

Test Procedures for Measuring Network Standby Power

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TEST PROCEDURES FOR MEASURING NETWORK STANDBY POWER

Prepared by:
Katherine Dayem
Catherine Mercier
Peter May-Ostendorp
Xergy Consulting, Durango, CO USA



xergyconsulting

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1. INTRODUCTION

When the international test procedure for standby power, International Electrotechnical Commission (IEC) 62301, was last revised in 2011, standby functionality in most products consisted only of “traditional” standby functions such as indicator lights, infrared remote controls, and clocks. Since then, many secondary functions, perhaps most dominantly network connectivity, have become prevalent in many types of end-use products.

Several testing guidelines, including guidance provided with the European Union (EU) Ecodesign standby regulation 1275/2008 Amendment 801/2013, the EU Code of Conduct (CoC) for Broadband equipment, and ENERGY STAR certification test methods, have built upon IEC 62301 with additional instructions on product setup and test conditions, particularly for network connections and the network standby state. These methods offer some basis for building a harmonized network standby test procedure, but they also present some conflicts and gaps.

This paper examines elements of existing test procedures that address network standby in some way. This includes horizontal test procedures that cover standby and network standby for a wide range of products, as well as product-specific procedures where network functionality is a common or essential feature of the product. We focus on test procedures for consumer electronics and appliances¹ that include guidance on for collecting power measurements of low power modes in which the network standby function is available. In addition to briefly summarizing the key elements of each test procedure, we identify areas of agreement and conflict between the various procedures, identify gaps, make recommendations to improve network standby test methods, and highlight actions and implications for policy makers.

2. KEY ELEMENTS OF A NETWORK STANDBY TEST PROCEDURE

The goal of any test procedure is to provide enough guidance to yield **repeatable** and **reproducible** results within a **reasonable** burden (time, effort, equipment) on the tester. A test is repeatable if the same result within measurement error is obtained when tested by the same person, in the same laboratory, with the same equipment. A test is reproducible if the same result within measurement error is obtained by different people, in different laboratories, with different equipment. In addition, policymakers are often interested in **representative** measurements that reflect a product’s energy use in the real world, as long as the representativeness does not negatively impact repeatability, reproducibility, or cause unreasonable burden.² Together, these characteristics (repeatable, reproducible, representative, reasonable) comprise the “4Rs” of test procedures that can help evaluate the sufficiency of a given procedure.

¹ Note that the focus is more so on edge devices than network products such as modems and routers.

² In some situations, policymakers intentionally forgo representativeness if it allows simplified rulemaking and testing, however further work in this area might improve representativeness.

To measure power of an electronic product or appliance, the tester requires guidance on how to control the test environment, how to prepare the product for testing, and how to make the repeatable, reproducible power measurement. For the purposes of discussing network standby power measurements in particular, we separate the key elements of a network standby test procedure into three categories, carried out sequentially (Figure 1):

- **General test requirements:** address ambient conditions in the measurement laboratory, measurement accuracy, and how to set up the product for testing (except for network connections).
- **Network set-up instructions:** product mode of operation, if applicable, and product and network configuration requirements including which network technology to enable for testing, and how that connection is made.
- **Power measurement guidance:** specifies data collection methods including how to determine stability, how long to collect data, and how to calculate average power.

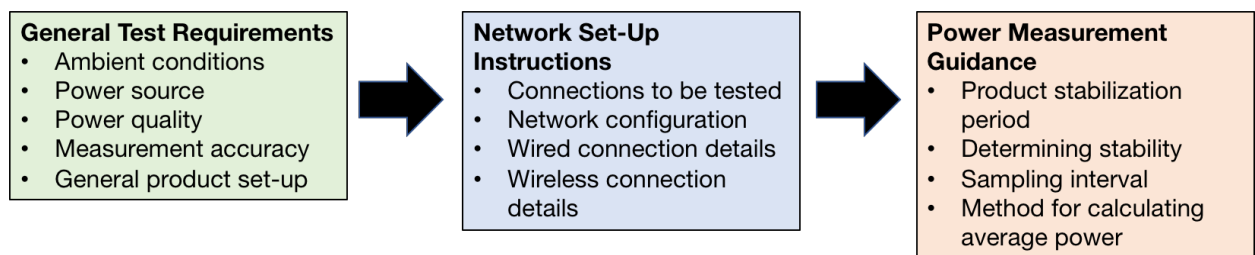


Figure 1: Key elements of a complete network standby test procedure.

In the discussion below, we review test procedures for these three key elements, note any specific detail that may impact the repeatability or reproducibility of the test, and any gaps.

3. TEST PROCEDURE OVERVIEW

We reviewed more than 15 test procedures that have guidelines for testing network standby. Three of these are horizontal test procedures that apply to low power operational states for a wide range of products. The remaining procedures apply to specific products and generally contain measurement instructions for all operational modes for the product in question. For these vertical test procedures, we examine testing guidelines for the low power modes that include network standby functionality, defined as a state in which a product maintains a network connection and awaits a network “trigger” or message to be woken as needed (IEA EDNA 2018). We do not examine the active mode testing guidelines contained in these test procedures.

Test procedures that provide relevant guidance on testing network standby power are summarized in Table 3 below. We introduce the test procedures below, and provide additional details in the Appendix.

HORIZONTAL NETWORK STANDBY TEST PROCEDURES

Horizontal test procedures that address network standby are crafted to apply to a wide range of products. They are designed to be referenced by other test procedures or standards, and consequently tend to be more general than product-specific procedures. Three horizontal test procedures provide guidance for collecting network standby power data (Table 1).

Table 1: Horizontal test procedures that address measurement of standby and network standby power

Test Procedure	Description
IEC 62301:2011	International test procedure for standby and network standby power measurement of appliances and electronic products.
EN 50564:2011	European version of IEC 62301:2011, which includes some EU-specific conditions (e.g., input voltage), but for the purposes of this discussion is equivalent to IEC 62301:2011.
EN 50643:2018	New European test procedure specifically addressing network standby power measurement.

Most of the test procedures reviewed reference IEC 62301:2011 for two of the key test procedure elements (Figure 1): general test set-up and power measurement guidance, some with slight modifications or additions. EN 50643:2018 addresses the third element, network set-up instructions. These include:

- The product under test is connected to a local area network (LAN) via a router or access point, but the LAN is not connected to a wide area network (WAN).
- Manufacturer data reporting requirements for each network connection: time to enter network standby state, reactivation trigger, maximum data rate, communication protocol, radio frequency.
- Measure each type of network connection with the others disconnected (if wired) or disabled (if wireless).³ For example, if the product has both Ethernet and Wi-Fi technology, two tests are required: one with Ethernet connected and Wi-Fi disabled, and one Wi-Fi enabled and Ethernet disconnected.
- Network connection is made on product’s maximum link rate.
- Ethernet connections: use 10 meter long Ethernet cable.
- Wi-Fi connection: router and product are placed 1 to 5 meters apart. Wi-Fi beacon is on.
- Bluetooth connection: peripheral and product are placed 0.6 to 1 meter apart.

Together IEC 62301:2011/EN 50564:2011 and EN 50643:2018 address the main components of a network standby test procedure. Upon examination of product-specific test procedures (discussed below), some potential gaps remain, including:

³ This approach simplifies setting of minimum efficiency performance standards (MEPS) or other targets by because data collected (and therefore targets) are based on network technology only, and not the number of ports of each technology. In addition, products with multiple ports of the same network connection type are effectively encouraged to power manage unused ports to low power states to meet the target. This situation may not, however, represent how the product is used in the real world, where the product could be used with multiple network connections.

- Guidance for testing direct current (DC) powered products less than 100 V.
- Test conditions for wireless network connections other than Wi-Fi and Bluetooth (e.g., Zigbee, Z-wave).
- Data link rate (between product and router or access point).
- Radio frequency (if wireless).
- Requirements for the connected router or wireless access point, for example:
 - Requiring the same efficient networking protocols that the product under test utilizes, such as IEEE 802.3az (Energy Efficient Ethernet (EEE)) or Link Layer Discovery Protocol (LLDP).
 - Requiring that the router or access point supports the maximum link rate of the product.
- Network security requirements (e.g., setting up network name or service set identifier (SSID) and Wi-Fi Protected Access (WPA2) passcode prior to test).

These gaps leave the tester to use his or her best judgment in setting up the test. The degree to which different set-up conditions impact measured network standby power is unknown, and needs further investigation.

NETWORK STANDBY IN VERTICAL TEST PROCEDURES

In addition to the horizontal test procedures reviewed above, we examined several vertical test procedures that address network standby in some fashion (Table 2). Because they address one specific product type, vertical test procedures can be more prescriptive and more specific than horizontal ones, but may not be transferrable to other products. As noted above, they often reference IEC 62301:2011 for general set-up and power measurement guidance. Therefore we focus on network connection set-up instructions contained in vertical test procedures that address network standby to some degree, and evaluate whether or not these instructions could be applied horizontally to a broad range of products.

Table 2: Product-specific test procedures that provide guidance for measuring network standby

Product Type	Test Procedure
Network equipment	ENERGY STAR Small Network Equipment Test Method EU Code of Conduct on Energy Consumption of Broadband Equipment
Audio/Video	IEC 62087 US DOE TV Test Procedure ENERGY STAR TV Test Method Korea Regulation on Standby Power Reduction Program
Computers	IEC 62623 ENERGY STAR Computers Test Method
Lighting	US DOE Test Procedures for Lighting Products ENERGY STAR Test Methods for Incandescent Replacement Lamps
Other Electronics	ENERGY STAR Test Methods for Imaging Equipment and Displays ENERGY STAR Connected Thermostats Test Method

In some cases, these product-specific test procedures present agree with horizontal test procedure EN 50643:2018 described above. In other cases, they provide conflicting or additional network requirements. We highlight these similarities and differences in Table 3. For each test procedure, we note whether it addresses various test procedure conditions, and if so note how in the right-hand column. The reader may refer to the Appendix for more details on each test procedure.

As shown in Table 3, network set-up instructions vary widely and provide requirements for different aspects of network connection set-up. For example, where one test procedure may contain several requirements for setting up a wireless network connection, other procedures may not specify anything beyond establishing the connection. Test procedures actually conflict each other in a few aspects, including:

- **Whether or not the product tested is connected to a live WAN.** Test procedures for network equipment require a live WAN connection, but other vertical procedures and horizontal procedures require the LAN not be connected to a WAN.
- **Which network connections are tested.** Both EN 50643 and ENERGY STAR's test method for SNE require all network connection types to be tested. Some product specific test procedures require testing of only one type of connection, picked from a prioritized list.
- **State of untested ports or technologies.** Most test procedures do not include requirements for untested ports or technologies. The exceptions are EN 50643 and IEC 62623, which specify that untested network ports are deactivated, disconnected, or unpowered.
- **Length of Ethernet cable for wired connections.** EN 50643 and the EU Code of Conduct for Broadband equipment specify a length of 10 meters, whereas the ENERGY STAR SNE test method requires 1 to 2 meters.
- **Frequency of wireless connections.** ENERGY STAR's test method for SNE provides a prioritized list of the connection tested, generally prioritizing higher frequencies. IEC 62087 requires testing using both 5 GHz and 2.4 GHz, if available in the product.
- **Distance between product under test and router or connected product:** EN 50563 requires a Wi-Fi connected product to be 1 to 5 meters from its connected router during the test, and a Bluetooth connected product to be 0.6 to 1 meter from the connected product. Other test procedures, including IEC 62087 and ENERGY STAR test methods, describe this distance qualitatively as "in vicinity" or "in close proximity."

The test procedures reviewed do, however, offer methods to fill the gaps in EN 50643:2018 outlined above, in particular:

- Requirements to connect at the product's maximum data link rate;
- Specifying radio frequencies tested for wireless technologies;
- Requirements for the connected router or access point to possess the same efficient networking protocols and support the maximum link rate of the product under test;
- Specifying network security requirements.

The product-specific test procedures do not address other gaps such as test conditions for low-voltage DC powered products and less prevalent or emerging wireless technologies.

Table 3: Conditions addressed by of applicable test procedures

Note: Test procedures are referred to by **bold type** alphabetic ID in line 2. A “√” represents the inclusion of a condition in a test procedure. A **bold type** letter indicates reference to the procedure with that ID. “O” indicates reference to a product-specific test procedure whose review was beyond the project’s scope. Row colors correspond to key test procedure elements illustrated in Figure 1.

Procedure Scope	Horizontal		Network Equipment		Audio/ Video		Com-puters		Other		
Procedure ID	A	B	C	D	E	F	G	H	I	J	
Procedure	IEC 62301/ EN 50564	EN 50643	ENERGY STAR SNE	EU CoC for Broadband	IEC 62087	US DOE	IEC 62623	US DOE	ES Imaging & Displays	ES connected thermostats	
Procedure element											Specifications
General set up	√	A	A	O	A	E	√	O	A	A	Most test procedures reference IEC 62301, some with additional ambient condition constraints or power meter requirements. Additional instructions include test in as-shipped configuration (C), and enrolling in applicable services and update to latest version of firmware (J).
Network set up, general											
WAN connection		√	√	√	√	√	√				Network equipment procedures (C,D) require live WAN connection. Horizontal and all other product specific procedures require no WAN connection (E,F) or state it "need not" be connected (G).
Manufacturer data reporting		√									Requires information reported for each network connection (time to network standby, reactivation trigger max data rate, communication protocol, radio frequency) (B).
Network connections tested		√	√		√	√			√		Two approaches: test each connection present (B,C), or test one connection from a prioritized list (E,F,I)
Untested ports/ technologies		√	√				√				One procedure specifies that untested network ports are deactivated if wireless, and disconnected if wired (B). One procedure specifies that non-network connections are not made unless a peripheral and it's attaching cable are shipped with product (C). Specifies no power to wireless radios or other network technologies during wired test (G).
OSI layer					√				√		Connect via address layer of protocol (E,I)
Link rate			√								Connect via the maximum link rate (C).
Data traffic rate			√	√							One procedure specifies traffic rate of 1 kb/s sent evenly up and down over user datagram protocol (UDP) (B). One procedure specifies no traffic except minimal handshakes (D).

Procedure Scope	Horizontal		Network Equipment		Audio/Video		Computers		Other		
Procedure ID	A	B	C	D	E	F	G	H	I	J	
Procedure	IEC 62301/ EN 50564	EN 50643	ENERGY STAR SNE	EU CoC for Broadband	IEC 62087	US DOE	IEC 62623	US DOE	ES Imaging & Displays	ES connected thermostats	
Procedure element											Specifications
Network setup, wired connections											
Cable type			✓		✓				✓		Specify Category 5e or better Ethernet cable (C,E,I)
Cable length		✓	✓	✓							Two different lengths specified: 10 m (B,D) and 1-2 m (C).
Requirements of connected router or switch			✓		✓		✓		✓		Supports IEEE 802.3az if product under test does (C,E,I). Supports LLDP if product does (C). Supports IEEE 802.3 (E). Supports highest and lowest speeds that the product does (E). Supports highest speed supported by product (I). Support power management functions provided by the product, including IEEE 802.3az (G).
Network setup, wireless connections											
Link configuration			✓		✓			✓			SSID, network encryption, network key: as shipped or required by product, configured for highest link rate (C). Establish through TV menu system, configure SSID with WPA2 passcode, run over mixed g/n/ac network (E). Connect according to manufacturer instructions, configure lamp in standby mode by sending signal to lamp for no light output. Lamp remains connected for test (H).
Frequency			✓		✓						Two approaches: prioritized list, generally higher frequency prioritized (C), or use both 5 GHz and 2.4 GHz bands (E).
Distance from router or connected product		✓			✓				✓		Quantified distance: Wi-Fi 1-5 m, Bluetooth 0.6-1.0m (B). Qualitative distance: "in vicinity" (E), or "in close proximity" (I).
Requirements of connected router or access point					✓				✓		Compatible with IEEE 802.11-2007, configured with SSID and secured with passcode WPA2 (C). Support highest speed supported by product (I).
Beacon state		✓									On (B).

Procedure Scope	Horizontal		Network Equipment		Audio/ Video		Com-puters		Other		
Procedure ID	A	B	C	D	E	F	G	H	I	J	
Procedure	IEC 62301/ EN 50564	EN 50643	ENERGY STAR SNE	EU CoC for Broadband	IEC 62087	US DOE	IEC 62623	US DOE	ES Imaging & Displays	ES connected thermostats	
Procedure element											Specifications
Power measurement	✓	A	✓	O	A	A	A	A	A	A	Except for network equipment procedures, reference IEC 62301.

Addition test procedures reviewed but not included above: ENERGY STAR Test Methods for TVs, computers, and incandescent replacement lamps generally utilize the corresponding US DOE test method. Of the 22 products addressed by the Korea Regulation on Standby Power Reduction Program, only TVs and set-top boxes have network standby test requirements, for which IEC 62301:2011 is referenced. For brevity, these test procedures are not included in this table.

4. REMAINING GAPS AND RECOMMENDATIONS

Based on the information gathered from reviewing the test procedures, we have identified differences and potential gaps. An important question, and one that cannot be answered through literature review alone, is which of these potential gaps need to be filled in order for the test procedure to produce repeatable, reproducible, and representative results, as discussed in Section 2. For example, Wi-Fi radio frequency can impact a product's power draw. For a product that supports both 2.4 and 5 GHz, if network standby power is significantly different if the product uses 2.4 GHz versus 5 GHz, then frequency should be specified by the test procedure to ensure fair comparisons across tests. On the other hand, if at the low data rate of network standby, frequency does not impact power draw within measurement error, it need not be specified.

To our knowledge, no systematic study of power draw sensitivity to the range of network standby test conditions has been conducted. Lacking that, we look to the contents of the test procedures to develop a preliminary list of gaps:

- Guidance for testing direct current (DC) powered products less than 100 V.
- Test conditions for wireless network connections other than Wi-Fi and Bluetooth (e.g., Zigbee, Z-wave).
- Data link rate (between product and router or access point).
- Data traffic levels during the test.
- Radio frequency (if wireless).
- Requirements for the connected router or access point, for example
 - Requiring the same efficient networking protocols that the product under test utilizes, such as IEEE 802.3az (Energy Efficient Ethernet (EEE)) or Link Layer Discovery Protocol (LLDP).
 - Requiring that the router or access point supports the maximum link rate of the product.
- Network security requirements (e.g., setting up SSID and passcode prior to test).

The recent release of EN 50643:2018 is a step toward a horizontal network standby test procedure that can be used across jurisdictions. However, given the remaining differences in network set-up instructions with other existing test procedures, policymakers should view this document as a step toward a network standby test procedure rather than the end result. Questions remain about conditions that are either not prescribed in any existing procedure, such as how to test low-voltage DC products, or those that are included in a small number of procedures but conflict, such as Wi-Fi radio frequency. If those conditions impact network standby power, then they should ultimately be prescribed in a network standby test procedure to ensure that it is repeatable, reproducible, and achieved for a reasonable test burden. Standards development bodies policymakers should work together to gather and share information on how network set-up conditions impact network standby power. This includes funding research and sensitivity testing, sharing results, and ultimately developing an international standard.

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6. APPENDIX

This appendix contains details on the reviewed test procedures, organized by into the three key elements (Figure 1).

HORIZONTAL NETWORK STANDBY TEST PROCEDURES

IEC 62301:2011

The international test procedure IEC 62301:2011 is a horizontal, foundational procedure that provides general test requirements and power measurement guidance for low power modes, including “network mode” (noting that this is dealt with primarily in an informative annex). It is referenced by most of the test procedures reviewed in this study for either general set-up requirements, power measurement guidelines, or both. It does not include network set-up instructions.

General test requirements

- Ambient conditions: Specifies maximum air speed near the product, ambient temperature range, and ambient light conditions (applies only to products with light sensors).
- Power source and quality: Specifies voltage and frequency to supply the product under test. Ensures the power supplied is “clean,” with little harmonic content.
- Uncertainty: Sets permitted uncertainty levels based on the size of the load under test.
- Product preparation: Set up according to manufacturer instructions, and to default settings if no instructions available. For products with rechargeable batteries, ensure they are not charging during the test by removing or fully charging.

Network set-up instructions

- None.

Power measurement guidelines

- Provides data collection methods for stable, cyclic, and unstable loads.
- Recommended method in most cases is the “Sampling method” for stable, cyclic, or unstable loads.
 - Record power, voltage, current, and other necessary parameters at intervals 1 sec or less.
 - Test conducted over at least 15 min. Discard first 3rd of measurement period, determine stability from data recorded in last 2/3rd of measurement period.
 - Gives guidelines for determining stability.
 - If stability not achieved in 15 min, extend test until it is up to 3 hours.
 - For cyclic loads, measure at least 4 cycles.
 - For unstable or irregular cycles, collect enough data to characterize the behavior (recommend min 10 cycles).

EN 50564:2011

The European Union's EN 50564:2011 is derived from IEC 62301:2011, with some EU-specific details like input voltages. It contains no significant differences from IEC 62301 regarding set up and testing of network standby power.

EN 50643:2018

Released this year, European Union's EN 50643 specifies methods of measurement of electrical power consumption in networked standby and the reporting of the results for edge equipment. It builds on EN 50564:2011 by providing guidance on how to set up network connected products.

General test requirements

- References EN 50564:2011.

Network set-up instructions

- **Manufacturer data requirements:** Requires manufacturer to provide information about each wired and/or wireless connection the product can make, such as the amount of time the connection remains active until it automatically powers down to networked standby, the type of trigger that can reactivate the product, the maximum data rate, the communication protocol used, and the radio frequency or other wireless characteristics. Manufacturer must also provide product information such as whether or not it has power management, and instructions for activating and deactivating each network connection.
- **Testing requirements:** One test conducted per network connection type.
- **Test conditions:** Approach is to restrict influence of external factors. Reactivation trigger is initiated within local area network, which is not connected to a wide area network unless the product requires such a connection. Ports other than that under test are deactivated (wireless) or disconnected (wired). Connect to appropriate equipment to form the network configuration for the test. If more than one type of reactivation trigger is available, determine which results in highest networked standby power and test.
- **Wired connection requirements:**
 - WAN: TCP/IC link established, synchronized, and operating under normal conditions.
 - LAN: Cable length 10 m \pm 0.5 m, all ports active, link established at maximum rate.
 - Powerline Communication: PLC active with user traffic, no other devices on the power line.
 - HDMI: Cable length 2 m \pm 0.2 m, cable type (standard or high speed) as specified by manufacturer, cable connected according to HDMI specification of the product's version.
- **Wireless connection requirements, Wi-Fi:**
 - Product 1 - 5 m from and in same room as connected wireless router.
 - No other products connected to the router or creating interference in the product's frequency band.
 - Beacon on.
 - One Wi-Fi client associated. For 802.11g and a, the client isn't specified. For 802.11n and ac, the client is 802.11n.
- **Wireless connection requirements, Bluetooth:**

- Connected device is 0.6 - 1.0 m from the product under test, connected according to the Bluetooth version specification of the product under test.

Power measurement requirements

- References IEC 62301 for power measurement guidance.

VERTICAL TEST PROCEDURES

ENERGY STAR SNE Test Method

ENERGY STAR's test method for small network equipment (SNE) provides highly prescriptive network set up instructions for residential and small commercial network equipment. The test method is used to test qualification for ENERGY STAR's SNE specification. The test method requires testing the equipment in a variety of states defined by network traffic, including a low data rate state in which the network standby function can be present.

General test requirements

- References IEC 62301 for general test requirements with additional requirements for ambient temperature, relative humidity, input voltage, and power meter attributes.
- Products tested in their "as-shipped" configuration.
- Products with rechargeable batteries to be fully charged.

Network set-up instructions

- Data rate: 1 kb/s, sent evenly up and down in a variety of frame sizes at random intervals over user datagram protocol UDP.
- Each wired and wireless technology present in the product is tested one at a time, with the other technologies present disconnected.
- Wired connection configuration:
 - Peripheral devices: Non-Ethernet wired connections are not made, unless a secondary device and cable are shipped with the product (e.g., an external disk with a USB connection).
 - Network link maintenance: The product's WAN is connected to a live source and the link is maintained continuously.
 - Ethernet port connection rate: Ethernet ports are connected at their maximum supported link rate.
 - Ethernet cabling: Use Category 5e Ethernet cables that are 1-2 meters.
 - Efficient Networking Protocols:
 - If the UUT supports IEEE 802.3az protocol, all connected devices must support IEEE 802.3az.
 - If the UUT supports LLDP for 802.3az, all connected devices must support LLDP for 802.3az.
 - For wired WAN connections: connect one Ethernet port at its highest supported link rate.

- For wired LAN connections: test with half the ports in use.
- Wireless network connections:
 - SSID: As-shipped, or assigned a random value as required by the product.
 - Network encryption: As-shipped, or 128-bit WPA2 as required by the product.
 - Network key: As shipped, or assigned a random value as required by the product.
 - Network channel: A supported channel shall be selected and maintained for the duration of testing.
 - Interference mitigation: Interference robustness or other interference mitigation technology as-shipped or set to "ON" if configuration required by the product.
- Wireless link precedence:
 1. IEEE 802.11ac @ 5 GHz
 2. IEEE 802.11n @ 5 GHz
 3. IEEE 802.11n @ 2.4 GHz
 4. IEEE 802.11g @ 2.4 GHz
 5. IEEE 802.11b @ 2.4 GHz
 6. IEEE 802.11a @ 5 GHz

Power measurement requirements

- References IEC 62301 for power measurement guidance.

EU Code of Conduct on Energy Consumption of Broadband Equipment

The EU Code of Conduct (CoC) for broadband equipment includes equipment-specific test procedure instructions that draw largely on European Telecommunications Standards Institute (ETSI) standards for measuring power in wired and wireless network equipment. The CoC covers consumer premises equipment like gateways, modems, and access points, as well as network infrastructure equipment that is beyond the scope of this project. The CoC contains some instructions for setting up WAN and LAN Ethernet connections, but not for wireless connections. It does not reference IEC 62301.

General test requirements

- ETSI standards.

Network set-up instructions

- WAN equipment:
 - Make 1 idle WAN connection with a link established and ready, but no user traffic.
 - A LAN port is available with physically and logically established link to a client with a 10 m Ethernet cable. No user traffic between product under test and client except minimal handshakes.
- LAN equipment is set up using the LAN port method above.

Power measurement requirements

- ETSI standards.

IEC 62087

IEC 62087 is the international test procedure for audio, video and related equipment such as TVs and computer monitors. The network standby mode of interest is standby-active, low. The test procedure provides network connection set up instructions, and references IEC 62301 for the power measurement.

General test conditions

- Specifies ambient temperature, power source & quality specifications, measurement uncertainty.

Network set-up instructions

- The procedure calls for one network connection to be tested, prioritizing Wi-Fi over Ethernet.
- Specifies how to connect the product to the LAN (via address layer of protocol). The LAN is not connected to a WAN.
- Wired network connections:
 - Use category 5e or better Ethernet cable.
 - Connect product to an Ethernet switch or router that supports IEEE 802.3, supports IEEE 802.3az (Energy Efficient Ethernet) if the product does, and supports the highest and lowest data speeds that the product does.
 - An initial connection between product and router or switch is established for the test.
- Wireless network connections:
 - Connect product to Wi-fi access point compatible with IEEE 802.11-2007. Not connected to WAN.
 - Establish through product's menu system.
 - Access point in vicinity of product, and configured with SSID named with 4 characters and secured with 13 character WPA2 passcode run over mixed g/n/ac network running on both 5 GHz and 2.4 GHz frequency bands, channel set to auto. Default settings for other options.

Power measurement guidelines

- IEC 62301.

DOE TV Test Procedure

The US DOE TV test procedure requires measurement of standby-active, low mode, which is analogous to networked standby. It provides some guidelines on network connection to be tested, lacks detailed setup instructions on how to do so. References the international test procedure for TVs, IEC 62087 for most product test conditions and measurement procedures. References IEC 62301 for the standby-active, low mode measurement.

General test conditions

- IEC 62087-3.
- States that network connections should be listed in the user manual, and if none are specified, verify that the TV does not have network capabilities by checking for the absence of physical connections and the absence of network settings in the menu.

Network set-up instructions:

- Connect the TV to a LAN which allows devices to ping other devices on the network but will not allow access to a WAN.
- If the TV has multiple network connections it is configured and connected to a single network source via the following hierarchy:
 1. Wi-Fi (IEEE 802.11-20072)
 2. Ethernet (IEEE 802.3). If the TV supports Energy Efficient Ethernet (IEEE 802.3az-20103), then it shall be connected to a device that also supports IEEE 802.3az.

Power measurement guidelines

- IEC 62301.

ENERGY STAR TV Test Method

The ENERGY STAR Test Method for TVs references the DOE test procedure for TVs for all aspects of the test.

IEC 62623

IEC 62623 is the international test procedure for computers. It provides network connection guidelines, and references EN 50564 to test the applicable network standby mode: sleep with WoL enabled.

General test conditions

- Provides power meter specifications and accuracy requirements.

Network set-up instructions

- Wired network connections:
 - Connect to active network switch that supports highest link supported by computer. The switch need not be connected to WAN.
 - Make one connection even on computers with multiple network connections.
 - Switch must support power management functions provided by computer, for example EEE.
 - No power to wireless radios or other network devices during the test (e.g., Wi-fi, Bluetooth).
- Wireless network connections:
 - Maintain live connection to wireless router or access point which supports highest and lowest data speeds of client radio.

Power measurement

- EN 50564.

ENERGY STAR Computers Test Method

The ENERGY STAR test method for computers calls on IEC 62301 (with additional requirements for ambient temperature, relative humidity, input voltage, and power meter attributes) for general set up conditions. It references IEC 62623 for network specific set up instructions, and power measurement guidelines.

US DOE Test Procedures for Lighting Products

The US DOE has test procedures for integrated CFLs, integrated LED lamps, and non-incandescent GSLs to verify compliance with efficiency standards. The mode of interest is standby mode with network connection established, which is the mode entered by using the network connection to set lamp output to zero. ENERGY STAR test methods for incandescent replacement lamps follow the US DOE test procedures.

General test conditions

- Applicable industry lighting test procedure (IES LM-66 and IES LM-79-08 for CFL and LED lamps, respectively), with additional constraints for ambient temperature, input voltage and power.

Network set-up instructions

- Connect the lamp to the manufacturer-specified wireless control network (if applicable) and configure the lamp in standby mode by sending a signal to the lamp instructing it to have zero light output.
- Lamp must remain connected to the network during testing.

Power measurement guidelines

- IEC 62301.

ENERGY STAR Test Methods for Other Electronics

Other ENERGY STAR test methods that address testing networked equipment include imaging equipment and displays. The test methods for these products have similar key elements.

General test conditions

- IEC 62301 Ed. 2.0 with additional requirements for ambient temperature, relative humidity, input voltage, and power meter attributes.

Network set-up instructions

- Test one network connection if more than one present from prioritized list.

- For Ethernet, use a category 5e or better cable.
- All data and network cables and routers must support the highest and lowest data speeds of the product's interface.
- Products capable of supporting IEEE 802.3az shall be connected to a switch or router that also supports IEEE 802.3az.
- Includes configuration requirements for the address layer of the protocol.
- Wireless products are connected in close proximity to the appropriate router or computer.

Power measurement guidelines

- IEC 62301.

ENERGY STAR Connected Thermostats Test Method

Connected thermostats test method includes a test for network standby power, which is a state where the connected thermostat is installed and interconnected, with no direct or remote user interaction, and has entered a low power state.

General test conditions

- IEC 62301.
- Enroll in applicable services (like apps).
- Update to the latest version of firmware.

Network set-up instructions

- Verify ability to control the device over the communication link, then close all apps and web interfaces.
- Ensure that the thermostat enters and remains in network standby mode for the duration of the test (e.g. no additional device user interactions, ensure occupancy sensing device doesn't detect occupancy, ensure apps and/or web remote interfaces remain closed).

Power measurement guidelines

- IEC 62301.

Korea Regulation on Standby Power Reduction Program

Korea regulates standby power of 22 product types. Two of these products, TVs and STBs have "active standby mode," in which product can be woken with external signal, including from a network. Each product within the regulation is addressed individually, essentially providing 22 vertical standards for standby power. The regulation references IEC 62301 for standby mode testing, with additional instructions for each product. These instructions generally give guidelines for how long the product should be powered before starting the test, the method for getting the product into sleep mode, and method to calculate average power. No instructions on how to set up the connections are given, however.