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INTERNATIONAL STANDARD

colour inside

Display lighting unit –
Part 2-1: Electro-optical measuring methods of LED backlight unit

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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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 62595-2-1 has been prepared by IEC Technical Committee 110: Electronic display devices.

This first edition cancels and replaces the first edition of IEC 62595-2 published in 2012. This edition constitutes a technical revision.

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

a) changed the series title in order to cover frontlight unit;
b) added the detailed measurement procedures particularly for block-wise BLU;
c) deleted Annex A;
d) revised Figure 1 and Figure 2 and some editorial errors.

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

FDIS	Report on voting
110/731A/FDIS	110/743A/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 *Display lighting unit*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

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

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.

DISPLAY LIGHTING UNIT –

Part 2-1: Electro-optical measuring methods of LED backlight unit

1 Scope

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

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

IEC 62595-1-2, *Display lighting unit – Part 1-2: Terminology and letter symbols* [1]

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.2 Abbreviations

BLU backlight unit

FOV field of view

LMD light measuring device

LSF light spread function

4 General measurement conditions

4.1 Standard atmospheric conditions for LED BLU

Unless otherwise specified, all tests and measurements for LED BLU shall be carried out after sufficient warm-up time (see 4.3), under the standard environmental conditions, at a temperature of 25 °C ± 3 °C, a relative humidity of 25 % to 85 %, and 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 61747-30-1).

[1] To be published.

4.2 Measuring setup

Figure 1 shows a typical setup of a BLU, luminance meter, power source, block controller, voltmeters and current meters for electro-optical measurements for LED BLU.

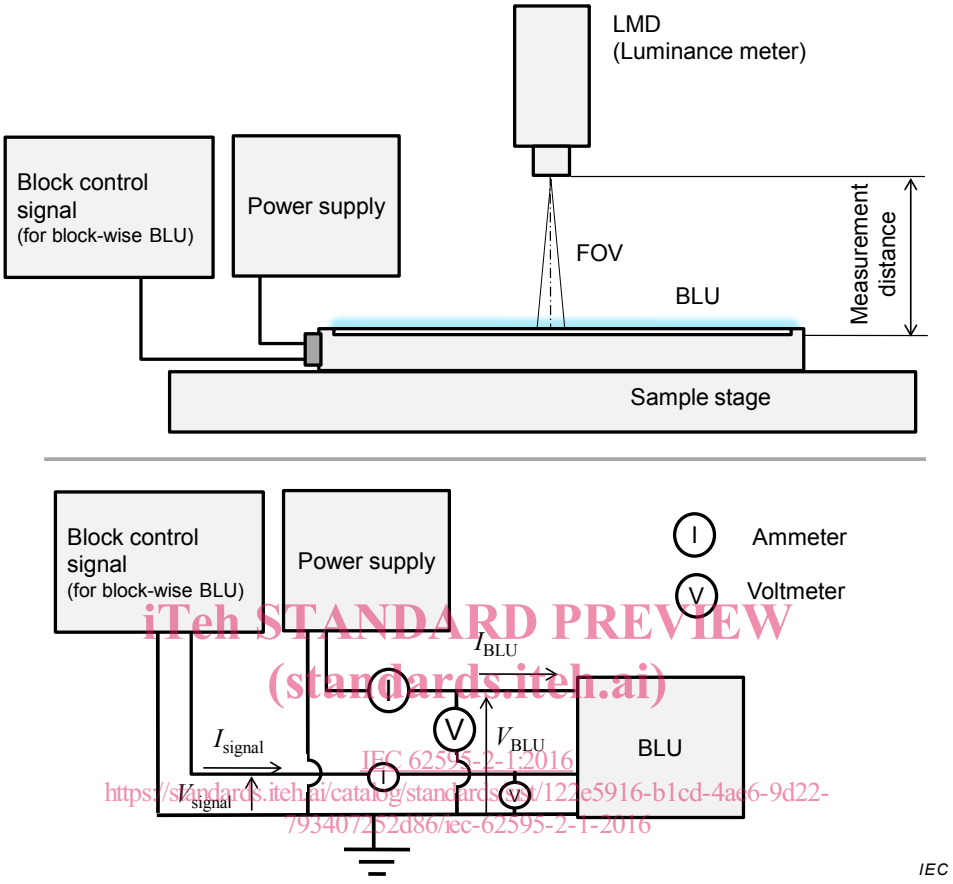

Figure 1 – Example of measuring setup for LED BLU

4.3 Warm-up time

The luminance of LED backlights is affected by the transient temperature behaviour of LED output as in Figure 2. It takes a certain time for LEDs until their junction temperature reaches the steady state. Luminance measurement shall be carried out and recorded until the fluctuations of luminance measured at an appropriate point (usually at the centre point) of the BLU become less than the range specified in IEC 61747-30-1 unless otherwise specified. The luminance measurement shall be carried out as in 5.2.2. All measuring conditions shall be kept constant during the measurements.

Chromaticity measurement shall be carried out in the same manner as in the above, unless otherwise specified. The chromaticity measurement shall be carried out as in 5.2.5.

The above measurements can be customized between the customer and the supplier, depending on various BLU sizes, applications, and so on.

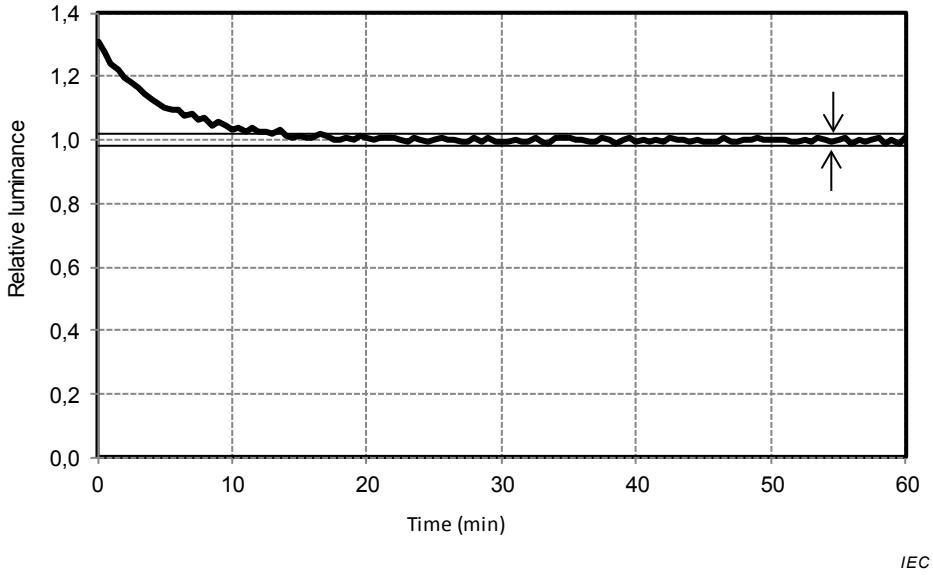

Figure 2 – Example of warm-up characteristic of BLU

5 Measurement methods

5.1 Electrical measurement methods

5.1.1 Conditions

The 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 shall be started.

5.1.2 Current

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

5.1.3 Voltage

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

5.1.4 Power consumption

The measurement of power consumption should be carried out under the standard measuring conditions in 4.1, using a power meter, or calculated by the measured values of voltage and currents in 5.1.2 and 5.1.3. For block-wise BLUs, the power consumption of the control signal shall be considered.

5.2 Optical measurement methods

5.2.1 Conditions

The 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 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. The measurement of this standard should be carried out at various angles between the BLU and the 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).

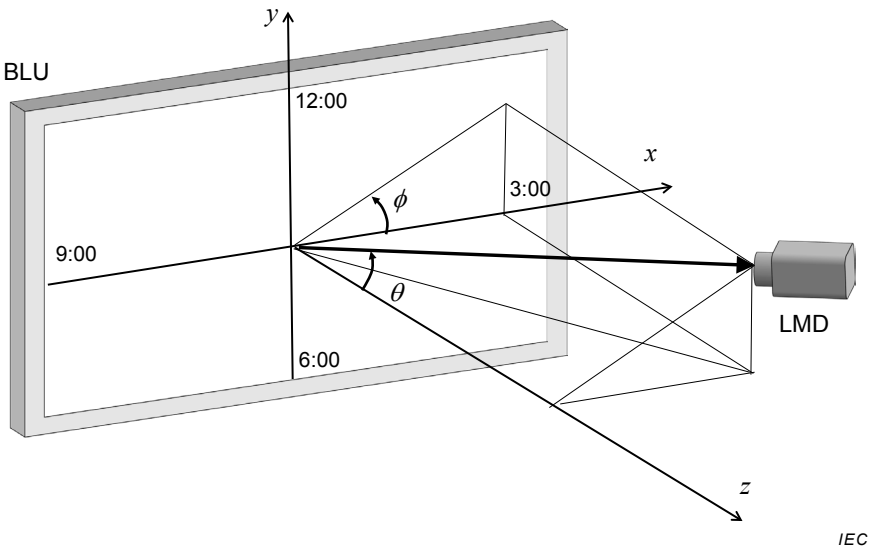

Figure 3 – Definition of zenith angle θ and azimuth angle ϕ

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, as follows:

a) Position the BLU.

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 BLU. Then measure the BLU 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 elements:

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

To ensure luminance accuracy for the intended LED sources, a broad bandwidth LMD should be calibrated using a spectrometer with a bandwidth 5 nm or less.

The luminance of BLU should be measured by synchronizing the LMD with the BLU refresh rate, or integrating the measured luminance over a number of frames.

NOTE ISO/CIE 19476 [1] [2] is available for reference to the LMD evaluation procedures.

5.2.3 Luminance uniformity or non-uniformity

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

The luminance uniformity or non-uniformity measurement is sensitive to the testing positions. Typical layouts of measurement points over the BLU surface are shown in Figure 4 [2].

Luminance non-uniformity, NU, is usually calculated using the following equation:

$$NU = \frac{L_{vM} - L_{va}}{L_{va}}$$

One of the following four equations is also used widely in display industries.

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

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 the i^{th} measurement 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 on the BLU on either five (positions p_0, p_{11}, p_{15}, p_{19}, and p_{23}) or nine (positions p_0, p_9, p_{11}, p_{13}, p_{15}, p_{17}, p_{19}, p_{21}, and p_{23}) points. This measurement is carried out usually at normal angle; however, other angles can also be considered for certain purposes.

2 Numbers in square brackets refer to the Bibliography.