

INTERNATIONAL STANDARD



**Organic light emitting diode (OLED) displays –
Part 6-1: Measuring methods of optical and electro-optical parameters**

IEC 62341-6-1:2022

<https://standards.iteh.ai/catalog/standards/sist/c3cc35f5-b7bc-4b2d-8020-bda5bd9690f4/iec-62341-6-1-2022>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2022 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

[IEC 62341-6-1-2022](https://standards.iteh.ai/catalog/standards/sist/c3cc35f5-b7bc-4b2d-8020-bda5bd9690f4/iec-62341-6-1-2022)

<https://standards.iteh.ai/catalog/standards/sist/c3cc35f5-b7bc-4b2d-8020-bda5bd9690f4/iec-62341-6-1-2022>

INTERNATIONAL STANDARD



**Organic light emitting diode (OLED) displays –
Part 6-1: Measuring methods of optical and electro-optical parameters**

[IEC 62341-6-1:2022](https://standards.iteh.ai/catalog/standards/sist/c3cc35f5-b7bc-4b2d-8020-bda5bd9690f4/iec-62341-6-1-2022)

<https://standards.iteh.ai/catalog/standards/sist/c3cc35f5-b7bc-4b2d-8020-bda5bd9690f4/iec-62341-6-1-2022>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.260

ISBN 978-2-8322-5856-9

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	5
1 Scope	7
2 Normative references	7
3 Terms, definitions, and abbreviated terms	7
3.1 Terms and definitions	7
3.2 Abbreviated terms	8
4 Structure of measuring equipment	8
5 Standard measuring conditions	9
5.1 Standard measuring environmental conditions	9
5.2 Standard measuring dark room conditions	9
5.3 Standard setup conditions	9
5.3.1 General	9
5.3.2 Adjustment of OLED display modules	9
5.3.3 Starting conditions of measurements	9
5.3.4 Measuring equipment requirements	9
5.4 Standard locations of measurement field	11
5.5 Standard test patterns	12
6 Measuring methods for optical parameters	17
6.1 Primary luminance, colour, and uniformity of full-colour high-resolution modules	17
6.1.1 Purpose	17
6.1.2 Measuring conditions	17
6.1.3 Measuring methods for high-resolution full-colour modules	17
6.1.4 Maximum luminance of white and RGB primaries	19
6.1.5 Average colour of maximum white and RGB primaries	19
6.1.6 Luminance uniformity of white and RGB primaries	20
6.1.7 Colour non-uniformity of maximum white and RGB primaries	20
6.1.8 Colour additivity of maximum white and RGB primaries	21
6.1.9 White correlated colour temperature	21
6.2 Primary luminance, colour, and uniformity of low-resolution modules	21
6.2.1 Purpose	21
6.2.2 Measuring conditions	22
6.2.3 Measuring methods for low-resolution modules and segmented displays	22
6.3 Signal loading	22
6.3.1 Purpose	22
6.3.2 Measuring conditions	22
6.3.3 Measuring methods	22
6.4 Dark room contrast ratio	23
6.4.1 Purpose	23
6.4.2 Measuring conditions	23
6.4.3 Measuring method	23
6.5 Display colour gamut, colour gamut area, and colour gamut volume	24
6.5.1 Purpose	24
6.5.2 Measuring conditions	24
6.5.3 Measuring methods	24
6.5.4 Display colour gamut	24

- 6.5.5 Display colour gamut area in the CIE 1976 chromaticity diagram 25
- 6.5.6 Colour gamut volume 25
- 7 Measuring methods for power consumption 27
 - 7.1 Purpose 27
 - 7.2 Measuring conditions 27
 - 7.3 Measuring methods 27
 - 7.3.1 Measuring the power consumption relevant to luminance of the OLED display module without a signal decoding process 27
 - 7.3.2 Measuring the power consumption of the OLED display module's embedded video connection terminal with a signal decoding process 29
- Annex A (normative) Response time of passive matrix display panels 31
 - A.1 Purpose 31
 - A.2 Measuring conditions 31
 - A.3 Measuring methods 31
- Annex B (normative) Luminance current efficiency 33
 - B.1 Purpose 33
 - B.2 Measuring conditions 33
 - B.3 Measuring methods 33
- Annex C (informative) Veiling glare frustum 35
- Annex D (informative) Methods to obtain the correlated colour temperature (CCT) from chromaticity coordinates 36
 - D.1 Method 1: Use of McCamy's approximate formula 36
 - D.2 Method 2: Use of Javier Hernandez-Andres's approximate formula 36
 - D.3 Method 3: Graphical determination of correlated colour temperature 37
- Annex E (informative) Measuring performance of modern colour-managed displays and panels 40
 - E.1 Legacy displays 40
 - E.2 Modern displays 40
 - E.3 Results 42
 - E.4 Conclusion 45
- Annex F (informative) Simple window luminance and colour measurements 46
 - F.1 Background 46
 - F.2 Measuring conditions 46
 - F.3 Maximum full screen luminance 46
 - F.4 4 % window luminance 46
 - F.5 Sampled luminance non-uniformity 46
 - F.6 4 % window centre colour 47
 - F.7 Sampled colour non-uniformity 48
- Bibliography 49

- Figure 1 – Layout diagram of measurement setup 10
- Figure 2 – Standard measurement positions in the display active area 12
- Figure 3 – Test pattern scaling used to define the area size of the coloured rectangles in the active area of the display 12
- Figure 4 – Low APL loading series of red, green, blue, and white test patterns used for basic luminance, colour, and uniformity measurements 13
- Figure 5 – Medium (top) and high (bottom) APL loading versions of CTR pattern 14

Figure 6 – Standard low APL RGBCMY test pattern used for centre luminance and colour measurements.....	15
Figure 7 – Optional medium signal loading RGBCMY test pattern used for centre luminance and colour measurements	16
Figure 8 – Sequence for measuring luminance and colour at the nine standard display positions for all coloured tile patterns.....	18
Figure 9 – Colour of blackbody source at various temperatures as represented on the CIE 1931 chromaticity diagram	21
Figure 10 – Example of representation of the same primary colours in the CIE 1931 (left) and CIE 1976 (right) chromaticity diagrams	25
Figure 11 – Example of range in colours produced by a given display as represented by the CIELAB colour space	27
Figure 12 – Example of measurement setup of power consumption	28
Figure 13 – Example of measurement setup of power consumption with embedded video terminal	29
Figure A.1 – Relationship between driving signal and optical response times.....	32
Figure B.1 – Example of a measurement configuration for measuring luminance current efficiency	34
Figure C.1 – Pattern for veiling glare frustum.....	35
Figure D.1 – CIE 1931 XYZ chromaticity diagram	38
Figure D.2 – Blackbody locus (Planckian locus) and isotherm lines in CIE 1931 chromaticity diagram.....	39
Figure E.1 – Legacy model where the independent drive electronics provide a direct correlation between the input RGB signals and the display’s colour primaries.....	40
Figure E.2 – Examples of modern drive models using multi-dimensional LUTs for RGB (top) and multi-primary (bottom) displays	41
Figure E.3 – Example of signal loading behaviour for an RGBW display (top) and RGB (bottom) OLED display.....	43
Figure E.4 – Low APL loading test pattern with small box size (1/9 of the screen size dimensions)	44
Figure E.5 – Signal loading profiles for several input colours measured at the centre of the test pattern using Figure 8	45
Figure F.1 – Example of simple 4 % white window pattern at the centre of the screen	47
Table 1 – Standard digital-equivalent input signals for rendering the white, primary and secondary colours in test patterns.....	16
Table 2 – Example of luminance measured for the same colour at the standard nine screen positions and the resulting luminance non-uniformity.....	18
Table 3 – Example of the same colour measured at the nine standard screen positions and the resulting chromaticity non-uniformity	19
Table 4 – Scaling the size of the colour boxes in the APL loading pattern relative to the screen dimensions	23
Table 5 – Example of a module power consumption measurements summary sheet	28
Table 6 – Example of module power consumption measurements with contents.....	30
Table 7 – Example of module power consumption measurements with images.....	30
Table D.1 – x_e , y_e , A_i and t_i for Formula(D.3) and Formula (D.4)	37
Table E.1 – Example of luminance data for an RGB display and an RGBW OLED display.....	42

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ORGANIC LIGHT EMITTING DIODE (OLED) DISPLAYS –**Part 6-1: Measuring methods of optical and electro-optical parameters**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 62341-6-1 has been prepared by IEC technical committee 110: Electronic display devices. It is an International Standard.

This third edition cancels and replaces the second edition published in 2017. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) measuring methods for power consumption of displays that have an embedded video connection terminal are added;
- b) the contents description including video signal for power consumption is modified.

The text of this International Standard is based on the following documents:

Draft	Report on voting
110/1454/FDIS	110/1471/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all the parts in the IEC 62341 series, under the general title *Organic light emitting diode (OLED) displays*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

[IEC 62341-6-1:2022](https://standards.iteh.ai/catalog/standards/sist/c3cc35f5-b7bc-4b2d-8020-bda5bd9690f4/iec-62341-6-1-2022)

[https://standards.iteh.ai/catalog/standards/sist/c3cc35f5-b7bc-4b2d-8020-bda5bd9690f4/iec-](https://standards.iteh.ai/catalog/standards/sist/c3cc35f5-b7bc-4b2d-8020-bda5bd9690f4/iec-62341-6-1-2022)

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

ORGANIC LIGHT EMITTING DIODE (OLED) DISPLAYS –

Part 6-1: Measuring methods of optical and electro-optical parameters

1 Scope

This part of IEC 62341 specifies the standard measuring conditions and measuring methods for determining the optical and electro-optical parameters of organic light emitting diode (OLED) display modules, and where specified, OLED display panels. These methods are limited to flat displays measured in a dark room.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-845, *International Electrotechnical Vocabulary – Part 850: Lighting* (available at www.electropedia.org)

IEC 61966-2-1, *Multimedia systems and equipment – Colour measurement and management – Part 2-1: Colour management – Default RGB colour space – sRGB*

IEC 62341-1-2, *Organic light emitting diode (OLED) displays – Part 1-2: Terminology and letter symbols*

IEC 62341-6-2:2015, *Organic light emitting diode (OLED) displays – Part 6-2: Measuring methods of visual quality and ambient performance*

IEC 62087-3, *Audio, video, and related equipment – Determination of power consumption – Part 3: Television sets*

CIE 15:2004, *Colorimetry*, 3rd edition

CIE S 014-1, *Colorimetry – Part 1: CIE Standard Colorimetric Observers*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-845, IEC 62341-1-2, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1.1**signal pixel**

smallest encoded picture element in the input image

3.1.2**pre-gamma average picture level**

average input level of all signal pixels relative to an equivalent white pixel driven by a digital RGB input

Note 1 to entry: Unless otherwise stated, the pre-gamma average picture level (APL) will simply be referred to as average picture level in this document.

Note 2 to entry: The APL will normally be expressed as a percentage, where a full white screen at maximum drive level would be 100 % APL.

3.1.3**average luminance level****ALL**

average luminance of the input signal on all pixels

Note 1 to entry: ALL, which is calculated by averaging of post-gamma signal pixels, is also called as the post-gamma APL.

3.2 Abbreviated terms

ALL	average luminance level
APL	average picture level
CCT	correlated colour temperature
CIE	Commission Internationale de L'Eclairage (International Commission on Illumination)
CIELAB	CIE 1976 ($L^*a^*b^*$) colour space
CMY	cyan, magenta, and yellow
DRCR	dark room contrast ratio
DUT	device under test
eDP	embedded display port
LMD	light measuring device
LUT	look-up table
MIPI	mobile industry processor interface
PMOLED	passive matrix organic light-emitting diode
RGB	red, green, and blue
RGBCMY	red, green, blue, cyan, magenta, and yellow
SPD	spectral power distribution
sRGB	standard RGB colour space as defined in IEC 61966-2-1
TCON	timing controller
UCS	uniform chromaticity scale
WRGB	white, red, green, and blue

4 Structure of measuring equipment

The system diagrams and/or operating conditions of the measuring equipment shall comply with the structure specified in each item.

5 Standard measuring conditions

5.1 Standard measuring environmental conditions

Measurements shall be carried out under the standard environmental conditions as follows:

- temperature: 25 °C ± 3 °C
- relative humidity: 25 % RH to 85 % RH
- atmospheric pressure: 86 kPa to 106 kPa

When different environmental conditions are used, they shall be noted in the report.

5.2 Standard measuring dark room conditions

The luminance contribution from unwanted background illumination reflected off the test display shall be less than 1/20 of the display's black state luminance. If these conditions are not satisfied, then background subtraction is required, and it shall be noted in the test report. In addition, if the sensitivity of the LMD is inadequate to measure 1/20 of the black level, then the lower limit of the LMD shall be noted in the test report.

5.3 Standard setup conditions

5.3.1 General

Standard setup conditions are given below in 5.3.2, 5.3.3 and 5.3.4. Any deviations from these conditions shall be reported.

5.3.2 Adjustment of OLED display modules

The display shall be measured at its factory default settings. If other settings are used, they shall be noted in the test report. These settings shall be held constant for all measurements, unless stated otherwise. It is important, however, to make sure that not only the adjustments are kept constant, but also that the resulting physical quantities remain constant during the measurement. This is not automatically the case because of, for example, warm-up effects.

5.3.3 Starting conditions of measurements

Measurements shall be started after the OLED displays and measuring instruments achieve stability. It is recommended that, when the display is first turned on, it be operated for at least 30 min with a loop of colour patterns rendered on the screen. Sufficient warm-up time has been achieved when the luminance of the test feature to be measured varies by less than ±3 % over the entire measurement method for a given display image.

5.3.4 Measuring equipment requirements

5.3.4.1 General conditions

Light measurements shall generally be made in terms of photometric or colorimetric units for a CIE 1931 standard colorimetric observer as defined in CIE S 014-1. Luminance can be measured by a photometer, and CIE tristimulus values (X , Y , Z) or CIE chromaticity coordinates by a colorimeter. A spectroradiometer can also obtain photometric and colorimetric values through a numerical conversion of the measured spectral radiance data (see for example [1]¹). A non-contact LMD, where the LMD is not in direct contact with the screen, shall be used without an illumination source. The following requirements are given for these instruments:

¹ Numbers in square brackets refer to the Bibliography.

- a) The LMD shall be a luminance meter, colorimeter, or a spectroradiometer. The spectroradiometer shall be capable of measuring spectral radiance over at least the 380 nm to 780 nm wavelength range, with a maximum bandwidth of 10 nm for smooth broadband spectra. For OLED primaries with a bandwidth ≤ 25 nm, the maximum bandwidth shall be ≤ 5 nm. The spectral bandwidth of the spectroradiometer shall be an integer multiple of the sampling interval. For example, a 5 nm sampling interval can be used for a 5 nm or 10 nm bandwidth.

Ensure that the LMD has enough sensitivity and dynamic range to perform the required task. The measured LMD signal shall be at least ten times greater than the dark level (noise floor) of the LMD, and no greater than 85 % of the saturation level.

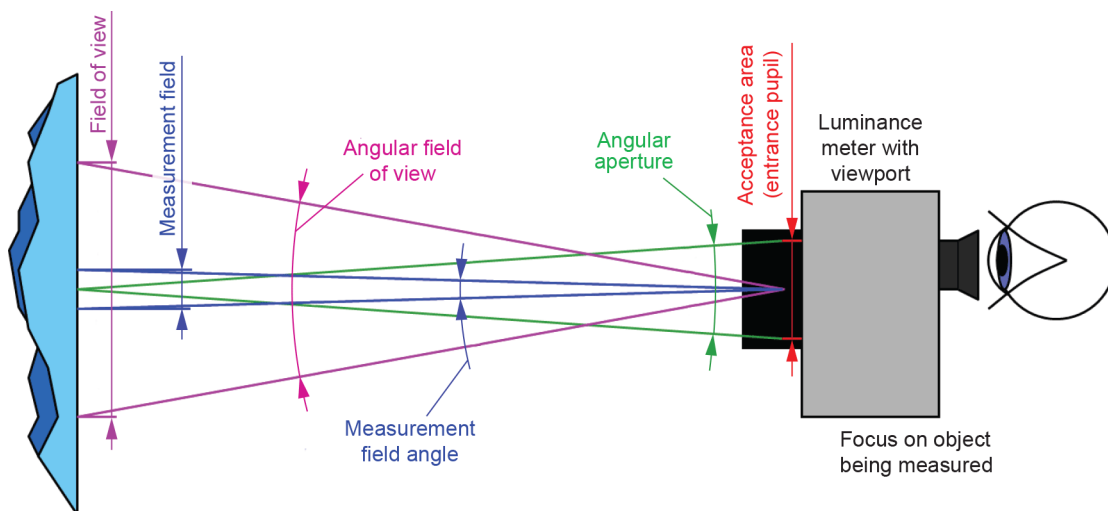
- b) The LMD shall be focused on the image plane of the display and generally aligned perpendicularly to the display surface at the centre of the measurement field, unless stated otherwise.
- c) The relative uncertainty and repeatability of all the measuring devices shall be maintained by following the instrument supplier's recommended calibration schedule.
- d) The LMD integration time shall be an integer number of frame periods, synchronized to the frame rate, or the integration time shall be greater than one hundred frame periods.
- e) If LMD measurements are taken for displays with impulse driving or duty driving, the high peak luminance of these displays can cause detector saturation errors. The accuracy of these measurements can be checked by attenuating the light with a neutral-density filter. If the change in signal amplitude of the detector is proportional to the transmittance of the neutral-density filter, then there are no detector saturation errors. This method is for measuring the maximum time-averaged full-screen luminance.

When using LMDs, stray light within the LMD (e.g. lens flare, veiling glare), and non-uniformities of sensitivity across detector area should be considered. Also, when measuring black regions, stray light from adjacent bright regions of the displays can introduce significant errors. The stray light can be significantly reduced by using a frustum (see Annex C).

IEC 62341-6-1:2022

In addition to LMDs that form an average value for the measured quantity over the measurement field under consideration (i.e. spot photometers, see Figure 1), there are imaging LMDs which give a value (or an array of values, e.g. R, G and B) for each individual area-element on the DUT. Such LMDs can replace a sequential mechanical scan of the surface of a display by an image of the entire active area of the DUT, and a subsequent evaluation of the data.

When imaging LMDs are used, a flat-field correction shall be applied to the LMD at the measuring distance.



IEC

Figure 1 – Layout diagram of measurement setup

5.3.4.2 High pixel count matrix displays (≥ 320 pixels \times 240 pixels)

The following applies for high pixel count matrix displays:

- a) When measuring matrix displays, the light-measuring devices should be set to a measurement field that includes more than 500 pixels. For LMDs with a circular measurement field, this would be equivalent to a disk with a diameter greater than 25 display pixels. If smaller measurement areas are necessary, photometric and colorimetric equivalence to 500 pixels shall be confirmed and noted in the test report.
- b) For small displays, the recommended measuring distance is between 20 cm to 50 cm. For larger displays, the measurement area shall contain at least 500 pixels. The measurement area contains at least 500 pixels. The measuring distance shall be noted in the report.
- c) The angular aperture shall be less than or equal to 5° , and the measurement field angle shall be less than or equal to 2° (see Figure 1).
- d) The display shall be operated at its design field frequency. When using separate driving signal equipment to operate a panel, the drive conditions shall be noted in the report.

5.3.4.3 Low pixel count matrix displays (< 320 pixels \times 240 pixels) and segmented displays

The following applies for low pixel count matrix displays:

- a) Low pixel count displays can contain fewer than 500 pixels. When the number of pixels in the measurement field is less than 500, it shall be noted in the report. The angular aperture shall be less than or equal to 5° , and the measurement field angle shall be less than or equal to 2° . The measuring conditions used shall be recorded.
- b) For segment displays, the angular aperture shall be less than or equal to 5° , and the measurement field angle shall be less than or equal to 2° . All measurements shall be performed at the centre of a segment with the measurement field completely contained within the segment.
- c) For small displays, the recommended measuring distance is between 20 cm to 50 cm. For larger displays, follow the manufacturer's recommended viewing distance. For larger displays, the measurement area shall contain at least 500 pixels. The measuring distance shall be noted in the report.

5.4 Standard locations of measurement field

Luminance, spectral distribution and/or tristimulus measurements may be taken at several specified positions on the display surface. The standard measurement locations are identified by positions P_1 to P_9 in the active area, as illustrated in Figure 2. The active screen area is divided into nine equal-sized boxes, with the measurement area centred within each box and identified by the corresponding numbering shown in Figure 2. Each box is $1/3$ of the width (W) and height (H) of the active area. Centre screen measurements are taken at position P_5 . The display or detector shall be translated in the horizontal and vertical directions to perform measurements at the desired display positions, with all measurements taken normal to the screen. Any deviation from the standard positions above shall be recorded.

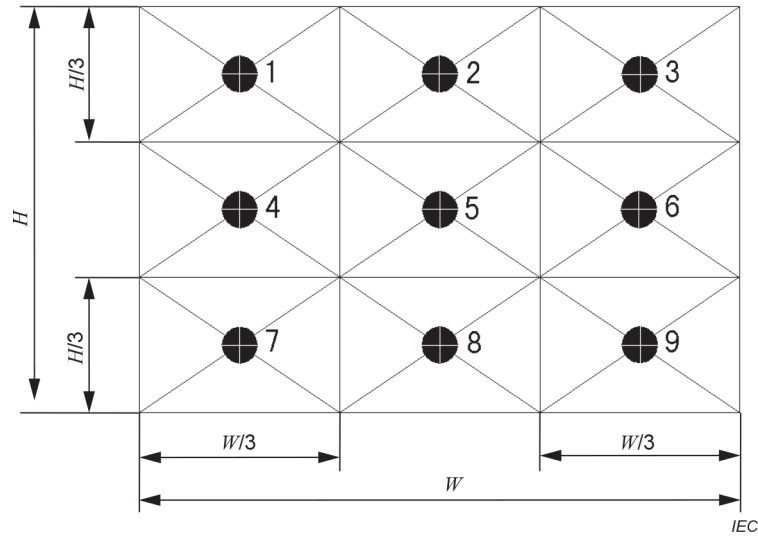


Figure 2 – Standard measurement positions in the display active area

5.5 Standard test patterns

The characterization of display luminance and colour can depend on the display test pattern. Therefore, several standard test patterns are given to help make the measurements more realistic to actual use cases (see Annex E). Additional test patterns may also be used (see Annex F). The standard test patterns use the scaling illustrated in Figure 3. The display is divided into a 3×3 array of rectangular areas, each of which has sides that are $1/3$ of the dimension of the height and width of the screen active area. Each of these nine rectangular areas can then be further subdivided into smaller rectangles, as demonstrated in the upper left-hand corner of Figure 3. The smallest subdivision would yield a rectangular box that has dimensions of $1/9$ of those of the active area of each region of the 3×3 array.

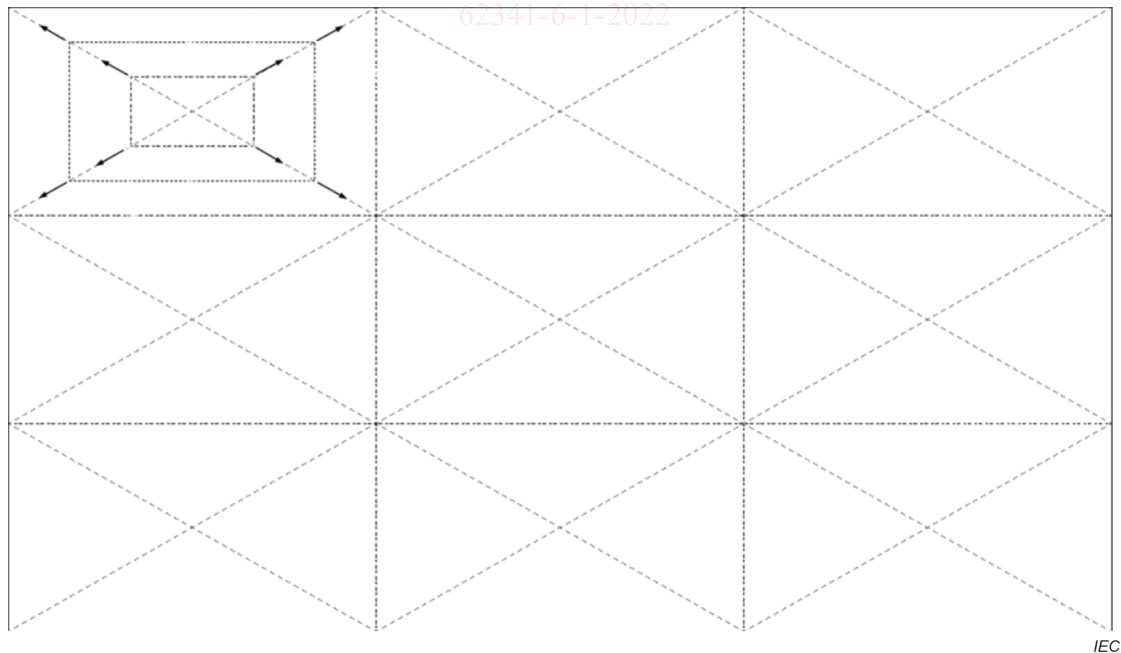


Figure 3 – Test pattern scaling used to define the area size of the coloured rectangles in the active area of the display

The standard test pattern for basic primary luminance and colour measurements shall use the low APL loading example of the colour tile test patterns illustrated in Figure 4. In this case, coloured rectangular boxes, with 1/9 of the dimensions of the active area, are centred on the nine standard active area locations on a black background. The red, green, and blue boxes are driven at the maximum input signal levels for the primary channels. For example, the red box is driven at the maximum input signal for the red channel, while the green and blue channels are at their minimum signal level. The white boxes are driven at their maximum red, green, and blue channel inputs. Each colour tile pattern is identified by the initials CT (colour tile) and the colour of the centre box. The patterns in Figure 4 are identified as CTR, CTG, CTW, and CTB starting at the upper left-hand pattern and moving clockwise.

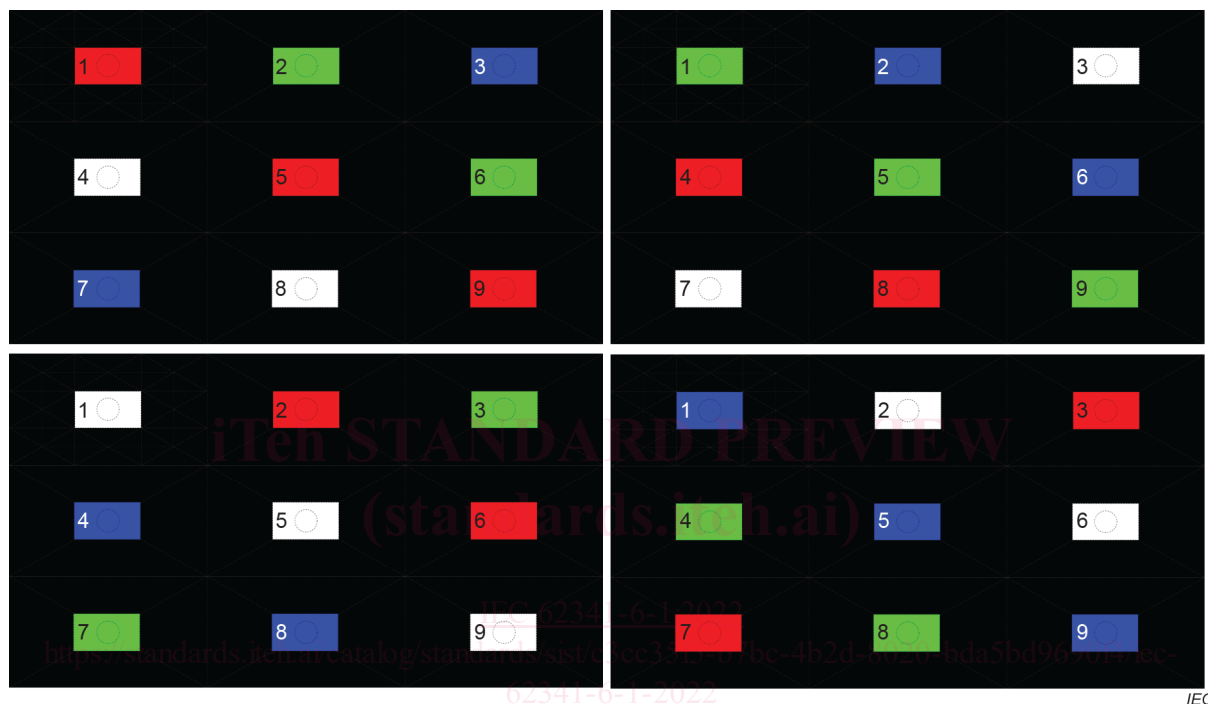


Figure 4 – Low APL loading series of red, green, blue, and white test patterns used for basic luminance, colour, and uniformity measurements

The area scaling of the coloured rectangles is adjusted to manipulate the APL loading on the display. The amount of APL loading is input-referred, assuming it is an RGB digital input. The percent APL is defined as:

$$\text{APL}(\%) = 100 \times \frac{\sum_{i=1}^N PL_i}{N} \quad (1)$$

where the summation is over all pixels in the active area, PL_i is the normalized signal pixel level of the i^{th} pixel relative to maximum white level, and N is the total number of pixels. A 100 % APL would be represented by all pixels in the active area at maximum white level. This would be implemented by setting the levels for the red, green, and blue input channels to their maximum values. A single primary colour (e.g. red) rendered on a full screen would have 1/3 of the APL of a full white screen. If it is assumed that the red, green, and blue areas correspond to 1/3 of the APL of the white areas, then the APL for each pattern in Figure 4 is (starting at the upper left-hand corner and going clockwise) 5,3 %, 5,3 %, 6,2 %, and 5,3 %. The average APL for the four patterns in Figure 4 is 5,6 %. An example calculation of the top left pattern in Figure 4 is given by: