL PRODUCTS

262 6.1 UUT and Test Preparation

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

266

267 6.2 On Mode Testing

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

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271 6.3 Sleep Mode Testing

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

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275 6.4 Special Sleep Mode Testing

- 276 A) User-enabled Deep Sleep State: User-enabled Deep Sleep power shall be measured according to
277 Section 8.3.1 of CEA-2043 along with the additional instructions in Section 8.3.3 of CEA-2043 and
278 with additional guidance from Section 5 of this document.
- 279 B) Scheduled Deep Sleep State: Scheduled Deep Sleep power shall be measured according to Section
280 8.3.1 of CEA-2043, with additional guidance from Section 5 of this document.

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282 **6.5 Power Mode Transitions**

- 283 A) APD Initiated On to Sleep: APD initiated on to sleep mode power and transition time shall be
284 measured according to Section 8.5.1 of CEA-2043, with additional guidance from Section 5 of this
285 document.
- 286 B) Reenter Sleep after Record Event: The transition time to reenter Sleep Mode after a recording event
287 shall be measured according to Section 8.5.3 of CEA-2043, with additional guidance from Section 5
288 of this document.
- 289 C) Reenter Sleep after Maintenance Event: The transition time to reenter Sleep Mode after a
290 maintenance event shall be measured according to Section 8.5.4 of CEA-2043, with additional
291 guidance from Section 5 of this document.
- 292 D) Sleep to On Mode Transition: The Sleep to On Mode transition time shall be measured according to
293 Section 8.5.5 of CEA-2043, with additional guidance from Section 5 of this document.

294 **7 REFERENCES**

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