IEC 62595-2

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

LCD backlight unit –
Part 2: Electro-optical measurement methods of LED backlight unit

Écran LCD à rétro-éclairage –
Partie 2: Méthodes de mesures électro-optiques d'un écran à rétro-éclairage à DEL

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LCD BACKLIGHT UNIT –

Part 2: Electro-optical measurement methods of LED backlight unit

FOREWORD

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International Standard IEC 62595-2 has been prepared by IEC Technical Committee 110: Electronic display devices.

The text of this standard is based on the following documents:

FDIS	Report on voting
110/384/FDIS	110/406/RVD

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

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

A list of all parts in the IEC 62595 series, published under the general title *LCD backlight unit*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

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LCD BACKLIGHT UNIT –

Part 2: Electro-optical measurement methods of LED backlight unit

1 Scope

This part of IEC 62595 series specifies the standard measurement conditions and measuring methods for determining electrical, optical, and electro-optical parameters of LED backlight units for liquid crystal displays.

NOTE Other backlights (Cold Cathode Fluorescent Lamps (CCFLs), External Electrode Fluorescent Lamps (EEFLs), Hot Cathode Fluorescent Lamps (HCFLs), Carbon Nano Tube (CNT), etc.) are excluded from this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at http://www.electropedia.org)

IEC 61747-6, *Liquid crystal and solid-state display devices – Part 6: Measuring methods for liquid crystal modules – Transmissive type*

IEC 62595-1-2, *LCD Backlight unit – Part 1-2: Terminology and letter symbols*

CIE publication 15:2004, *Colorimetry*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62595-1-2 apply.

4 General measurement conditions

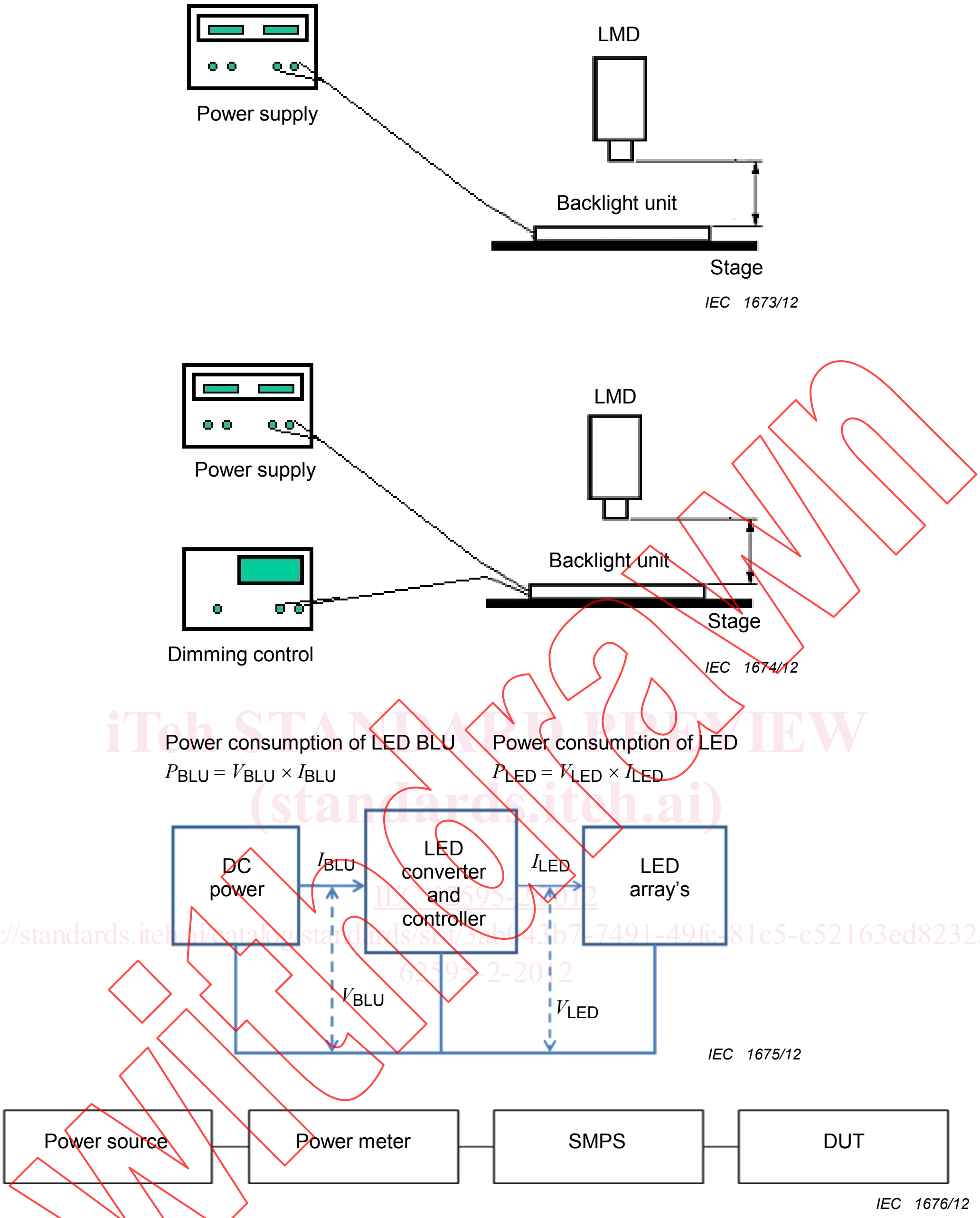
4.1 Standard atmospheric conditions for LED BLU

Unless otherwise specified, all tests and measurements for LED backlight unit shall be carried out after sufficient warm-up time for illumination sources and devices under test (see 4.3), under the standard environmental conditions, at a temperature of 25 °C ± 3 °C, at a relative humidity of 25 % to 85 %, and at an atmospheric pressure of 86 kPa to 106 kPa. When different environmental conditions are used, they shall be noted in the detail specification (see IEC 61747-6).

4.2 Measuring setup

DUT, LMD, power source, driving and control devices for LED, and electrical measuring devices should be arranged appropriately for electro-optical measurements for LED BLU.

An example of measuring setup is shown in Figure 1.



Key

LMD light measuring device

SMPS switching-mode power supply

DUT device under test

Figure 1 – Example of measuring setup for LED BLU

4.3 Warm-up time

Transient measurement shall be carried out and recorded until the fluctuations of luminance measured at the centre point of the BLU become less than the range specified in IEC 61747-6. As in Figure 2, luminance of LED backlights is affected by transient temperature behaviour of LED output. It takes a certain time for LEDs until their junction temperature reach the steady state. All measuring conditions shall be kept constant over the time range of recording. Transient measurement of chromaticity should be carried out in the same manner as in the above.

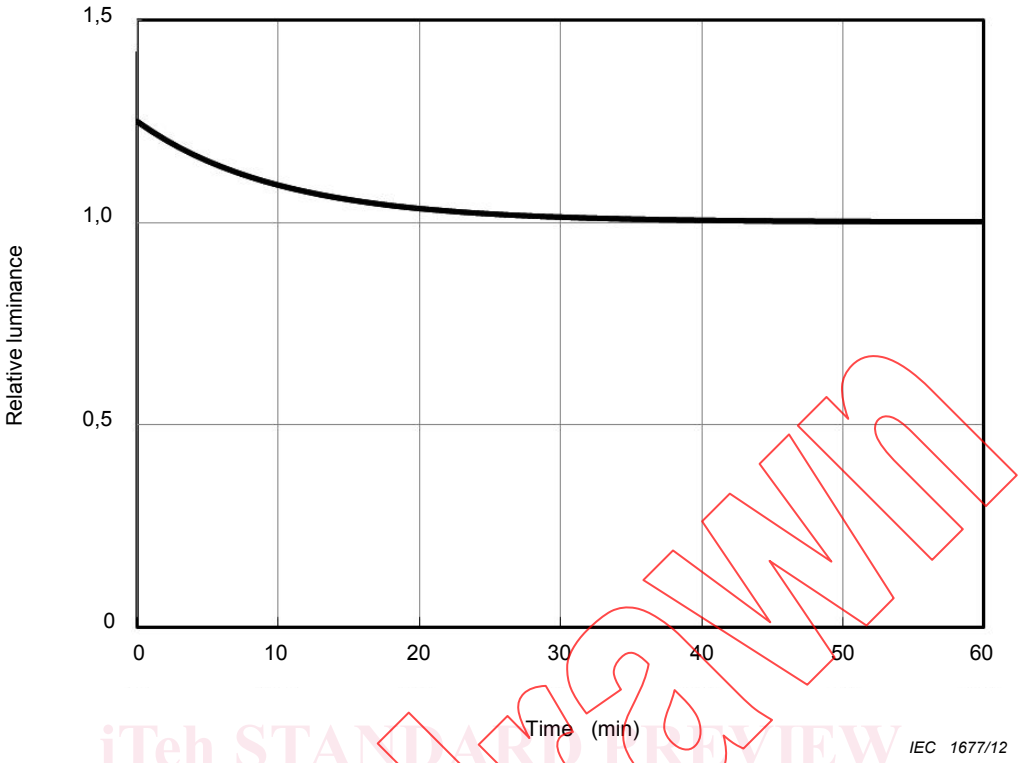


Figure 2 – Example of warm-up characteristic of BLU

5 Measurement methods

5.1 Electrical measurement methods

5.1.1 Conditions

BLU shall be placed in the measurement arrangement and it shall be assured that all required conditions are fulfilled.

After applying the initial electrical driving conditions (i.e. analogue input voltage(s) or digital input signals) of the BLU and waiting during the warm-up time specified in 4.3 in order to reach the steady state, the measurement of the electrical quantities of interest should be started.

5.1.2 Current

The measurement of input current is performed under standard measuring conditions using current meter shown in Figure 1.

5.1.3 Voltage

The measurement of input voltage is performed under standard measuring conditions using voltage meter shown in Figure 1.

5.1.4 Power consumption

Basically, the measurement of power consumption should be carried out under the standard measuring conditions in 4.1, using a power meter.

5.2 Optical measurement methods

5.2.1 Conditions

LED BLU to be measured should be placed in the measurement arrangement and it shall be assured that all required conditions are fulfilled.

After applying the initial electrical driving conditions to the BLU and after waiting during the warm-up time specified in 4.3 in order to reach the steady state, the measurement of the optical quantities of interest shall be started.

Basically, the measurement of this standard should be carried out at various angles between DUT and LMD. A polar coordinate system (θ,ϕ), with the zenith denoted by θ and the azimuth denoted by ϕ should be considered (see Figure 3).

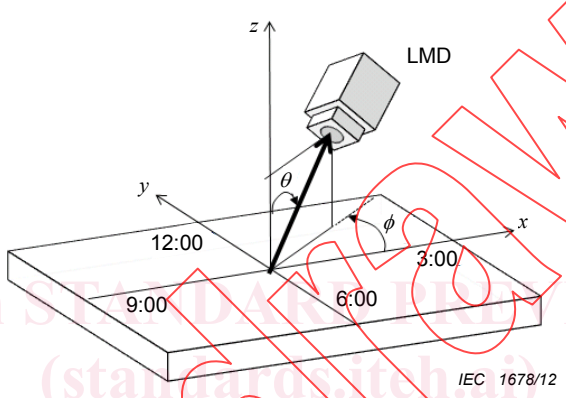


Figure 3 – Definition of zenith angle θ and azimuth angle ϕ.

5.2.2 Luminance

The measurements should be carried out in the dark room under the standard measuring conditions and for the design viewing directions.

a) Position the DUT.

b) Adjust the LMD to the specified viewing direction, according to angles θ and ϕ.

c) Supply the value of the input signals to the DUT. Then measure the DUT at position p_i to obtain the luminance L_{vi} (θ,ϕ). (In case of i = 0, the position implies the centre of the active area of the BLU.)

The LMD should be carefully checked before measurements, considering the following checkpoints:

- sensitivity of the measured quantity to measuring light;
- errors caused by veiling glare and lens flare (i.e., stray light in optical system);
- timing of data-acquisition, low-pass filtering and aliasing-effects;
- linearity of detection and data-conversion.

NOTE CIE publication 69:1987 is available for reference of LMD evaluation procedures.

5.2.3 Luminance uniformity

Luminance uniformity, U, is a calculated value of how well the luminance remains constant over the surface of the active area and it is a closely related to luminance measurement itself.

The luminance uniformity measurement is sensitive to testing positions. Typical layouts of measurement points over the BLU surface are shown in Figure 4.

Luminance uniformity, U is calculated using one of the following four formulas which are popularly used industry-wide.

$$U = \frac{L_{vm}}{L_{vM}}$$

$$U = \frac{L_{vM}}{L_{vm}}$$

$$U = \frac{L_{vM} - L_{vm}}{L_{vM}}$$

$$U = \frac{L_{vM} - L_{vm}}{L_{va}}$$

where

L_{vM} is the maximum luminance value of all measurement points in Figure 4;

L_{vm} is the minimum luminance; and

L_{va} is the average luminance calculated as:

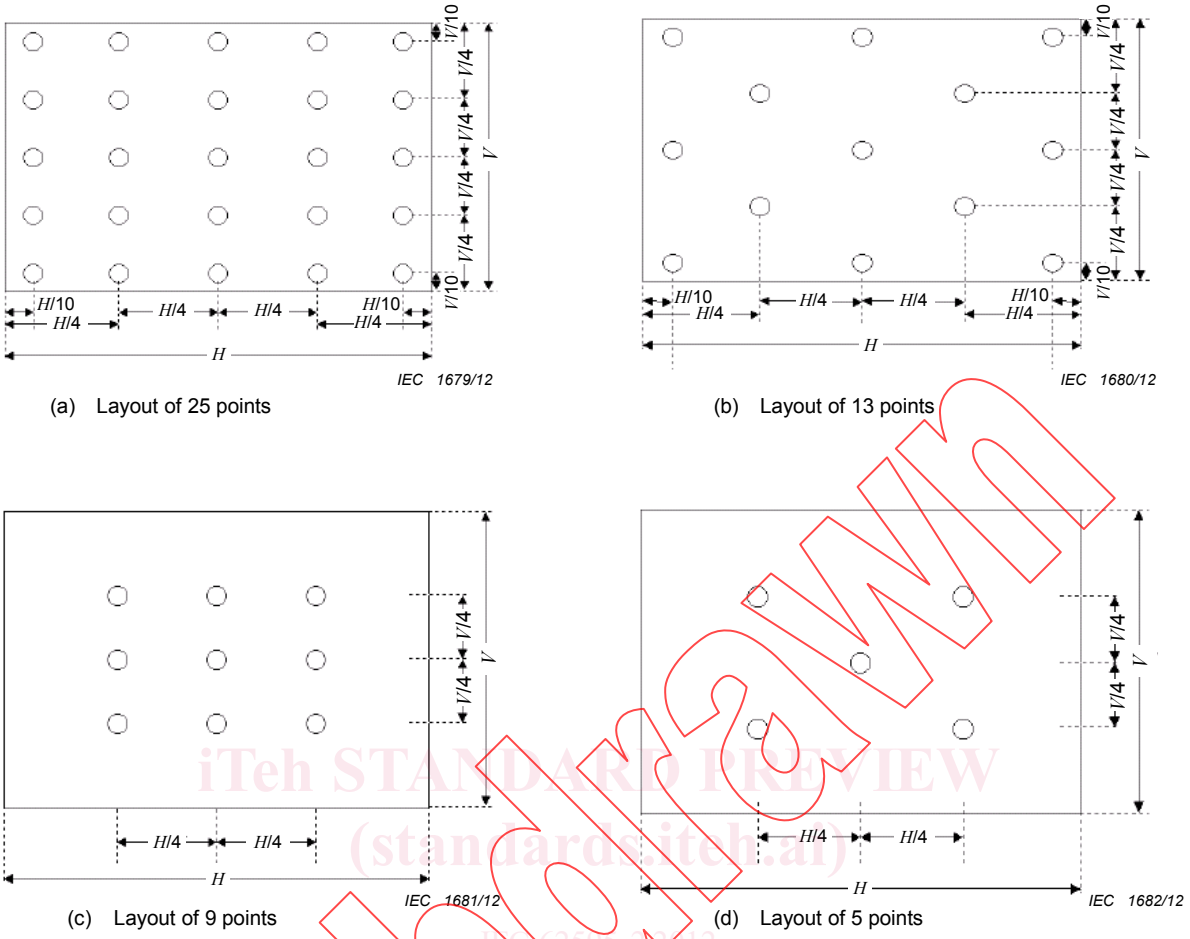
$$L_{va} = \sum_{i=1}^{N} \frac{L_{vi}}{N}$$

where

N is the number of measurement points; and

L_{vi} is luminance of an arbitrary point.

Typical measurement procedures of luminance uniformity U are as follows. At first, specified input current and voltage are supplied to the BLU to be measured. Secondly, luminance is measured at each point of the BLU (5, 9, 13 or 25 points). Basically, this measurement is carried out usually at normal angle, however, the other angles can be also considered for certain purposes.



(a) Layout of 25 points

(b) Layout of 13 points

(c) Layout of 9 points

(d) Layout of 5 points

Figure 4 – Examples of measurement point layout

5.2.4 Spectral power distribution

A spectral power distribution $S(\lambda)$ is measured using a spectrometer or an equivalent optical instrument. The measuring procedures are basically in accordance with 5.2.2 and 5.2.3.

5.2.5 Chromaticity

CIE 1931 chromaticity coordinates (IEC 60050-845:1987,845-03-28), x, y, z on the BLU surface of the active area are obtained using the tristimulus values, X, Y, Z calculated from measured spectral power distribution $S(\lambda)$ given in 5.2.4 (see IEC 62595-1-2). Basically, this measurement is carried out usually at normal angle, however, the other angles can be also considered for certain purposes.

5.2.6 Colour uniformity

Colour uniformity, $\Delta u'v'$ should be basically evaluated using CIE 1976 chromaticity(IEC 60050-845:1987,845-03-53) differences between the centre and the other points on the BLU surface, using the following equation.

$$\Delta u'v' = \mathrm{Max}\ [\ \{\ (u'_i - u'_{\mathrm{centre}})^2 + (v'_i - v'_{\mathrm{centre}})^2\ \}^{1/2}\ ]\ i = 1,2,3,...$$

where

$u' = 4x\ /\ (-2x + 12y + 3)$;

$v' = 9y\ /\ (-2x + 12y + 3)$;