

- notify EPA of a change in the designated responsible party or contacts for displays within 30 days.

114 **Performance for Special Distinction**

115 In order to receive additional recognition and/or support from EPA for its efforts within the
116 Partnership, the ENERGY STAR Partner may consider the following voluntary measures and should keep
117 EPA informed on the progress of these efforts:

- 118
- 119 • consider energy efficiency improvements in company facilities and pursue the ENERGY STAR
120 label for buildings;

- 122 • purchase ENERGY STAR qualified products. Revise the company purchasing or procurement
123 specifications to include ENERGY STAR. Provide procurement officials' contact information to
124 EPA for periodic updates and coordination. Circulate general ENERGY STAR qualified product
125 information to employees for use when purchasing products for their homes;
126
- 127 • ensure the power management feature is enabled on all ENERGY STAR qualified displays in use in
128 company facilities, particularly upon installation and after service is performed;
129
- 130 • provide general information about the ENERGY STAR program to employees whose jobs are
131 relevant to the development, marketing, sales, and service of current ENERGY STAR qualified
132 product models;
133
- 134 • feature the ENERGY STAR mark on Partner Web site and in other promotional materials. If
135 information concerning ENERGY STAR is provided on the Partner Web site as specified by the
136 ENERGY STAR Web Linking Policy (this document can be found in the Partner Resources
137 section on the ENERGY STAR Web site at www.energystar.gov), EPA may provide links where
138 appropriate to the Partner Web site;
139
- 140 • provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the
141 program requirements listed above. By doing so, EPA may be able to coordinate, communicate,
142 and/or promote Partner's activities, provide an EPA representative, or include news about the
143 event in the ENERGY STAR newsletter, on the ENERGY STAR Web pages, etc. The plan may
144 be as simple as providing a list of planned activities or planned milestones that Partner would like
145 EPA to be aware of. For example, activities may include: (1) increase the availability of ENERGY
146 STAR qualified products by converting the entire product line within two years to meet ENERGY
147 STAR guidelines; (2) demonstrate the economic and environmental benefits of energy efficiency
148 through special in-store displays twice a year; (3) provide information to users (via the Web site
149 and user's manual) about energy-saving features and operating characteristics of ENERGY STAR
150 qualified products, and (4) build awareness of the ENERGY STAR Partnership and brand
151 identity by collaborating with EPA on one print advertorial and one live press event;
152
- 153 • provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase
154 availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR
155 and its message.
156

157 **Note:** EPA proposes the following additions to the "Performance for Special Distinction" section of the
158 Partner Commitments for Display Partners:
159

- Join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. SmartWay Transport works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway;
- Join EPA's Climate Leaders Partnership to inventory and reduce greenhouse gas emissions. Through participation, companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders. For more information on Climate Leaders, visit www.epa.gov/climateleaders;
- Join EPA's Green Power partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities, visit <http://www.epa.gov/grnpower/>.



**ENERGY STAR® Program Requirements
for Displays
Eligibility Criteria (Version 5.0)
DRAFT 2**

166
167 Below is the Draft 2 (Version 5.0) product specification for ENERGY STAR qualified displays. A product
168 must meet all of the identified criteria if it is to be labeled as ENERGY STAR by the Partner.
169

170 1) **Definitions:** Below is a brief description of an Electronic Display and other terms as relevant to
171 ENERGY STAR.

172
173 A. **Electronic Display (also referred to as "Display"):** A commercially-available, electronic product with
174 a display screen and its associated electronics encased in a single housing that, as it's primary
175 function, displays visual information from (i) a computer, workstation or server via one or more
176 inputs, such as VGA, DVI, HDMI, and/or IEEE 1394, or (ii), ~~Set (leave as-is - deleted in error)~~
Common display technologies include
177 liquid crystal display (LCD), light emitting diode (LED), cathode-ray tube (CRT), or other device.
178 To qualify, the display must be capable of being powered by a separate AC wall outlet, a battery
179 unit that is sold with an AC adapter, or from a data or network connection. Displays with a tuner
180 may qualify as ENERGY STAR under this specification as long as they are marketed and sold to
181 consumers as displays (i.e., focusing on electronic display as the primary function) or as dual-
182 function displays and televisions. However, products with a tuner and computer connectivity that
183 are marketed and sold as televisions are not included in this specification.
184

Note: EPA has broadened the scope of the 'computer monitor' definition provided under the Version 4.1 Monitor specification to now apply to a wider category of electronic display devices. It is EPA's intent that when finalized, this Version 5.0 Displays specification will cover a variety of electronic displays, computer monitors, and professional signage. As such, EPA has modified all references to 'computer monitors' in the Version 4.1 specification to now read 'displays' in this Draft 2 Version 5.0 document. However, while broadening the scope, EPA wants to ensure that the intent of the ENERGY STAR Displays program is maintained by allowing only products for which we have relevant power consumption test data to qualify. These product types include, computer monitors, and professional signage. For stakeholder reference, the smallest product in EPA's current displays dataset has a viewable diagonal screen size of 15 inches and the largest has a viewable diagonal screen size of 84 inches. **As such, EPA is considering including minimum and maximum viewable diagonal screen sizes for eligible products to the above definition and seeks stakeholder input on the appropriate size constraints.**

Consistent with the Version 4.1 Monitor specification, products with a tuner may continue to qualify under this proposed Version 5.0 set of requirements as long as they are marketed and sold as displays or as dual function displays and televisions. However, it is EPA's intent that under Tier 2, only those products without tuners will be able to qualify under the proposed Version 5.0 displays specification. All displays products with tuners will have to qualify under Tier 2 of the Version 3.0 ENERGY STAR TV specification.

During the comment period on Draft 1 of this specification, EPA received a comment recommending the removal of the requirement that the display screen and its associated electronics be encased in a single housing. EPA notes this terminology is taken from the Version 4.1 of this specification, and that it would be interested in receiving further information on why this may be a constraint. ~~we don't have plans for that topology, but it is possible to put the power supply in a box, the video circuits in another box and the display head in a 3rd~~

185
186 B. **External Power Supply:** A component contained in a separate physical enclosure external to the

- Deleted: a USB flash drive, a memory card, or
177 wireless Internet connection to obtain primary functionality
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187 display casing and designed to convert line voltage ac input from the mains to lower dc voltage(s)
188 for the purpose of powering the display. An external power supply must connect to the display via
189 a removable or hard-wired male/female electrical connection, cable, cord or other wiring.

Note: EPA has included a definition for external power supplies in this Draft 2 specification because of the inclusion of external power supply requirements under Section 3, Energy Efficiency Specifications for Qualifying Products.

- 190
191 C. On Mode: The product is connected to a power source and produces an image.
192
193 D. Sleep Mode: The reduced power state the display enters after receiving instructions from a
194 content source (e.g. computer, game console, or set-top box), or via other functions (e.g. timers or
195 sensors). A blank screen and reduction in power consumption characterize this mode. The display
196 returns to On Mode with full operational capability upon sensing a signal from a source or function
197 that can initiate that can initiate the reduced power state.

Note: EPA has modified the definition of Sleep Mode in order to reflect the fact that the specification now encompasses a greater variety of displays than only computer monitors.

- 198
199 E. Off Mode: The reduced power state the display is in when it is connected to a power source,
200 produces no images, and is waiting to be switched to On Mode by a direct signal from a user (e.g.,
201 user pushes power switch). It is engaged by a power switch. If there is more than one such switch,
202 the tester shall use the most readily available switch.

Note: EPA has clarified the definition of Off Mode to respond to confusion concerning hard off and soft off modes. Recognizing a display may have more than one off switch, EPA specifies here that the tester is to engage the Off Mode via the switch the user is most likely to use by virtue of its ease of access relative to other off switches the display may have. We would prefer that the vacation switch is allowed for off mode independently of other switches

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204 **2) Qualifying Products:** In order to qualify as ENERGY STAR, a display model must meet the definition
205 in Section 1.A and the specification requirements provided in Section 3, below. As explained in
206 Section 1, this specification does not cover products with computer capability that are marketed and
207 sold as televisions.
208

209
210 **3) Energy-Efficiency Criteria:** Only those products listed in Section 2 that meet the following criteria
211 may qualify as ENERGY STAR. Effective dates for Tiers 1 and 2 are provided in Section 6 of this
212 specification.

213 A. On Mode Requirements

- 214
215 1. Tier 1: To qualify as ENERGY STAR, display models must not exceed the maximum On
216 Mode power consumption (P) found from the equations provided in Table 1, based on the
217 unit's resolution and viewable screen area. The maximum On Mode power consumption is
218 expressed in watts and rounded up to one decimal place. In the following equations, MP is the
219 number of megapixels in decimal form (e.g., 1,920,000 pixels = 1.92 megapixels), and A is the
220 viewable screen area of the product rounded to the nearest whole number, found by
221 multiplying the viewable display width by the viewable display height.
222

223 **Table 1. Tier 1 On Mode Power Consumption Requirements for Displays**

Display Category	Maximum On Mode Power Consumption
Less than 30" viewable diagonal screen size and less than or equal to 1.1 MP resolution	$P = 6*(MP) + 0.05*(A) + 3$
Less than 30" viewable diagonal screen size and greater than 1.1 MP resolution	$P = 9*(MP) + 0.05*(A) + 3$
Greater than or equal to 30" viewable diagonal screen size	$P = 35*(MP) + 0.12*(A) + 4$

224 For example, the maximum power consumption for a display with 1440 x 900 resolution, or
225

226 1,296,000 pixels, a 19 inch viewable diagonal screen size and a viewable screen area of 162
227 square inches, would be: $((9 \times 1.296) + (0.05 \times 162)) + 3 = 22.8$ watts when rounded to one
228 decimal place. Under these metrics, maximum allowed power consumption for displays with
229 various resolutions and screen sizes is provided below in Table 2.

230
231

Table 2. Sample Tier 1 On Mode Maximum Power Levels

Viewable Diagonal Screen Size (Inches)	Resolution	Total Megapixels	Viewable Screen Size in Inches	Screen Area in Square Inches	Maximum On Mode Power Use (Watts)
7	800 x 480	0.384	5.9 x 3.5	21	6.4
15	1024 x 768	0.786	12 x 9	108	13.1
19	1440 x 900	1.296	16.07 x 10.05	162	22.8
46	1366 x 768	1.049	40.1 x 22.5	902	149
54	1920 x 1080	2.074	47 x 26.4	1,241	225.5

Note: EPA established the On Mode power requirements in Table 1, above, using the prescribed luminance levels in Table 4, below. For units to be tested at 175 cd/m², EPA used manufacturer submitted data corresponding to the On Mode power testing results under the luminance setting prescribed in Version 4.1 of the ENERGY STAR Monitors specification (175 cd/m²). This applies to all models of less than 30 inches viewable diagonal screen size and less than 1.1 megapixel. For models with greater than or equal to 1.1 MP resolution or of greater than or equal to 30" viewable diagonal screen size, EPA used the manufacturer's four submitted data points (175 cd/m², minimum luminance, default luminance, and maximum luminance) to determine a luminance to On Mode power relationship. EPA used this relationship on a model-by-model basis to adjust the On Mode power consumption to the appropriate prescribed luminance level. EPA checked the accuracy of the estimated relationship by calculating On Mode power at the current ENERGY STAR prescribed setting and then checking this estimate against manufacturer-submitted On Mode power data. EPA found high levels of consistency with a +2% difference in predicted vs. actual On Mode power consumption across the entire dataset, meaning that overall, there was a greater tendency to overestimate as opposed to underestimate industry power levels. The plasma displays in EPA's dataset currently have luminance settings significantly lower than the proposed 350 nits (see Table 4, below); therefore, EPA would like to receive additional data on plasma displays to further review this effect. **here are no plasma displays, only plasma TV**

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In conducting a statistical analysis on the data submitted by manufacturers, EPA found that both screen resolution and screen size play a role in determining a display's On Mode power consumption. For standard LCD displays, EPA found that On Mode power consumption (at default luminance setting) was most strongly correlated to resolution. However, for displays of the same resolution, screen size was clearly an important variable for determining On Mode power consumption. For very small screen models, EPA found On Mode power consumption to be most strongly correlated to resolution. For very large screen models, EPA found On Mode power consumption to be most strongly correlated to screen area. EPA determined it was feasible to integrate both variables into a single equation for determining On Mode performance levels. Market research also indicates that both screen area and resolution are key variables consumers look for when purchasing display products. This approach allows us to address the power consumption of models with the same resolution but different viewable screen sizes and conversely, the power consumption of models with the same viewable screen size but different resolutions. The approach also creates more consistency with the Version 3.0 ENERGY STAR TV specification, which will facilitate addressing convergence under Tier 2 for both televisions and displays. Including both resolution and screen area as independent variables explained over 70% of the variance in On Mode power consumption for LCD displays.

Continued on next page...

Note continued:

As a result of including both screen size and resolution, On Mode requirements proposed under this Draft 2 Version 5.0 specification indicate reduced power consumption allowances for low resolution, smaller screen sizes and increased power consumption allowances for higher resolution and/or larger screen sizes. Sample Tier 1 maximum on mode power consumption levels are provided in Table 2 for a variety of display resolutions/sizes.

271 Per EPA's preliminary analysis of monitor unit shipment data collected for calendar year 2007, market
272 penetration of ENERGY STAR qualified monitors is estimated to be at over 90%. Based on EPA's
273 current dataset, approximately 23% of display models would be able to meet the Tier 1 On Mode
274 requirements proposed in this Draft 2 Version 5.0 displays specification.
275

- 276
- 277 2. Tier 2: To qualify as ENERGY STAR, display models must not exceed the following maximum
278 On Mode consumption equations: TBD.

279 To qualify a display as ENERGY STAR, it must be tested according to the protocol outlined in
280 Section 4, Test Method.
281

282 **Note:** EPA has left Tier 2 requirements under this Draft 2 Version 5.0 displays specification as TBD.
283 However, it is EPA's intent to engage in dialogue with industry during the Tier 2 development process
284 to discuss potential Tier 2 requirements that contribute to EPA's goal of pursuing convergence with the
285 ENERGY STAR TV specification, and take into account energy-saving features for displays, such as (i)
286 modulating backlights, (ii) automatic brightness control, (iii) polarizing films, (iv) timers/occupancy
287 sensors, etc. **Approximately 24%** **(seems quite high)** of EPA's current displays dataset incorporates
288 automatic brightness control, and it is anticipated that this feature, along with the others listed here, will
289 increase in prevalence over the next several years.
290

291 For those products that already incorporate automatic brightness control, it is EPA's intent under Tier 1
292 of this proposed Version 5.0 specification to request manufacturers to submit On Mode power
293 consumption data under both low and average ambient light conditions. EPA will subsequently use this
294 data as part of the development process for determining Tier 2 levels.
295

296 EPA developed the proposed requirements for Tier 1 of this Draft 2 Version 5.0 specification to allow
297 display models with added functionality such as built-in speakers or USB ports to qualify. Similarly,
298 when developing Tier 2 requirements EPA is committed to recognizing full-featured products.
299

300 EPA is beginning review of other energy and safety related impacts associated with this product
301 category for discussion with stakeholders for possible inclusion in Tier 2 of this specification. EPA is
302 interested in receiving input on means to address this interest in a way that aligns with ENERGY
303 STAR's guiding principles, and fully expects to engage stakeholder input during this process.
304
305

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308
309 **3. Displays with Automatic Brightness Control:** EPA has noted a substantial increase in the
310 default luminance settings of displays, and a near 1:1 relationship between increasing
311 luminance and increasing power consumption. Hence, while EPA recognizes the benefit in
312 offering the consumer full-featured products, higher luminance settings tend to offset power
313 consumption reductions achieved through improved component efficiency. The use of
314 displays in conditions where ambient light tends to vary offers an opportunity to offset this
315 effect by matching delivered luminance to "needed" luminance through the implementation of

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Automatic Brightness Control (ABC). In addition to offering significant energy savings, this feature can also improve the user viewing experience. As such, EPA is recognizing products shipped with ABC enabled by default both as a means to deliver energy savings and to advance harmonization with the ENERGY STAR TV specification.

317 To account for the power savings achieved through ABC, where the feature is activated by
318 default when shipped, On Mode power consumption shall be determined as follows:
319 $P_{a1} = 0.8 * P_o + 0.2 * P_{abc}$, where P_{a1} is the average On Mode power consumption in watts and
320 rounded to the nearest whole number, taking into consideration that the display will be in low
321 ambient light level conditions 20% of the time; P_o is the On Mode power consumption in watts
322 and rounded to the nearest whole number when tested with a minimum ambient light level of
323 300 lux entering directly into the sensor; and P_{abc} is the On Mode power consumption in watts
324 and rounded to the nearest whole number when tested with an ambient light level of 0 lux
325 entering directly into the sensor. (See Section 4.J. Test Method, below, for further information
326 on how to test displays with Automatic Brightness Control to determine ENERGY STAR
327 qualification.) When determining ENERGY STAR qualification, products that ship with
328 automatic brightness control enabled should compare their On Mode power consumption
329 (P_{a1}), found using the equation above, to the maximum On Mode power consumption allowed
330 (P), determined using the equations in Table 1, above.
331

Note: Recognizing the growing use of Automatic Brightness Control in Displays, and bringing this specification further in line with the TV specification, EPA has incorporated from the TV specification 3.0 the procedure for determining an alternative power consumption value for products that ship with automatic brightness control enabled. EPA intends for this power consumption value to be compared to the model's power consumption limit as determined by the appropriate equation in Table 1 in order to determine ENERGY STAR qualification.

332
333 B. Display Products Using an External Power Supply: To qualify, the external power supply must be
334 ENERGY STAR qualified or meet the no-load and active mode efficiency levels provided in the
335 ENERGY STAR Program Requirements for Single Voltage Ac-Ac and Ac-Dc External Power
336 Supplies. The ENERGY STAR specification and qualified product list can be found at
337 www.energystar.gov/powersupplies.
338

Note: EPA has incorporated external power supply requirements for displays in this Draft 2 Version 5.0 ENERGY STAR displays specification. The inclusion of external power supply requirements is consistent with EPA's approach to other electronics product specifications developed/revised since the launch of the ENERGY STAR specification for single voltage ac-ac and ac-dc external power supplies, e.g., computers, set-top boxes, and televisions, whereby products must meet their respective energy-efficiency requirements and when coupled with external power supplies, those power supplies must also meet ENERGY STAR requirements.

C. Sleep and Off Modes

1. Tiers 1 and 2: Maximum power consumption levels for Sleep and Off Modes are provided in Tables 3a and 3b below. Displays capable of multiple Sleep Modes (i.e., Sleep and Deep Sleep) shall meet the Sleep Mode requirement below in all such modes. For example, a display of greater than or equal to 30" viewable diagonal screen size tested at 5 watts in Sleep and 4 watts in Deep Sleep would not qualify because one of the Sleep Modes exceeded 4 watts.

Table 3a. Tier 1 Ener^{gy}-Efficienc^y Criteria for Slee^p and Off Modes

Product Type	Sleep Mode (W)	Off Mode (W)
Less than 30" viewable diagonal screen size	~ 2	~ 1
Greater than or equal to 30" viewable diagonal screen size	~ 4	~ 2

351

352

Table 3b. Tier 2 Ener^{gy}-Efficienc^y Criteria for Slee^p and Off Modes

Product Type	Sleep Mode (W)	Off Mode (W)
All displays	~ 1	~ 1

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340
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342
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350

Note: Under this Draft 2 Version 5.0 specification, EPA has replaced the Tier 1 Sleep and Off Mode requirements that were present in Draft 1 and applied to all displays regardless of screen area or resolution, with Tier 1 Sleep and Off Mode requirements that vary depending on screen area and resolution (Table 3a). EPA suggests this modification in order to address the pass rate of large screen area products that are typically employed as professional displays, which under Draft 1 was significantly below EPA's goal of 25%. Tier 2 (Table 3b) under this Draft 2 specification remains unchanged from Draft 1. Hence, consistent with Draft 1, EPA is proposing to lower the Sleep Mode requirement under Tier 2 to ≤ 1 watt. This proposal would allow consistency between Tier 2 displays

353 criteria and other ENERGY STAR specifications, such as the TV specification.
354
355 2. **Power Management Requirements:** Displays must have at least one mechanism enabled by default that
356 allows the display to automatically enter Sleep or Off Mode. For instance, any data or network connection
357 must support powering down the display according to standard mechanisms, such as Display Power
358 Management Signaling, while displays generating their own content must have a sensor or timer enabled by
359 default to automatically engage Sleep or Off Mode.
360

Note: In this Draft 2 specification, EPA has substituted the section titled "Sleep Mode Exception" in the Version 4.1 Monitor specification with the section above, "Power Management Requirements," to clarify EPA's approach to the management of Sleep and Off modes under this specification, noting that displays must have at least one mechanism enabled by default that allows the display to automatically enter Sleep or Off Mode. EPA notes that over 50% of the digital picture frames (DPFs) in its dataset were reported as having a Sleep Mode, and would like to receive further information from DPF Partners regarding whether their DPF products have a Sleep Mode, and how these products engage this mode.

361
362 4) **Test Method**
363

364 **Product Testing Set-up, Method, and Documentation:** EPA utilizes, where possible, widely-accepted industry
365 practices for measuring product performance and power use under normal or typical operating conditions.
366 The testing and measurement methods below reference published specifications from the Video Electronics
367 Standards Association (VESA) Display Metrology Committee and the International Electrotechnical
368 Commission (IEC), and supplement those guidelines where necessary with methods developed in
369 cooperation with the display industry.
370

371 Partners are required to perform tests and self-certify those product models that meet the ENERGY STAR
372 guidelines. In order to conduct testing in support of qualification for ENERGY STAR, the display must be tested
373 in a laboratory that is accredited by an accreditation body that is a signatory, in good standing, to a mutual
374 recognition arrangement of a laboratory accreditation cooperation (i.e. ILAC, APLAC, etc.) that verifies, by
375 evaluation and peer assessment, that its signatory members are in full compliance with ISO/IEC 17011 and that
376 their accredited laboratories comply with ISO/IEC 17025. Laboratories must be specifically qualified to carry out
377 tests to determine whether displays meet key product criteria for displays as outlined in this document. A
378 laboratory's Scope of Accreditation must reflect its specific competence to carry out the test procedures as
379 outlined in the ENERGY STAR Program Requirements for Displays. Same comments as earlier – do not
380 want the expense and delay of limiting the labs. As an alternative, we want at least 5 accredited labs identified
381 in both Taiwan and China prior to the effectivity of ES 5.0.

Note: EPA is proposing applying the accreditation requirements above to laboratories associated with product qualification. It is EPA's intention to apply these requirements to all relevant product specifications.

382
383
384 Families of display models that are built on the same chassis and are identical in every respect but housing
385 and color may be qualified through submission of test data for a single, representative model. Likewise,
386 models that are unchanged or that differ only in finish from those sold in a previous year may remain
387 qualified without the submission of new test data, assuming the specification remains unchanged.
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389 Power shall be measured from the outlet or power source to the product under test. The average true
 390 power consumption of the display shall be measured during On Mode, Sleep Mode, and Off Mode.
 391 When performing measurements to self-certify a product model, the product being tested must initially
 392 be in the same condition (e.g., configuration and settings) as when shipped to the customer, unless
 393 adjustments need to be made pursuant to instructions below. If a product's electrical power comes
 394 from Mains, USB, IEEE1394, Power-over-Ethernet, telephone system, or any other means or
 395 combinations of means, the net AC electrical power consumed by the product (taking into account ac-
 396 to-dc conversion losses) must be used for qualification.
 397

398 To ensure a consistent means for measuring the power consumption of electronics products, the
 399 following protocol must be followed, which has three main components:

- 400 • Product Testing Set-up and Conditions
- 401 • Product Testing Method
- 402 • Product Testing Documentation

403 This protocol ensures that outside factors do not adversely affect the test results and that the test
 404 results can be consistently reproduced. Partners may elect to use an in-house or independent
 405 laboratory to provide the test results.
 406

407 **Product Testing Set-up and Conditions**

408 A. Test Conditions:

Supply Voltage:	North America/Taiwan: Europe/Australia/New Zealand: Japan:	115 (± 1%) Volts AC, 60 Hz (± 1%) 230 (± 1%) Volts AC, 50 Hz (± 1%) 100 (± 1%) Volts AC, 50 Hz (± 1%)/60 Hz (± 1%) <i>Note: For products rated for > 1.5 kW maximum power, the voltage range is ± 4%</i>
Total Harmonic Distortion (THD) (Voltage):	< 2% THD (< 5% for products which are rated for > 1.5 kW maximum power)	
Ambient Temperature:	23°C ± 5°C	
Relative Humidity:	10 – 80 %	

411 (Reference IEC 62301 Ed 1.0: Household Electrical Appliances – Measurement of Standby Power, Sections 4.2,
412 4.3)
413

414 B. Models Capable of Operating at Multiple Voltage/Frequency Combinations: Partners shall test
415 their products based on the market(s) in which the models will be sold and promoted as ENERGY
416 STAR qualified. For products that are sold as ENERGY STAR in multiple international markets
417 and, therefore, rated at multiple input voltages, the Partner must test at and report the required
418 power consumption or efficiency values at all relevant voltage/frequency combinations. For
419 example, a Partner that is shipping the same model to the United States and Europe must
420 measure, meet the specification, and report test values at both 115 Volts/60 Hz and 230 Volts/50
421 Hz in order to qualify the model as ENERGY STAR in both markets. If a model qualifies as
422 ENERGY STAR at only one voltage/frequency combination (e.g., 115 Volts/60 Hz), then it may
423 only be qualified and promoted as ENERGY STAR in those regions that support the tested
424 voltage/frequency combination (e.g., North America and Taiwan).

Note: EPA has updated the Test Conditions in Draft 2 to be consistent with language related to qualifying products capable of operating at multiple voltage/frequency combinations in other recently developed/revised ENERGY STAR specifications, e.g., computers, set-top boxes, and TVs. The test conditions are based on IEC 62301, Ed 1.0. The intent of this language is identical to that of the text included in the Version 4.1 specification under the heading, “**Supply Voltage**,” whereby models must be tested at the voltage/frequency combination for each region where the manufacturer intends to sell the model as ENERGY STAR qualified.

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- C. Dark Room Conditions: When performing light measurements, the display shall be located in a dark room condition. The display screen illuminance measurement (E) when in Off Mode must be 1.0 Lux or less. Measurements should be made at a point perpendicular to the center of the screen using a Light Measuring Device (LMD) with the display in Off Mode (Reference VESA FPDM Standard 2.0, Section 301-2F).
- D. Color Controls and Peripherals: All color controls (hue, saturation, gamma, etc.) shall be placed at their factory default settings. No external devices shall be connected to any included Universal Serial Bus (USB) hubs or ports. Any built-in speakers, TV tuners, etc. may be placed in their minimum power configuration, as adjustable by the user, to minimize power use not associated with the display itself. Circuit removal or other actions not under user control may not be taken to minimize power use.
- E. Power Measurement Test Conditions: For LCDs and other fixed pixel technologies, pixel format shall be set to the native level. LCD refresh rate shall be set to 60 Hz, unless a different refresh rate is specifically recommended by the Partner, in which case that rate shall be used. CRT pixel format shall be set at the preferred pixel format with the highest resolution that is intended to be driven at a 75 Hz refresh rate. A VESA Discrete Monitor Timing (DMT) or newer industry standard pixel format timing must be used for the test. The CRT display must be capable of meeting all its Partner-stated quality specifications in the tested format.
- F. Power Measurement Protocols: Display power consumption shall be measured in watts with an imposed test pattern. Warm-up time shall be a minimum of a 20-minute period (Reference VESA FPDM Standard 2.0, Section 301 -2D or 305-3 for warm-up test). A true RMS power meter with a crest factor of at least three shall be used to measure the power use of each randomly chosen unit at one or more, as appropriate, of the voltage/frequency combinations provided in Section 4.A (Reference VESA Standard: Display Specifications and Measurement Procedures, Version 1.0, Revision 1.0, Section 8.1.3). Measurements shall be taken after wattage values are stable over a three-minute period. Measurements are considered stable if the wattage reading does not vary more than 1% over the three-minute period (Reference IEC 4.3.1). (Testers shall ignore the input sync signal check cycle when metering the model in Sleep Mode and Off Mode.) Testers shall use calibrated measuring equipment capable of measurements accurate to one-tenth of a watt or better.

Note: To bring this specification further into alignment with the TV specification, EPA has changed the required minimum crest factor of the power meter from five to three, after IEC 62301 Ed 1.0: Household Electrical Appliances – Measurement of Standby Power.

Also, in light of the fact that the definition of “Electronic Display” in section 1.A. above, allows for the qualification of displays capable of being powered by a data or network connection, EPA has added the methodology above to measure the power consumption of products powered by a standard low voltage dc supply.

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Products powered by a standard low voltage dc supply (e.g., USB, USB PlusPower, IEEE 1394, and Power Over Ethernet) shall utilize a suitable ac-powered source of the dc power. This ac-powered source’s energy consumption shall be measured and recorded as the power consumption of the display under test. For a display powered by USB, a powered hub serving only the display being tested shall be used. For a display powered by Power Over Ethernet or USB PlusPower, it is acceptable to measure the power distribution device with and without the display connected, and record the difference between the two readings as the display’s power consumption. The tester should confirm that this reasonably reflects the unit’s dc consumption plus some allowance for power supply and distribution inefficiency. Any product with both ac and standard low-voltage dc capability should be tested only at ac.

473 G. Number of Units Required for Testing: Borrowing from European Norm 50301 (Reference BSI 03-
474 2001, BS EN 50301:2001, Methods of Measurement for the Power Consumption of Audio, Video,
475 and Related Equipment, Annex A), EPA has established a test procedure where the number of
476 units required for test depends on the test results for the first unit. If a tested display uses at least
477 15% less power (i.e., greater than or equal to 15%) than the ENERGY STAR specification in all
478 three operating modes (On Mode, Sleep Mode, and Off Mode), then it only has to be tested once.
479 However, if a tested display is within 15% of the ENERGY STAR specification in any of the three
480 operating modes, then two more units must be tested, and their test results reported to EPA via
481 the Online Product Submittal tool along with the average On, Sleep, and Off Mode values for that
482 model based on the three units tested. None of the test values may exceed the ENERGY STAR
483 specification for the model to be ENERGY STAR qualified.

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485 The following example further illustrates this approach:

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487 **EXAMPLE:** For simplicity, assume the specification is **100 watts or less and only applies to one**
488 **operational mode. 85 watts would represent the 15% threshold...**

- 489 • If the first unit is measured at **80 watts, no more testing** is needed and the model qualifies
490 (80 watts is at least 15% more efficient than the specification and is “outside” the 15%
491 threshold).
- 492 • If the first unit is measured at **85 watts, no more testing** is needed and the model qualifies
493 (85 watts is exactly 15% more efficient than the specification).
- 494 • If the first unit is measured at **90 watts**, then **two more units** must be tested to determine
495 qualification (90 watts is only 10% more efficient than the specification and is “within” the 15%
496 threshold).
- 497 • If three units are tested at **90, 98, and 105 watts**, the model **does not qualify** as ENERGY
498 STAR—even though the average is 98 watts— because one of the values (105) exceeds the
499 ENERGY STAR specification.

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502 H. Luminance Test Patterns and Procedures: **For all fixed pixel displays (e.g., LCDs and others),**
503 test pattern (VESA FPDM Standard 2.0, A1 1 2-2F, SET01 K) shall be displayed that provides eight
504 shades of gray from full black (0 volts) to full white (0.7 volts).¹ Input signal levels shall conform to
505 VESA Video Signal Standard (VSIS), Version 1.0, Rev. 2.0, December 2002. With the brightness
506 and contrast controls at maximum, the technician shall check that, at a minimum, the white and
507 near white gray levels can be distinguished. If white and near white gray levels cannot be
508 distinguished, then contrast shall be adjusted until they can be distinguished. The technician shall
509 next display a test pattern (VESA FPDM Standard 2.0, A1 12-2H, L80) that provides a full white
510 (0.7 volts) box that occupies 80% of the image. The technician shall then adjust the brightness
511 control until the white area of the screen is set at the correct luminance setting as described in
512 Table 4, below, measured according to VESA FPDM Standard 2.0, Section 302-1. The luminance
513 value shall be reported to EPA with other required testing documentation.

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515 **For CRT displays,** the technician shall initiate the AT01 P (Alignment Target 01 Positive Mode)
516 pattern (VESA FPDM Standard 2.0, A1 1 2-2F, AT01 P) for screen size and use it to set the display
517 to the Partner’s recommended image size, which is typically slightly smaller than maximum
518 viewable screen size. Then, test pattern (VESA FPDM Standard 2.0, A1 1 2-2F, SET01 K) shall be

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520 displayed that provides eight shades of gray from full black (0 volts) to full white (0.7 volts).¹ Input
521 signal levels shall conform to VESA Video Signal Standard (VSIS), Version 1.0, Rev. 2.0,
522 December 2002. The technician shall adjust (where feasible) the display brightness control
523 downward from its maximum until the lowest black bar luminance level is just slightly visible

¹ Corresponding voltage values for digital only interface displays that correspond to the brightness of the image (0 to 0.7 volts) are:

0 volts (black) = a setting of 0

0.1 volts (darkest shade of gray analog) = 36 digital gray

0.7 volts (full white analog) = 255 digital gray

Please note that future digital interface specifications may widen this range, but in all cases, 0 volts shall correspond

DRAFT 2 ENERGY STAR Program Requirements for Displays (Version 5.0)

to black and the maximum value shall correspond to white, with 0.1 volts corresponding to one-seventh of the maximum value.

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(VESA FPDM Standard 2.0, Section 301-3K). The technician shall then display a test pattern (VESA FPDM Standard 2.0, A1 12-2H, L80) that provides a full white (0.7 volts) box that occupies 80% of the image. The technician shall then adjust the contrast control until the white area of the screen is set at the correct luminance setting as described in Table 4, below, measured according to VESA FPDM Standard 2.0, Section 302-1. The luminance value shall be reported to EPA with other required testing documentation.

Table 4. Luminance Settings for Testing Displays

Product	Cd/m ²
All CRTs	100
Less than 30" viewable diagonal screen size and less than or equal to 1.1 MP resolution	175
Less than 30" viewable diagonal screen size and greater than 1.1 MP resolution	disagree. Higher resolution displays are not TV and are operated at same conditions as other monitors. 175 nits
Greater than or equal to 30" viewable diagonal screen size	350 too high for 30" monitor. LP3085 max is 370 typical. Many less

Note: While Draft 1 of this specification revision called for testing displays at default, as-shipped luminance settings, EPA has updated the luminance settings in this Draft 2 Version 5.0 specification to specify that manufacturers must test their displays at prescribed luminance settings to determine ENERGY STAR qualification. EPA has made this change to align the specification with luminance values that are closer to actual usage than the 175 candelas/square meter called for in the Version 4.1 specification.

Currently, the plasma displays in the dataset have luminance settings significantly lower than the proposed 350 nits. EPA would like to receive additional data on plasma displays to further improve

Table 4.

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I. Light Measurement Protocols: When light measurements, such as illuminance and luminance, need to be made, an LMD shall be used with the display located in dark room conditions. The LMD shall be used to take measurements at the center of and perpendicular to the display screen (Reference VESA FPDM Standard 2.0, Appendix A1 15). The screen surface area to be measured shall cover at least 500 pixels, unless this exceeds the equivalent of a rectangular area with sides of length equal to 10% of the visible screen height and width (in which case this latter limit applies). However, in no case may the illuminated area be smaller than the area the LMD is measuring (Reference VESA FPDM Standard 2.0, Section 301-2H).

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Note: EPA has removed the Display Set-Up and Characterization section after determining that it represented only a small subset of the information the Online Product Submittal (OPS) tool for Displays requires Partners to submit when qualifying a product. Rather than reproduce the entire set of OPS fields here, which would differ from what is done in other ENERGY STAR specifications, EPA decided to remove this section and direct Partners to the OPS tool for Displays should they wish to consult the informational fields they will be required to complete when submitting a product for qualification.

Testing Method

J. Test Method: Following are the test steps for measuring the true power requirements of the test unit in On Mode, Sleep Mode, and Off Mode. Partners are required to test their displays using the analog interface, except in those cases where one is not provided (i.e., digital interface monitors, which for the purposes of this test method are defined as having only a digital interface). For digital interface displays, please see Footnote 1 on page 14 for voltage information, and follow the test method below using a digital signal generator.

On Mode

1. Connect the test sample to the outlet or power source and test equipment. For displays shipped with an external power supply, the external power supply (as opposed to a reference

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- 555 power supply) must be used in the test.
- 556 2. Power on all test equipment and properly adjust power source voltage and frequency.
- 557 3. Check for normal operation of the test unit and leave all customer adjustments set to factory
- 558 default settings.
- 559 4. Bring the test unit into On Mode either by using the remote control device or by using the
- 560 ON/OFF switch on the test unit cabinet. Allow the unit under test to reach operating
- 561 temperature (approximately 20 minutes).
- 562 5. Set the proper display mode. Refer to Section E, Power Measurement Test Conditions.
- 563 6. Provide dark room conditions. See Sections I, Light Measurement Protocols, and C, Dark
- 564 Room Conditions.
- 565 7. Set size and luminance. Refer to Section H, Luminance Test Patterns and Procedures for
- 566 CRT or Fixed Pixel displays. Once luminance is set, dark room conditions are no longer
- 567 needed.
- 568 (Note, if the test sample is equipped with Automatic Brightness Control, and this feature is
- 569 enabled by default, then substitute points 6 and 7 above with the procedure for testing such
- 570 models as described in Section 3.A.3, testing the sample at ambient light levels of 0 and 300
- 571 lux, and continuing with steps 8 through 13, below.)
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- 574 8. Either verify that the wall outlet power is within specifications or adjust the AC power source
- 575 output as described in Section A (e.g., 1 15V ± 1%, 60Hz ± 1%).
- 576 9. Set the power meter current range. The full-scale value selected multiplied by the crest factor
- 577 rating (I_{peak}/I_{rms}) of the meter must be greater than the peak current reading from the
- 578 oscilloscope.
- 579 10. Allow the readings on the power meter to stabilize and then take the true power reading in
- 580 watts from the power meter. Measurements are considered stable once the wattage reading
- 581 does not vary more than 1% over a three-minute period. See Section F, Power Measurement
- 582 Protocols.
- 583 11. Power consumption shall be recorded, as well as total pixel format (horizontal x vertical pixels
- 584 displayed), to calculate pixels/watt.
- 585 12. Record the test conditions and test data.
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Note: In light of the addition of Automatic Brightness Control to Section 3.A.3. of this Draft 2 of Version 5.0 of the Displays specification, EPA has modified the On Mode Testing Method above to allow the tester to substitute steps 6 and 7 of this method, "Provide dark room conditions," and "Set size and luminance," respectively, with the procedure for testing ABC models as described in Section 3.A.3.

Sleep Mode (Power Switch On, No Video Signal)

1. At the conclusion of the On Mode test, initiate the display's Sleep Mode. The method of adjustment shall be documented along with the sequence of events required to reach the Sleep Mode. Power on all test equipment and properly adjust operation range.
2. Allow the display to remain in Sleep Mode until stable power readings are measured. Measurements are considered stable once the wattage reading does not vary more than 1% over a three-minute period. Tester shall ignore the input sync signal check cycle when metering the unit in Sleep Mode.
3. Record the test conditions and test data. The measurement time shall be sufficiently long to measure the correct average value (i.e., not peak or instantaneous power). If the device has different Sleep Modes that can be manually selected, the measurement should be taken with the device in the most energy consumptive of those modes. If the modes are cycled through automatically, the measurement time should be long enough to obtain a true average that includes all modes.

Off Mode (Power Switch Off)

1. At the conclusion of the Sleep Mode test, initiate the display's Off Mode using the power switch ~~that reduces the power consumption the most~~. The method of adjustment shall be documented along with the sequence of events required to reach the Off Mode. Power on all

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- test equipment and properly adjust operation range.
2. Allow the display to remain in Off Mode until stable power readings are measured.

609 Measurements are considered stable once the wattage reading does not vary more than 1% over a
610 three-minute period. Tester shall ignore the input sync signal check cycle when metering the model in Off
611 Mode.

612 3. Record the test conditions and test data. The measurement time shall be sufficiently long to measure the
613 correct average value (i.e., not peak or instantaneous power).

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615 **Product Testing Documentation**

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617 K. Submittal of Qualified Product Data to EPA: Partners are required to self-certify those product models
618 that meet the ENERGY STAR guidelines and report information to EPA through the Online Product
619 Submittal tool. ENERGY STAR qualifying product data, including information about new as well as

620 discontinued models, must be provided on an annual basis, or more frequently if desired by the Partner.
621 This is outdated language that must be updated to reflect the agreement reached with the EPA/ICFI to
622 simply remove qualified displays from the list of qualified products x months after the product was listed
623 There is no reason to add additional burden requiring manufacturers to go back into the OPS tool and
624 de-list products that may no longer be sold.

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626 5) **User Interface:** Partners are strongly recommended to design products in accordance with the user
627 interface standard IEEE P1621: Standard for User Interface Elements in Power Control of Electronic
628 Devices Employed in Office/Consumer Environments. The Power Management Controls project
629 developed this standard to make power controls more consistent and intuitive across all electronic
630 devices. For details, see <http://eetd.lbl.gov/Controls>.

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632 6) **Effective Date:** The date that Partners may begin to qualify products as ENERGY STAR, under the
633 Version 5.0 specification, will be defined as the effective date of the agreement. Any previously
634 executed agreement on the subject of ENERGY STAR qualified displays shall be terminated effective
635 October 20, 2009.

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637 A. Qualifying Products Under Tier 1 of the Version 5.0 Specification: Tier 1 of the Version 5.0
638 specification shall commence on **October 21, 2009**. All products, including models originally
639 qualified under Version 4.1, with a **date of manufacture** on or after **October 21, 2009**, must meet
640 the new (Version 5.0) requirements in order to qualify for ENERGY STAR (including additional
641 shipments of models originally qualified under Version 4.1). The **date of manufacture** is specific
642 to each unit and is the date (e.g., month and year) of which a unit is considered to be completely
643 assembled.

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645 B. Qualifying Products Under Tier 2 of the Version 5.0 Specification: The second phase of this
646 specification, Tier 2, shall commence on **October 21, 2011**. Specifications for Tier 2 shall apply to
products with a date of manufacture on or after **October 21, 2011**. For example, a unit with a date
of manufacture of October 21, 2011 must meet the Tier 2 specification in order to qualify as
ENERGY STAR.

Note: EPA anticipates finalizing the Version 5.0 ENERGY STAR displays specification in January
2009. The proposed effective date of October 21, 2009 would allow industry the typical nine months
transition time prior to the revised specification taking effect. At the September 25, 2008 stakeholder
meeting, in response to a stakeholder request EPA indicated it would investigate the impact of
manufacturer design cycles on the effective date of the specification. EPA spoke with several
manufacturers and other stakeholders with regards to this issue, and concluded there is no consistent
design cycle for displays across manufacturers, and that instead, design cycles tend to vary across the
calendar.

EPA has subsequently allowed two years prior to Tier 2 requirements taking effect in October 2011.

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648 C. Elimination of Grandfathering: EPA will not allow grandfathering under this Version 5.0 ENERGY STAR
650 specification. **ENERGY STAR qualification under Version 4.1 is not automatically granted for the life of
651 the product model.** Therefore, any product sold, marketed, or identified by the manufacturing partner as
652 ENERGY STAR must meet the current specification in effect at the time of manufacture of the product.

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656 7) **Future Specification Revisions:** EPA reserves the right to change the specification should
657 technological and/or market changes affect its usefulness to consumers, industry, or the environment. In
658 keeping with current policy, revisions to the specification are arrived at through stakeholder discussions.

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660 EPA will periodically assess the market in terms of energy efficiency and new technologies. As always,
661 stakeholders will have an opportunity to share their data, submit proposals, and voice any concerns. EPA
662 will strive to ensure that the Tier 1 and 2 specifications recognize the most energy-efficient models in the
663 marketplace and reward those Partners who have made efforts to further improve energy efficiency.

664 **Greenhouse Gas Emissions**

665 EPA is interested in working with LCD industry stakeholders through the ENERGY STAR program to reduce
666 the emission of high global warming potential gases associated with LCD production, specifically NF3,
667 SF6, and CF4. This area of concern presents an opportunity to significantly reduce emissions beyond product
668 use-phase and to engage our partners in achieving significant, measurable greenhouse gas and energy
669 reductions from the other phases of the product lifecycle.

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672 **Note:** At the September 25, 2008 stakeholder meeting, EPA briefly presented its thoughts on how to address
673 these GHGs, and agreed to craft a more detailed description of it rational and a proposed path forward (to include
hosting a series of web meetings to discuss and work through the proposals). EPA is interested in receiving
input from stakeholders on ways to address these high global warming potential gases. Initial thoughts
include limiting the amount of emissions associated with LCD panels by either requiring the use of control
technologies or by setting a limit on the amount of emissions per area of LCD panels produced.
Manufacturers would then be responsible for working with their suppliers to track these emissions for LCD
panels used in ENERGY STAR qualified displays. EPA will distribute an invitation to the first web meeting by
early November 2008. HP opposes this change. Refer to comments at the beginning of the draft standard.

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