

This initial draft of CTA-2037-C has not been reviewed by TV manufacturers. It is meant to document the test method proposed by NEEA and Pacific Crest Labs so that TV manufacturers may consider it.

Delete revision table before publishing

2037-C revision	Description
v1 – Dave Wilson, 11/2/20	Initial draft sent to PCL
v4 – Gregg Hardy, 11/14/20	Initial PCL revision
v5 – Gregg Hardy, 11/19/20	Updated cam distance reqmt. Added note about HDR10 PPS.
v6 – Gregg Hardy, 11/22/20	Updated notes. Changed to require same LAN/WAN/casting/speaker conditions for On and Standby tests. Removed unused definitions and acronyms.
v7 – Gregg Hardy, 12/2/20	Removed manual settings check. Updated network requirements to require WAN/LAN for all testing. Reorganized a bit.
V8 – Ben Hardy, 1/20/21	Updated wake time measuring and reflective card placement procedures.
V9 – Ben Hardy, 1/29/21	Changes to: 8.11.1 (mobile device & UUT on same WAN)
V10 – Gregg Hardy, 2/24/21	Updated 8.8.2 (identify PPSs)
V11 – Gregg Hardy, 2/24/21	Updated Annex A to remove old references.

Note from Gregg (PCL): I've included several note boxes like this throughout the document. Sometimes to pose questions, sometimes to explain content. My thought is that these will be deleted before publication.

CTA Standard Template

Doc. Number: CTA-2037-C

Date: 2/24/2020

Document Title: Determination of Television Set Power Consumption and Average Luminance

For further information:

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FORWARD

This standard was developed by the Consumer Technology Association's Video Systems Committee (R4).

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Determination of Television Set Power Consumption and Average Luminance

1 SCOPE

This standard defines a method for measuring television set power consumption and luminance. It is intended for television sets powered from an external source. Television sets with a non-removable main battery are excluded.

2 REVISION HISTORY

CTA-2037-B

This revision was intended to add persistence rules.

CTA-2037-C

The purpose of this revision is to add requirements to:

- measure screen-average dynamic-luminance with a camera photometer in SDR default, SDR brightest, and HDR10 preset picture settings,
- perform ABC tests using an overhead, LED ambient light source,
- measure standby power in an environment where streaming apps are polling for devices capable of receiving audio or video casting content, and
- measure standby power with leading smart speakers configured to wake the UUT.

3 REFERENCES

3.1 Normative References

The following standards contain provisions that, through reference in this text, constitute normative provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed here.

3.1.1 Normative Reference List

- [CIE](#) (1932) proceedings, *CIE 1931 luminosity function*
- ISO/CIE 19476:2014, *Characterization of the performance of illuminance meters and luminance meters*
- IEC 62087-1: 2015, Audio, video, and related equipment - Determination of power consumption - Part 1: General
- IEC 62087-2: 2015, Audio, video, and related equipment - Determination of power consumption - Part 2: Signals and media

- IEC 62087-3: 2015, Audio, video, and related equipment - Determination of power consumption – Part 3: Television sets
- IEC 62301:2011, Household electrical appliances - Measurement of standby power

3.1.2 Normative Reference Acquisition

- IEC Standards:
 - Global Engineering Documents, World Headquarters, 15 Inverness Way East, Englewood, CO USA 80112-5776; Phone 800-854-7179; Fax 303-397-2740; Internet <http://global.ihs.com>; Email global@ihs.com
 - IEC Central Office, 3, rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland; Phone +41 22 919 02 11; Fax +41 22 919 03 00; Internet <http://www.iec.ch>; Email pubinfor@iec.ch
- Commission Internationale de l'Eclairage (CIE) proceedings, Cambridge: [Cambridge University Press](#)

3.2 Informative References

The following references contain provisions that, through reference in this text, constitute informative provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

3.2.1 Informative Reference List

- HDMI Specification

3.2.2 Informative Reference Acquisition

- HDMI: <http://www.hdmi.org>; <http://en.wikipedia.org/wiki/HDMI>

4 COMPLIANCE NOTATION

CTA defines the following compliance terms for use in its documents:

shall	This word indicates specific provisions that are to be followed strictly (no deviation is permitted).
shall not	This phrase indicates specific provisions that are absolutely prohibited.

should	This word indicates that a certain course of action is preferred but not necessarily required.
should not	This phrase means a certain possibility or course of action is undesirable but not prohibited.
May	This phrase indicates that a certain course of action is optional.

5 DEFINITIONS, SYMBOLS AND ABBREVIATIONS

5.1 Definitions

Automatic brightness control – Feature that senses ambient light conditions and changes display brightness accordingly, possibly reducing power consumption.

Brightest selectable Preset Picture Setting – This is the user-selectable, Preset Picture Setting that produces the highest luminance picture in Home configuration.

Forced menu – Configuration selections required of the user when a television set is turned on for the first time that forces the user to make several set-up configuration decisions when prompted.

High definition multimedia interface (HDMI) – Audio-visual interface that is capable of carrying uncompressed video data, compressed or uncompressed digital audio data, and other information. For reference, see HDMI specification.

Home configuration – Forced menu selection most likely to be chosen for home use. This configuration selection is sometimes named “home”.

Illuminance – Photometric measure of the total luminous flux incident on a surface, per unit area, expressed in lux.

Luminance – Photometric measure of the luminous intensity per unit area of light traveling in a given direction, expressed in units of candelas per square meter (cd/m^2).

Main battery – Power storage device capable of powering equipment such that the equipment can provide its primary functions.

Neutral density filter (ND filter) – Optical device that reduces the light intensity in the visible wavelength region.

On Mode – TBD

Partial On mode – A collection of power sub-modes, including Standby-passive, Standby-active, low, and Standby-active, high.

Quick start – Function that reduces the television’s resume time, which is the length of time required for the television to display content when switching from Partial On mode to On mode after pressing the “power” button on the remote control.

Retail configuration – Forced menu selection most likely to be chosen for use in a retail environment. This configuration selection is generally recommended by the manufacturer for presentation in a public space when the television set is offered for sale and might be named “retail”, “store”, “shop”, or equivalent.

Retail picture setting – Out-of-the-box picture setting for television sets with a forced menu in the retail configuration. (See Figure 1.)

Remote Start – The ability to wake a TV using any network-connected device not physically connected to TV.

Special functions – Functions that are related to, but not required for, the basic operation of the device.

Preset Picture Setting – TV picture setting that is selectable by a user from a set of manufacturer-defined picture settings.

Television set (TV) – Commercially available electronic product designed primarily for the display and reception of audio-visual signals from terrestrial, cable, satellite, Internet Protocol TV (IPTV), or other transmission of analog and/or digital signals, consisting of a tuner/receiver and a display encased in a single housing. The product usually relies upon a liquid crystal display (LCD), organic light emitted diode (OLED) display, or other display device.

Wake-on-Cast – The ability to wake a TV by choosing to cast streaming audio or video from a mobile device.

Wake-by-Voice – The ability to wake a TV by voice command to a smart speaker.

5.2 Symbols and Abbreviations

ABC	Automatic Brightness Control
AC	alternating current
cd/m ²	candela per square meter
cm	centimeters
CTA	Consumer Technology Association
CLASP	Collaborative Labeling & Appliance Standards Program
DAM	Download Acquisition Mode
EPG	Electronic Program Guide
fps	frames per second
HDMI® ¹	High Definition Multimedia Interface
HDR	high dynamic range
HEVC	High Efficiency Video Codec
Hz	Hertz
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol

¹ HDMI® is a registered trademark of HDMI Licensing, LLC. This information is given for the convenience of users of this document and does not constitute an endorsement by CTA of the product named.

IPTV	Internet Protocol TV
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication Sector
jpg	digital image format developed by Joint Photographic Experts Group
LAN	Local Area Network
LED	light-emitting diode
LCD	Liquid Crystal Display
lx	symbol for lux, the SI derived unit of illuminance
ND	Neutral Density
NIST	National Institute of Standards and Technology
PAR	parabolic aluminized reflector
QS	Quick Start
RF	Radio Frequency
SDR	standard dynamic range
SMPTE	Society of Motion Picture and Television Engineers
TV	Television Set
US	United States
USB	Universal Serial Bus
UUT	Unit Under Test
V	volts
W	watts
WAN	Wide Area Network

6 GENERAL OVERVIEW OF TEST METHOD

This TV test procedure is organized into three sections:

- General requirements
- Unit Under Test (UUT) set-up and plan development
- Test conduct

7 GENERAL REQUIREMENTS

7.1 Lab equipment

The test shall be conducted using test and measurement equipment that meets the following requirements.

Note: There are new requirements for Spot (i.e. Luminance) and Illuminance photometers. We propose to call the luminance meter a spot photometer to distinguish it from the newly introduced camera photometer.

7.1.1 AC power supply

In On mode, the following requirements apply:

The fluctuation of the voltage supplied shall not exceed $\pm 2\%$. The frequency fluctuation and the harmonic components of the supplied power shall not exceed $\pm 2\%$ and 5% respectively.

In the Partial On and Off modes, the following requirements apply:

The test voltage shall be the declared voltage $\pm 1\%$ and the test frequency shall be the rated frequency $\pm 1\%$. Where a number of models of equipment are being tested and compared for use in the same country, the declared voltage $\pm 1\%$ and declared frequency $\pm 1\%$ may be used for all tests. Where the test voltage and frequency are not defined by an external standard, the test voltage and the test frequency shall be the declared voltage and the declared frequency of the country for which the power consumption is being determined $\pm 1\%$.

The total harmonic content of the source voltage when supplying the UUT in the specified mode shall not exceed 2% (up to and including the 13th harmonic); harmonic content is defined as the root-mean-square (r.m.s.) summation of the individual components using the fundamental as 100% .

The ratio of peak value to r.m.s. value of the test voltage (i.e. crest factor) shall be between 1.34 and 1.49.

Note: How to determine this and other specs in this section? Our Chroma power source only shows current crest factor, not voltage crest factor.

The power supply shall be capable of delivering the voltage and current defined in 8.5.

7.1.2 Power meter

Power measurement shall be carried out directly by means of a wattmeter, a wattmeter with an averaging function, or a watthour meter by dividing the reading by the measuring time. For measurements where the input video signal varies over time, a wattmeter with an averaging function shall be used to carry out the measurement.

Note: I don't understand what the averaging function is [GHardy]. To my knowledge labs log 1 second data and calculate the average power using Excel. The meter does not do the averaging. This appears to be the best approach because one retains a record of the 1 second interval readings, which can provide valuable insights.

The power measuring instrument used shall measure the real power consumed regardless of the power factor of the device under test.

The test instrument used to measure power consumption shall have the following attributes:

- An available current crest factor of 3 or more at its rated range value, and lower bound on the current range of 10 mA or less.
- The power measurement instrument shall have a resolution of 0.01 W or better for power measurements of 10 W or less; 0.1 W or better for power measurements of greater than 10 W up to 100 W; and 1 W or better for power measurements of greater than 100 W.

In addition, the test instrument shall have these following attributes:

- Calibration with a standard that is traceable to the U.S. National Institute of Standards and Technology (NIST) or equivalent.
- The sampling rate of the watt-hour meter or wattmeter with averaging function shall be one measurement per second or more frequent.

Measurements of power of 0.5 W or greater shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level. Measurements of power of 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.

NOTE: For more information about the determination of uncertainty of measurement, refer to IEC 62301:2011, Annex D.

For loads less than 10 W, power figures shall be reported in watts and rounded to the second decimal place. For loads greater than or equal to 10 W, three significant figures shall be reported.

7.1.3 Spot photometer [AKA Luminance Meter]

When directed to measure display luminance, a spot photometer luminance measuring device, which may be of either the contact or non-contact type, shall be used. The spot photometer shall have an acceptance (or measuring) angle in the range of 1° to 3°, inclusive. For contact spot photometers, the measuring area shall have a diameter of 25 mm or more.

The spot photometer shall have an accuracy of $\pm 2\% \pm 2$ digits of the digitally displayed value or better. If the luminance measuring device is neither a spectroradiometer nor calibrated against an illuminant replicating the spectral emission of LEDs, and relies on filters to match the CIE 1931 luminosity function, it shall additionally have a <2% spectral mismatch index f_1' against its calibration illuminant as defined in ISO/CIE 19476:2014: "Characterization of the performance of illuminance meters and luminance meters"

Note: NEEA research indicates that because older spot photometers like the Konica-Minolta LS-100 have higher spectral mismatch than newer spot photometers like the KM LS-150, they can have significant (up to 9%) error when measuring the luminance of LED -backlit TVs or OLED TVs. They are calibrated against and their specified accuracy is assessed against incandescent standard illuminant A, which does not guarantee accuracy when measuring other light sources. Some luminance meters are calibrated against LED sources (e.g. KM CA 410 with CA P427 probe). Spectroradiometers are not dependent on filter match and are therefore fit for use with modern TVs.

[Dave W]: Need to add requirement that device be calibrated with a standard that is traceable to NIST or equivalent.

7.1.4 Illuminance photometer

When directed to illuminate one or more ABC sensors, an illuminance photometer shall be used to adjust the light level to the specified value.

The illuminance photometer shall have an accuracy of $\pm 2\% \pm 2$ digits or better. If the illuminance photometer is neither a spectroradiometer nor calibrated against an illuminant replicating the spectral emission of LEDs, and relies on filters to match the CIE 1931 luminosity function, it shall additionally either have a $<2\%$ spectral mismatch index f_1' against its calibration illuminant as defined in ISO/CIE 19476:2014: "Characterization of the performance of illuminance meters and luminance meters", or be adjusted using the manufacturer recommended method against a traceable reference device not requiring such an adjustment.

Note: The rationale for these requirements is similar to that for the spot photometer.

[Dave W]: Need to add requirement that device be calibrated with a standard that is traceable to NIST or equivalent.

7.1.5 Camera photometer

Dynamic Luminance shall be measured with a monochrome camera photometer system that meets the following requirements:

- Must be capable of measuring screen-average luminance (in cd/m²) during video test clip play with $\pm 5\%$ accuracy
- Must be able to sample luminance and log images at 6 fps without dropping data between frames and to log data averaged from samples at 1 second intervals
- Must have minimum resolution of 720 x 540 pixels
- Must have 12-bit dynamic range
- Must be capable of TV screen border identification and geometry correction
- Must be capable of master black correction
- Must be capable of vignette correction

[Dave W] I assume the "camera photometer" is the PCL system, including the camera, computer and associated software. Need to explain the calibration requirement for the camera photometer.

Reply by Gregg H: Last point is noted. The PCL test kit is the only solution that meets these requirements now, but that may change in the future.

7.1.6 USB thumb drive

USB thumb drives shall be used as the primary means of playing test patterns and video files as specified in section 8.7.

7.1.7 Blu-ray player

BRPs shall be used as a secondary means of playing test patterns and video files as specified in section 8.7.

7.1.8 Network

7.1.8.1 Internet Service and Modem

The internet service provider and modem combination used to provide network connectivity must support confirmed download speeds of 25 Mbps and upload speeds of 10 Mbps.

7.1.8.2 Router

The router used to provide LAN connectivity must comply with the 802.11ac standard and must be a stand-alone router (i.e. not be part of a mesh network).

7.1.8.3 Smart speaker

The smart speaker used to conduct wake-by-voice testing must be from the one of the following product families: Amazon Echo, Google Home, or Google Nest. Any model and generation of these devices is sufficient.

[Dave W]: We typically include “or equivalent” when listing a specific product in a standard. This is for antitrust reasons. We don’t want our standard to be perceived as a boycott of other products. What are the technical requirements of the smart speaker that led to this proposed list of products? Perhaps we can just list those technical requirements instead.

7.1.8.4 Network traffic

Network traffic shall be configured to meet the requirements of 8.11.

7.1.9 ABC light source

The light source used for illuminating the ABC sensor to specific illuminance levels shall use a dimmable LED reflector lamp and shall have a diameter of 90 mm \pm 5mm. The rated beam angle of the lamp shall be 45° \pm 5°. The rated correlated color temperature (CCT) shall be 2 700 K \pm 145 K at all light output levels. In other words, the lamp shall not be specifically designed to achieve warmer color (lower color temperature) when it dims. The lamp shall not be color-tuneable (e.g. RGB). The rated color rendering index (CRI) shall be 80 \pm 3. The front surface of the lamp shall be clear (i.e., not colored or coated with spectrum modifying material) and may have a smooth or granular front surface; when shined against a uniform white surface, the diffusion pattern should appear smooth to the naked eye. The lamp assembly shall not modify the spectrum of the LED source, including the IR and UV bands.

Note: Intertek recommended that we add a criterion stating that the lamp’s SPD must be within specified limits. I will explore this possibility. All of the lamps we purchased that met the currently stated requirements had similar SPDs, but that’s not a guarantee that they will in the future. Because PCL has a spectroradiometer, PCL could check lamps for test labs and maintain a global qualified lamp list.

To reach the illumination levels specified in 9.1, the lamp must have dimming capability incorporated (e.g. wifi or zigbee dimming) or be wired with a compatible dimming switch capable of dimming it to the lowest level required in 9.1. The lamp shall be capable of providing the highest illumination level when wired with the dimming switch. For illuminance levels below 10 lx, a 2 stop ND filter may be used as a

contingency if a lamp/dimmer combination cannot be found for which the lowest setting does not reach the required level below 10 lx. No ND filter shall be used for luminance levels at or above 10 lx. The ND filter shall be large enough to cover the entire surface of the diffusion area of the lamp. The ND filter shall have an average transmission of $25 \% \pm 2.5 \%$ within the visible range, which is 400 nm to 700 nm, without selectively absorbing light at specific wavelengths.

Specific illuminance levels shall be obtained by adjusting the dimming switch.

The model of the lamp and dimmer (and versions thereof if available) used for illuminating the ABC sensor to specific illuminance levels shall be reported.

The lamp shall be stabilized by setting it to maximum output for at least 10 minutes.

Note: Several compatible lamp/dimmer pairs for North America are listed below.

Brand	Model	Dimmer	CCT (K)	CRI	Diameter (mm)	Beam Angle (degrees)	Nominal Rated Lumens
Philips	10PAR30L/LED/827/F40/DIM/ULW/120V	Lutron MACL-153M	2700	80	95	40	800
GE Lighting	LED12DP30RW82740	Lutron MACL-153M	2700	83	95	40	1000
Satco	S9415	Leviton DSL06-1LZ, Lutron MACL-153M	2700	82	95	40	850

7.1.10 ABC table surface

A black cloth and reflective card shall be placed on the table surface when testing according to the requirements in section 8.2.

7.2 Test media

These clips have all been provisionally approved by IEC MT62087. Need to figure out how to reference.

The following video files shall be used for determination of On mode power consumption. The file with the highest resolution supported by the UUT shall be used.

For determination of the brightest PPS, one of the following static pattern video signal shall be used:

IEC_ThreeBar_SD_5994p_SDR_HEVC_AC-3.MP4

IEC_ThreeBar_HD_5994p_SDR_HEVC_AC-3.MP4

For stabilization and determination of On mode power consumption in SDR PPSs, one of the following dynamic broadcast-content video files shall be used:

IEC_Broadcast_SD_5994p_SDR_HEVC_AAC.mp4

IEC_Broadcast_HD_5994p_SDR_HEVC_AAC.mp4

For determination of On mode power consumption in the HDR10 PPS, one of the following dynamic broadcast-content video signal shall be used:

IEC_Broadcast_HD_5994p_HDR10_HEVC_AAC.MP4

IEC_Broadcast_UHD_5994p_HDR10_HEVC_AAC.MP4

In each of the above cases the higher of the two resolution levels shall be used if supported by the UUT.

Note: The camera photometer supplier may provide other test patterns to configure and calibrate the camera photometer.

7.3 Environmental conditions

The ambient temperature of the room used for testing shall be $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and the relative humidity shall be between 10% and 80% for the duration of the measurement procedure. The max and min ambient temperature shall be reported.

Note: Ambient temperature requirements from IEC 62087-1: 2015, humidity from 10 CFR 430, Subpart B, Appendix H, Section 4.2.

7.4 Ambient light conditions

For determining On mode power consumption for television sets with ABC enabled, ≤ 1 lx shall be confirmed at the surface of the ABC sensor assembly with the ABC lamp off and the UUT in the Standby, Off or Disconnected mode.

8 UUT TEST SETUP & PLANNING

The UUT shall be tested with ABC enabled or disabled for each PPS consistent with the default state of ABC for that PPS. For tests with ABC enabled, all the test set-up requirements in this section shall be in effect. For tests with ABC disabled, lamp set-up and reflective card requirements do not apply.

8.1 Initial set-up

Configure the UUT and test equipment per Figure 1, the general requirements documented in section 7, and the detailed instructions noted in section 8.

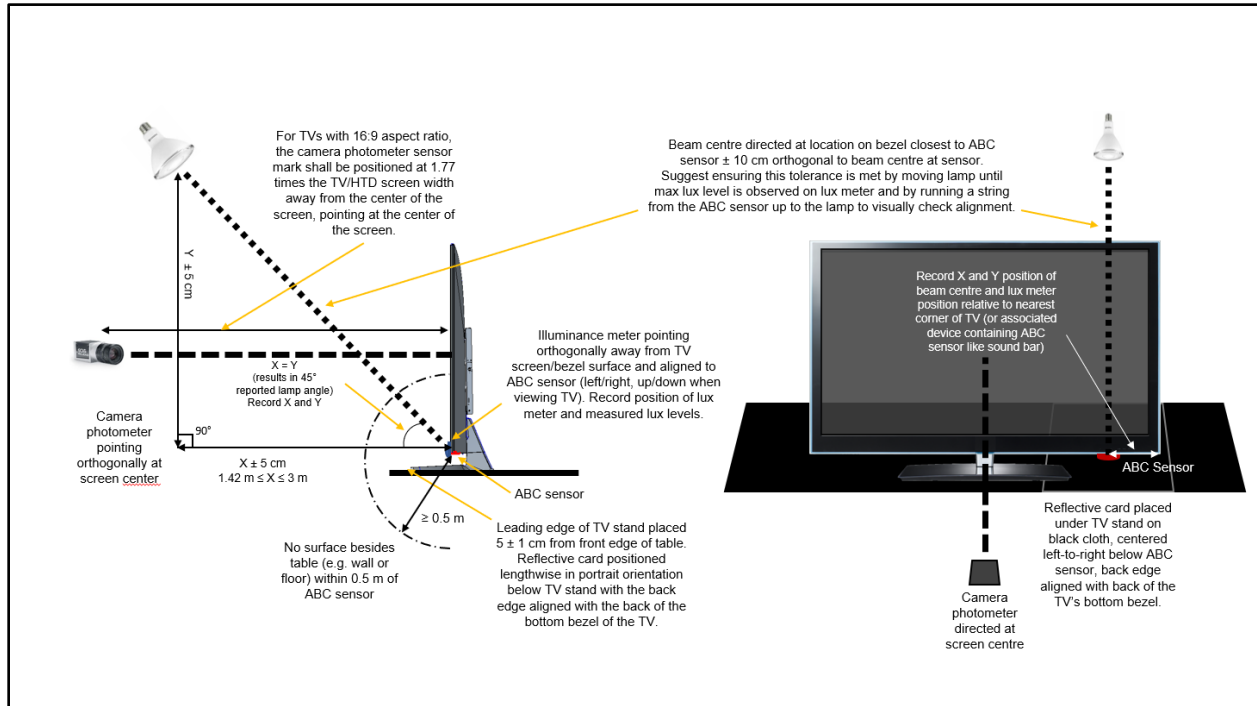


Figure 1: UUT test set-up for measurements with ABC enabled

Note: For the next year or two (e.g. until a possible VA Tier 1 takes effect), all VA-related tests shall be conducted at a lamp angle of 45 degrees.

8.2 Table surface

For ABC tests the table used to hold the UUT shall be covered with black, non-reflective cloth and shall have the area immediately in front of and underneath the UUT's ABC sensor as shown in Figure 1 covered with reflective card having a gloss measurement of 15GU as measured by a 60-degree gloss meter. The material must not alter visible light in the 400 to 700nm range that arrives on or is reflected by the material. The thickness of the ABC sensor reflective card shall be 4mm or less and shall be at least 203mm wide by 177mm deep; shall be printed with a matte finish, with a colour adhering to the M1 lighting standard having CMYK values of (43, 53, 84, 84)+/-2. The card shall not polarize light reflected off its surface. The reflective card shall be placed under the stand of the UUT and centered left-to-right under the ABC sensor and with the back edge of the card aligned with the back of the TV's bottom bezel. If this placement causes the card to extend beyond the table's front edge, or if the UUT's stand covers the table beneath the ABC sensor, align the front of the card with the front edge of the table instead.

Note: see section 8.2 for further information about the reflective card.

8.3 UUT installation

The UUT shall be installed in accordance with the manufacturer's instructions.

In order to simplify alignment of the light source, all four corners of the face of the UUT should be equidistant from a vertical reference plane (e.g., wall) and the bottom two corners of the face of the UUT should be equidistant from a horizontal reference plane (e.g., floor). See section 8.1 for test environment setup.

The environmental conditions (7.3) and ambient light conditions (7.4) shall be confirmed.

8.4 Main batteries

Main batteries, if any, shall be removed for the duration of the measurement procedure.

8.5 Power

Provide power to the ABC lamp, camera and UUT from the AC power source per the power quality requirements defined in section 7.1.1 and the geographical requirements defined in Table 1.

Table 1: Typical declared electricity supplies for some regions

Country/Region	Declared voltage ¹ and frequency
North America	115 V, 60 Hz
Europe	230 V, 50 Hz
Japan ²	100 V, 50/60 Hz
China	220 V, 50 Hz
Republic of Korea	220 V, 60 Hz
Australia and New Zealand	230 V, 50 Hz

Note 1: Values are for single phase only.

Note 2: 50 Hz is applicable for the Eastern part; 60 Hz is applicable for the Western part.

8.6 Plug-in modules

No user-removable plug-in module, such as a conditional access module, a point of deployment module, a USB or HDMI stick or an external media storage unit, shall be connected to the UUT during the measurement procedure, unless it is installed in the UUT as shipped to the end customer. If the UUT is shipped to the end customer with a user-removable plug-in module which is described in the User Manual as necessary for the product's primary out-of-box functionalities, that user-removable module shall remain connected during the measurement procedure.

A USB stick that contains media files (video, image, audio) for testing as specified in this document may be connected to the UUT as test media source during the measurement procedure.

8.7 Provision of test media

A USB input port on the UUT shall be selected, using a USB port recommended in the UUT manual for video file playback and one with the highest data rate specified (e.g. USB 3.0 supports higher data rates than USB 2.0).

For USB inputs, a single USB 3.0 stick of at least 32GB that holds all the test media shall be inserted directly into the UUT's USB port. The USB stick should be formatted in either Fat32 or ExFAT format. The UUT's native file player shall be used to play test files located on the USB stick. Before testing, confirm that the UUT remains in the same preset picture setting when switching from HDMI input to USB input. In the unlikely event that it does not, then either test with HDMI input selected, or select the USB input and manually ensure that the UUT is set to the default or specified preset picture setting associated with the HDMI input during all On mode tests.

The manufacturer, model and storage size of the USB stick used shall be reported.

If the UUT does not have a USB port capable of playing the test video files, the test files shall be played from a Blu-ray player with a compatible USB port using the BRP's default settings. The BRP shall be connected to the UUT using an HDMI cable that meets the HDMI 2.0 standard or more recent update.

Note: Should add an anti-defeat clause that reduces that risk that TVs will be designed to perform more efficiently when playing content from USB sticks than via HDMI input for example? For example, the TV could be designed to increase local dimming when playing from USB stick with little customer impact since few people watch content from USB stick.

Note: Simplified relative to 62087 by requiring USB 3.0, which is backward compatible. Plan to comment in 62087 CD review.

8.8 UUT planning

8.8.1 Task overview

Record the information required below to make a test plan for the UUT.

- Record UUT screen width.
- For UUTs with at least one USB port, identify the USB spec level (i.e. 2.0 vs 3.0) of the highest-speed port available or the port that is intended for video file playback as required by section 8.7.

Note: We could possibly allow the use of any USB port unless there is a problem with file playback. Maybe just document which port is used.

- For TVs without a USB port, identify the appropriate HDMI port per section 8.7.
- Power on the UUT using the UUT remote control.
- Proceed through initial set-up prompts. When prompted to enable features like location services or crash reporting, or any other feature that has the potential to increase energy consumption, always enable.

[Dave W] This clause encourages manufacturers to minimize the number of features consumers are prompted to enable. This could have unintended consequences, such as encouraging manufacturers to not prompt for enabling voice control, which could negatively impact blind people. I don't have a specific counterproposal at the moment, but it seems like this deserves some thought.

- Update the firmware if possible (8.8.2.1), and factory reset the UUT using the above guidance on initial set-up prompts.
- Record SDR default PPS and whether ABC is enabled by default.
- Record HDR10 default PPS and whether ABC is enabled by default. Do this by ensuring that the UUT starts in the SDR default PPS and default ABC setting and then play the HDR10 broadcast dynamic test clip (7.2). Pause the video and check the PPS and ABC settings.

[Dave W] Does factory resetting also reset the firmware? If so, then step 2 makes step 1 irrelevant.

Note: in rare cases, the USB media player closes when one selects the settings menu to check for PPS and ABC settings. In these cases, try again to determine the HDR10 default PPS using HDMI input (e.g. USB stick in BRP). If that also fails, assume that the HDR10 default PPS and ABC setting are the same as the default SDR PPS and ABC setting.

- Identify and record the SDR brightest PPS by following the instructions in section 8.8.2.3.
- Identify whether UUT has Quick Start feature and whether QS is enabled by default in the SDR default PPS (8.8.2.4)
- For TVs with QS disabled by default in the SDR default PPS, measure the wake time per (8.8.2.4).
- Identify if Remote Start is available
- Identify if Wake-by-Voice is available (7.1.8.3)

8.8.2 Specific procedures

8.8.2.1 UUT firmware update

If a firmware update for the UUT is available, it shall be updated following the manufacturer's instructions, e.g., via a USB stick or the UUT's network connection by connecting it to the Internet. Upon completing any firmware update, disconnect the USB stick containing the firmware update files.

The firmware version of the UUT as tested shall be reported.

8.8.2.2 Identify the default SDR and HDR10 PPSs

Play test videos (7.2) from USB media via a USB-enabled Blu-ray player, in its default configuration, connected to the UUTs HDMI input.

Play the IEC SDR Broadcast Video clip and identify the SDR default PPS and whether ABC is enabled by default in that PPS.

Then, with the TV still in its default SDR PPS and ABC configuration, play the IEC HDR10 Broadcast Video and identify the HDR10 default PPS and whether ABC is enabled by default in that PPS.

Note: Make best attempts when testing to ensure that the TV is in fact in an HDR10 PPS. Some TVs temporarily show an HDR badge on the screen when playing HDR content. Others will indicate HDR in the PPS title. Others will indicate ST2084 as the gamma curve or EOTF in the advanced picture settings. The product manual and/or technical support may also be helpful. If one cannot confirm that the TV is in HDR10 mode when playing the HDR10 test clip, then conduct the test with the HDR10 clip anyway starting from the default SDR PPS.

8.8.2.3 Identify brightest PPS

Play test videos (7.2) from USB media via a USB-enabled Blu-ray player, in its default configuration, connected to the UUTs HDMI input.

Play the IEC SDR Broadcast Video clip for 5 minutes to stabilize the UUT. Then use the spot photometer to measure the luminance of each of the PPSs orthogonally at screen center while playing the Three Bar test pattern. Move camera photometer if necessary. Trigger the spot photometer after displaying the Three Bar test pattern in that PPS for 15 seconds. The video, which starts with 10 seconds of black, shall be restarted between each PPS during this determination.

Note: Some spot photometers require a few seconds to record a measurement. This time can be variable depending the luminance level. Therefore, we specify that the measurement shall be stated 15 seconds after the three-bar pattern is displayed, 25 seconds after the start of the test clip.

While all PPSs, including Filmmaker, shall be tested if present, Filmmaker mode shall not be selected as the brightest mode in the near term.

8.8.2.4 Quick Start

For TVs that have a quick start function, after enabling Remote Start, Wake-by-Cast, and Wake-by-Voice where possible per 8.11.1 plan to test the UUT with quick start in its default state if the UUT's resume time is less than 10 seconds as measured per 8.8.2.5. Otherwise, test the UUT with quick start adjusted to provide the shortest possible resume time.

8.8.2.5 Measure wake time

When required in this spec, one must use the following procedure to measure wake time.

- 1 Connect the UUT to a LAN with no other connected devices and no WAN connection.
- 2 Before each standby test a continuous video feed shall be supplied via HDMI cable, and the relevant UUT HDMI input shall be selected such that the SDR video feed is displayed by the UUT. The test media selected shall be one of the SDR broadcast video files specified in section 7.2. This video stream shall continue throughout the test. If changing the settings of the TV is required to wake the TV to the HDMI input, those settings shall be configured to wake the TV to the HDMI input.
- 3 All UUT inputs, other than the abovementioned HDMI input, shall be removed.
- 4 Power down the UUT with the remote-control unit.

- 5 Leave the UUT in this state for 20 minutes.
- 6 Measure wake time by recording the time duration between issuing a wake command and when the UUT displays video content. The method of waking the UUT will be determined by setup performed per section 8.11.1. The TV settings may need to be adjusted to wake to the HDMI input instead of a home menu.
 - 6.1 If the UUT has Wake-by-Voice configured wake time is determined by recording the time between the smart speaker receiving the voice command to wake the UUT and the UUT displaying the above mentioned HDMI video feed.
 - 6.2 If the UUT does not have Wake-by-Voice capabilities but has Wake-by-Cast configured wake time is determined by measuring the time between casting to the UUT and the UUT displaying the casted content.
 - 6.3 If the UUT has neither Wake-by-Voice nor Wake-by-Cast but has Remote Start wake time is determined by measuring the time between pressing the power button within the Remote Start application and the UUT displaying the video content supplied by the HDMI input.
 - 6.4 If the UUT has no configurable wake settings wake time is determined by measuring the time between pressing the UUT remote control Power button and when the UUT displays the video content supplied by the HDMI input.

8.9 Camera photometer set-up

The camera photometer shall be positioned at a distance of 1.76 - 1.78 times the UUT screen width away from the center of the screen, pointing at the center of the screen. The full active area of the UUT screen shall be visible within the measurement area of the camera photometer.

The camera photometer must be powered with the AC Power Supply configured per section 8.5.

The camera photometer must be stabilized before testing is conducted, requiring a 60-minute warm-up, and it must be set to log data at 1 second intervals.

The camera shall be focused on the screen with the appropriate vignette correction in place for the test.

8.10 Lamp set-up

The lamp must be powered with the AC Power Supply configured per section 8.5. The center of the light source shall be aligned as shown in Figure 1.

Aside from the possible use of a 2 stop ND filter when applying low illuminance levels to the ABC sensor assembly of the UUT, there shall be no obstructions (e.g. diffusing media, IR filters, UV filters, etc.) between the illuminating light source and the UUT's automatic brightness control (ABC) sensor assembly during power measurements.

If used, the ND filter, shall be positioned immediately in front of the illumination light source assembly with care to not exceed the filter's operating temperature range. The illumination levels shall be verified with the illuminance measuring instrument positioned immediately in front of the ABC sensor assembly,

parallel with the unit's front frame regardless of the orientation of the ABC sensor (i.e. forward facing or downward facing), as shown in Figure 1.

No test room surface (i.e. floor, ceiling, and wall) shall be within a 0.5 m hemisphere in front of the center of the UUT's ABC sensor. If the UUT ships with or has a built-in table stand, the UUT shall be setup on a table as shown in Figure 1. The table in front of the UUT's ABC sensor shall be covered with material the Test Table Surface Material as specified in section 8.2.

Note: To improve test repeatability, it is suggested that the lux meter be hung over top of TV with string fixed by tape on the back side of the TV, and two pieces of tape on the TV's top bezel, one on either side of the string during initial placement, to indicate string alignment and improve placement accuracy during subsequent ABC measurements (e.g. to confirm 100, 35, 12 and 3 lux ambient light levels).

For UUTs that are not capable of being positioned on a tabletop, for example TVs without a stand, they shall be tested as close as possible to their intended configuration:

- a) For wall mounted UUTs that include the ABC sensor [Figure 2] within the display enclosure the UUT shall be mounted on a matt white wall at least 1m above floor level with no other objects on the wall within 50cm of all screen edges.

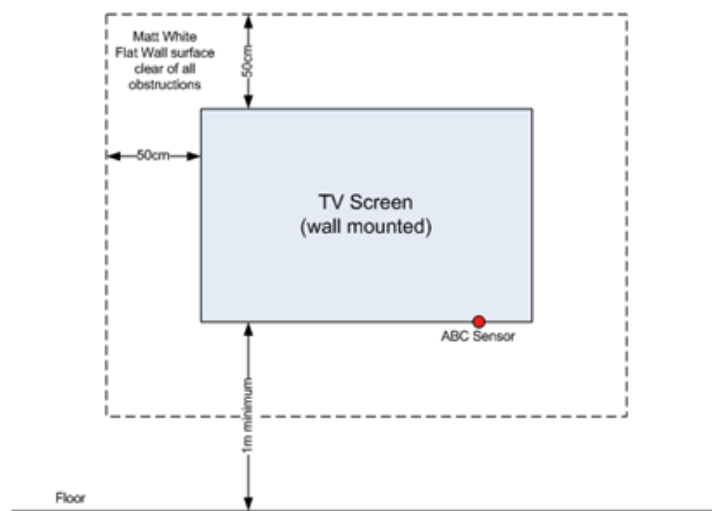


Figure 2: Wall Mounted TV with Built-in ABC Sensor

- b) In addition, for wall mounted UUTs where the ABC sensor is located externally to the display [Figure 3], e.g. in an external electronics box enclosure or sound bar, the ABC sensor enclosure shall be positioned in the same vertical plane as the screen (e.g. fixed to the same wall) at no further than 50cm distance. The ABC sensor enclosure shall be fixed with or placed on (right angled) brackets and not on a shelf.

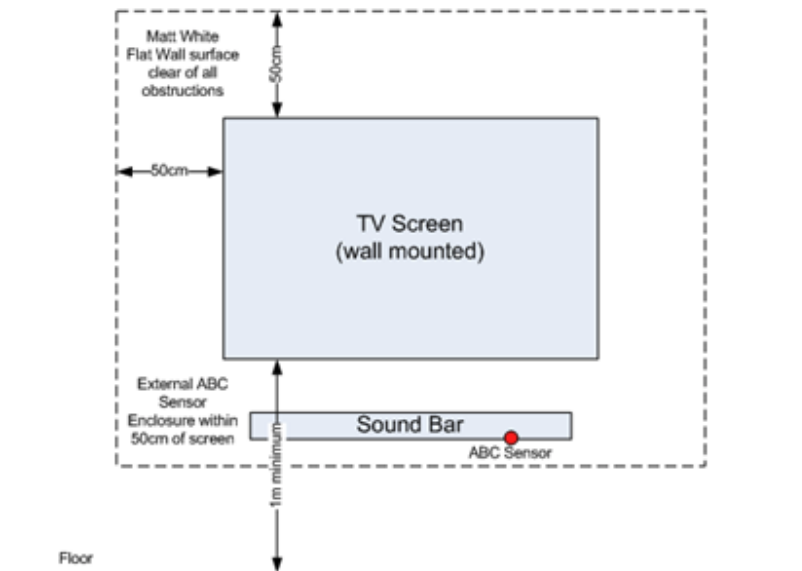


Figure 3: Wall Mounted TV with External ABC Sensor

- c) For all other TV designs that do not fit within the above guidance, for example a rollable display integrated into a furniture-stand supplied by the TV manufacturer, the UUT shall be tested with all such furniture on a floor covered with black felt material to a distance of at least 1m away from all such furniture.

The UUT mounting configuration used in Figure 1, Figure 2, or Figure 3 during testing, including details of the exact light source configuration used, shall be reported. NOTE: This standard cannot consider every variation of consumer (or laboratory) test environments (e.g., exact ambient lighting color temperature; lighting angle of incidence with respect to UUT's ABC sensor; wall, floor, ceiling paint color, texture, reflectivity; specific UUT mounting configuration; etc.). Therefore, this standard provides the two methods most representative of consumer use, i.e., on an entertainment stand/table or wall-mounted/manufacturer-supplied furniture stand.

If the UUT includes multiple ABC sensors, each sensor shall be illuminated to the same level, within the rated tolerance limits, and multiple light sources may be used.

8.11 UUT Settings

8.11.1 Network connections and wake

For all On and Partial-On Mode tests, if the UUT is network enabled, connect it to an internet-connected (i.e. WAN connected) LAN that includes no other networking devices besides the modem used for WAN connectivity and a network traffic generator configured to output multicast discovery packets to the

LAN every 1 second. Details on the packet contents are in “Informative Annex C: Multicast Network Traffic”. More than one TV may be connected to the LAN used for testing.

If the UUT has multiple network connections (e.g., Wi-Fi and Ethernet), configure the UUT and connect it to a single network source in accordance with the hierarchy of connections listed in Table 2 of this section.

Table 2: NETWORK CONNECTION HIERARCHY

Priority	Network Connection Type
1	Wi-Fi (Institution of Electrical and Electronics Engineers - IEEE 802.11- 20072)
2	Ethernet (IEEE 802.3). If the UUT supports Energy Efficient Ethernet (IEEE 802.3az-20103), then it shall be connected to a device that also supports IEEE 802.3az.

Conduct all tests with Remote Start, Wake-on-Cast and smart speaker Wake-by-Voice enabled where possible.

- When the UUT is capable of casting from first-party or third-party applications, this feature along with the ability to power-on remotely with mobile device, when present, shall be enabled. This feature is sometimes called “Remote Start” or “Power-on with Mobile”.
- Enabling Remote Start will typically enable Wake-by-Cast. However, if this is not the case, then Wake-by-Cast capability must be separately enabled if possible.
- If possible, configure the UUT to connect to a smart speaker with Wake-by-Voice enabled. Current major speaker brands known to support this capability are limited to Amazon and Google per section 7.1.8.3. Before choosing the smart speaker, check the UUT and/or smart speaker manufacturer websites to determine which speaker brand(s) support Wake-by-Voice. Some TVs advertise support for smart speaker Wake-by-Voice, but it is difficult or impossible to successfully configure this feature. If after a reasonable effort, a test lab cannot configure Wake-by-Voice, then try the other smart speaker brand specified in section 7.1.8.3. If neither speaker brand supports Wake-by-Voice, then test without this capability enabled.
- One or both smart speaker brands may be configured to wake the UUT during testing. In other words, if the tester has attempted but failed to configure Wake-by-Voice with one or two brands of smart speaker, the tester does not have to disable speaker connections before testing. This can avoid the need for a UUT factory reset.

Which of these capabilities (Remote Start, Wake-on-Cast and smart speaker Wake-by-Voice) is advertised to work and which ones are confirmed to work (and therefore tested) shall be documented. In addition, the applications used to perform Remote Start (first-party applications, etc...), Wake-by-Cast (Youtube, Netflix, etc...), or Wake-by-Voice shall be documented. Any devices used to configure the above settings shall be connected to the same WAN as the UUT.

8.11.2 Motion Detection Dimming (MDD)

All tests for On Mode power determination per clause 6.4 shall be performed with MDD disabled. If MDD cannot be disabled, the unit must be tested in the brightest selectable preset picture settings as determined by section 8.8.2.2.

Preset Picture Settings used for testing shall exclude the following:

- Picture setting labeled “PC” or “Computer” or otherwise intended for the use case where the Television Set is to be used as a monitor connected to a computer.
- Picture setting labeled “Game” or “Gaming” or otherwise intended for low-latency use when the Television Set is connected to a gaming console.
- Picture setting labeled “Accessibility” or “Low Vision” or otherwise intended to produce high contrast pictures explicitly for use by viewers with limited vision capabilities.

The state of the MDD feature during testing shall be reported.

8.11.3 Quick start

The Quick Start setting must be set per the determination made in section 8.8.2.4.

8.11.4 Video aspect ratio

The UUT shall be set such that the active area of the video input signal fills the entire display area.

8.11.5 Sound level adjustments

The volume control shall be adjusted to a level greater than zero that is closest to 2% of maximum.

Note: For a TV with a maximum level of 50, this would be a setting of 1.

8.11.6 Input selection

The input source chosen in section 8.7 (i.e. USB where possible) shall be selected.

9 TEST SEQUENCE

On Mode tests shall be conducted before Partial On Mode tests.

9.1 On Mode

- 1) Configure camera: Identify screen border in camera FOV and needed geometry corrections

[Dave W] Move this up to Camera config section?

- 2) Stabilize UUT: by repeatedly playing the first 5 minutes of the SDR broadcast test clip (a “stabilization run”) in the default PPS with ABC off until a stabilization run has an average power level that is within 2% of the previous run.

[Dave W] Seems like this could be a new 8.11.7 with the heading “Stabilization” because it’s part of the setup.

- 3) Calibrate camera if necessary, per manufacturer’s instructions.

[Dave W] Seems like this should be in 8.9 (Camera photometer set-up) because it’s part of the setup.

- 4) Conduct ABC off tests with default backlight level for all 3 PPSs listed below.
Backlight shall be in the default setting for all 3 PPS tests listed below. Start each test by 5 minutes after completion of the previous test. Each broadcast test clip has 5 minutes of grey after the broadcast content with a timer that counts-up to 5 minutes. Log power and screen-average luminance at 1 sec intervals.
 - a) SDR Default PPS
 - b) SDR Brightest PPS
 - c) HDR10 Default PPS

[Dave W] See my comment in 7.2 about need to identify the standard where these video signals are defined, or say where the video files can be obtained.

- 5) Conduct ABC off tests, with backlight level set to its lowest level, only for PPSs where ABC is not enabled by default.
 - a) SDR Default PPS
 - b) SDR Brightest PPS
 - c) HDR10 Default PPS

[Dave W] Just to confirm, the intent of this proposed language is that ABC must be enabled by default for at least one PPS for ABC to play a role in a TV set’s energy consumption rating?

- 6) Conduct ABC on tests only for PPSs where ABC is enabled by default
 - a) Set ambient light to 100 lux \pm 5%
 - i) SDR Default PPS
 - ii) SDR Brightest PPS
 - iii) HDR10 Default PPS
 - b) Set ambient light to 35 lux \pm 5%
 - i) SDR Default PPS

- ii) SDR Brightest PPS
- iii) HDR10 Default PPS
- c) Set ambient light to 12 lux \pm 5%
 - i) SDR Default PPS
 - ii) SDR Brightest PPS
 - iii) HDR10 Default PPS
- d) Set ambient light to 3 lux \pm 5%
 - i) SDR Default PPS
 - ii) SDR Brightest PPS
 - iii) HDR10 Default PPS

[Dave W] Do we have any data indicating how variations in ambient light affect the final test results? Would allowing +/- 5% here put at risk the ability of the overall system to produce repeatable results within +/- 5% of each other.

[Gregg H] +/- 5% is a tightening of tolerance relative to today's IEC/DOE requirements. It's provisionally approved by IEC. Glad to discuss context and history in 2037 meeting.

9.2 Partial On Mode

9.2.1 Test Conditions Partial On Mode Test

Standby-active, low power and wake-time measurements shall be conducted by powering down the UUT from the SDR Default Preset Picture Setting configuration in its default state.

Standby tests must be conducted with updated software and active LAN and WAN connections.

Before each standby test a continuous video feed shall be supplied via HDMI cable, and the relevant UUT HDMI input shall be selected such that the SDR video feed is displayed by the UUT. The test media selected shall be one of the SDR broadcast video files specified in section 7.2. This video stream shall continue throughout the test. If changing the settings of the TV is required to wake the TV to the HDMI input, those settings shall be configured to wake the TV to the HDMI input.

All UUT inputs, other than the abovementioned HDMI input, shall be removed, including the USB stick used to play video files during On mode testing.

For UUTs with a Quick Start (QS) feature that is disabled by default, if the wake time measured per section 8.8.2.5 is equal to or greater than 10 seconds, then the standby-active, low test shall be performed with QS enabled.

9.2.2 Measuring standby-active, low

Measure power at 1 second intervals for 40 minutes and determine the average power by calculating the average of the power readings taken during the last 20 minutes of the test.

Measure wake time after measuring standby-active, low average power according to section 8.8.2.5.

10 NORMATIVE ANNEX A: REPORTING

Note: This section requires updates.

10.1 Items to be reported

The following summarizes the items to be reported:

- Description/identification of the UUT (brand name, model number, etc),
- The date and location of the measurements,
- The name of the person/people who executed the measurements,
- The type of power source used (7.1.1). Indicate the included external power supply, mains power, and/or power from other than the mains.
- The ambient temperature (7.3),
- The voltage and frequency of the power source,
- The model of the lamp used for illuminating the ABC sensor to specific illuminance levels,
- The model of the lamp used for disabling the ABC feature,
- Selected input terminals,
- Selected video resolution and frame rate,
- Automatic brightness control capabilities,
- Network connection capabilities,
- Initial set-up prompt selection(s),
- On mode power consumption, $P_{\text{on_mode}}$ (W),
- Power factor,
- The manufacturer's name or label associated with the brightest selectable Preset Picture SettingPreset Picture Setting,
- Whether $L_{\text{brightest_selectable}}$ or L_{retail} is greater,
- Peak Luminance ratio, L_{ratio} ,
- Power consumption in Standby-passive, $P_{\text{standby-passive}}$ (W),
- Power consumption in Standby-passive with Quick Start enabled, $P_{\text{standby-passive_quick-start}}$ (W or N/A),
- The availability of the Standby-active, low sub-mode,
- Power consumption in Standby-active, low, $P_{\text{standby-active, low}}$ (W or N/A),
- The availability of Off mode,
- Power consumption in Off mode, P_{off} (W or N/A).

11 INFORMATIVE ANNEX B: DAM TESTING

Note: We should assess the continued need for DAM testing. It's not clear to NEEA that it is needed.

11.1 Standby-active, high

If the UUT has networking capabilities (6.2.6), Standby-active, high could be tested while connected to a network. A single networking connection could be made using the following priority order: Wi-Fi, Ethernet (Energy Efficient Ethernet, if available), RF Coax, and Other. For this measurement, if a Wi-Fi or Ethernet connection is used, the network could be configured as described in 6.6.5.1.

A subset of Standby-active, high mode is Download Acquisition Mode (DAM). If the UUT supports DAM, Download Acquisition Mode power consumption, P_{DAM} , could be measured using either the Ideal or Practical measurement method.

Brief communications in order to "Wake-up" or change the mode of the TV are excluded from the measurement of DAM.

In order to measure P_{DAM} , 3rd party testing laboratories may require proprietary information from the manufacturer regarding the UUT's DAM-related processes.

11.2 Definitions

Download Acquisition Mode

Where the product is connected to a mains power source, is not producing a sound or a picture, and is actively downloading data, to include but not limited to, channel listing information according to a defined schedule for use by the electronic programming guide, TV setup data, channel map updates, TV firmware updates, monitoring for emergency messaging/communications and/or otherwise communicating through a network protocol. The power use in this mode is typically greater than the power requirement in Standby and less than that in On Mode.

Frequent download

Any DAM download that does not meet the definition of an Infrequent Download.

Infrequent download

Any DAM download that occurs no more than four times per year and has a duration of less than six hours per instance (i.e., total of less than 24 hours/year or 0.27%). Some examples of infrequent downloads are TV firmware updates, TV setup data downloads, and the Rovi EPG Setup State.

11.3 Ideal

To ideally measure the DAM mode power consumption, the TV should be connected to a power meter that measures the total energy consumed (E_{TOTAL}) and a signal source that can provide a signal containing the same type and amount or duration of data that the TV will acquire in its actual application DAM use. The following procedure should be followed:

1. UUT could be connected to a power meter that will measure the total energy consumed over duration of the test.
2. A signal source could be prepared that can provide a signal containing the same type and amount or duration of data that the TV will acquire over the course of an average 24-hour period. This signal could include representative segments from all Frequent Downloads.
3. The energy consumption of the UUT could be measured over a 24-hour period (E_{TOTAL}), during which the TV is turned on for 1 hour then turned off for 1.5 hours 4 times then turned on for 1 hour and off for 13 hours.
4. The following equation could be used to derive the energy used in DAM (E_{DAM}):

$$E_{DAM} = E_{TOTAL} - (P_{ON} * 5 \text{ Hours}) - (P_{standby-passive} * 19 \text{ Hours})$$

Where:

E_{TOTAL} – Total energy used by the UUT over a 24-hour period

P_{ON} – On mode power consumption

$P_{standby-passive}$ – Standby-passive mode power consumption

T_{DAM} – Average time spent in DAM per day

11.4 Practical

For practical measurement of DAM mode power consumption, it can be verified that the E_{DAM} can be calculated by simply multiplying the instantaneous ($P_{DAM} - P_{standby-passive}$) by the time in DAM mode. The following steps should be followed:

1. The TV could be connected to a power meter and power source.
2. The TV could be connected to an appropriate signal source for communicating with the DAM function being tested.
3. The signal which causes the TV to activate the DAM function should be applied.
4. Confirm that the TV has activated the DAM function and is communicating with the DAM signal source as appropriate for the DAM function being tested.
5. Record P_{DAM} (watts) power consumption in DAM using the power meter.
6. Confirm T_{DAM} (hours) time of DAM per day, and calculate E_{DAM} by the following equation:

$$E_{DAM} = (P_{DAM} - P_{standby-passive}) \times T_{DAM}$$

7. If there are different DAM functions for the same TV, repeat steps 1 through 6 for each DAM function. In this case, the total E_{DAM} is calculated:

$$E_{DAM} = \text{SUM}((P_{DAM} - P_{standby-passive}) \times T_{DAM})$$

Where:

$P_{\text{standby-passive}}$ – Standby-passive mode power consumption

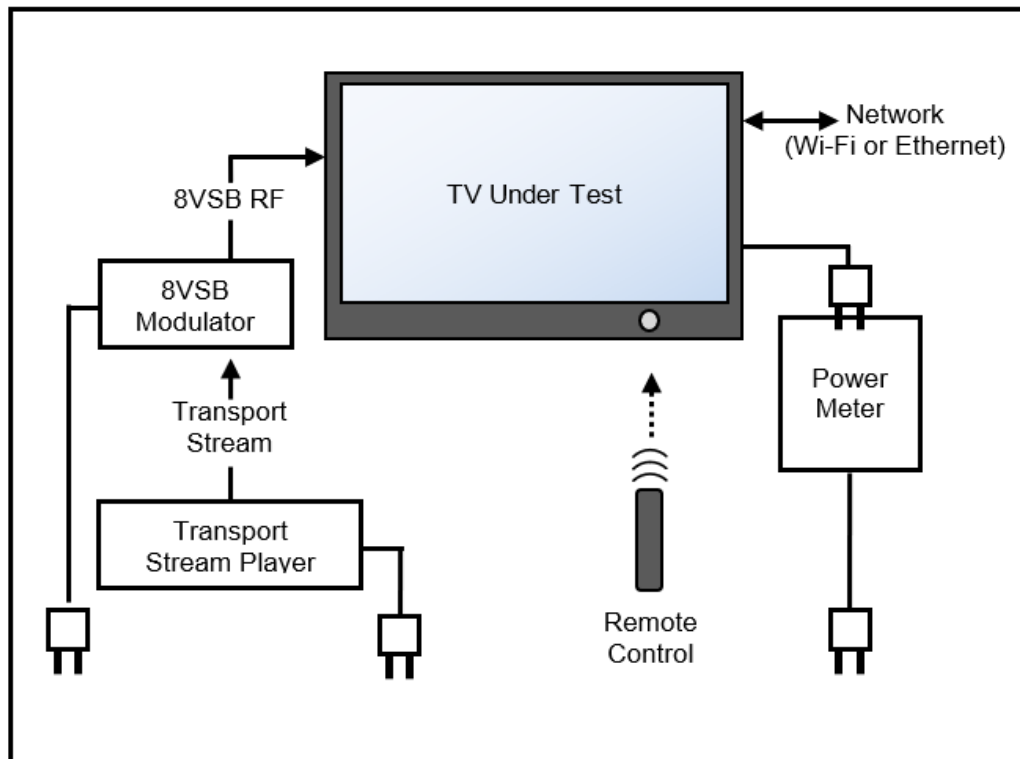
P_{DAM} – DAM power consumption for each DAM function

T_{DAM} - Time spent per day in DAM for each DAM function

11.5 Verification

The average time per day spent in DAM mode is easily estimated and easily verified by connecting the TV into its intended application and monitoring the energy usage. It is self-evident when the TV is in On mode. When the TV is off and drawing less than 1W it must be in Standby-active, low mode, and when it is off and drawing more than 1W, it must be in DAM mode. The verification should be repeated for several days in case a less frequent download occurs on one day.

11.6 Connection Diagram



Note: Depending on the DAM features in the UUT, The 8VSB RF input and related equipment might not be needed for measuring DAM with the Practical method.

11.7 Template for DAM power measurement

The following table may be used for declaring frequent and infrequent DAM functions

DAM Declarations						PDAM	PDAM – Pstandby-passive	TDAM	EDAM*	
	Function	Trigger	Duration(s)	Frequency	Estimate	Power (W)		Hrs:Min	(W-hrs)	Notes
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
					Total					

$$* E_{DAM} = (P_{DAM} - P_{standby-passive}) \times T_{DAM}$$

Table D.1, Template for DAM power measurement

11.8 Example template for DAM power measurement

DAM Declarations						PDA M	PDAM – Pstandby-passive	TDA M	ED AM *	
	Function	Trigger	Duration(s)	Frequency	Estimate	Power (W)		Hrs: Min	(W-hrs)	Notes
1	Firmware Update	Availability detected by check	1 hr 45 min	Infrequent	2x / year	26.5	28			Only if require for feature update /fix
2	Download Setup Data	New installation	5 min	Infrequent	Once	26.5	26			
3	Update Setup/Channel Map	Availability detected by check	5 min	Infrequent	2x / year	26.5	26			When new channels added or room setup change required
4	Check for new version of 1, 2, or 3	Turn off + 15 minutes	3 min	Frequent	5x / day	26.5	26	0:15	6.5	Check for new version – downloads only if new version available

5	Initialize EPG Setup	New installation	3 hrs	Infrequent	Once	26.5	26			
6	Update EPG Data	Daily	15 min	Frequent	4x / day	26.5	26	2:22	62.4	
			2 hrs			26.5	26			
			5 min			26.5	26			
			2 min			26.5	26			
7	Weekly Download	Weekly	1 hr	Frequent	1x / week	26.5	26	0:09	3.9	
8										
9										
10										
					Total			2:46	72.8	

$$* E_{DAM} = (P_{DAM} - P_{standby-passive}) \times T_{DAM}$$

Table D.2, Example template for DAM power measurement

12 INFORMATIVE ANNEX C: MULTICAST NETWORK TRAFFIC

When directed to broadcast packets to simulate high network traffic home activity, configure a program capable of sending packets to multicast addresses on the LAN to send the following list of packets at the specified interval:

MDNS (Multicast DNS) Packets (IPv4 address 224.0.0.251:5353)

- Standard query 0x0000 PTR _googlecast._tcp.local, "QM" question
- Standard query 0x0000 PTR _spotify-connect._tcp.local, "QM" question
- Standard query 0x0000 A wpad.local, "QM" question

SSDP (Simple Service Discovery Protocol) Packets (IPv4 address 239.255.255.250:1900)

- HOST: 239.255.255.250:1900\r\nMAN: "ssdp:discover"\r\nMX: 1\r\nST: urn:dial-multiscreen-org:service:dial:1\r\n\r\n
- HOST: 239.255.255.250:1900\r\nMAN: "ssdp:discover"\r\nMX: 3\r\nST: urn:schemas-upnp-org:device:MediaServer:1\r\n\r\n
- HOST: 239.255.255.250:1900\r\nMAN: "ssdp:discover"\r\nMX: 3\r\nST: urn:schemas-upnp-org:device:MediaRenderer:1\r\n\r\n

Note: The PCL Kit Manual contains instructions for using Packet Sender to send these packets.

13 INFORMATIVE ANNEX D: REPRESENTATIVE TEST TOOLS

The following items, while not required by implementers of this standard, met this standard's specifications and measurement accuracies as used by the IEC 62087 Maintenance Team to confirm the utility and repeatability of this standard:

- Pantone Black 2C SuperSwatch (section 8.2 for test table ABC sensor material);
- Photo Research PR655 Spectroradiometer (see section 7.1.3 for characterizing luminance meters appropriate for measuring LED panels)
- PCE-GM 60Plus Gloss Meter (60 degree);
- Fing network scanner application (for mobile devices);
- Magic Packet™ network signal used for Wake-on-LAN functions

