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INTERNATIONAL STANDARD

colour inside

Display lighting unit –
Part 2-2: Measuring methods of LED light bars used in LCD BLUs

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DISPLAY LIGHTING UNIT –

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FOREWORD

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

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

CDV	Report on voting
110/890/CDV	110/932A/RVC

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 parts in the IEC 62595 series, published under the general title *Display lighting unit*, 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- withdrawn,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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DISPLAY LIGHTING UNIT –

Part 2-2: Measuring methods of LED light bars used in LCD BLUs

1 Scope

This document specifies the standard measurement conditions and measuring methods for determining electrical and optical performances of LED light bars with white LEDs used in LCD backlight units.

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

IEC 62595-2-1:2016, *Display lighting unit – Part 2-1: Electro-optical measuring methods of LED backlight unit*

ISO 11664-3, *Colorimetry – Part 3: CIE tristimulus values*

ISO/CIE 11664-5, *Colorimetry – Part 5: CIE 1976 L*u*v* colour space and u', v' uniform chromaticity scale diagram*

3 Terms, definitions, abbreviated terms and letter symbols

3.1 Terms and definitions

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

3.2 Abbreviated terms

BLU Backlight unit

CCT Correlated colour temperature

DUT Device under test

FOV Field of view

FWHM Full width at half maximum

LCD Liquid crystal display

LED Light emitting diode

LMD Light measuring device

MCPCB Metal core printed circuit board

3.3 Letter symbols (quantity symbols/unit symbols)

The letter symbols for this document are shown in Table 1.

Table 1 – Letter symbols (quantity symbols/unit symbols)

Distance between the LMD and the diffuser plate (see Figure 1)	D_1	(mm)
Distance between the diffuser plate and the LED light bar (see Figure 1)	D_2	(mm)
Mechanical origin of LED light bar	(x_o, y_o)	
Luminance profile of the effective area along the x-axis	$L_v(x, 0)$	(cd/m^2)
Luminance profile along the y-axis aligning the designed optical centre of the i^{th} LED	$L_v(x_{di}, y)$	(cd/m^2)
Average luminance of $L_v(x, 0)$	L_{va}	(cd/m^2)
Maximum luminance of $L_v(x, 0)$	L_{vM}	(cd/m^2)
Minimum luminance of $L_v(x, 0)$	L_{vm}	(cd/m^2)
Luminance non-uniformity of $L_v(x, 0)$	NU	(%)
CIE 1931 chromaticity coordinate of the i^{th} LED	$(x_{c,i}, y_{c,i})$	
CIE 1931 chromaticity coordinate of the LED light bar	(x_{ca}, y_{ca})	
CIE 1976 UCS chromaticity coordinate of the i^{th} LED	(u'_i, v'_i)	
CIE 1976 UCS chromaticity coordinate of the LED light bar	(u'_a, v'_a)	
Chromaticity difference for the i^{th} LED	$\Delta u'v'_i$	
Colour uniformity (maximum chromaticity difference)	U_c	
NOTE 1 An effective illuminating area is an illuminating area with acceptable uniformity for both supplier and vendor. NOTE 2 The effective area of a LED light bar is determined between the supplier and the vendor.		

4 Measuring configuration

4.1 General

The system configurations and the measuring equipment shall comply with 4.2 and 4.3. An example of the measuring system arrangement is shown in Figure 1.

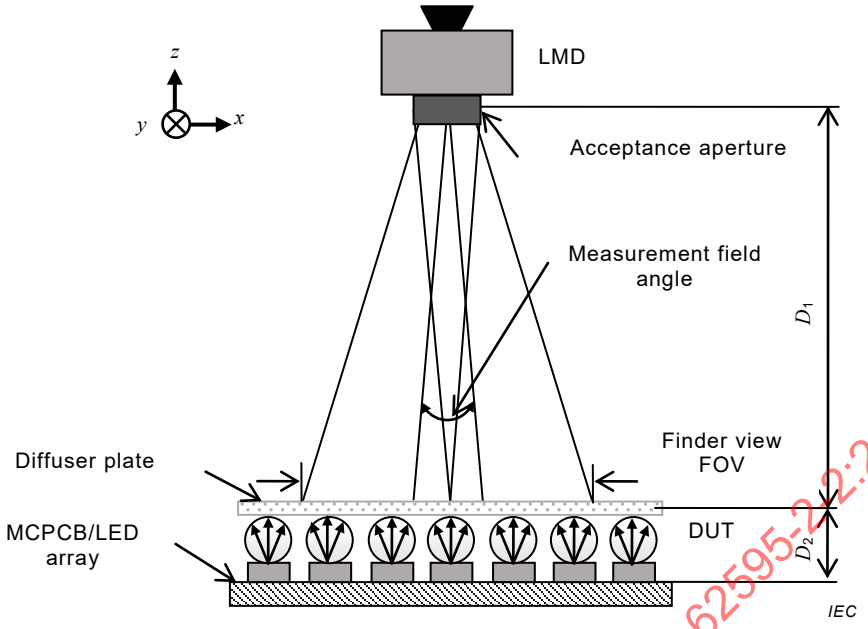

Figure 1 – Example of measuring system and arrangement for LED light bar

4.2 Light measuring device (LMD)

4.2.1 Luminance meter

The spectral sensitivity of a luminance meter, whether a spot meter or an imaging meter, shall comply with the CIE photopic vision. The equipment shall be calibrated and carefully checked before measurement, taking into account the following elements:

– sensitivity and dynamic range coverage;
– errors that are caused by veiling glare and lens flare (i.e., stray light in optical system);
– timing of data-acquisition and low-pass filtering;
– linearity of detection and data-conversion;
– FOV or field angle of the measurement device.

NOTE More information is found in ISO 19476.

4.2.2 Spectroradiometer

The spectroradiometer (spectral radiance-meter) shall be equipped with a camera lens and view finder. The wavelength range shall be at least 380 nm to 780 nm and the spectral bandwidth shall be 5 nm or less. The wavelength accuracy shall be 0,3 nm or less. The equipment shall be calibrated. The performance of the spectrometer shall be carefully checked before measurement, considering the same elements as in 4.2.1.

4.2.3 Colorimeter

The colorimeter (a spot meter or an imaging meter) shall comply with the CIE 1931 tristimulus values and shall be equipped with a camera lens and view finder. The equipment shall be calibrated with the dedicated standards. The colorimeter can be used as a luminance meter. It shall not be used for measuring the absolute colour quantities, but can be used for measuring the relative quantities such as colour uniformity. The performance shall be carefully checked before measurement, considering the same elements as in 4.2.1.

4.3 Sample stage

The orthogonal two-axes stage should be used to adjust the measurement points of the DUT. The positioning accuracy shall be enough to make the specified repeatability.

5 Measuring conditions

5.1 Standard measuring conditions

Measurements shall be carried out under the standard environmental conditions:

– temperature: 22 ºC to 28 ºC;
– relative humidity: 25 % to 85 % RH;
– atmospheric pressure: 86 kPa to 106 kPa.

When different environmental conditions are used, the conditions should be noted in the measurement report.

5.2 Electrical driving conditions

LED light bar driving and control devices, and electrical and optical measuring devices should be appropriately controlled for electro-optical measurements of the LED light bar (see IEC 62595-2-1).

5.3 Warm-up time

The measurements shall be carried out after sufficient warm-up time for the DUT. The measurement of the DUT shall be performed in the steady state of the LED's junction temperature as specified in IEC 62595-2-1.

NOTE The light output variation of the DUT can be ±3 % or less during measurement.

5.4 Dark room conditions

The dark room conditions should be darker than 1/20 of the minimum optical output from the DUT. In the case of other dark room conditions, these shall be reported.

5.5 Standard thermal conditions

The LED light bar (LEDs on MCPCB) under test shall be mounted on a heatsink, where the heat conduction and diffusion are the same as the product application.

5.6 Setting conditions

The distance (D_1) between the LMD and diffuser plate, and the distance (D_2) between the diffuser plate and LED light bar shall be provided by the BLU manufacturer or the LED light bar supplier in the relevant specification, and noted in the test report.

5.7 Mechanical alignment condition

The mechanical origin (x_0, y_0), x-axis direction and y-axis direction of LED light bar shall be printed on the LED light bar otherwise provided by the BLU manufacturer or the LED light bar supplier.

6 Measuring methods

6.1 Electrical parameters

6.1.1 Purpose

To determine voltage, current and power consumption for LED light bars.

6.1.2 Measuring conditions

The standard measuring conditions specified in IEC 62595-2-1:2016, 5.1.1, shall be applied.

6.1.3 Measuring method

The measuring methods specified in IEC 62595-2-1:2016, 5.1.2, 5.1.3 and 5.1.4 shall be applied, and the results of current, voltage and power consumption shall be reported.

6.2 Luminance distribution profile

6.2.1 Purpose

To determine the luminance distribution on the LED light bar (see Figure 2).

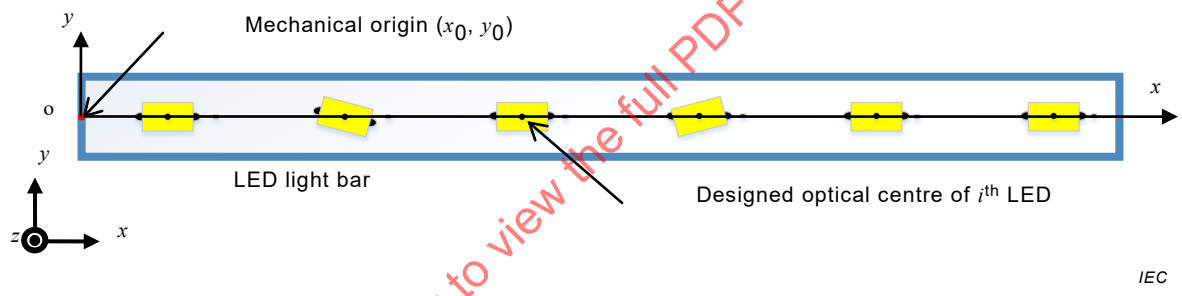

Figure 2 – Example of LED light bar set and mechanical origin alignment

6.2.2 Measuring conditions

The following measuring conditions shall be applied:

a) apparatus:
- an imaging luminance meter which covers the entire diffuser plate,
- a sample stage for an imaging luminance meter,
- a spot luminance meter with a sample stage,
- a spectroradiometer with a sample stage,
- a colorimeter including the function of luminance meter that can be used as luminance meter,
- a power supply;

b) environmental conditions: dark-room;

c) standard set-up conditions shown in Figure 1. The distance from the front of the LED board to the diffuser plate should be kept at a specified value given in the product specification.

6.2.3 Measuring method

1) Set the DUT to the mechanical origin and adjust the measurement device to the origin.

2) Set the diffuser plate to the appropriate defined position.
3) Set the driving current and voltage as indicated in the product specification.
4) Align the LMD along the x-axis and y-axis.
5) Capture the 2D luminance distribution on the diffuser surface's normal direction with sufficient resolution on the diffuser plate using an imaging LMD or using a spot LMD with a scanning sample stage (see Figure 3).
6) Obtain the luminance profile of the effective area along the x-axis, $L_v(x, 0)$ (see Figure 4).
7) Calculate the maximum luminance L_{vM}, minimum luminance L_{vm}, and average luminance L_{va} of $L_v(x, 0)$ (see Figure 5).
8) Calculate the luminance non-uniformity of $L_v(x, 0)$ using the following formula:

$$NU = \frac{L_{vM} - L_{vm}}{L_{va}} \quad (1)$$

where

NU is the luminance non-uniformity;

L_{vM} is the maximum luminance of $L_v(x, 0)$;

L_{vm} is the minimum luminance of $L_v(x, 0)$;

L_{va} is the average luminance of $L_v(x, 0)$.

9) Obtain the luminance profile along the y-axis by aligning the designed optical centre of each LED, $L_v(x_{di}, y)$ from the captured 2D luminance distribution (see Figure 4).

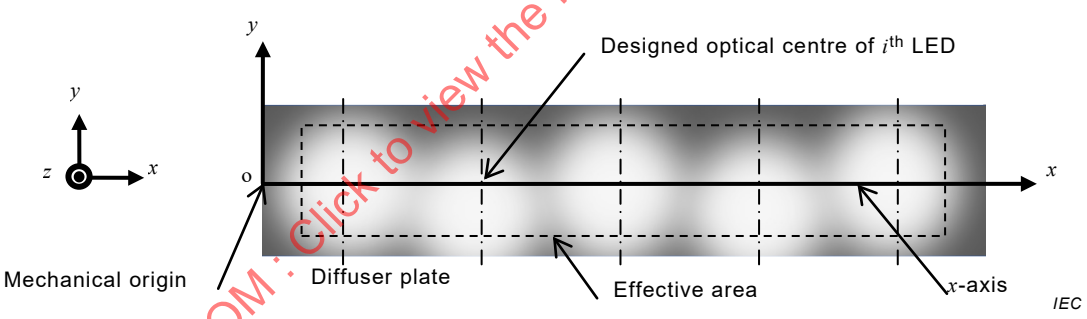

Figure 3 – Example of 2D luminance distribution on the diffuser plate with lit LED light bar

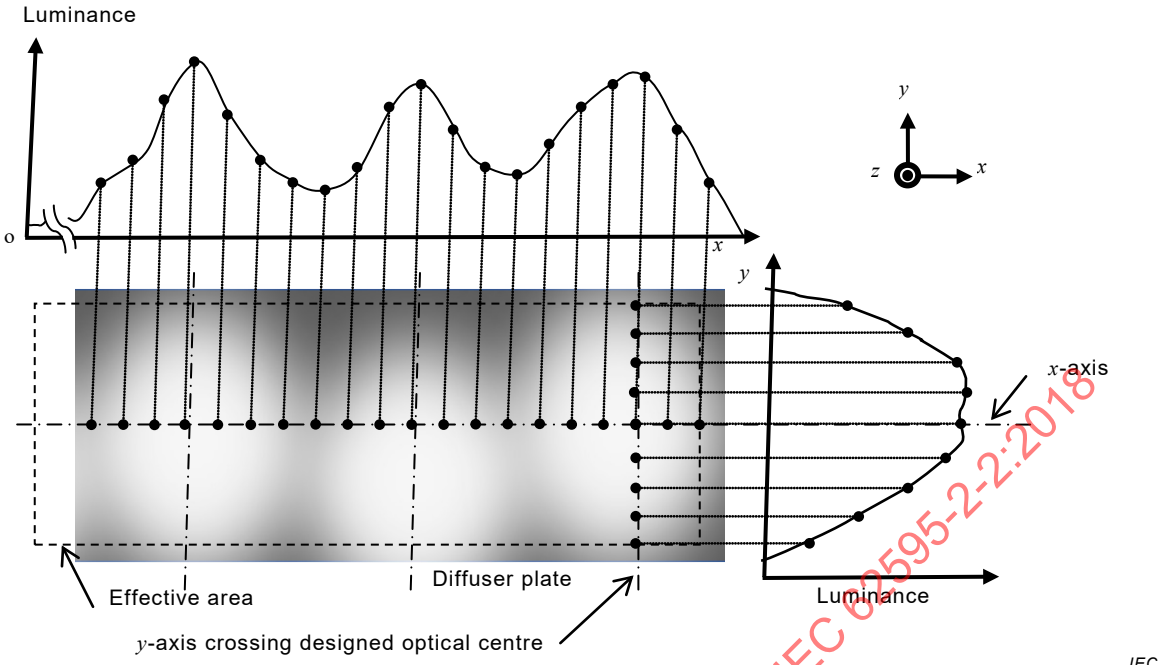

Figure 4 – Example of the luminance distribution profiles along the x- and y-axes

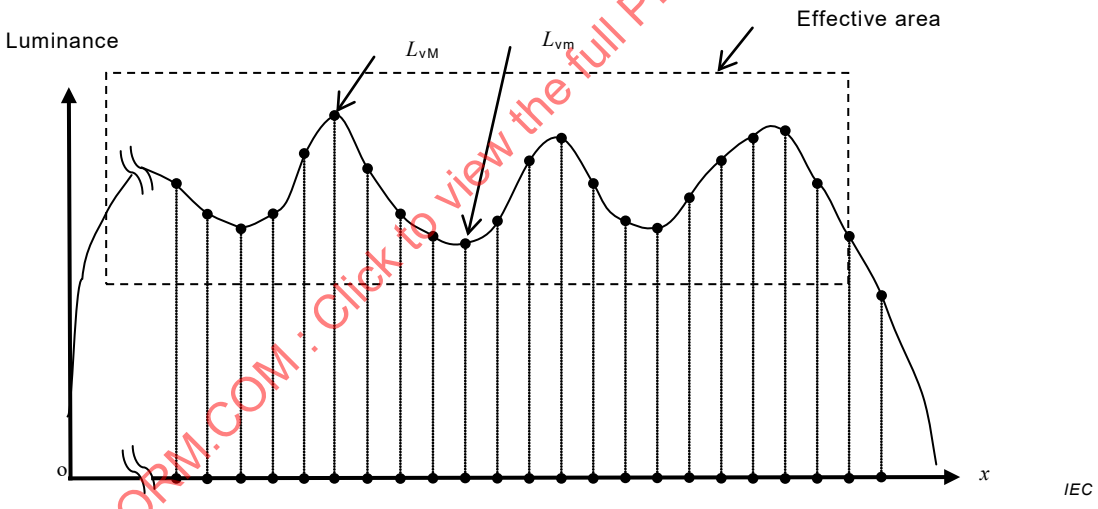

Figure 5 – Example of the luminance distribution profiles along the x–axis, $L_v(x, 0)$

6.2.4 Report

The following items shall be reported:

– luminance profile along the x-axis, $L_v(x, 0)$;
– maximum luminance L_{vM}, minimum luminance L_{vm}, and average luminance L_{va} of $L_v(x, 0)$;
– luminance non-uniformity NU of $L_v(x, 0)$;
– luminance profiles along the y-axis by aligning the designed optical centre of each LED, $L_v(x_{di}, y)$.