ENERGY STAR® Test Method for Small Network Equipment

**Draft 3
Rev. Nov-2010**

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

Note: Table 1 has been moved to the applicability section from its previous location in Rev. 2.

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) 6.3shall be conducted for all SNE products.

- Sections 7.2.B), A), and A) 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**	**7.2.B)** **Wired Network – WAN**	**7.2.A)** **Wired Network – LAN**	**7.2.A)** **Wireless Network – LAN**
Modem	X	X		
Integrated Access Device	X	X	X	X
Switch/Router	X		X	
Wireless Product	X			X
Wired/Wireless Product	X		X	X

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. The following terms are also referenced in this Test Method:

A) Integrated Access Device (IAD): A device providing one of the following capability combinations: (1) modem and switch, (2) router, or (3) switch and router capability.

Deleted: Products must be tested with hardware and software in the default "as-shipped" configuration, unless otherwise specified in this document. ¶

Deleted: : An acronym for "integrated access

Deleted: ," a device combining modem, switch, and/or router

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B) Link Rate: The maximum raw bit rate possible on a particular link (e.g., 1000BASE-T Ethernet supports 1 Gb/s in each direction [2 Gb/s total]; IEEE 802.11g supports 54 Mb/s total).

C) Unit Under Test (UUT): The network equipment device being tested.

D) WLAN Test Client: A device that is capable of establishing an 802.11x link with an AP and transmitting data to and from the AP.

4 TEST SETUP

Note: Section 4 has been revised for consistency with standard format now in use by the ENERGY STAR program. The test voltages and tolerances presented are consistent with the settings used across the ENERGY STAR program and are intended to ensure consistent and repeatable measurement across laboratories and ENERGY STAR Partners.

A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this procedure shall be in accordance with the requirements of IEC 62301, Ed. 1.0, "Measurement of Household Appliance Standby Power", Section 4, "General Conditions for Measurements". In the event of conflicting requirements, the ENERGY STAR test method shall take precedence.

B) Input Power: Input power shall be as specified in Table 2.

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 %
China	220 Vac	+/- 1.0 %	2.0 %	50 Hz	+/- 1.0 %
Japan	100 Vac	+/- 1.0 %	2.0 %	50 Hz and 60 Hz	+/- 1.0 %

C) Ambient Temperature: Ambient temperature shall be from 18 $^{\circ}$C to 28 $^{\circ}$C.

D) Relative Humidity: Relative humidity shall be from 10% to 80%.

E) Power Meter: Power meters shall possess the following attributes:

    1) Crest Factor: Capability to measure the current waveform without clipping.

        i) The peak of the current waveform measured during Sleep Mode and On Mode shall determine the crest factor rating requirement and the appropriate current range setting.

ii)   The full-scale value of the selected current range multiplied by the crest factor for that range ~~shall be at least 15% greater than the peak current.~~

2) Bandwidth: Minimum bandwidth as determined by an analysis of current and voltage to determine the highest frequency component (harmonic) with a magnitude greater than 1% of the fundamental frequency under the test conditions.

3) Minimum Frequency Response: 3.0 kHz

4) Minimum Sampling Frequency: 60 Hz

5) Minimum Resolution:

    i)   0.01 W for measurement values less than 10 W;

    ii)   0.1 W for measurement values from 10 W to 100 W; and

    iii) 1.0 W for measurement values greater than 100 W.

F) Measurement Accuracy:

1) Power measurements with a value greater than or equal to 0.5 W shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level.

2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less than or equal to 0.01 W at the 95% confidence level.

5   TEST CONDUCT

Note: The Test Conduct section, previously titled "Test Conditions," has been revised for consistency, to clarify EPA's intent, and to add standard conditions for devices with integral batteries.

A) As-shipped Condition: Products must be tested in their "as-shipped" configuration. For products that offer a choice of user-configurable options, all options shall be set to their default condition.

B) Test Procedure Order: All portions of this test method shall be followed in the order in which they are written.

C) Data Source/Transfer Requirements: A network traffic generator shall be used to simulate traffic and monitor link reliability. The generator shall be configured for the correct traffic topology and traffic profile, and as follows:

1) All data transfers shall occur via UDP;

2) The "data rate" is the average number of bits per second passing over a link in one direction. Data rates are expressed as the average number of bits found in UDP data frames passing over a link in a one second period;

3) Test traffic shall contain random data in a variety of datagram (or frame) sizes based on an Internet traffic mix (IMIX) sent at random intervals. See references in Table 3 for more information;

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4) Data shall be evenly split between both directions (transmission and reception) for a given link unless otherwise specified in this test procedure;

5) Port numbers for data traffic shall be randomly selected in advance of each test from the available pool of valid UDP ports. Once selected, port numbers shall not be changed for the duration of testing. If the selected port results in blocked traffic by a UUT firewall, select a different port at random before proceeding with the test.

Table 3: Data Source/Transfer References

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

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

6   UUT CONFIGURATION

6.1   SUPPLIED POWER CONFIGURATION

A UUT that can be powered by either mains power or low-voltage dc shall be powered from the mains. Low voltage dc shall be used only for devices that do not offer a mains power option.

1) Mains-powered: If the UUT is shipped with an external power supply, or powered directly by mains ac, power consumption of UUT shall be measured and tested between the ac power source and the UUT.

2) Low-voltage Dc Powered: For products powered by standard low-voltage dc (e.g., Power over Ethernet [IEEE 802.3af or .3at], or USB), the following protocol applies:

   i)   If the UUT supports LLDP for PoE for its power supply, the PoE source shall also support LLDP for PoE. See Figure 1.

   ii)   If a manufacturer-supplied low-voltage dc power supply is shipped with the UUT, it shall be used for testing.

   iii) If there is no power supply shipped with the UUT, a commercially available device (e.g., PoE power injector or powered USB hub) shall be used to supply power to the UUT for testing. If the UUT manufacturer sells an appropriate standard low-voltage dc supply, then a model from the UUT manufacturer shall be used. The brand and model number of the power supply shall be recorded on the test data sheet. The selected power supply shall be considered the external power supply for the unit for purposes of testing.

   iv)   Power consumption of UUT shall be measured and tested between the ac power source and the low-voltage dc power supply as identified in Figure 1.

Figure 1: Low-voltage Dc Power Setup.
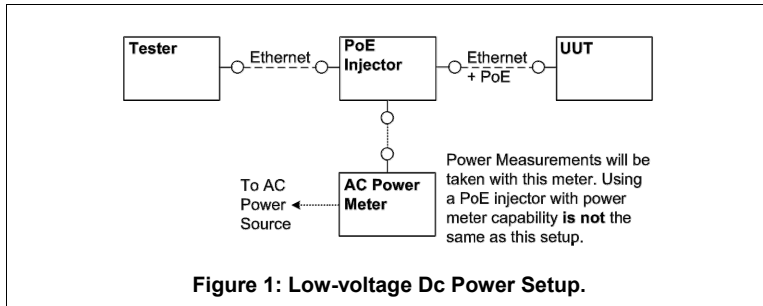
6.2 WIRED PORT UUT CONFIGURATION

Only Ethernet ports are considered wired LAN network ports for purposes of testing. Ethernet connectivity and all other wired ports shall be configured for testing as follows:

1) Alternative LAN Technologies: Non-Ethernet wired ports (e.g., HPNA, MoCA, USB, analog connections, POTS, audio) shall not be connected, unless a secondary device and cable are shipped with the UUT (e.g., an external disk with a USB connection).

2) Network Link Maintenance: The UUT's WAN port shall be connected to a live source. Network links shall be continuously maintained, with the exception of brief lapses when transitioning between link speeds.

3) Ethernet Port Connection Rate: Ethernet ports shall be connected at the maximum supported link rate unless otherwise specified in this test procedure.

4) Ethernet Cabling: All Ethernet cables used for testing shall meet ANSI/EIA/TIA-568 Category 5e (Cat5e) specifications and shall be no shorter than 2 meters in length.

5) Power over Ethernet (PoE): PoE capability shall be configured with default as-shipped settings.

6) Efficient Networking Protocols:

   a. If the UUT supports IEEE 802.3az protocol, all connected devices must support IEEE 802.3az,

   b. If the UUT supports LLDP for 802.3az, all connected devices must support LLDP for 802.3az.

6.3 WIRELESS UUT CONFIGURATION

The UUT shall be tested with wireless network settings in their default as-shipped configuration. Default settings shall not be modified unless modification is necessary to complete this procedure, or if no default setting exists. Any features that require special configuration to achieve intended function (e.g., initial setup before use as indicated in a reference manual) shall be configured per the following requirements. If additional required settings are not listed below, the setting type and option shall be recorded in the test report.

1) SSID: As-shipped, or assigned a random value as required by the UUT;

2) Network Encryption: As-shipped, or 128-bit WPA2 as required by the UUT;

3) Network Key: As shipped, or assigned a random value as required by the UUT;

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4)	Network Channel: A supported channel shall be selected and maintained for the duration of testing;

5)	Interference Mitigation: Interference robustness or other interference mitigation technology shall be as-shipped or set to "ON" if configuration required by UUT.

6)	Wireless Link Precedence:

Note: Tables 4 and 5 reorganize information presented in list for in Revision 2. The content has not been modified.

i)	*Single instantaneous frequency band support*: The first supported wireless standard and frequency band from Table 4 shall be used for access point testing. Only one band shall be active during the test.

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

Wireless Band	Frequency
IEEE 802.11n	5 GHz (2 channels bonded if supported)
IEEE 802.11n	2.4 GHz (single, unbonded channel)
IEEE 802.11g	2.4 GHz
IEEE 802.11b	2.4 GHz
IEEE 802.11a	5 GHz

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

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 (single channel, 5 GHz bonded channels if supported)	IEEE 802.11n	2.4 GHz (single channel, 5 GHz bonded channels if supported)
IEEE 802.11g	2.4 GHz	IEEE 802.11n	5 GHz (bonded channels if supported)
IEEE 802.11g	2.4 GHz	IEEE 802.11a	5 GHz
IEEE 802.11b	2.4 GHz	IEEE 802.11a	5GHz

iii)	*Alternative configurations*: If a device does not support any configuration listed above, the test client shall provide a configuration. The configuration shall be recorded in the test report.

6.4 UUT WIRED NETWORK SETTINGS

The UUT shall be tested with wired network settings in their default as-shipped configuration. Default settings shall not be modified unless modification is necessary to complete this procedure, or if no default setting exists. Any features that require configuration for the UUT to function (e.g., required setup before use as indicated in a reference manual) shall be configured per the following requirements. If additional required settings are not listed below, the setting type and option shall be recorded in the test report.

1) Enable Network Address Translation (NAT) for IPv4 networks;

2) Enable IPv6 Link Local, Neighbor Solicitation, Neighbor Discovery, Router Solicitation and Router Advertisement;

3) Enable Single Class C Subnet;

4) Enable single hop (router TTL + 1) to source on WAN side;

5) Enable DHCP, if available, and have the UUT autonomously assign each configured test client an address by the DHCP service in the router, or manually assign addresses in a manner typical of DHCP (e.g., incremental, 3 day TTL); the WAN port shall be configured via DHCP or manually assigned if DHCP is not supported;

6) Disable Internet Protocol Security (IPsec);

7) Disable features not in compliance with IEEE 802.3 standards;

8) WAN connections and corresponding link speeds shall be selected in the order specified in Table 6 rather than using as shipped default valuesTable 6. If UUT is not capable of the specified link speed, set the UUT to operate at the maximum possible speed.

Table 6: WAN Connection Precedence and Default Link Speeds

	Connection Type	Test Speed Down	Test Speed Up	Media Type
1	DOCSIS (Cable)	12 Mbps	3 Mbps	Coax
2	PON	1 Gbps	1 Gbps	Fiber
3	MoCA	20 Mbps	20 Mbps	Coax
4	DSL	6 Mbps	1 Mbps	Copper (Twisted Pair)
5	HPNA	60 Mbps	60 Mbps	Coax
6	WiMAX (802.16e)	60 Mbps	15 Mbps	Wireless
7	Ethernet (802.3)	1 Gbps	1 Gbps	Copper (Twisted Pair)

6.5 UUT PREPARATION

The UUT shall be configured for testing as follows.

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1) <u>Test Report</u>: Record the manufacturer and model name of the UUT. Record all basic information about the UUT's configuration including, but not limited to, the settings listed Sections 6.1 through 6.4.

2) <u>Network Connection</u>: Connect the UUT to network resources as follows:

   i) *Modem (DSL, Cable, or ONT)*: See Figure 2: Modem setup.

Figure 2: Modem setup.

WAN port selected based on Table 6. Only 1 WAN port connected.
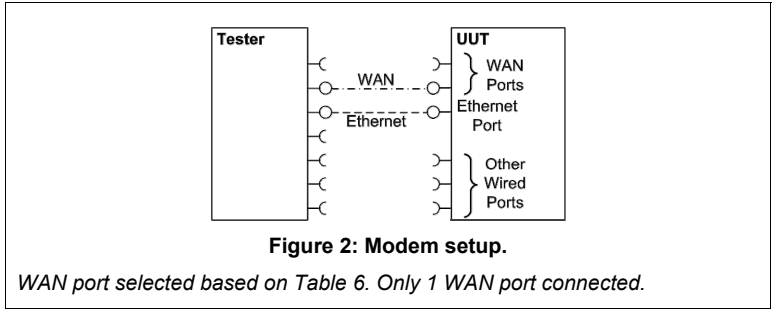
   (a.) Connect the UUT WAN port to the test client at the rate specified in Table 6. If the UUT has multiple WAN connections, select according to the precedence specified in Table 6.

   (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.

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

Figure 3: Switch or router test setup.
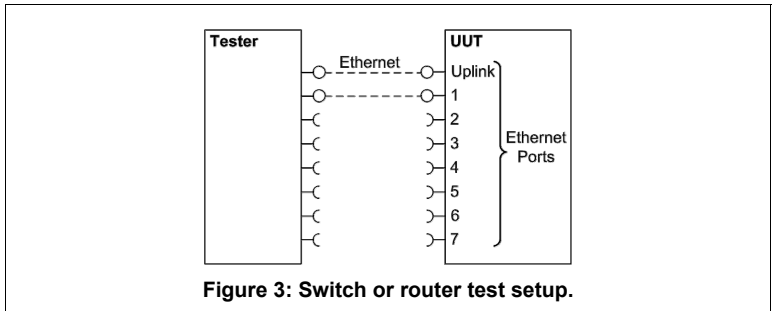
   (a.) Connect two of the UUT's available ports to the test client and ensure that live links are maintained for the duration of testing on all connections.

   (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.

   iii) *IAD or Access Point:*

   (a.) *Access Points*: Connect the uplink Ethernet port to the test source at the highest available link rate and ensure that live links are maintained for the duration of testing.

   (b.) *IADs*: Ensure a WAN port is connected according to the priority outlined in Table 6Table 6 and ensure that live links are maintained for the duration of testing. Connect the first

Ethernet port to the test source at the highest available link rate. Traffic for this test will pass over the Ethernet link and not the WAN link.

(c.) *UUTs with external removable antennas*: (see Figure 4: AP setup with removable antennas shown and Figure 5: IAD test setup for wireless testing with removable antennas)
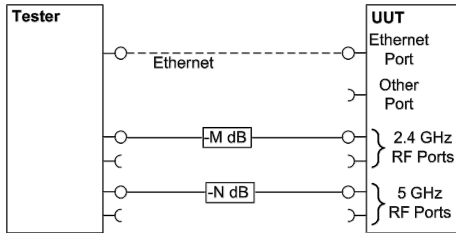
Figure 4: AP setup with removable antennas shown.

Attenuation is set according to Section 6.5.iii). Test configured for 802.11g (2.4 GHz) and 802.11a (5 GHz) with one RF connection required for each to achieve maximum throughput.
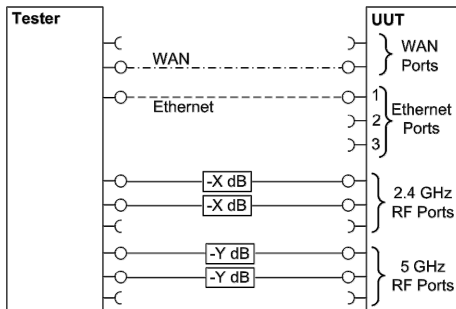
**Figure 5: IAD test setup for wireless testing with removable antennas.**

Use WAN port identified in Table 6 but no data passes over the WAN link. The first Ethernet shall be used for data transfer. Test configured for 2x3 MIMO

(802.11n). Two streams are supported requiring two RF connections for maximum throughput in each band.

(i.) Remove all antennas.

(ii.) Connect an RF coaxial cable to each antenna port. The cable shall be connected through an appropriate RF attenuator to a WLAN client simulator. The attenuation and test client transmit power shall be set such that the received signal strength is -50 dBm ± 3 dB at both the test client and the AP. If received signal strength information is unavailable from the AP and/or the test client, use RF test equipment to determine the appropriate settings.

(iii.) If the AP has multiple antennas for a single band, an appropriate number of cables shall be connected to achieve the maximum supported data rate (i.e., one cable for 802.11a/b/g and ≥1 cable for 802.11n).

(d.) *UUTs without removable antennas*: (see Figure 6: AP setup with fixed antennas)
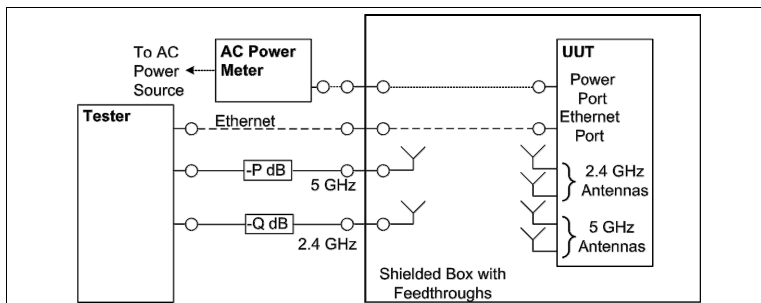
Figure 6: AP setup with fixed antennas.

Attenuation is set according to Section 6.5.iii). Test configured for 802.11g (2.4 GHz) and 802.11a (5 GHz) with one antenna connection required for each to achieve maximum throughput.

(i.) Place the UUT inside a shielded enclosure large enough to fit the UUT without contact with enclosure walls. The enclosure must sufficient have RF, Ethernet, and power feed-throughs to service the UUT.

(ii.) Connect antennas to the RF feed-throughs on the inside of the enclosure.

(iii.) Connect cables to the exterior feed-throughs via appropriate RF attenuators to achieve a signal strength of -50dBm ± 3dB. The test client transmit power shall be set to ensure that the received signal strength at the AP is -50 dBm ± 3 dB. If received signal strength information is unavailable from the AP and/or the test client, use RF test equipment to determine the appropriate settings.

(iv.) If the AP has multiple antennas for a single band, an appropriate number of cables and antennas shall be connected to achieve the maximum supported data rate (i.e., 1 cable/antenna for 802.11a/b/g and ≥1 cable/antenna for 802.11n).

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

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

3) Power Meter Connection:

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

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

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

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

(c.) The power meter shall remain connected until all testing is complete. Deleted: analyzer

6.6 TEST CLIENT SETUP

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

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

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

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

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

5) Configure the test client to transmit variable length packets or frames using the basic IMIX given in Table 7 (see Table 3 for references).

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%

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6) Configure the test client to test in a modified aggregation mode. All traffic will pass over a single link (the uplink or WAN port), and this traffic will be evenly divided between the other connected Ethernet ports. See Figure 7: Data distribution for multilink tests.
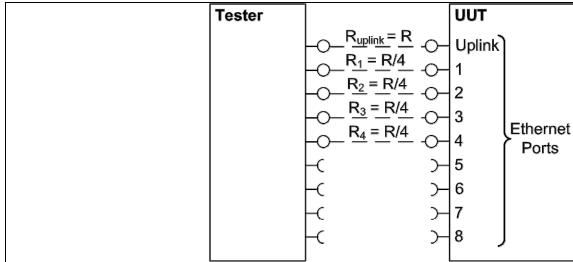
Figure 7: Data distribution for multilink tests.

Half port test case shown. R is the rate specified in the procedure.

7) If the UUT has wireless capability, the test client shall be capable of functioning as a wireless client for the wireless standard(s) specified in Section 6.3.

8) Configure data connections to the test client as specified in Section 6.5.

9) Record the test equipment used for the test client and provide a functional diagram of the test equipment and UUT configuration, including all connections in the test setup.

7   TEST PROCEDURES FOR ALL PRODUCTS

7.1   POWER MEASUREMENT GUIDELINES

Note: Section 7.1 includes updates to the test rate selection information from Rev. 2 based on limited stakeholder feedback.

A) Tests are performed at two data rates, 0.5 kb/s and the highest rate supported by the link shown in Table 8. If the link has asymmetric data rate support, choose the highest rate supported for the direction shown in the table. For data rates higher or lower than those shown in the chart, choose the highest data rate according to Equation 1 and adjusting the variable Y as required to achieve the desired data rate. **Note**: A link with 100 Mb/s raw throughput will not support 100 Mb/s of traffic as specified in this procedure. In this case the traffic rate should be set to 50 Mb/s.

Equation 1

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

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

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

B) If there is

B) a port on the UUT identified as the uplink or WAN port, it shall be selected as the uplink port in Section 7.2.A). 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.

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

1) Reset the power meter (if necessary).

2) Begin recording elapsed time.

3) Set the meter to begin accumulating true power values at a rate of greater than or equal to 1 Hz (1 reading per second).

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

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.

7.2   POWER CONSUMPTION TESTS

Note: EPA has simplified the testing processes based on analysis of the data received from stakeholders using the Rev. 2 test method. Specific notes follow in appropriate testing sections in 7.2.

A) All Devices – Idle

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

2) Measure and record UUT power per Section 7.1.

B) Wired Network – WAN

Note: EPA has simplified the testing process for Wired Network – WAN to collapse the incremental testing present in Rev. 2 into two steps: a midpoint test (step 2) and maximum (step 3).

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.

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.

3) Run data at the maximum data rate supported between the WAN and LAN ports. Measure and record power per Section 7.1.

Wired Network – LAN:

Note: EPA has simplified the testing process for Wired Network – LAN by removing the minimum and maximum port tests.

4) <u>Half-Ports Test</u>: Test with half of ports in use, at all supported speeds, as applicable. See Figure 7: *Data distribution for multilink tests.*

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

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

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

D) Wireless Network – WLAN

Note: EPA has simplified the testing process for Wireless Network – WLAN to collapse the incremental testing present in Rev. 2 into two steps: a midpoint test (step 3) and maximum (step 4).

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

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

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

4) Run data at maximum data rate supported between the LAN port and the WLAN client. Measure and record power per Section 7.1.

8 PERFORMANCE EVALUATION

Performance capabilities shall be evaluated using the tests listed below as applicable to the functions and features of the UUT. UUT configuration shall be as specified in Section 6.

A) <u>Ethernet Throughput</u> - Using a test setup consistent with Section 7.2.A), determine the maximum data rate supported by the UUT for which there is no packet loss. Record this rate as the measured maximum throughput.

B) <u>Maximum Number of Wireless Clients</u> - Using a test setup consistent with Section 7.2.A), determine the maximum number of clients supported by the UUT. Clients shall be evenly split between bands if there is simultaneous dual band support. No data shall be passed other than that required to setup clients. Record this number as the maximum number of wireless clients.

C) <u>Maximum Number of NAT Clients</u>

1) <u>Record</u> the maximum number of supported NAT clients.

Margin deletion markers:

Deleted: Table : Wired Network – LAN: Test Selection¶
UUT Port Configuration   [... [7]]

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<#>Run data at 1000 Mb/s (500 Mb/s in each direction) between the LAN ports. Measure and record the power consumption.¶
¶
<#>Full Ports Tests: Test with all ports used and at all of the following speeds supported by the UUT. ¶   [... [8]]

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2) The addition of downstream switches to the test setup and/or combination of tests similar to Sections 7.2.A) and 7.2.A) may be required to achieve a large number of NAT clients. No data shall be passed other than that required to configure the clients. If an additional switch is required, record the number of wireless NAT and the number of wired NAT clients.

9 REPORTING

9.1 UUT INFORMATION AND FUNCTIONALITY

The following characteristics are recommended for reporting using this procedure:

1. Manufacturer and model name;

2. Basic configuration information;

3. Powering options (e.g., direct ac, external ac-dc power supply, standard low-voltage dc). If powered over Ethernet, whether LLDP for PoE is supported;

4. Number and type of all wired data and network ports. Additional related details (e.g., Ethernet speed, 802.3az, LLDP for 802.3az);

5. Feature activity conflicts;

6. Number and type of wireless network support including supported bands, simultaneous band support, supported standards, and MIMO configuration. Additional details as required;

7. Supported network traffic functions (e.g., firewall, VPN, VOIP functionality for POTS ports);

8. Mass storage options integral to or shipped with the UUT;

9. Any special equipment ratings (e.g., IEC 61850 / IEC61000 and IEEE1613, KEMA).

9.2 REPORTED TEST RESULTS

1. Voltage and frequency used in test;

2. If low-voltage dc, type of supply used;

3. Wireless Link information from Table 4 or Table 5;

4. Any settings changed per Section 6.4;

5. Uplink link rate;

6. Uplink and downlink data rates;

7. Power levels - Report all that apply:

   - One port: Idle, low data rate, high data rate;

   - Half ports: Idle, low data rate, high data rate;

   - Wireless: Idle, low data rate, high data rate;

8. Ethernet throughput - Maximum data rate in UDP data payload (expressed in b/s);

9. Maximum wireless clients;

10. Maximum NAT clients.

<div style="float:right; border:1px solid;">

Deleted: Report if an additional switch was required, the number of wireless NAT and the number of wired NAT clients.

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Deleted: <#>DATA REPORTING REQUIREMENT¶
The test results shall be reported to EPA or the European Commission, as appropriate, taking care to ensure that all required information is included. ¶
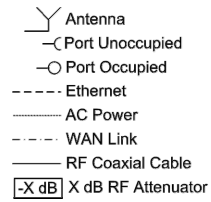**<#>REQUIRED INFORMATION¶**

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</div>

10 TEST CONFIGURATION REFERENCES

Note: With the exception of the legend below, figures have been moved inline into the test method from this section.

Y Antenna
—C Port Unoccupied
—O Port Occupied
– – – – Ethernet
·············· AC Power
– · – · – WAN Link
———— RF Coaxial Cable
-X dB X dB RF Attenuator

Figure 8: Legend for all figures.