

# Transitional Methods of Measurement for Electronic Displays, in relation to:

- **Ecodesign for Energy-related Products and Energy Information Regulations 2021 (with respect to Ecodesign Requirements for Electronic Displays)**
- **Energy Labelling Regulation for Electronic Displays (EUR) 2019/2013**

## Context

This document outlines the transitional methods of measurement intended to support the ecodesign requirements for electronic displays provided for in The Ecodesign for Energy-Related Products and Energy Information Regulations 2021 (“the 2021 Regulations) and in Commission Delegated Regulation 2019/2013 with respect to energy labelling for electronic displays (EUR 2019/2013).

This document is intended for the use of persons responsible for the compliance or verification of compliance of electronic displays with the ecodesign and energy labelling requirements in the 2021 Regulations and EUR 2019/2013.

The intention is that the transitional methods of measurement set out in this document will be used for the measurements and calculations required by the 2021 Regulations and EUR 2019/2013 until the relevant designated standards are available to underpin these regulations.

**Part 1** details the references and qualifying notes for the measurements of Standard Dynamic Range, High Dynamic Range, screen luminance for Automatic Brightness Control, Peak White luminance ratio and other luminance measurements; and the functioning of the forced menu.

**Part 2** details the test equipment requirements and UUT configuration; information on additional elements for measurements and calculations; the summary of order of testing; and the details of testing.

## Part 1

**Table 1: References and qualifying notes**

	Notes
<p><b>P<sub>measured</sub></b> Standard dynamic range (SDR) on-mode, “normal”</p>	<p><b>Power measurement notes</b> (See Part 2 for informative notes regarding the testing of Displays with a standardised DC input or a non-removable battery providing the primary power. For the purposes of these Transitional Measurement Methods a standardised DC input is solely one compatible with the various forms of USB power delivery.</p> <p><b>Video Signals Notes</b> The 10-minute Dynamic Broadcast video sequence described in existing relevant standards shall be replaced with an updated 10-minute Dynamic Broadcast video sequence. This is available for download at: <a href="https://circabc.europa.eu/ui/group/1582d77c-d930-4c0d-b163-4f67e1d42f5b/library/23ab249b-6ebc-4f45-9b0e-df07bc61a596?p=1&amp;n=10&amp;sort=modified_DESC">https://circabc.europa.eu/ui/group/1582d77c-d930-4c0d-b163-4f67e1d42f5b/library/23ab249b-6ebc-4f45-9b0e-df07bc61a596?p=1&amp;n=10&amp;sort=modified_DESC</a></p> <p>Two files are available, in SD and HD. They are respectively titled “SD Dynamic Video Power.mp4”, and “HD Dynamic Video Power.mp4”. SD resolution is made available for the limited types of display that cannot accept or display higher resolution standards. The HD resolution file is used for all other display resolutions since this closely matches the average picture level (APL) of the current IEC HD dynamic broadcast dynamic test sequence described in existing relevant standards. Upscaling from HD to higher native resolution shall be performed by the Unit Under Test (UUT) and not by an external device. Where upscaling has to be performed by an external device the full details of the device and the signal interface with the UUT shall be recorded. The data signal from the downloaded file storage system to the UUT digital signal interface shall be confirmed to provide peak white and full black video levels. If the file playback system has special picture optimisation features (e.g. deep blacks or enhanced colour processing) these shall be disabled. For repeatability of measurement purposes, the details of the file storage and playback system shall be recorded as well as the type of digital interface with the UUT (e.g. HDMI, DVI etc.) The power measurement P<sub>measured</sub> is an average value from the full 10-minute length of the dynamic test sequence, taken with ABC disabled.</p>

<p><b>P<sub>measured</sub></b> High dynamic range (HDR) on-mode “normal” (auto mode switching to HDR)</p>	<p>No existing relevant standard is published so far.</p> <p>Following the P<sub>measured</sub> (SDR) dynamic test sequence measurement two HDR dynamic test sequences shall be played.</p> <p>These 5-minute sequences are rendered in HD resolution only, in the common HDR standards of HLG and HDR10. Upscaling from HD to a higher native display resolution shall be performed by the UUT and not an external device. Where upscaling has to be performed by an external device the full details of the device and the signal interface with the UUT shall be recorded.</p> <p>These files are available for download at: <a href="https://circabc.europa.eu/ui/group/1582d77c-d930-4c0d-b163-4f67e1d42f5b/library/38df374d-f367-4b72-93d6-3f48143ad661?p=1&amp;n=10&amp;sort=modified_DESC">https://circabc.europa.eu/ui/group/1582d77c-d930-4c0d-b163-4f67e1d42f5b/library/38df374d-f367-4b72-93d6-3f48143ad661?p=1&amp;n=10&amp;sort=modified_DESC</a> and have identical programme content.</p> <p>The files are respectively titled “HDR-HLG Power.mp4” and “HDR_HDR10 Power.mp4”</p> <p>It is essential that the UUT switch to the HDR display mode is confirmed in the picture settings menu before power data is logged. The integrated power measurement for each sequence (P<sub>av</sub>) shall be summed and halved for the calculation of the label HDR energy efficiency class and label HDR power declaration.</p> <p>If the UUT cannot be tested in one of these HDR formats, this shall be noted and the power declared shall be the P<sub>av</sub> measured for the HDR format that is supported.</p> <p>An ABC allowance does not apply in HDR display mode.</p> <p><math>P_{measured\ HDR} = 0.5 * (P_{av\ HLG} + P_{av\ HDR10})</math></p> <p>If one of these HDR display modes is not supported, the measured numerical value of (P<sub>av</sub> HLG) or (P<sub>av</sub> HDR10) as appropriate, shall be used for Label VII and Label VIII declarations.</p>
<p>Screen Luminance Measurement for automatic brightness control (ABC) control characteristics evaluation and any other peak white luminance measurement requirement.</p>	<p>No existing relevant standards can be used.</p> <p>A new variant of the “box and outline” dynamic test pattern providing a dynamic format with colour shall be used for all peak white display luminance measurements and not the 3-bar black and white pattern.</p> <p>A set of these variant dynamic test patterns, which combine the box and outline format and VESA L10 to L80 white measurement box format shall be used as described in Section 2.3.4. of Part 2 and are available for download at: <a href="https://circabc.europa.eu/ui/group/1582d77c-d930-4c0d-b163-4f67e1d42f5b/library/4f4b47a4-c078-49c4-a859-84421fc3cf5e?p=1&amp;n=10&amp;sort=modified_DESC">https://circabc.europa.eu/ui/group/1582d77c-d930-4c0d-b163-4f67e1d42f5b/library/4f4b47a4-c078-49c4-a859-84421fc3cf5e?p=1&amp;n=10&amp;sort=modified_DESC</a></p>

	<p>They are contained in the subfolders labelled SD, HD and UHD.</p> <p>Each subfolder contains eight peak white dynamic test patterns from L10 to L80. A resolution may be chosen according to the native resolution and signal compatibility of the UUT. The selection of pattern within the appropriate resolution shall be based upon a) the minimum required white box dimensions for correct operation of the contact luminance measuring instrument and b) such that no power limiting effect is exhibited by the UUT (large areas of white may result in a reduction of peak white levels) Any upscaling shall be performed by the UUT and not an external device. The data signal from the downloaded file storage system to the UUT digital signal interface shall be confirmed to provide peak white and full black video levels and have no other video enhancement processing (e.g. deep blacks / colour enhancement) Both the storage system and signal interface type shall be noted. For displays tested using a USB, or USB compatible data interface with the feature of power delivery, both the UUT and USB connected signal source shall operate from their own power source with the data path only connected.</p>
<p>Measurements related to ABC for “Allowances and adjustments for the purposes of the EEI calculation and functional requirements”</p>	<p>The methodology for ABC ambient light source set-up and luminance control as specified in existing standards shall not be used for the purposes of ABC related measurements for this regulation. The methodology to be used is detailed in Section 2.3.5. of Part 2.</p>
<p>Peak white luminance ratio</p>	<p>No existing relevant standards can be used.</p> <p>The “box and outline” dynamic test pattern selected for the ABC peak white luminance measurements (Part 2 Section 2.3.4) shall be used to measure the peak white luminance of the “normal configuration” with ABC on. If this is less than 150 cd/m<sup>2</sup> for monitors or 220 cd/m<sup>2</sup> for other display products, then a further measurement shall be made of the peak white luminance of the brightest pre-set configuration in the user menu (not the retail setting). ABC need not be on for the luminance ratio measurements but the status of the ABC (on or off) shall apply to both measurements. Where ABC is on, the illuminance shall be 100lux for both measurements. Care shall be taken to ensure that the dynamic test pattern selected for peak white luminance measurement in the “normal configuration” does not cause luminance instability in the brightest pre-set configuration. A smaller peak white box pattern shall be selected for both measurements if instability occurs.</p>
<p>Forced Menu and set-up menus</p>	<p>A UUT set up flow chart evaluating conformity with the set-up requirements of the regulation is shown in Section 2.1 of Part 2</p>

General notes	<p>The following test standards provide important supporting information for the specification of test equipment and the required testing conditions relevant to measurement and testing guidance given in this Annex.</p> <p>EN 50564:2011</p> <p>EN 50643:2018</p> <p>EN 62087-1:2016</p> <p>EN 62087- 2:2016</p> <p>EN 62087-3:2016</p> <p>EN IEC 62680 series of standards 2013 to 2020</p> <p>IEC TR 63274 ED1:2020 (Advisory technical report on HDR testing requirements)</p>
---------------	--

## Part 2

### 2.1 Additional elements for measurements and calculations

**Table 2: Test equipment requirements and UUT\* configuration**

Description of Equipment	Capabilities	Additional Capabilities and Characteristics
Power Measuring	Defined in relevant standard	Data logging function
Luminance Measuring Device (LMD)	Defined in relevant standard	Contact probe type with data logging function
Illuminance Measuring Device (IMD)	Defined in relevant standard	Data logging function
Signal Generation equipment	Defined in relevant standard	See Relevant Notes in: <i>Part 1 Table 1</i> . References and qualifying notes
Light Source (Projector)	Shall provide an illuminance at the ABC sensor of less than 12 lux and up to 150 lux for TVs and monitors and up to 20,000 lux for DSD from a minimum distance of approximately 1.5m from ABC sensor.	Solid state lamp engine (LED, Laser or LED /Laser combination). Colour gamut of projector shall be equal to or better than REC 709. Tilting Mounting platform allowing precise alignment of projector beam. This may be combined with or replaced by a built in Optical alignment feature.
Light Source (dimmable LED Lamp)	As specified in Section 2.3.1.	
Computer for simultaneous data logging on common timescale	At least 3 appropriate ports allowing interface with power, luminance and illuminance measuring devices.	USB and Thunderbolt ports are considered to be appropriate ports.
Computer with slide show and or picture editing application interfaced with projector	Application allowing projection of full-frame white image slides with simultaneous control over colour temperature and luminance (grey) level	

\* Unit Under Test

## 2.2 Summary of order of testing

1. Setup UUT on a stand identifying location of Auto Brightness Control (ABC) sensor where applicable and position display luminance and ambient light measuring instruments.
2. Run through initial setup confirming correct implementation of forced menu warnings and default settings of “normal configuration”.
3. Mute Audio where applicable.
4. Continue warm-up of sample while setting up test equipment and identifying peak white dynamic test pattern providing stable display luminance and power measurement.
5. If the ABC allowance is claimed, determine the illumination range and the ABC latency required for the sample. Profile the ABC of display luminance between 100 lux and 12 lux ambient light levels and measure on-mode power reduction between those limits. To provide detailed profiling of the ABC influence on power and display luminance, the ambient illumination range may be divided into several steps from just above the 100 lux illumination datum point (e.g. 120 lux) through 60 lux, 35 lux and 12 lux to the darkest level allowed by the test environment. For digital signal displays additional profiling may be recorded up to daylight illuminance levels of 20 000 lux for data gathering for future reviews of the Regulation.
6. Measure peak luminance in the normal configuration. If this is less than 150 cd/m<sup>2</sup> for a monitor or 220 cd/m<sup>2</sup> for other display types, also measure the peak luminance of the brightest pre-set configuration in the user menu (not the shop configuration).
7. Measure the on-mode power using the SDR dynamic broadcast video sequence with ABC disabled. Measure the on-mode power using the HDR dynamic broadcast video sequences confirming that HDR mode has been triggered (confirmed by display notification at start of HDR playback and / or change in normal configuration picture settings).
8. Measure the power requirement of low power and off modes and the time required by the automatic power down functions to take effect.

## 2.3. Details of testing

### 2.3.1. UUT (display) and measuring instrument set up

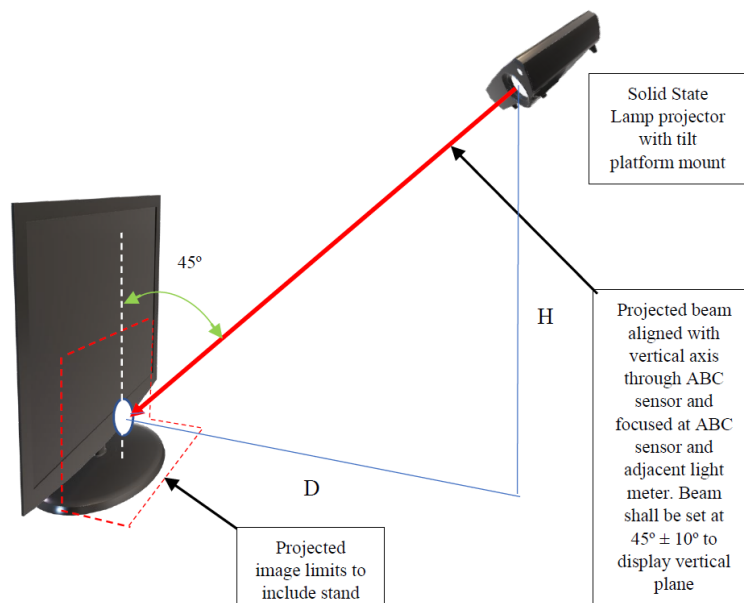


Figure 1: Physical set up of Display and ambient light source

If ABC function is available and the UUT is supplied with a stand this shall be attached to the display part and the UUT placed on a horizontal table or platform of at least 0,75 metres height covered in a black low reflectivity material (typical materials are felt, fleece or canvas theatrical backdrop). All parts of the stand shall remain exposed. Displays intended primarily for wall mounting shall be frame mounted for ease of access with the lower edge of the display at least 0,75 metres from the floor. The floor surface under the display and up to 0,5 metres in front of the display must not be highly reflective and ideally covered in black, low reflectivity material.

The physical location of the UUT ABC sensor shall be determined and measured coordinates of that location, relative to a fixed point outside the UUT, noted. The distances H and D as well as the projector beam angle (see Figure 1) shall be noted to aid repeatability of measurements. Depending on, the light source illuminance level requirements the distances H&D shall normally be equal  $\pm 5\text{mm}$  and measure between 1,5 m to 3 m. For the projector beam angle adjustment, a black slide with a small white centre box can be used to focus at the ABC sensor and provide a narrow beam of light for angular measurement. If an ABC sensor is designed to work optimally with an illuminance beam angle outside the  $45^\circ$  recommended, this preferred angle may be employed and the details recorded. Where a non-contact (distant location) luminance meter is used with a low beam angle for the light source, care shall be taken to ensure that the source is not reflected in the area of the display used for luminance measurement.

An illuminance meter shall be mounted as close as possible to the ABC sensor, taking precautions to avoid reflections of ambient light from the meter casing entering the sensor. This may be achieved by various methods in combination, including shrouding the illuminance meter in black felt and facilitating an adjustable mechanical mounting which does not allow the meter casing to protrude beyond the front of the ABC sensor.



The following proven procedure is recommended for an accurate and repeatable logging of ABC sensor illuminance levels with a minimum of mechanical mounting challenges. This procedure allows correction for any illuminance error introduced by the practical impossibility of mounting the illuminance meter at exactly the same physical position as the ABC sensor for simultaneous illumination. The procedure thus allows simultaneous illumination of the ABC sensor and illumination meter without physical disturbance of the UUT and meter after set-up. With appropriate logging software, the required step changes in illuminance can be synchronised to on-mode power measurement and display luminance measurement to automatically log and profile the ABC.

The illuminance meter shall be located a few centimetres away from the ABC sensor to ensure that direct reflections of the projector beam, from the meter casing, cannot enter the ABC sensor. The illuminance meter detector horizontal axis shall be on the same horizontal axis as the ABC sensor with the meter vertical axis strictly parallel to the display vertical plane. The physical coordinates of the meter mounting point relative to the fixed external point used to record the physical location of the ABC sensor shall be measured and noted.

The projector shall be mounted in a position with the axis of its projected beam in line with a vertical plane perpendicular to the display surface and running through the vertical axis of the ABC sensor (see Figure 1) The projector platform height, tilt and distance from the UUT shall be adjusted to allow a full frame peak white projected image to focus on an area covering the ABC sensor and illuminance meter whilst delivering the maximum ambient illumination level (lux) required at the sensor for testing. In this context it shall be noted that some Digital Signage Displays have ABC operative in ambient light conditions from up to 20 000 lux to below 100 lux.

The contact luminance meter for display luminance measurement shall be rigged to align with the centre of the UUT screen. The projected illuminance image overlapping the horizontal surface below the UUT display shall not extend beyond the vertical plane of the display unless a reflective stand encroaches into a larger forward area than this, in which case the edge of the image shall be aligned with the extremities of the stand (see Figure 1). The top horizontal edge of the projected image shall not be less than 1 cm below the lower edge of the contact luminance meter shroud. This may be achieved by optical adjustment or the physical positioning of the projector, within the constraints of the required 45° beam angle and the required maximum illuminance at the ABC sensor.

With the UUT and illuminance meter position coordinates noted and the projector producing a stable illuminance within the range to be measured (normally stability is achieved a few minutes from switch-on with solid state lamp engines) the UUT shall be moved sufficiently to allow the illuminance meter front face and detector centre to be aligned with the physical position coordinates noted for the UUT ABC sensor. The illuminance measured at this point shall be noted and the meter returned to its original set-up position along with the UUT. The illuminance shall be measured again at the set-up position. The percentage difference between the illuminance measured at the two test positions (if any) may be applied in final reporting as a correction factor to all further illuminance measurements (this correction factor does not change with illuminance level). This provides an accurate data set for the illuminance at the ABC sensor even though the lux measuring instrument is not situated at that point and allows the simultaneous plotting of display luminance, power and illuminance to accurately profile the ABC.

No further physical changes shall be made to the test set up.

Unlike televisions, digital signage displays may have more than one ambient light sensor. For testing purposes, the technician shall determine a single sensor to be utilised in the test, eliminating the other light sensors by obscuring them with opaque tape. Unwanted sensors may also be disabled if control is provided to do so. In most instances the most suitable sensor to use would be a front-facing one. Measurement methods for digital signage displays with multiple light sensors may be explored further as a test method refinement to be qualified in a harmonised standard.

For test laboratories preferring to use a dimmable lamp source instead of a projector light source in the described test set up, the following lamp specification shall apply and the measured lamp characteristics recorded.

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  $90 \text{ mm} \pm 5 \text{ mm}$ . The rated beam angle of the lamp shall be  $40^\circ \pm 5^\circ$ . The rated correlated colour temperature (CCT) shall be  $2700 \text{ K} \pm 300 \text{ K}$  throughout the illuminance range 12 lux to the peak illuminance required for testing. The rated colour rendering index (CRI) shall be  $80 \pm 3$ . The front surface of the lamp shall be clear (i.e., not coloured or coated with a spectrum modifying material) and may have a smooth or granular front surface; when shined against a uniform white surface, the diffusion pattern shall appear smooth to the naked eye. The lamp assembly shall not modify the spectrum of the LED source, including the IR and UV bands. The characteristics of the light shall not vary across the full range of dimming required for the ABC testing.

### **2.3.2. Check of correct implementation of “normal configuration” and energy impact warnings**

A power meter shall be connected to the UUT for observation purposes and at least one video signal source provided. During this test the persistence of ABC in all other pre-set configurations, except “shop configuration” shall be confirmed.

### **2.3.3. Audio Setting**

An input signal shall be provided containing audio and video (the 1 kHz tone on the SDR video power test material is ideal) The sound volume setting shall be reduced to a zero-display indication, or a mute control activated. It must be confirmed that activation of the mute control has no effect on “normal configuration” picture parameters.

### **2.3.4. Identifying the peak white luminance pattern for peak white luminance Measurements**

When a UUT displays a peak white pattern, the display may quickly dim within the first few seconds and gradually dim until stable. This makes it impossible to measure, in a consistent and repeatable way, power and luminance values, immediately after the image is displayed. In order to have repeatable measurements, some level of stability must be achieved. Testing on displays using current technology indicates that 30 seconds shall be sufficient time to allow for luminance stability of a peak white image. As a practical observation, this time window also allows for any on-screen status display to disappear.

Current display products often have built-in electronics and display drive software to protect, the display power supply from being over-driven and the screen from suffering persistence (burn-in) by limiting total power to the screen. This can result in a limited luminance and limited power consumption when displaying, for example a large area of white dynamic test pattern.

In this test methodology, the measurement of peak luminance is made while displaying a 100% white dynamic test pattern, but the area of white is empirically limited to avoid the triggering of protection mechanisms. The appropriate dynamic test pattern is determined by displaying the range of eight “box and outline” dynamic test patterns based on VESA “L” dynamic test patterns from smallest (L 10) to largest (L 80), while recording power and screen luminance. A graph of power and screen luminance vs L pattern shall assist in determining if and when display drive limiting is occurring. For example, if power consumption is increasing from L 10 to L 60, while luminance is either increasing or constant (not decreasing) then those patterns are not appearing to cause limiting. If dynamic test pattern L 70 indicates no increase in power consumption or luminance (where there was an increase in previous L patterns), this would indicate that limiting is occurring at L 70 or between L 60 and L 70. It may also be that limiting has occurred between L 50 and L60 and the graphed points at L 60 were in fact sloping downward. Therefore, the largest pattern where we are sure no limiting occurs is L 50 and this is the correct pattern to use for the peak luminance measurement. Where a luminance ratio has to be declared, the selection of the luminance pattern shall be made in the brightest pre-set setting. If the UUT is known to have display luminance drive characteristics which do not allow the selection of an optimum dynamic peak white luminance dynamic test pattern by the above selection procedure the following simplified selection process may be employed. For displays equal to or greater than 15,24 cm (6 inches) and less than 30,48 cm (12 inches) diagonally, the L 40 PeakLumMotion signal shall be used. For displays greater than or equal to 30,48 cm (12 inches) diagonally, the L 20 PeakLumMotion signal shall be used. The dynamic peak white luminance dynamic test pattern selected by either procedure shall be declared and used for all luminance testing.

### **2.3.5. Determination of ABC ambient light control range and latency of ABC action.**

For the purposes of the Regulation (EU) 2019/2021 an ABC power allowance is provided in the EEI declaration if the ABC control characteristic meets specific requirements of display luminance control between ambient light levels of 100 lux and 12 lux with datum points of 60 lux and 35 lux. The change in display luminance between 100 lux and 12 lux ambient light change must provide a 20 % decrease in display power requirement for conformance with a regulation power allowance. The dynamic luminance “L” dynamic test pattern used to assess ABC luminance control conformance may also be simultaneously used to assess the power reduction conformance.

For digital signage displays, a much wider range of ABC control with illuminance change may apply and the test methodology described here may be extended to gather data for future revisions of the Regulation.

#### **2.3.5.1 ABC Latency Profiling**

The latency of the ABC control function is the time delay between the ambient light change sensed at the ABC detector and the resulting change in UUT display luminance. Testing data has shown that this delay can be as long as 60 seconds and this must be taken into account when profiling ABC control. For latency estimation, the 100 lux slide (see 2.3.5.2), at a stable display luminance condition, is switched to the 60 lux slide and the time interval required to achieve a stable lower display luminance level recorded. At the lower stable luminance level, the 60 lux slide is switched to the 100 lux slide and the time interval to achieve a stable higher luminance level noted. The higher value of time interval is the one used for latency with a discretionary 10 seconds added. This is saved as the slide show projection period for each slide.

### 2.3.5.2 Light Source Illumination Control

For ABC profiling, a peak white dynamic test pattern as identified in 2.3.4 is displayed on the UUT, as the brightness of the light source is altered from white through a range of grey slides to simulate ambient illumination changes. For illumination level control the first slide grey transparency is altered to achieve the starting point of the profiling (e.g. 120 lux) by measuring the lux level at the illuminance meter. The slide is saved and copied. A new grey transparency level is set for the copy to the required datum point of 100 lux and the slide saved and copied. The process is repeated for the datum points of 60 lux, 35 lux and 12 lux. A black (0 % transparency) illuminance slide can be added here for data plotting symmetry and the datum point slides copied and introduced in ascending illumination order back to 120 lux.

### 2.3.5.3 Light Source Colour Temperature Control

A further requirement is to set a colour temperature for the white point of the projected light to ensure repeatability of test data if a different projector light source is used for verification purposes. For this test methodology a white point colour temperature of  $2700\text{ °K} \pm 300\text{ °K}$  is specified for consistency with ABC methodology in earlier test standards.

This white point is readily set in any major computer application for slide creation by the use of a suitable colour solid fill (e.g. Red/Orange) and transparency adjustment.

With these tools the normally colder projector white point may be adjusted to the  $2700\text{ °K}$  suggested, by altering the transparency of the selected colour whilst measuring colour temperature via a function of the illuminance meter. Once the required temperature is achieved it is applied to all slides.

### 2.3.5.4 Data Recording

The power consumption, screen luminance and illuminance at the ABC sensor are measured and logged during the slide show. This data must correlate with time. Data points for three parameters must be logged in order to relate power consumption, to screen luminance and illuminance of the ABC sensor. Any number of slides can be created between datum points for high granularity of data within the constraints of available test time duration.

For DSD designed to operate in a wide range of ambient lighting conditions the operating range of the ABC control over display luminance can be manually established with the black transparency control operating on a single projected slide of peak white pre-set to the required colour temperature. The recommended pre-set configuration of the DSD for a wide range of ambient light operating conditions shall be selected from the user menu. At a stable display luminance point the projected slide shall be switched from 0 % to 100 % black transparency to establish the latency period. This shall then be applied to slide grey transparency steps from black to a point where no change occurs in display luminance to establish the operating range of the ABC. A slide show can then be created in the granularity required to profile that range.

### 2.3.6. Display luminance measurements

With ABC enabled and 100 lux ambient light level measured at the illuminance meter, the UUT shall display the selected peak white luminance pattern (see 2.3.4) at a stable luminance. For Regulation conformance, luminance measurement shall confirm that the display luminance level is  $220\text{ cd/m}^2$  or more for all display categories other than monitors. For monitors, a conformance level of  $150\text{ cd/m}^2$  or more is required. For displays without

ABC or devices that do not claim the ABC allowance, measurements may be made without the ambient light part of the test rig.

For those displays which by design intention have a declared display peak white luminance level, in the normal configuration, of less than the conformance requirement of 220 cd/m<sup>2</sup> or 150 cd/m<sup>2</sup>, as applicable, a further peak white measurement shall be made in the pre-set viewing configuration providing the highest measured peak white luminance. For Regulation conformance the calculated ratio of the normal viewing configuration peak white luminance measurement and the highest peak white luminance measurement shall be 65 % or greater. This is declared as the “luminance ratio”.

For those UUT with ABC that can be switched off a further Conformance test should be conducted in the normal configuration.

The stabilised peak white luminance pattern shall be displayed in the measured 100 lux ambient illumination condition. It shall be confirmed that the UUT power requirement, measured with ABC on, is the same as or less than the power requirement measured at a stabilised luminance with ABC off. If the measured power is not the same, the mode which yields the highest measured power shall be used for on mode power.

### **2.3.7. Measurement of on-mode power**

For each of the UUT powering systems covered below, SDR power shall be measured in the normal configuration, using the HD version of the 10 minute “SDR dynamic video power test” file, unless input signal compatibility is restricted to SD. The file source and UUT input interface shall be confirmed to be capable of delivering full black and full white video data levels. Any upscaling of HD video resolution to the native resolution of the UUT display must be processed by the UUT and not an external device where the UUT allows this. If an external device must be used to achieve upscaling to the native resolution of the UUT then details of that device and its interface with the UUT shall be recorded. The power declaration is the average power determined during the playback of the full 10-minute file.

HDR power, where the function applies, is measured using the two 5-minute HDR files “HDR-HLG power” and “HDR- HDR10 power”. If one of these HDR modes is not supported, HDR power shall be declared on the supported mode.

Test instrumentation characteristics and test conditions as detailed in relevant standards apply to all power testing.

Product warm up with current UUT display technology need not be protracted and is most conveniently conducted with the dynamic peak white luminance dynamic test pattern identified in section 2.3.4 above. When power readings are stable with the UUT displaying this pattern power measurements with the SDR and HDR dynamic video power test files may commence.

Where a product has ABC, this shall be switched off. If it cannot be switched off the product shall be tested in the 100 lux measured ambient light conditions described in section 2.3.5 above.

For UUT intended for use on AC mains including those using a standardised DC input but with an external power supply (EPS) provided packaged with the UUT, onmode power shall be measured at the AC supply point.

- (a) For UUT with a standardised DC input (only USB-compatible power delivery standards apply) power measurement shall be made at the DC input. This is

facilitated by a USB break out unit (BOU) which maintains the data path of the supply connector and UUT DC input but interrupts the power delivery path to allow current measurement and Voltage measurement inputs to the power meter. The USB BOU power meter combination must be fully tested to ensure that their design and maintenance condition do not interfere with the cable impedance sensing function of some USB power delivery standards. The power recorded via the USB BOU shall be the power declared or the on-mode power measurement declaration (Ecodesign and labelling,  $P_{measured}$ ) in SDR mode and HDR mode).

- (b) For unusual UUT covered by the definitions of the Regulation but designed to operate from an internal battery which cannot be bypassed or removed for the required power testing the following methodology is proposed. The caveats or EPS and standardised DC input detailed above apply in the choice of AC or DC input power declaration.

For the purposes of the methodology the following qualifications apply:

*Fully charged battery:* Point during charging when according to the manufacturer's instructions, by indicator or time period the product does not need to be charged anymore. Visual profiling of this point shall be made for subsequent reference with a graphical representation of the power meter charging log made with power measurements of 1 second granularity in a 30-minute period before and after the fully charged point.

*Fully discharged battery:* A point in on-mode, with the UUT disconnected from an external power source, where the display switches off automatically (not through auto standby functions) or ceases to function while displaying an image.

If there is no indicator or no stated charge time period the battery shall be fully discharged. The battery shall then be recharged with all display user-controlled functions off. The power input against time with a data granularity no less than one reading per second shall be automatically logged. Where the log shows the start of a low power flat line battery maintenance mode or the start of a very low power period with spaced bursts of power, the time logged to that point from the start of the charge cycle of the battery, shall be regarded as the basic charge time.

*Preparation of battery:* Any unused Li-ion batteries shall be fully charged and fully discharged once, prior to conducting the first test on a UUT. All other unused battery chemistry/technology types shall be fully charged and fully discharged three times, prior to conducting the first test on the UUT.

### **Method**

Set up UUT for all the relevant testing as described in this testing methodology document. For the choice of AC or DC power measurement declaration, apply the caveats on powering above.

All dynamic test sequences involving power measurement for regulation conformance and declaration shall be performed with the product battery fully charged and the external power source disconnected. The fully charged condition shall be confirmed by the power meter log charging profile graph. The product shall be switched to the measurement mode required and the dynamic test sequence started immediately. After the dynamic test sequence is completed the product shall be switched off and a logged charging sequence commenced. When the charging log profile indicates a fully charged condition the average power recorded from the

logged start of charging to the logged start of the fully charged condition is the power to be recorded for the Regulation requirement.

Standby, networked standby and off modes (if applicable) will require long periods of battery loading to provide good data repeatability from the recharge average power (e.g. 48 hours for off or standby and 24 hours for networked standby).

For luminance measurement and ABC luminance profiling the external power source can remain connected.

For ABC power reduction test, the appropriate dynamic peak luminance sequence shall be continuously played for 30 minutes in a 12 lux ambient light condition. The battery shall be immediately recharged and the average power noted. The same shall be repeated for the 100 lux ambient condition and the difference between the average recharge powers confirmed to be 20 % or more.

For the SDR power declaration the appropriate 10-minute SDR dynamic power measurement sequence shall be played 3 times sequentially and the average battery recharge power requirement logged ( $P_{\text{measured (SDR) Watts}} = \text{recharge energy Watt hours} / \text{total playback time in hours}$ ).

For the HDR power declaration each of the two five-minute HDR dynamic power measurement files shall be played three times in quick succession and the average battery recharge power requirement logged ( $P_{\text{measured (HDR) Watts}} = \text{recharge energy Watt hours} / \text{total playback time hours}$ ).

### **2.3.8. Measure power requirement of low power and off modes**

Test instrumentation and test conditions as detailed in relevant standards apply to all low power and off mode power testing. The AC or DC power measuring caveats of 2.3.7 above apply and the special test procedure for battery powered displays covered in 2.3.7 shall be used where applicable.