



ENERGY STAR® Test Method for Small Network Equipment

Final Draft
Rev. November-2012

1 OVERVIEW

The following protocol shall be followed when testing products for compliance with the Version 1.0 ENERGY STAR Small Network Equipment (SNE) specification.

2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the feature set of the product under evaluation. The following guidelines shall be used to determine the applicability of each section of this document:

- Section 7.2.A) shall be conducted for all SNE products.
- Sections 7.2.B), C), and D) shall be completed for applicable product types as referenced in Table 1.

Table 1: Test Procedure Structure

Product Type	Test Procedure Section			
	7.2.A) All Devices – Idle State	7.2.B) Wired Network – WAN	7.2.C) Wired Network – LAN	7.2.D) Wireless Network – LAN
Modem (DSL, Cable, ONT)	X	X		
Integrated Access Device	X	X	X	X
Switch/Router	X		X	Routers with Wireless
Access Point	X			X

Note: The wireless product and wired/wireless product categories from Draft 1 have been replaced by an Access Point category.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions contained in the ENERGY STAR Eligibility Requirements for Small Network Equipment.

Acronyms referenced in this ENERGY STAR Test Method draft:

- ANSI: American National Standards Institute

- 18 • AP: Access Point
- 19 • dB: Decibels
- 20 • DHCP: Dynamic Host Configuration Protocol
- 21 • DSL: Digital Subscriber Line
- 22 • EIA: Electronic Industries Alliance
- 23 • EPS: External Power Supply
- 24 • HPNA: Home Phonenumber Networking Alliance
- 25 • IAD: Integrated Access Device
- 26 • IEC: International Electrotechnical Commission
- 27 • IEEE: Institute of Electrical and Electronics Engineers
- 28 • IMIX: Internet Traffic Mix
- 29 • IPsec: Internet Protocol Security
- 30 • ISP: Internet Service Provider
- 31 • L2TP: Layer 2 Tunneling Protocol
- 32 • LAN: Local Area Network
- 33 • LLDP: Link Layer Discovery Protocol
- 34 • MAC: Media Access Control
- 35 • MIMO: Multiple-Input/Multiple-Output
- 36 • MoCA: Multimedia over Coax Alliance
- 37 • NAT: Network Address Translation
- 38 • ONT: Optical Network Terminal
- 39 • PoE: Power over Ethernet
- 40 • PON: Passive Optical Network
- 41 • POTS: Plain Old Telephone Service
- 42 • PPPoX: Point-to-Point Protocol over X
- 43 • RF: Radio Frequency
- 44 • SSID: Service Set Identifier
- 45 • TIA: Telecommunications Industry Association
- 46 • TTL: Time To Live
- 47 • UDP: User Datagram Protocol
- 48 • USB: Universal Serial Bus
- 49 • UUT: Unit Under Test
- 50 • VoIP: Voice over Internet Protocol
- 51 • VPN: Virtual Private Network
- 52 • WAN: Wide Area Network

- 53 • WLAN: Wireless Local Area Network

54 4 TEST SETUP

- 55 A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this procedure shall
 56 be in accordance with the requirements of IEC 62301, Ed. 2.0, “Household electrical appliances –
 57 Measurement of standby power”, Section 4, “General Conditions for Measurements”. In the event of
 58 conflicting requirements, the ENERGY STAR test method shall take precedence.
- 59 B) Input Power: Input power shall be as specified in Table 2.

60 **Table 2: Input Power Requirements**

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

- 61 C) Ambient Temperature: Ambient temperature shall be from 18 °C to 28 °C.
- 62 D) Relative Humidity: Relative humidity shall be from 10% to 80%.
- 63 E) Power Meter: Power meters shall possess the following attributes:
- 64 1) Crest Factor: Capability to measure the current waveform without clipping.
- 65 i) The peak of the current waveform measured during Idle State shall determine the crest factor
 66 rating requirement and the appropriate current range setting.
- 67 ii) The full-scale value of the selected current range multiplied by the crest factor for that range
 68 shall be at least 15% greater than the peak current.
- 69 2) Bandwidth: Minimum bandwidth as determined by an analysis of current and voltage to determine
 70 the highest frequency component (harmonic) with a magnitude greater than 1% of the
 71 fundamental frequency under the test conditions.
- 72 3) Minimum Frequency Response: 3.0 kHz
- 73 4) Minimum Sampling Frequency: 60 Hz
- 74 5) Minimum Resolution:

- 75 i) 0.01 W for measurement values less than 10 W;
- 76 ii) 0.1 W for measurement values from 10 W to 100 W; and
- 77 iii) 1.0 W for measurement values greater than 100 W.
- 78 6) Measurement Accuracy:
- 79 i) Power measurements with a value greater than or equal to 0.5 W shall be made with an
80 uncertainty of less than or equal to 2% at the 95% confidence level.
- 81 ii) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less
82 than or equal to 0.01 W at the 95% confidence level.

83 5 TEST CONDUCT

- 84 A) As-shipped Condition: Products must be tested in their “as-shipped” configuration. For products that
85 offer a choice of user-configurable options, all options shall be set to their default condition, unless
86 otherwise specified in this test procedure.
- 87 B) Test Procedure Order: All portions of this test method shall be followed in the order in which they are
88 written.
- 89 C) Data Source/Transfer Requirements: A network traffic generator shall be used to simulate traffic and
90 monitor link reliability. The generator shall be configured for the correct traffic topology and traffic
91 profile, and as follows:
- 92 1) All data transfers shall occur via User Datagram Protocol (UDP);
- 93 2) The “data rate” is the average number of bits per second passing over a link in one direction.
94 Data rates are expressed as the average number of bits found in UDP data frames passing over
95 a link in a one second period;
- 96 3) The traffic generator shall be able to support the maximum theoretical data rate of the unit under
97 test (UUT) with UDP traffic.
- 98 4) Test traffic shall contain random data in a variety of datagram (or frame) sizes based on an
99 Internet traffic mix (IMIX) sent at random intervals. See references in Table 3 for more
100 information;
- 101 5) Data shall be evenly split between both directions (transmission and reception) for a given link
102 unless otherwise specified in this test procedure;
- 103 6) Port numbers for data traffic shall be randomly selected in advance of each test from the
104 available pool of valid UDP ports. Once selected, port numbers shall not be changed for the
105 duration of testing. If the selected port results in blocked traffic by a UUT firewall, select a
106 different port at random before proceeding with the test.

107 **Table 3: Data Source/Transfer References**

Reference	Description
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Reference	Description
http://spcprev.spirentcom.com/documents/4079.pdf	<u>Spirent</u> , Test Methodology Journal, IMIX (Internet Mix) Journal, March 2006
http://www.ixiacom.com/library/test_plans/display?skey=testing_pppox	<u>IXIA Library: Test Plans</u> , Broadband PPPoX and L2TP Testing

108 D) Battery Operated Products: For products designed to operate using batteries either when not
 109 connected to the mains or during a power disruption, the battery shall be fully charged before the start
 110 of testing and shall be left in place for the test. To ensure the battery is fully charged, perform the
 111 following steps:

- 112 1) For UUTs that have an indicator to show that the battery is fully charged, continue charging for at
 113 least an additional 5 hours after the indication is present.
- 114 2) If there is no charge indicator, but the manufacturer's instructions provide a time estimate,
 115 continue charging for at least an additional 5 hours after the manufacturer's estimate.
- 116 3) If there is no indicator and no time estimate in the instructions, but the charging current is stated
 117 on the UUT or in the instructions, terminate charging 1 hour after the calculated charge duration
 118 or, if none of the above applies, the duration shall be 24 hours.

119 **Note:** The language above is added to clarify steps that must be taken to ensure a fully-charged battery
 120 at the start of the test. It is aligned with similar provisions present in other ENERGY STAR Test Methods.

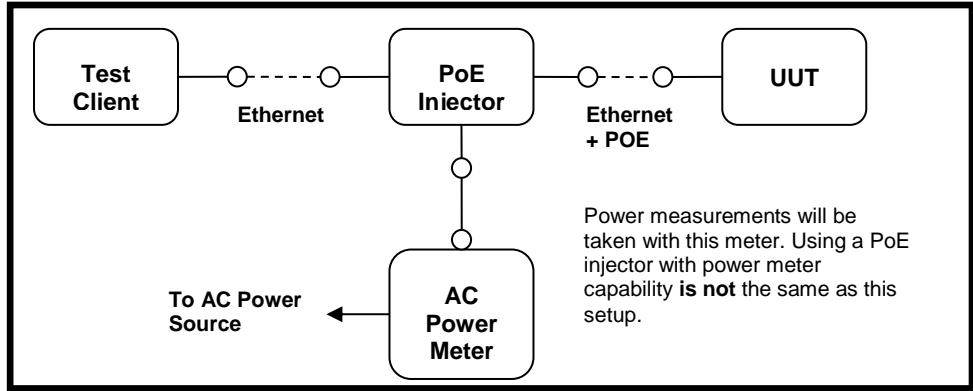
121 6 UUT CONFIGURATION

122 6.1 Supplied Power Configuration

123 A UUT that can be powered by either mains power or low-voltage dc shall be powered from the mains.

- 124 1) Mains-powered: If the UUT is shipped with an external power supply (EPS), or powered directly
 125 by mains ac, power consumption of the UUT shall be measured and tested between the ac power
 126 source and the UUT.
- 127 2) Low-voltage Dc Powered : For products powered by standard low-voltage dc (e.g., Power over
 128 Ethernet (PoE) [IEEE 802.3af or .3at], or Universal Serial Bus (USB)), the following protocol
 129 applies:
 - 130 i) If a manufacturer-supplied low-voltage dc power supply is shipped with the UUT, it shall be
 131 used for testing.
 - 132 ii) If there is no power supply shipped with the UUT, a commercially available device (e.g., PoE
 133 Midspan or powered USB hub) shall be used to supply power to the UUT for testing. If the
 134 UUT manufacturer sells an appropriate standard low-voltage dc supply, then a model from
 135 the UUT manufacturer shall be used. The brand and model number of the power supply shall
 136 be recorded on the test data sheet. The selected power supply shall be considered the EPS
 137 for the unit for purposes of testing.

138 iii) Power consumption of the UUT shall be measured and tested between the ac power source and
 139 and the low-voltage dc power supply as identified in Figure 1: Low-voltage Dc Power Setup
 140 (PoE shown as example).



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 142 **Figure 1: Low-voltage Dc Power Setup (PoE shown as example).**
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144 **6.2 Wired Port UUT Configuration**

145 Only Ethernet ports are considered wired local area network (LAN) ports for purposes of testing. Ethernet
 146 connectivity and all other wired ports shall be configured for testing as follows:

- 147 1) Peripheral Devices: Non-Ethernet wired ports (e.g., HPNA, MoCA, USB, analog connections,
 148 POTS, audio) shall not be connected, unless a secondary device and cable are shipped with the
 149 UUT (e.g., an external disk with a USB connection).
- 150 2) Network Link Maintenance: The UUT’s wide area network (WAN) port shall be connected to a live
 151 source. Network links shall be continuously maintained, with the exception of brief lapses when
 152 transitioning between link speeds.
- 153 3) Ethernet Port Connection Rate: Ethernet ports shall be connected at the maximum supported link
 154 rate unless otherwise specified in this test procedure.
- 155 4) Ethernet Cabling: All Ethernet cables used for testing shall meet ANSI/EIA/TIA-568 Category 5e
 156 (Cat5e) specifications and shall be between 1 and 2 meters in length.

157 **Note:** The Ethernet Cable length requirement has been modified and now requires the length of the
 158 testing cable to be between 1 and 2 meters.

- 159 5) Power over Ethernet: PoE capability shall be configured with default as-shipped settings.
- 160 6) Efficient Networking Protocols:
 - 161 i. If the UUT supports IEEE 802.3az protocol, all connected devices must support IEEE
 162 802.3az,
 - 163 ii. If the UUT supports Link Layer Discovery Protocol (LLDP) for 802.3az, all connected devices
 164 must support LLDP for 802.3az.

165 **6.3 Wireless UUT Configuration**

166 The UUT shall be tested with wireless network settings in their default as-shipped configuration. Default
 167 settings shall not be modified unless modification is necessary to complete this procedure, or if no default

168 setting exists. Any features that require special configuration to achieve intended function (e.g., initial
 169 setup before use as indicated in a reference manual) shall be configured per the following requirements.
 170 If additional required settings are not listed below, the setting type and option shall be recorded in the test
 171 report.

- 172 1) SSID: As-shipped, or assigned a random value as required by the UUT;
- 173 2) Network Encryption: As-shipped, or 128-bit WPA2 as required by the UUT;
- 174 3) Network Key: As shipped, or assigned a random value as required by the UUT;
- 175 4) Network Channel: A supported channel shall be selected and maintained for the duration of
 176 testing;
- 177 5) Interference Mitigation: Interference robustness or other interference mitigation technology shall
 178 be as-shipped or set to “ON” if configuration required by UUT.
- 179 6) Wireless Link Precedence:
 - 180 i) *Single instantaneous frequency band support*: The first supported wireless standard and
 181 frequency band starting from the top of Table 4 shall be used for Access Point testing. Only
 182 one band shall be active during the test.

183 **Table 4: Wireless Link Precedence - Single Instantaneous Frequency Band Support**

Wireless Band	Frequency
IEEE 802.11ac	5 GHz (Maximum supported channel bandwidth)
IEEE 802.11n	5 GHz (Maximum supported channel bandwidth)
IEEE 802.11n	2.4 GHz (20MHz channel bandwidth)
IEEE 802.11g	2.4 GHz
IEEE 802.11b	2.4 GHz
IEEE 802.11a	5 GHz

- 184 ii) *Simultaneous instantaneous frequency band support*: The first supported pair of wireless
 185 standards and frequency bands starting from the top of Table 5 shall be used for access point
 186 testing.

187 **Table 5: Wireless Link Precedence - Simultaneous Instantaneous Frequency Band Support**

Wireless Band 1	Frequency 1	Wireless Band 2	Frequency 2
IEEE 802.11n	2.4 GHz (20 MHz channel bandwidth)	IEEE 802.11ac	5 GHz (Maximum supported channel bandwidth)

Wireless Band 1	Frequency 1	Wireless Band 2	Frequency 2
IEEE 802.11n	2.4 GHz (20 MHz channel bandwidth)	IEEE 802.11n	5 GHz (Maximum supported channel bandwidth)
IEEE 802.11g	2.4 GHz	IEEE 802.11n	5 GHz (Maximum supported channel bandwidth)
IEEE 802.11g	2.4 GHz	IEEE 802.11a	5 GHz
IEEE 802.11b	2.4 GHz	IEEE 802.11a	5GHz

188 iii) *Alternative configurations:* If a device cannot support any configuration listed in either Table 4
189 (for support of a single instantaneous frequency band) or Table 5 (for support of multiple
190 instantaneous frequency bands), the test client shall provide a configuration. The
191 configuration shall be recorded in the test report.

192 **Note:** Table 4 and Table 5 above have been revised to clarify appropriate channel bandwidths and
193 address the inclusion of 802.11ac.

194 **6.4 UUT Wired Network Settings**

195 The UUT shall be tested with wired network settings in their default as-shipped configuration. Default
196 settings shall not be modified, unless otherwise specified in this test method or if no default setting exists.
197 Any features that require configuration prior to the UUT functioning (e.g., required setup before use as
198 indicated in a reference manual) shall be configured per the following requirements. If additional required
199 settings are not listed below, the setting type and option shall be recorded in the test report.

- 200 1) Enable Network Address Translation (NAT) for IPv4 networks;
- 201 2) Enable IPv6 Link Local, Neighbor Solicitation, Neighbor Discovery, Router Solicitation and Router
202 Advertisement;
- 203 3) Enable Single Class C Subnet;
- 204 4) Enable single hop (router TTL + 1) to source on WAN side;
- 205 5) Enable DHCP, if available, and have the UUT autonomously assign each configured test client an
206 address by the DHCP service in the router, or manually assign addresses in a manner typical of
207 DHCP (e.g., incremental, 3 day TTL); the WAN port shall be configured via DHCP or manually
208 assigned if DHCP is not supported;
- 209 6) Disable Internet Protocol Security (IPsec);
- 210 7) For any wired network interface connected for testing as required by this Test Method, the
211 interface shall be configured in full compliance with the relevant published or draft standard
212 governing the technology (e.g., all features comply with IEEE 802.3);

213 **If the UUT offers more than one WAN connection option, the UUT shall be configured using the**
214 **first available WAN connection presented in**

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- 8) Table 6, from top to bottom. Only a single WAN port shall be connected.
- 9) The WAN connection shall be configured to operate at the maximum possible speed.

Table 6: WAN Link Precedence

Connection Type	Media Type
DOCSIS (Cable)	Coax
PON	Fiber
DSL	Copper (Twisted Pair)
Ethernet (IEEE 802.3)	Copper (Twisted Pair)

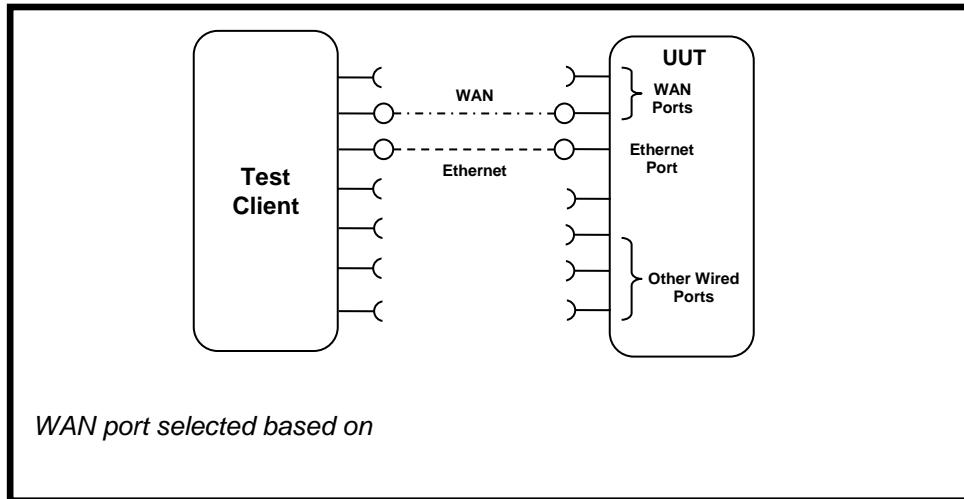
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Note: MoCA, HPNA and WiMAX (802.16e) connection types have been removed from Table 6, due to limited data and inability to test them in the current test method. These protocols should be turned off during testing.

226 **6.5 UUT Preparation**

227 The UUT shall be configured for testing as follows.

- 228 1) Test Report: Record the manufacturer and model name of the UUT. Record all basic information
229 about the UUT's configuration including, but not limited to, the settings listed Sections 6.1 through
230 6.4.
- 231 2) Network Connection: Connect the UUT to network resources as follows:
 - 232 i) Modem (DSL, Cable, or ONT): See Figure 2: Modem setup.



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Figure 2: Modem setup.

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(a.) Connect the UUT WAN port to the test client using the priority and link rate specified in Section 6.4.

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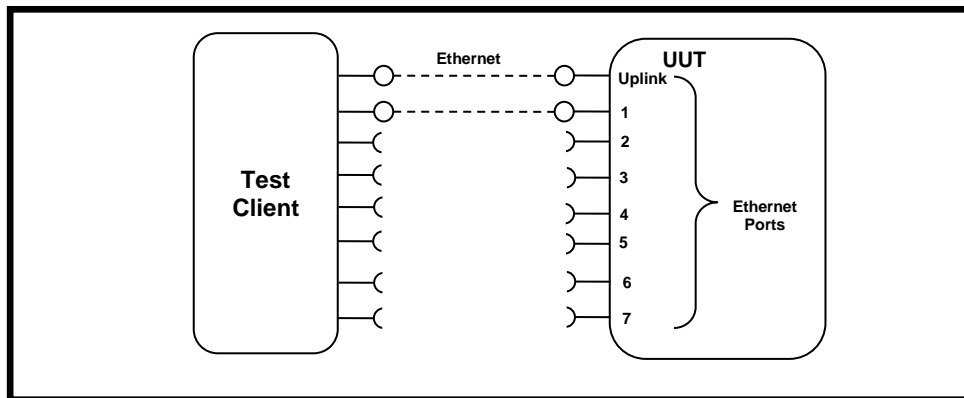
(b.) Connect one LAN port to the test client. If Ethernet is available, the Ethernet port shall be used. If more than one Ethernet port is present, the first non-uplink Ethernet port shall be used.

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ii) Switch/Router: See Figure 3: Switch or router test setup.



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Figure 3: Switch or router test setup.

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(a.) Connect two of the UUT's available ports to the test client and ensure that live links are maintained for the duration of testing on all connections.

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(b.) If there is a port on the UUT identified as the uplink or WAN port, it shall be selected as one of the two ports connected for testing. Otherwise, the first port shall be used as the uplink port.

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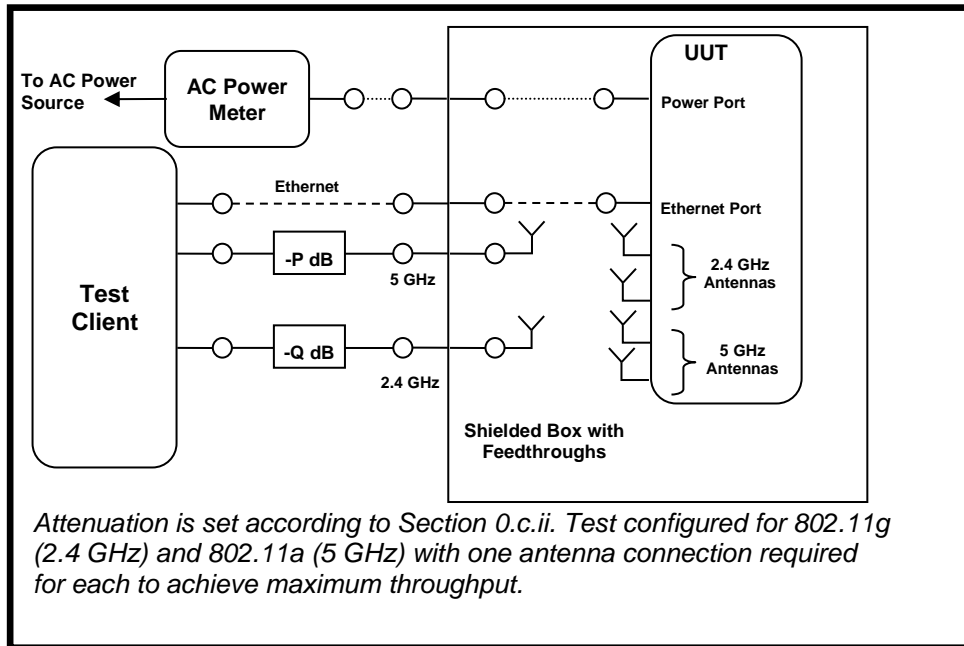
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(c.) *For Wireless Router Testing:* see setup in section 6.5D)3)iii)(c.)

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iii) IAD or Access Point:

- 253 (a.) *Access Points*: Connect the uplink Ethernet port to the test source at the highest
 254 available link rate and ensure that live links are maintained for the duration of testing.
- 255 (b.) *IADs*: Ensure a WAN port is connected according to the priority specified in Section 6.4
 256 and ensure that live links are maintained for the duration of testing. Connect the first
 257 Ethernet port to the test source at the highest available link rate. Traffic for this test will
 258 pass over the Ethernet link and not the WAN link.
- 259 (c.) *Wireless UUTs*: (see Figure 4: AP setup with fixed antennas.).
- 260 (i.) Place the UUT inside a shielded enclosure large enough to fit the UUT without
 261 contact with enclosure walls. The enclosure must have sufficient RF absorbing
 262 material lining all inside surfaces and also have sufficient RF, Ethernet, and power
 263 feed-throughs to service the UUT.
- 264 (ii.) Connect antennas to the RF feed-throughs on the inside of the enclosure.
- 265 (i.) Connect cables to the exterior feed-throughs via appropriate RF attenuators to
 266 achieve a signal strength of $-50 \text{ dBm} \pm 5 \text{ dB}$. The test client transmit power shall be
 267 set to ensure that the received signal strength at the UUT is $-50 \text{ dBm} \pm 5 \text{ dB}$, with
 268 received signal strength measured within the bandwidth of interest. Use of RF test
 269 equipment (e.g., spectrum analyzer) to determine the appropriate use of attenuation
 270 is recommended. The model names and numbers of equipment used shall be
 271 recorded.
- 272 (ii.) If the UUT has multiple antennas for a single band, an appropriate number of cables
 273 and antennas shall be connected to achieve the maximum supported data rate (i.e.,
 274 1 cable/antenna for 802.11a/b/g and ≥ 1 cable/antenna for 802.11n).



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Figure 4: AP setup with fixed antennas.

- 278 (d.) If the UUT requires an access point controller for normal operation, an access point
 279 controller from the same manufacturer as the UUT shall be added to the network for
 280 testing. If the UUT is capable of full operation without an access point controller, it shall
 281 be tested without a controller on the test network.

282 (e.) Record sufficient details of the test setup to allow for the test to be independently re-
283 created and verified.

284 3) Power Meter Connection:

285 i) Connect the power meter(s) to an ac voltage source set to the appropriate voltage and
286 frequency for the test.

287 ii) Plug the UUT into the measurement power outlet on the power meter, as follows:

288 (a.) No other devices (e.g., power strips or UPS units) may be connected between the meter
289 and the UUT;

290 (b.) If the UUT uses an EPS, the EPS is considered part of the UUT. Plug the EPS input into
291 the measurement power outlet on the meter;

292 (c.) The power meter shall remain connected until all testing is complete.

293 **6.6 Test Client Setup**

294 The tests outlined in Section 7 require the use of network tester equipment (the test client) capable of
295 supporting the protocols used during testing. The test client may consist of several discrete pieces of test
296 equipment used together to test Ethernet, WAN, and wireless links. This section is intended to provide
297 guidelines for test client configuration to be applied to the specific pieces of equipment serving the UUT.

298 1) Configure the test client Ethernet ports to be DHCP clients with unique, random MAC addresses.

299 2) Configure the WAN port or uplink Ethernet port to assign a random IPv4 address to the UUT. A
300 static IPv4 address may be set in the UUT if the test client is unable to support random address
301 assignment. IPv6 may be used if IPv4 support is not present in the test client hardware. If the
302 UUT is configured for DHCP pass-through functionality, the test client shall assign addresses
303 through the UUT.

304 3) Configure the test client to send traffic using UDP.

305 4) Configure the test client to provide statistics on data reliability (% of packets received
306 successfully).

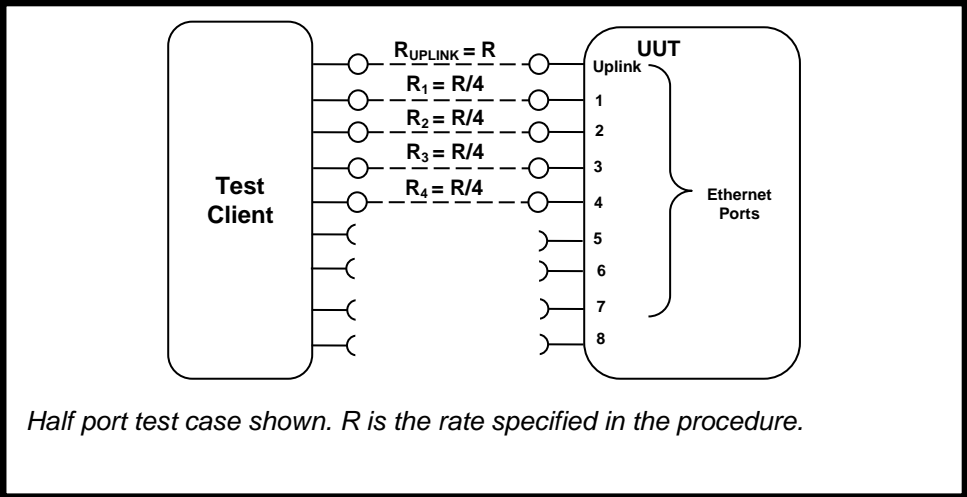
307 5) Configure the test client to transmit variable length packets or frames using the basic IMIX given
308 in Table 7 (see Table 3 for references). The packet content shall be random as specified in
309 Section 5.C).4).

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Table 7: IMIX Packet Length Distribution

Datagram Size (IP Length in Bytes)	Frame Length (Bytes)	% of total packets
40	64	61%
576	594	23%
1500	1518	16%

- 311 6) Configure the test client to test in a modified aggregation mode. All traffic will pass over a single link
 312 link (the uplink or WAN port), and this traffic will be evenly divided between the other connected
 313 Ethernet ports. See Figure 5: Data distribution for multilink tests.



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Figure 5: Data distribution for multilink tests.

- 316 7) If the UUT has wireless capability, the test client shall be capable of functioning as a wireless
 317 client for the wireless standard(s) specified in Section 6.3.
- 318 8) Configure data connections to the test client as specified in Section 0.
- 319 9) Record the model names and numbers of test equipment used for the test client and provide a
 320 functional diagram of the test equipment and UUT configuration, including all connections in the
 321 test setup.

322 **7 TEST PROCEDURES FOR ALL PRODUCTS**

323 **7.1 Power Measurement Guidelines**

- 324 A) Tests are performed at two data rates, 1 kb/s (0.5 kb/s in each direction), and the highest rate
 325 supported by the link shown in Table 8. The 1 kb/s rate shall be achieved as a moving average,
 326 where the data rate averages 1 kb/s in any 30 second window. If the link has asymmetric data rate
 327 support (e.g., DSL, with a higher download rate than upload rate), choose the highest rate supported
 328 for the direction shown in the table. For data rates higher or lower than those shown in the chart,
 329 choose the highest data rate according to Equation 1 and adjusting the variable Y as required to
 330 achieve the desired data rate. **Note:** A link with 100 Mb/s PHY throughput will not support 100 Mb/s of
 331 traffic as specified in this procedure. In this case the traffic rate should be set to 50 Mb/s.

332 **Equation 1**

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$$DataRate = Z \times 10^Y \text{ (in bits per second)}$$

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- Where:
- Z is 1, 2, or 5, and
 - Y is an integer. Adjust as required to achieve the desired data rate

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Table 8: Test Rate Selection

Direction	Rate (Mb/s)								
Downlink or Symmetric link	1.0	2.0	5.0	10	20	50	100	200	500
Uplink	0.5	1.0	2.0	5.0	10	20	50	100	200

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B) If there is a port on the UUT identified as the uplink or WAN port, it shall be selected as the uplink port in Section 7.2.C). Otherwise, the first port shall be used as the uplink port. If present, additional Ethernet ports shall be connected sequentially, and there shall be no open Ethernet ports between occupied Ethernet ports.

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C) If any standard power reduction mechanisms are supported by the UUT, such features may be enabled during testing in both the UUT and test equipment, provided that all enabled features are disclosed along with reported test results.

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D) The following procedure shall be used for each test component in Section 7.2:

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1) Reset the power meter (if necessary).

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2) Begin recording elapsed time.

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3) After 5 minutes have elapsed, set the meter to begin accumulating true power values at a rate of greater than or equal to 1 Hz (1 reading per second).

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4) Accumulate power values for 5 minutes and record the average (arithmetic mean) value observed during the 5 minute period.

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5) Record the test procedure step and measurements on the test report. If a step is repeated at a different link rate, record the additional measurements in the test report.

355 7.2 Power Consumption Tests

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A) All Devices – Idle State

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1) Turn on the UUT and configure the UUT per the requirements in Section 6.

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2) Measure and record UUT power per Section 7.1.

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B) Wired Network – WAN

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1) If the UUT only supports WAN connection (IADs only), connect one Ethernet port. Ensure all Ethernet ports are connected at their highest supported link rate. Measure and record power per Section 7.1.

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2) Run data at 1 kb/s (0.5 kb/s in each direction) between the WAN and LAN ports. Measure and record power per Section 7.1.

365 3) Run data at the rate specified in Section 7.1 between the WAN and LAN ports. Measure and
366 record power per Section 7.1.

367 C) Wired Network – LAN:

368 1) Half-Ports Test: Test with half of ports in use, at all supported speeds, as applicable. See Figure
369 5: Data distribution for multilink tests.

370 i) If the UUT has more than two Ethernet ports, connect half of the Ethernet ports (round up to
371 the nearest whole number of ports). Connect each port sequentially (e.g., a 5-port product
372 would have ports 1-3 connected and ports 4 and 5 disconnected). Ethernet and other LAN
373 ports on the UUT must be connected at their highest supported link rate. If a port on the UUT
374 is specified as the uplink port, it shall be used as the uplink port for testing; otherwise, the first
375 port shall be used as the uplink port. Measure and record power per Section 7.1.

376 ii) Run data at 1 kb/s (0.5 kb/s in each direction) between the LAN ports. Measure and record
377 power per Section 7.1.

378 iii) Run data at the rate specified in Section 7.1 between the LAN ports. Measure and record
379 power per Section 7.1.

380 D) Wireless Network - WLAN

381 1) Ensure only one Ethernet port is connected to the UUT.

382 2) Establish a single client device in the test client. The wireless local area network (WLAN) type
383 must be consistent with the priority specified in Section 6.3 and shall be configured for the highest
384 supported link rate. Record the supported rate for the network port, the wireless link, and the
385 version of 802.11 being used for this test. Measure and record power per Section 7.1.

386 3) Run data at 1 kb/s (0.5 kb/s in each direction) between the LAN port and the WLAN client.
387 Measure and record power per Section 7.1.

388 4) Run data at the rate specified in Section 7.1 between the LAN port and the WLAN client. Measure
389 and record power per Section 7.1.

390 8 PERFORMANCE EVALUATION

391 **Note:** In response to Stakeholder feedback, the optional performance reporting criteria previously
392 appearing in this section are moved to the ENERGY STAR Specification, where they now appear as
393 optional reporting criteria.

394 9 REPORTING

395 9.1 Reported UUT information and Functionality

396 The following characteristics are recommended for reporting using this procedure:

- 397 1. Manufacturer and model name;
- 398 2. Basic configuration information;
- 399 3. Powering options (e.g., direct ac, external ac-dc power supply, standard low-voltage dc). If
400 powered over Ethernet, report whether LLDP for PoE is supported;

- 401 4. Number and type of all wired data and network ports. Additional related details (e.g.,
 402 Ethernet speed, 802.3az, LLDP for 802.3az);
- 403 5. Number and type of wireless network support including supported bands, simultaneous
 404 band support, supported standards, and MIMO configuration. Additional details as required;
- 405 6. Supported network traffic functions (e.g., firewall, VPN, VOIP functionality for POTS ports);
- 406 7. Mass storage options integral to or shipped with the UUT;
- 407 8. Any special equipment ratings (e.g., IEC 61850 / IEC61000 and IEEE1613, KEMA).
- 408 9. Ethernet throughput - Maximum data rate in UDP data payload (expressed in b/s);
- 409 10. Maximum wireless clients;
- 410 11. Maximum NAT clients.

411 **Note:** Ethernet throughput, Maximum wireless clients, and Maximum NAT clients have been moved from
 412 Section 9.2 to Section 9.1 as they are no longer required to be reported.

413 **9.2 Reported Test Results**

- 414 1. Voltage and frequency used in test;
- 415 2. If low-voltage dc, type of supply used;
- 416 3. Wireless Link information from Table 4 or Table 5;
- 417 4. Any settings changed per Section 6.4;
- 418 5. Uplink link rate;
- 419 6. Uplink and downlink data rates;
- 420 7. Power levels - Report all that apply:
- 421 • One port: Idle State, low data rate, high data rate;
- 422 • Half ports: Idle State, low data rate, high data rate;
- 423 • Wireless: Idle State, low data rate, high data rate;

424 **10 TEST CONFIGURATION REFERENCES**

