IEC 62341-6-3

Edition 2.0 2017-11

INTERNATIONAL STANDARD

colour inside

Organic light emitting diode (OLED) displays – Part 6-3: Measuring methods of image quality

IEC 62341-6-3:2017-11(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub
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 It also gives information on projects, replaced and withdrawn publications.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 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 also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

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: csc@iec.ch.

IEC 62341-6-3

Edition 2.0 2017-11

INTERNATIONAL STANDARD

colour inside

Organic light emitting diode (OLED) displays –
Part 6-3: Measuring methods of image quality

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.260

ISBN 978-2-8322-4977-2

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

ORGANIC LIGHT EMITTING DIODE (OLED) DISPLAYS –

Part 6-3: Measuring methods of image quality

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.

International Standard IEC 62341-6-3 has been prepared by IEC technical committee 110: Electronic display devices.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

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

a) the measuring method for viewing angle has been modified. Measurement of the half luminance angle, gamma distortion, and directional colour variation is added;

b) measurement method for colour characteristics is added;

c) additional explanation is added in static image resolution clause;

d) moving image resolution clause has been moved to Annex B.

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

FDIS	Report on voting
110/901/FDIS	110/923/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 "http://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.

A bilingual version of this publication may be issued at a later date.

The contents of the corrigendum of October 2019 have been included in this copy.

IMPORTANT – The 'colour inside' logo on the cover page of this publication 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 6-3: Measuring methods of image quality

1 Scope

This part of IEC 62341 specifies the standard measurement conditions and measuring methods for determining the image quality of organic light emitting diode (OLED) display panels and modules.

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 62341-1-2:2014, *Organic light emitting diode (OLED) displays – Part 1-2: Terminology and letter symbols*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in 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 http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
average picture level
APL
average loading percentage of display sub-pixels based on input signal levels

3.1.2
static image resolution
maximum number of lines that can be adequately distinguished horizontally and vertically across the screen for static image signal inputs

Note 1 to entry: The unit of resolution is line, but pixel is also available as the unit of resolution.

3.1.3
colour fidelity
ability to reproduce the intended colour

3.1.4
colour desaturation
difference in chromaticity coordinates between solid colour and grilled pattern caused by image sharpening algorithm

3.1.5
directional gamma distortion
ratio of gamma differences between the perpendicular and other viewing direction

3.1.6
colour scale
range of luminance levels between maximum luminance and minimum luminance for the primary colour

3.2 Abbreviated terms

APL	average picture level
CCD	charge coupled device
CFF	critical flicker frequency
CIE	Commission Internationale de l'Eclairage (International Commission on Illumination)
CIELAB	CIE 1976 (L*a*b*) colour space
DUT	device under test
HVS	human visual system
LED	light emitting diode
LMD	light measuring device
MPPR	moving picture perceptual resolution
OLED	organic light emitting diode
PSF	point spread function
RGB	red, green, blue
SDF	stray light distribution function
SLSF	spectral line spread function

4 Standard measuring equipment and coordinate system

4.1 Light measuring device

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

To ensure reliable measurements, the following requirements apply to the light measuring equipment:

1) Luminance meter [1][1]: the instrument's spectral responsivity shall comply with the CIE photonic luminous efficiency function with a CIE-*f*1' value no greater than 3 % [2]; the relative luminance uncertainty of measured luminance (relative to CIE Illuminant A source) shall not be greater than 4 % for luminance values over 0,1 cd/m^2 and not greater than 10 % for luminance values 0,1 cd/m^2 and below.
2) Colorimeter: the detector's spectral responsivity shall comply with the colour matching functions for the CIE 1931 standard colorimetric observer with a colorimetric accuracy of 0,002 for the CIE chromaticity coordinates x and y (relative to CIE Illuminant A source) for luminance values over 1 cd/m^2. A correction factor can be used for the required accuracy by application of a standard source with similar spectral distribution as the display to be measured.

[1] Numbers in square brackets refer to the Bibliography.

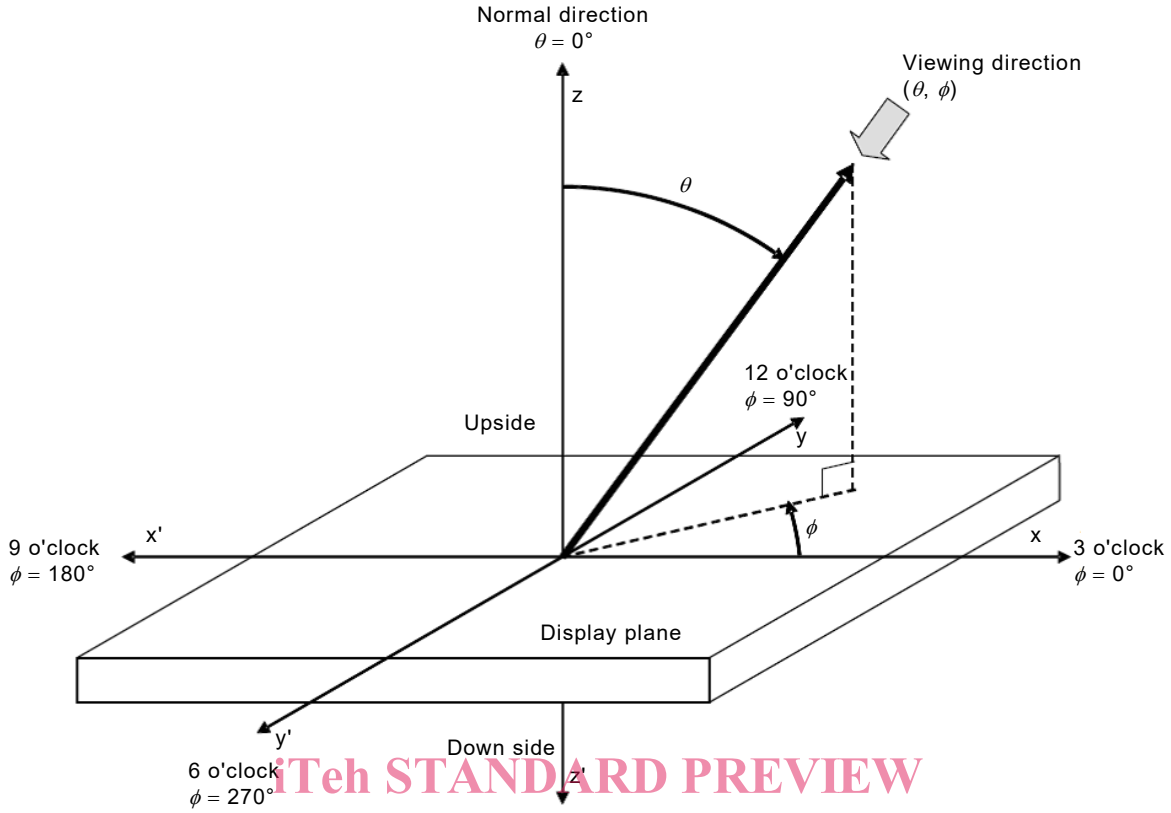
3) Spectroradiometer: the wavelength range shall be at least from 380 nm to 780 nm, and the wavelength scale accuracy shall be less than 1 nm. The relative luminance uncertainty of measured luminance (relative to CIE Illuminant A source) shall not be greater than 4 % for luminance values over 0,1 cd/m^2 and not greater than 10 % for luminance values 0,1 cd/m^2 and below. Note that errors from spectral stray light within a spectroradiometer can be significant and shall be corrected. A simple matrix method may be used to correct the stray light errors, by which stray light errors can be reduced by one to two orders of magnitudes. Details of this correction method are discussed in [3].

4) Goniophotometric mechanism: the DUT or LMD can be driven rotating around a horizontal axis and vertical axis; angle accuracy shall be better than 0,5°.

5) Fast-response photometer: the linearity shall be better than 0,5 % and the frequency response higher than 1 kHz.

4.2 Viewing direction coordinate system

The viewing direction is the direction in which the observer looks at the spot of interest on the DUT (see also IEC 62341-1-2:2014, Figure A.2). During the measurement, the LMD replaces the observer, looking from the same direction at a specified spot (i.e. measuring spot, measurement field) on the DUT. The viewing direction is conveniently defined by two angles: the angle of inclination θ (related to the surface normal of the DUT) and the angle of rotation ϕ (also called azimuth angle) as illustrated in Figure 1. The azimuth angle is related to the directions on a watch-dial as follows: $\phi = 0°$ is referred to as the 3-o'clock direction ("right"), $\phi = 90°$ as the 12-o'clock direction ("top"), $\phi = 180°$ as the 9-o'clock direction ("left") and $\phi = 270°$ as the 6-o'clock direction ("bottom").



Key

3 o'clock: right edge of the screen as seen from the perspective of the user

6 o'clock: bottom edge of the screen as seen from the perspective of the user

9 o'clock: left edge of the screen as seen from the perspective of the user

12 o'clock: top edge of the screen as seen from the perspective of the user

NOTE This coordination is defined by the angle of inclination and the angle of rotation (azimuth angle) in a polar coordinate system.

Figure 1 – Representation of the viewing direction

4.3 Standard measuring environmental conditions

Measurements shall be carried out under the standard environmental conditions:

- temperature: 25 ºC ± 3 ºC,
- 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 measurement report.

4.4 Power supply

The power supply for driving the DUT shall be adjusted to the rated voltage ± 0,5 %. In addition, the frequency of the power supply shall provide the rated frequency ± 0,2 %.

4.5 Warm-up time

Measurements shall be carried out after sufficient warm-up. Warm-up time is defined as the time elapsed from when the supply source is switched on, and a 100 % grey level of input signal is applied to the DUT, until repeated measurements of the display show a variation in luminance of no more than 2 % per minute and 5 % per hour.

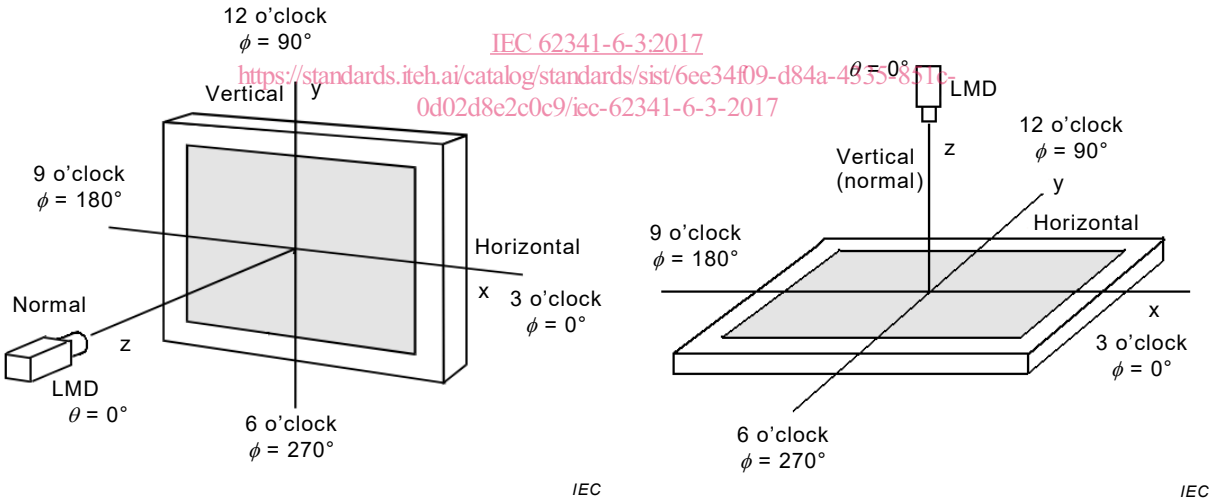
4.6 Standard measuring dark-room conditions

The luminance contribution from the background illumination reflected off the test display shall be < 0,01 cd/m^2. If these conditions are not satisfied, then background subtraction is required and it shall be noted in the measurement report. In addition, if the sensitivity of the LMD is inadequate to measure these low levels, then the lower limit of the LMD shall be noted in the measurement report.

4.7 Standard set-up conditions

By default, the display shall be installed in the vertical position (Figure 2a)), but the horizontal alternative (Figure 2b)) is also allowed. When the latter alternative is used, it shall be noted in the measurement report.

Luminance, contrast and chromaticity of the white field and other relevant parameters of the displays have to be adjusted to nominal status in the detailed specification and they shall be noted in the measurement report. When there is no level specified, the maximum contrast and/or luminance level shall be used. These adjustments shall be held constant for all measurements, unless noted otherwise in the measurement report. Additional conditions are specified separately for each measuring method.



a) Primary installation

b) Alternative installation

Figure 2 – DUT installation conditions

5 Measuring methods

5.1 Measuring methods for spatial image quality

5.1.1 Viewing angle

5.1.1.1 Purpose

The purpose of this method is to measure the viewing angle of an OLED display module in the horizontal (ϕ = 0˚, ϕ = 180˚) and vertical (ϕ = 90˚, ϕ = 270) viewing direction.

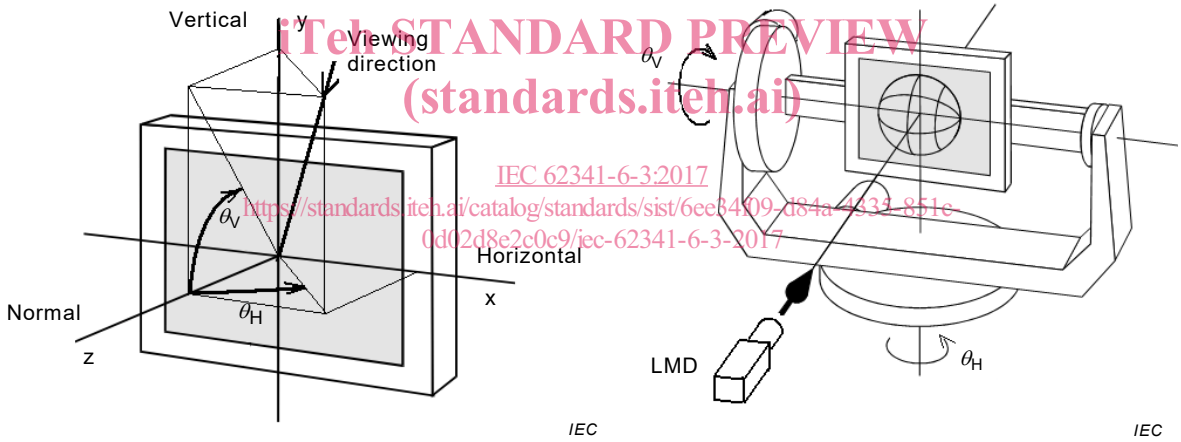
5.1.1.2 Measuring conditions

Standard measuring is implemented under standard dark-room and set-up conditions.

5.1.1.3 Set-up

For this measurement, the LMD and DUT shall be set up as follows:

1) Apparatus: an LMD to measure luminance and chromaticity of the DUT; a driving power source; a driving signal equipment; a geometric mechanism illustrated in Figure 3.
2) Mount the display and LMD in a mechanical system that allows the display to be measured along its vertical and horizontal planes, which lie normal to the display surface. Figure 3 illustrates the geometry to be used in this measurement. The angle relative to the display normal in the horizontal plane, the 3 o'clock and 9 o'clock direction, is expressed as θ_H, and the angle in the vertical plane, the 6 o'clock and 12 o'clock direction, by θ_V. Either the display can be tilted to scan both planes, or the LMD can be moved within these planes. During the measuring procedure, the LMD shall be directed at the same field of measurement for all angles of inclination. In either case, the centre of the measurement field shall remain at the same location on the DUT surface for all angles of inclination. The angular positioning of the display in the goniophotometric system shall be accurate to ±0,5º, and the measuring range shall be implemented from -90° to +90° both in the vertical and horizontal planes.



a) Geometric structure of display to be measured

b) Geometric system

Figure 3 – Conceptual geometry used for measuring the viewing angle range

3) Align the LMD perpendicular to the display surface (θ = 0, ϕ = 0), and position it to the centre of the display.

5.1.1.4 Measurement of the half luminance angle

The measurement shall be as follows:

1) Apply a 4 % window size white screen with a 100 % signal level (R = G = B = 255 for an 8-bit input signal) to the DUT as shown in Figure 4.
2) Measure the centre luminance (L_0) perpendicular to the display surface (θ = 0°, ϕ = 0°). The measurement area shall cover at least 500 pixels, or demonstrate equivalent results with fewer sampled pixels.
3) Take luminance ($L_{0,\phi}$) measurements as the LMD steps through the various angles in the horizontal (ϕ = 0°, ϕ = 180°) and vertical (ϕ = 90°, ϕ = 270°) viewing planes. The measurement area should not expand past the 4 % window at large viewing directions.