

INTERNATIONAL STANDARD



Liquid crystal display devices –
Part 30-5: Optical measuring methods of transmissive transparent LCD modules
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IEC 61747-30-5:2019

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LIQUID CRYSTAL DISPLAY DEVICES –

Part 30-5: Optical measuring methods of transmissive transparent LCD modules

FOREWORD

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International Standard IEC 61747-30-5 has been prepared by IEC technical committee 110: Electronic display devices.

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

FDIS	Report on voting
110/1047/FDIS	110/1070/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 61747 series, under the general title *Liquid crystal display devices*, 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- withdrawn,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.

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LIQUID CRYSTAL DISPLAY DEVICES –

Part 30-5: Optical measuring methods of transmissive transparent LCD modules

1 Scope

This part of IEC 61747 specifies the standard measurement conditions and measuring methods for determining the optical properties of transparent liquid crystal display modules which operate in a transmissive mode.

More specifically, this document focuses on three particular aspects of the transparent properties, i.e. transmittance, haze, and image distortion.

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 61747-1-2, *Liquid crystal display devices – Part 1-2: Generic – Terminology and letter symbols*

[IEC 61747-30-5:2019](#)

IEC 61747-30-1, *Liquid crystal display devices – Part 30-1: Measuring methods for liquid crystal display modules – Transmissive type*

ISO 11664-1, *Colorimetry – Part 1: CIE standard colorimetric observers*

ISO 11664-2, *Colorimetry – Part 2: CIE standard illuminants*

ISO 14782, *Plastics: Determination of haze for transparent materials*

3 Terms, definitions, symbols and units

For the purposes of this document, the terms, definitions, symbols and units given in IEC 61747-1-2, as well as 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

transparent liquid crystal display module

direct-view liquid crystal display module that can show the information on the screen and allow real objects to be viewed through the screen

3.2

on-screen property

visual properties when the focus of the viewer is on the display screen

**3.3
through-screen property**

visual properties when the focus of the viewer is on the object behind the display screen

**3.4
transmittance**

ratio of the transmitted radiant or luminous flux to the incident flux in the given conditions

[SOURCE: IEC 60050-845:1987, 845-04-59, modified – The text in brackets after the term has been omitted.]

**3.5
transmitted haze**

percentage of transmitted light that is scattered more than 2,5° from the direction of the incident beam relative to the total transmitted light

**3.6
sharpness**

apparent blurring of the border between two adjacent areas with different brightness

**3.7
colour shift**

change in chromaticity of an object when viewed through transparent liquid crystal display devices

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**3.8
contrast ratio offset**

change in contrast ratio of the reference object when viewed through transparent liquid crystal display devices

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**3.9
MTF****modulation transfer function**

ratio of the final to the initial signal amplitude as a function of the spatial frequency of the initial signal

[SOURCE: IEC 60050-881:1983, 881-04-65, modified – The abbreviated term "MTF" has been added, and the Note to entry, omitted.]

4 Measurement conditions**4.1 Standard measurement environmental conditions**

Measurements shall be carried out under standard environmental conditions:

- 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 measurement report.

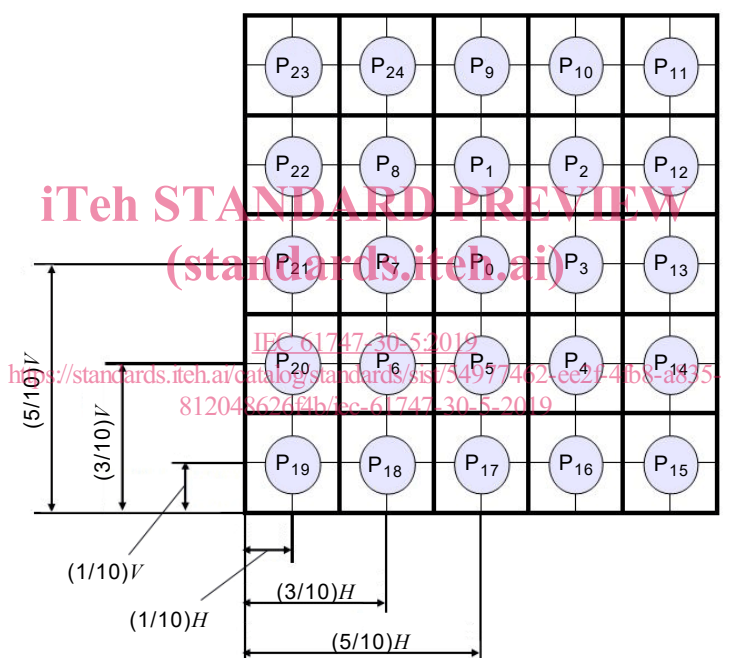
4.2 Standard measurement darkroom conditions

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

4.3 Standard measurement locations

Luminance, radiance distribution and/or tristimulus values may be measured at several specified positions on the surface of the device under test (DUT), see Figure 1. Unless otherwise specified, measurements are carried out in the centre of each circle. Care shall be taken to ensure that the measuring spots on the display do not overlap.

Any deviation from the above-described standard positions shall be added to the detail specification.



IEC

Figure 1 – Measurement points

5 Measurement methods of on-screen properties

5.1 Measurement equipment and its setup

Three different instruments may be applied to measure the light transmitted and/or reflected by the DUT: a luminance meter, colorimeter or spectroradiometer. The optical system is shown schematically in Figure 2 and will allow for measurement of well-defined spot sizes (measurement field) on the DUT.

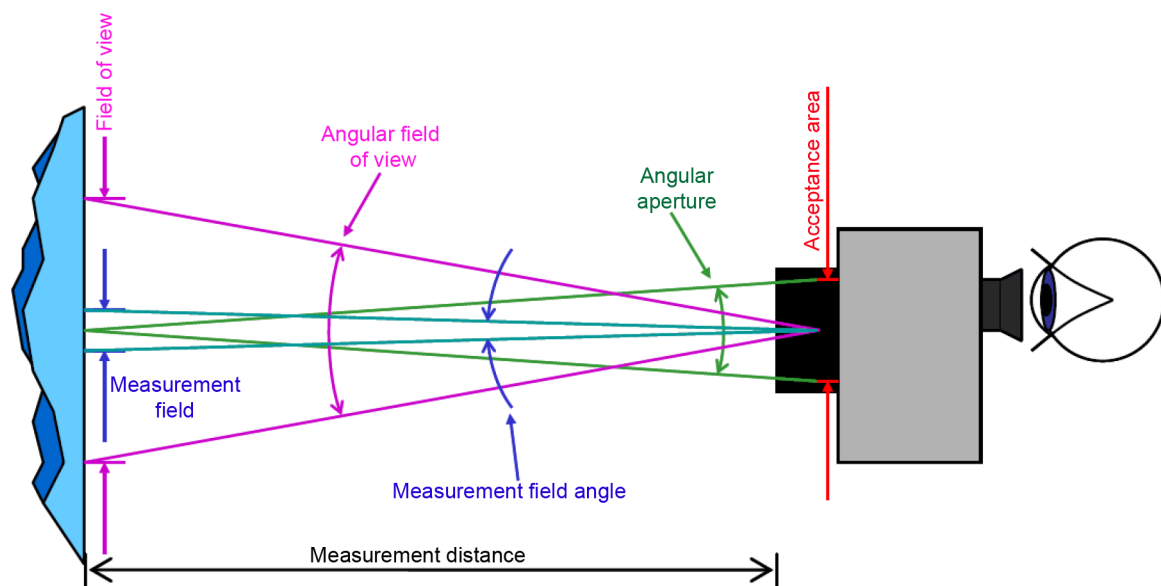


Figure 2 – Measurement equipment and its configuration

When the measure matrix displays, the above-mentioned meters should be set to a circular or rectangular field of view that includes more than 500 pixels on the display, and measured perpendicular to the screen surface (the standard measurement direction). Total angular aperture of detection by these meters: angular aperture shall be less than 5° and the measurement field angle should be less than 2° (see Figure 2). This can be obtained, for example, by having a measuring distance of 50 cm between the meters and the display area centre (recommended) (see Figure 2). If measuring segmented displays, the measurement field should be located completely inside a single segment, and should not include any of its surroundings.

For DUTs not equipped with their own source of illumination, an external backlight source should be used to provide uniform illumination to the DUT.

The isolated directed light source is the preferred directed source. If the display exhibits strong asymmetric scatter, then integrating spheres with the sample port close to the screen shall be used (e.g., Figure 3).

Measure the following parameters of the light source:

- spectrum of emission;
- luminance, L ;
- temporal stability of the luminance, $L(t)$;
- luminance distribution with viewing angle, $L(\theta, \phi)$.

Unless otherwise specified, it is recommended to use a spectrally smooth broadband light source that approximates the spectrum of CIE-D₆₅.

5.2 Measurement methods

For on-screen properties, such as luminance, chromaticity, viewing angle, reflection and so on, the test methods specified in IEC 61747-30-1 shall apply.

The choice of the appropriate tests depends on the application of the display modules. The relevant specification shall state which tests are applicable.

6 Measurement methods of through-screen properties

6.1 Luminous transmittance and its uniformity

6.1.1 Purpose

The purpose of this method is to determine the transmittance and the uniformity of transmittance of a transparent LCD panel under test.

6.1.2 Measurement conditions

For this measurement, the following conditions shall be applied.

- Apparatus: an integrating sphere with standard light source; a light measurement device that can measure the luminance; driving power source, and driving signal equipment. The measurement geometry is as shown in Figure 3.
- Standard environmental conditions for measurements: darkroom conditions; standard setup conditions.
- The distance between the light measurement device and integrating sphere should be consistent during the test, for example, set at 50 cm.

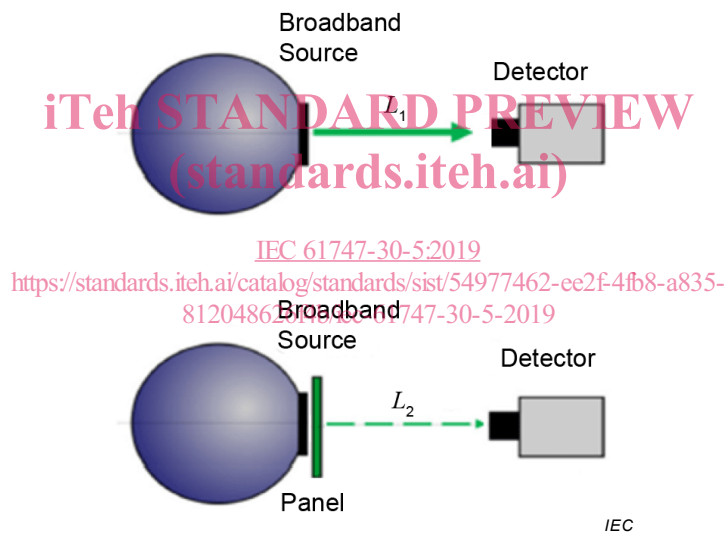


Figure 3 – Measurement configuration with light source

6.1.3 Measurement methods

The transmittance of the liquid crystal display device is obtained by comparing the luminous value of the DUT to the light source. It shall be ensured that all conditions remain constant during the measurement of both luminance values (temperature, illumination, etc.).

Proceed as follows:

- allow the apparatus sufficient time to reach thermal equilibrium before making any measurements;
- measure the luminance of the light source L_1 at the centre position P_0 ;
- mount the transparent LCD panel in front of the light source;
- apply a full-screen white signal at a 100 % grey level;
- measure the transmitted luminance L_2 at position P_0 .

Calculate the luminous transmittance, τ , as a percentage, using Equation (1):