IEC 62595-1-2

Edition 3.0 2024-12

INTERNATIONAL STANDARD

colour inside

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

IEC 62595-1-2:2024-12(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.120; 31.260

ISBN 978-2-8327-0094-5

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FOREWORD

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IEC 62595-1-2 has been prepared by IEC technical committee 110: Electronic displays. It is an International Standard.

This third edition cancels and replaces the second edition published in 2016. This edition constitutes a technical revision.

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

a) new terms are added considering recent advances in display lighting unit (DLU) technology;
b) some of the terms and definitions are corrected and revised, particularly to be consistent with IEC 60050 policy;
c) clause structure is updated for categorizing terms correctly;

d) some of the figures in informative Annex A and their captions are revised for better understanding;

e) an informative Annex B is added for pictorial definition of the backlight unit structure.

f) an informative Annex C is added for pictorial definition of the backlight unit varieties and light-guide plate shapes.

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

Draft	Report on voting
110/1698/FDIS	110/1725/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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DISPLAY LIGHTING UNIT –

Part 1-2: Terminology and letter symbols

1 Scope

This part of IEC 62595 gives the preferred terms, their definitions and symbols, for display lighting units such as backlight units of transmissive and transflective displays, and frontlight units of reflective displays, with the objective of using standardized terminology when publications are prepared.

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 60050-845, *International Electrotechnical Vocabulary (IEV) – Part 845: Lighting* (available at www.electropedia.org)

3 Terms and definitions

3.1 General

For the purposes of this document, the terms and definitions given in IEC 60050-845[1] and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.2 Classification of terms

Terms for display lighting units, such as backlight units and frontlight units are classified as follows:

a) Fundamental terms (3.3);
b) Terms related to passive optical components (3.4);
c) Terms related to spatio-temporally modulated BLUs (3.5);
d) Terms related to solid-state light sources (3.6);
e) Terms related to light shaping guide in frontlight unit (3.7);
f) Terms related to specifications (3.8);
g) Terms related to backlight dimming (3.9);
h) Terms related to photoluminescent materials (3.10);

[1] Identical to CIE 17.4.

i) Terms related to DLU luminance (3.11).

The following definitions are applied for international standardization of the display lighting units.

For background to the terms in 3.3 to 3.11, refer to [1] to [27][2].

3.3 Fundamental terms

3.3.1
display lighting unit
DLU
lighting unit for recognition of the displayed images on a non-emissive electronic display device

Note 1 to entry: A display lighting unit illuminates a spatio-temporal light modulator (STLM or SLM), for example a liquid crystal panel, which together constitute an electronic display.

3.3.2
backlight unit
BLU
display lighting unit that is set at the rear of a non-emissive electronic display device which is a spatio-temporal light modulator (STLM or SLM) device such as a transmissive or transflective liquid crystal (LC) device

Note 1 to entry: For an example, see Figure A.1.

Note 2 to entry: Terms included in this document are mainly adopted from the references listed in the Bibliography.

3.3.3
edge-lit backlight unit
backlight unit in which an optically transparent medium (typically light-guide plate) is used in proximity with the light source(s) for introducing the light into the medium from one or multiple sides of the medium to illuminate a liquid crystal display or device (LCD)

Note 1 to entry: For an example, see Figure A.2.

Note 2 to entry: The "edge-lit backlight unit" is sometimes called "side-lit backlight unit", "edge-light backlight unit" or "side-light backlight unit".

Note 3 to entry: For information on backlight unit, see [1] to [17].

3.3.4
direct-lit backlight unit
backlight unit in which a light cavity is used in combination with light source(s) that is(are) mounted inside the cavity, for illuminating a transmissive LC device mounted on the light cavity for image reconstruction

Note 1 to entry: For an example, see Figure A.3.

3.3.5
side-driven direct-lit backlight unit
backlight unit in which a light chamber is used in combination with light sources(s) that is(are) mounted on the inner sides of the light cavity for illuminating a panel mounted on the cavity for image reconstruction

Note 1 to entry: For an example, see Figure C.1.

2 Numbers in square brackets refer to the Bibliography.

3.3.6
static backlight unit
single or integrated planar illumination system that operates with steady-state direct or alternating current and is free from temporal modulation of the spectral power distribution

3.3.7
dynamic backlight unit
single or integrated illumination units, the light output of which are spatially or temporally modulated, or both, in synchronization with the display's input signal, with any image formation or analysing unit of the display, or with ambient environment sensors

3.3.8
blinking backlight unit
backlight unit without spatial modulation that is switched on and off synchronously with and at the same frequency as the vertical synchronization input signal of the display

3.3.9
scanning backlight unit
backlight unit that is divided optically or spatially into several line blocks and is periodically switched on and off, block by block, synchronously with the display's scan drivers

3.3.10
directional backlight unit
backlight unit that collimates emergent light into a predefined solid angle or directs the collimated emergent light toward a spatial zone or surface on the back side of the LC device

3.3.11
diffractive BLU
functional BLU that includes a lightguide plate or film with micro or sub micro-gratings on one of its surfaces, for example the light introduction surface, rear surface or front light emerging surface for diffracting the light in a predefined direction or a solid angle

3.3.12
multi-directional backlight unit
backlight unit in which the light sources (LEDs or LDs) are mounted in an array around a micro- or submicron-featured light-guide plate (LGP) or film (LGF), for sequentially switching to obtain directional light for reconstructing a 3D image on the SLM (LC) device

Note 1 to entry: LED and LD are defined in "Terms related to solid-state light sources" (3.6).

3.3.13
segmented backlight unit
backlight unit that is divided into blocks or segments for synchronization with the driving of an SLM (LC) device for individually illuminating each block or segment of the SLM (LC) device

3.3.14
scanning directional backlight unit
directional BLU that continuously or distinctively illuminates a wide solid angle or an area in front of the backlight unit, i.e., the backside of the LC device, by consecutively switching (on and off) the spatially distributed light source array on the side surfaces of the light-guide plate (LGP)

3.3.15
field-alternating LC display lighting unit
unit having a single light-guide plate or which is spatially divided into top and bottom, with distinctive upper and lower light source groups for illuminating an SLM (LC) device in which an image is divided into top and bottom parts to reconstruct the upper and lower parts of an image alternately on the SLM (LC) device for compensating the response time of the SLM

Note 1 to entry: Sometimes "field-alternating" is called "top and bottom flashing".

Note 2 to entry: There is an explanation for field alternate LCD backlight unit, as follows: "Backlight unit that includes a single light-guide plate (LGP) or stacked LGPs for illuminating an SLM (LC) device, in which an image is divided into a left and right image in which the two images are oriented in different directions and where the left and right images are displayed alternately on the SLM (LC) device in order to create a 3D image display". Sometimes this backlight unit is called "field-alternating" or "left and right alternating flashing".

3.3.16
spatio-temporal switching backlight unit
backlight unit that is divided optically or spatially into several horizontal blocks and periodically switched on and off from top to bottom under a time table for illuminating or flashing red, green, or blue light in synchronization with a field-sequential colour LC device with or without micro colour filters

3.3.17
single-side light emission backlight unit
backlight unit that emits light either from a front surface or rear surface for illuminating a single SLM (LC) device

Note 1 to entry: A BLU has front and rear surfaces of illumination. A special case is using two LC panels each on the front and rear.

3.3.18
narrow-band backlight unit
backlight unit with light emitters, at least one of which has a full-width half-maximum (FWHM) of maximum 5 nm

3.3.19
mobility enhanced backlight unit
optical components with reduced weight and power consumption used in DLU, i.e., for enhanced portability

3.3.20
LGP-corner driven backlight unit
edge-lit backlight unit in which the light is driven from one or several flattened corners of a rectangular light-guide plate using single or multiple light sources

3.3.21
stack backlight unit
backlight unit in which more than one single light control medium or light-guide plate is used in stack form in the structure for additional light shaping capability

Note 1 to entry: For an example, see Figure C.2.

3.3.22
tandem backlight unit
backlight unit that is an integration of multiple distinct and overlapped edge-lit backlight units

Note 1 to entry: For an example, see Figure C.3.

3.3.23
wide SPD backlight unit
backlight unit that uses light sources of three or more emission peaks in order to produce a wide colour gamut on an SLM (LC) device

Note 1 to entry: The colour gamut of a QD-based LCD module depends on the respective peak wavelength (PWL) and full-width half-maximum (FWHM) of the three primary colours (R, G, B), and other optical units in the LCD module including the lightguide plate (LGP), diffuser plate and colour filter.

Note 2 to entry: The colour gamut in "lighting and imaging" (IEV 845-32-007) has been defined as "volume, area, or solid in a colour space, consisting of all those colours that are either; present in a specific scene, artwork, photograph, photomechanical, or other reproduction; or capable of being created using a particular output device and/or medium". Refer to Note 3.

Note 3 to entry: In reproduction and media applications only the volume or solid in a colour space is regarded as colour gamut. In applications such as signal lighting the colour gamut is an area.

3.3.24
light-emitting diode backlight unit
LED backlight unit
backlight unit that uses LEDs as light sources

Note 1 to entry: Sometimes the "light-emitting diode (LED) backlight unit" is called "LED backlight unit".

3.3.25
laser backlight unit
backlight unit that uses laser(s) as light source(s)

3.3.26
laser diode backlight unit
LD backlight unit
laser backlight unit that uses LD(s) as light source(s)

Note 1 to entry: Sometimes the "laser diode backlight unit" is called "LD backlight unit".

3.3.27
RGB backlight unit
backlight unit that uses LEDs with primary colours of red, green, and blue, such as six-primary ($R_1G_1B_1$ with $R_2G_2B_2$), quasi-monochromatic LEDs or monochromatic LDs as light sources

3.3.28
three-primary (R,G,B) backlight unit
backlight unit that uses three primary colours of red, green, and blue quasi-monochromatic LEDs or monochromatic LDs as light sources

3.3.29
six-primary (R_1,G_1,B_1,R_2,G_2,B_2) backlight unit
backlight unit employing two groups of red, green and blue light sources for illuminating an SLM (LC) device which is used for reproduction of colours of photographs

3.3.30
single-flash backlight unit
backlight unit that flashes periodically and is synchronized with an SLM (LC) device for the purpose of inserting a grey frame in order to enhance the moving image quality on the display

Note 1 to entry: The BLU is synchronized with the LCD, to be switched off when the black is written on the panel.

3.3.31
multi-flash backlight unit
spatially linear segmented backlight unit for scanning or field-sequential colour display that flashes periodically and is synchronized with the SLM (LC) device for the purpose of inserting colour fields (displayed image with single colour) or grey fields in order to enhance the displayed image quality on the display or spatially combining the different spectra for displaying colour images

3.3.32
multi-chromatic backlight unit
backlight unit that consists of multiple primaries or multiple quasi-monochromatic or more than three primaries light sources to illuminate an LC device for display of a wide colour gamut to be used for soft proofing, such as in printing applications, or alternative wide colour gamut applications

3.3.33
frontlight unit
FLU
transparent medium with side illuminating light sources that is set on the front side of non-emissive electronic display devices such as a reflective or transflective (partially transmissive or partially reflective) SLM (LC) panel or electronic paper display

Note 1 to entry: For an example, see Annex D.

Note 2 to entry: For information on frontlight unit, see [18] to [22].

3.4 Terms related to passive optical components

3.4.1
light-guide plate
LGP
optically transparent medium with a thick and solid structure that is generally employed in an edge-lit backlight unit or frontlight unit for forming the required light distribution spatially for transmissive, transflective or reflective SLM (LC) display devices

Note 1 to entry: For an example, see Annex C.

3.4.2
light-guide film
LGF
optically transparent medium with a thin and flexible structure that is employed instead of a light-guide plate (LGP) in an edge-lit backlight unit or frontlight unit for forming the required light distribution spatially for a transmissive, transflective or reflective SLM (LC) display devices

3.4.3
micro-featured light-guide plate
micro-featured light-guide film
optically transparent medium characterized by optical micro- or submicron-structures for shaping spatially or angularly the required light distribution in an edge-lit backlight or frontlight unit for illuminating a transmissive, transflective or reflective SLM (LC) device

3.4.4
slab light-guide plate
slab light-guide film
light-guide plate or light-guide film that has a plane or plate-like geometrical shape

3.4.5
wedge light-guide plate
wedge light-guide film
light-guide plate or light-guide film with a trapezoidal wedge shape that can be a half of a trapezoidal wedge plate (upper or lower part) in which the light from a source is introduced from either thicker side

3.4.6
inverted wedge light-guide plate
inverted wedge light-guide film
light-guide plate or light-guide film with a single or double wedge in which the light is introduced from the thinner side

Note 1 to entry: For an example, see Figure C.4.

3.4.7
double-side micro-featured light-guide plate
double-side micro-featured light-guide film
light-guide plate or light-guide film structured with light reflecting micro-reflectors or light deflecting micro-deflector arrays on the rear or front surface for shaping and extracting the propagating light

3.4.8
diffusing light-guide plate
diffusing light-guide film
light-guide plate or light-guide film structured with light diffusing micro-structures on its rear, front, or both surfaces for light shaping, or a structure for light shaping that is constructed with light-diffusing materials such as beads

3.4.9
reflective light-guide plate
reflective light-guide film
light-guide plate or light-guide film structured with optical micro-reflectors on the rear surface for extracting light from the front surface

3.4.10
deflective light-guide plate
deflective light-guide film
light-guide plate or light-guide film structured with optical micro-deflective elements on the front surface for the purpose of deflecting the emergent light rays from the front surface of the light-guide plate or light-guide film

3.4.11
dispersive light-guide plate
dispersive light-guide film
light-guide plate or light-guide film structured with micro-optical elements for dispersing the emergent light from the light-guide plate or light-guide film

3.4.12
polarizing light-guide plate
polarizing light-guide film
light-guide plate or film which to a certain degree preserves the polarization of the light source or polarizes the light of the light source before emitting it from the LGP/LGF front surface

3.4.13
diffuser film
optical film that functions as a light-diffusing component in a display lighting unit

Note 1 to entry: For an example, see Figure A.4.

3.4.14
prism film
optical film that possesses discrete prism lines or continuous prism lines with triangular prismatic cross-section structures for collimating or deflecting (on its surface) the rays that are incident on the rear surface of the film

3.4.15
circular prism film
film that possesses a geometrically circular prism structure with a triangular prismatic cross section for collimating and deflecting azimuthally the incident light rays striking the prism's inner surfaces

3.4.16
luminance enhancement film
brightness enhancement film
BEF
light-collimating film in which the incident light on its rear surface, i.e., the inner surface of the triangular cross section, is collimated on its front surface, i.e., the V-shaped prism side, resulting in luminance enhancement

Note 1 to entry: For an example, see Figure A.4.

Note 2 to entry: In the display industry the "luminance enhancement/enhancing film" is called "brightness enhancement film", so-called "BEF".

3.4.17
dual brightness enhancement film
DBEF
light recycling film used in an LCD backlight unit to recycle the light that is normally lost in the rear polarizer of the LC panel

3.4.18
circular polarizer film
CP film
type of polarizer that selectively blocks certain polarizations of light waves, reducing glare and improving colour saturation in photography and displays by allowing only light with a specific, i.e., left or right circular polarization orientation to pass through

Note 1 to entry: See [27].

3.4.19
inverted prism film
optical film with an array of line prisms in which the tips of the triangular prismatic cross-section are directed towards the light-guide plate in a display lighting unit

3.4.20
total-internal-reflection film
TIR film
light turning film
optical film such as an inverted prism film that has a light-ray deflecting function based on the total internal reflection

3.4.21
reflector film
film for reflecting back the light that emerges from the surfaces next to the front surface, i.e., LC panel side, of the light-guide plate or light-guide film

3.4.22
light-collimating film
optical film having V- or U-shape prismatic structures on front surface and which collimates the incident light on its front surface where the triangular prisms exist

3.4.23
micro-deflector element
optical micro-structure with light ray deflection function structured on the front or rear surface of a micro-featured light-guide plate or light-guide film

3.4.24
micro-reflector element
optical micro- or submicron-structure with light ray reflection function at TIR, structured on the front or rear or both surfaces of the micro-featured light-guide plate or light-guide film

Note 1 to entry: Sometimes the micro-reflector element is a submicron-reflector element.

3.4.25
micro-diffusive element
optical micro- or submicron-structure with a light ray dispersing function structured on the front or rear or both surfaces of the micro-featured light-guide plate or light-guide film

Note 1 to entry: Sometimes the element size is less than a single micron, so that the micro-diffusive element is called submicron-diffusive element.

3.4.26
specular light reflector film
optical film which is coated with metal such as silver, aluminium or structured with multiple optical layers for reflection of incident light without diffusion of the incident light

3.4.27
partially specular light reflector
optical reflector film with specular reflection characteristic and partially light diffusing characteristic

3.4.28
light-diffusing reflector
optical film that scatters back the incident light toward the light introduction side

3.4.29
light-source reflector
piece of metal or paper with a highly reflective surface that is used for introducing or re-reflecting light that travels in other directions rather than towards the light control medium in a backlight unit

3.4.30
light-guide reflector
piece of metal or paper with a highly reflective surface that is used on the rear or side surfaces of a light-guide plate or light-guide film for reflecting back the light that emerges from the rear surface or side surfaces of the light guide-plate or light-guide film

3.4.31
light cone
solid angle into which the light radiates from the front surface of a backlight or frontlight unit, or light-guide plate or film

Note 1 to entry: For an example, see Figure A.7.

3.5 Terms related to spatio-temporally modulated BLUs

3.5.1
block
<backlight unit> segment of a two-dimensionally divided backlight unit for synchronization with an SLM (LC) device for the purpose of local dimming

3.5.2
partition
<backlight unit> piece of metal, coated paper or light diffusing reflector for optically isolating the segments or blocks of a one- or two-dimensionally divided backlight unit to control or reduce the amount of leakage light or cross-talk between the segments and smoothing the viewed display image on the SLM (LC) panel

Note 1 to entry: Sometimes the "partition" is called "rib".

3.5.3
addressed block
segment of spatially divided backlight unit for two-dimensional dimming (local dimming) that cooperates with the locally addressed SLM (LC) device for improving image quality and power savings

3.5.4
dimming block
segment of a spatially divided backlight unit that dims in response to written data of a local segment of an LC device

3.5.5
boosting block
local boosting block
segment of a spatially divided backlight unit that boosts in response to written data of a local segment of an SLM (LC) device

Note 1 to entry: The boosting function can be applied to a whole BLU, linearly divided or block-wise BLU.

3.5.6
hollow backlight
light-controlling hollow cavity structured by optically micro- or submicron-features or surrounded by optically micro- or submicron-structured films for directing light toward the rear of an SLM (LC) device

Note 1 to entry: For an example, see Figure C.1.

3.5.7
light cavity
light box whose inner side is optically characterized for light shaping and extracting and is used in a direct-lit backlight unit

Note 1 to entry: For an example, see Figure C.1.

3.5.8
bezel
<backlight unit> geometrically shaped metal or non-metal front frame at the periphery of the display screen for mechanically fixing together an LC device and a backlight unit

Note 1 to entry: For an example, see Figure A.4.

3.5.9
case
<backlight unit> housing of the backlight unit

Note 1 to entry: For an example, see Figure A.4.

3.5.10
flexible printed circuit
FPC
<backlight unit> piece of flexible material such as polyimide that has a printed circuit on its surface for electrically driving the light sources and complementary electrical devices in a backlight unit

Note 1 to entry: For an example, see Figure A.4.

3.5.11
metal core printed circuit board
MCPCB
<backlight unit> solid metal board on which an electric circuit has been printed for mounting solid-state light sources and for use as a heat sink in the backlight unit structure

Note 1 to entry: For an example, see Figure A.4.

3.6 Terms related to solid-state light sources

3.6.1
pseudo-white LED
solid-state light source that has a LED die (chip) emitting blue light and typically yttrium aluminium garnet (YAG) phosphor for converting a part of the blue light into yellow colour for generating white light based on complementary colour mixing

Note 1 to entry: For display applications, tri-chromatic emitters are not pseudo-white.

Note 2 to entry: The definition is not limited to LED, OLED or laser.

3.6.2
RGB LED
combination of solid-state quasi-monochromatic, i.e., having a spectrum of wider than 5 nm, light sources with primary colours

Note 1 to entry: RGB LED can also be defined as a set of LED dies (chips) with quasi-monochromatic light of primaries that are packed together to mix additionally and obtain a white light at a predefined area on a backlight unit.

3.6.3
ultra-violet stimulated white LED
UV-white LED
solid-state light source with a LED die (chip) emitting light in the ultraviolet wavelength range that stimulates a combination of blue, green and red phosphors to create light having white colour

3.6.4
near UV stimulated white LED
NUV-white LED
solid-state white light source with a LED die (chip) emitting light in the near ultraviolet wavelength range (e.g., 380 nm to 410 nm) and a combination of blue, green and red phosphors that are stimulated by the light of the LED die

3.6.5
RG-white LED
solid-state white light source with a LED die (chip) emitting blue light that stimulates red (R) and green (G) phosphors which are added to the cavity of the LED package

3.6.6
quasi-monochromatic LED
LED die emitting light at a dominant wavelength and possessing a relatively wide bandwidth

3.6.7
LED light bar
strip light source in which multiple binned top firing or side firing LEDs are mounted along the length of the strip to create a linearly uniform distribution of illuminance in the display lighting unit

Note 1 to entry: For an example, see Figure A.3.

Note 2 to entry: A light bar with binned top or side firing LEDs can be used in a side-illuminating BLU in which a LGP or a hollow cavity BLU is used.

3.6.8
side-view light bar
light bar that employs LEDs with a side-fire radiation pattern

3.6.9
top-view light bar
light bar that employs LEDs with a top-fire radiation pattern

3.6.10
bulk-coupling light bar
light bar that employs omni-directional LEDs in which the light from the LEDs is coupled into the body of the light-guide plate or light-guide film, that is, in the holes made in the bulk-LGP or film-LGP

3.6.11
omni-directional light bar
light bar that employs LEDs with an omni-directional radiation pattern

3.6.12
uniform chromaticity light bar
light bar possessing uniform chromaticity, i.e., non-distinguishable chromatic differences across the bar

3.6.13
light bar tolerance
light bar output tolerance which is specified for a backlight unit (BLU), determined at a set distance from the light bar, and applied to various BLU types, including bulk-coupling, LGP edge-coupling, and hollow cavity direct-lit with LEDs placed underneath or at the sides of the cavity

3.6.14
light bar spatial intensity distribution
spatial intensity distribution over and along the light bar or at a pre-defined direction and distance from the light bar

3.6.15
light bar directional intensity distribution
luminous intensity distribution along a predefined tilt angle with respect to light bar surface normal which is defined in the spherical coordinate system

3.6.16
coloured light bar
light source such as cyan or magenta that is paired with combinations of QD or perovskite film to form a wide colour gamut lighting solution

3.6.17
laser module
<of display lighting unit> display light source that generates an optical output by merging the emitted light from multiple laser devices

3.6.18
monochromatic laser module
<of display lighting unit> display light source that produces an optical output by merging the emitted light from numerous laser devices, all falling within a wavelength range of 10 nm

3.6.19
multi-colour laser module
<of display lighting unit> display light source which generates an optical output by merging the emitted light from various laser devices, each emitting at distinct monochromatic wavelengths

3.6.20
RGB laser module
<of display lighting unit> source of illumination used in display units, utilizing emitted light from red, green, and blue monochromatic laser devices to create its optical output

3.6.21
wall-plug efficiency
WPE
<of laser module> ratio of the optical output power produced by a laser module to the electrical input power it receives

3.6.22
near field pattern
NFP
<of laser module> spatial distribution of characteristics such as intensity, radiation, or energy of an electromagnetic or acoustic wave in close proximity to the source or emitter, rather than at a distance where the wave has fully developed its far-field properties

3.6.23
far field pattern
FFP
monochromatic FFP
<of laser module> power distribution of the laser module's output which is assessed on a plane situated at a notably greater distance than W^2/λ, wherein λ denotes the wavelength expressed in nm and W signifies the largest dimension present within the output aperture expressed in nm

3.6.24
colorimetric far field pattern
colorimetric FFP
colour FFP
<of laser module> chromaticity distribution of the laser module's output which is gauged upon a plane located at a considerable distance, surpassing W^2/λ, where λ represents the wavelength expressed in nm and W stands for the largest dimension within the output aperture expressed in nm

3.7 Terms related to light shaping guide in frontlight unit

3.7.1
prismatic light-guide plate
prismatic light-guide film
transparent optical medium for controlling direction and shaping the light using prismatic micro-structures that are fabricated on the front, the rear or both the surfaces of the light-controlling medium

Note 1 to entry: A prismatic structure functions as light reflector, however, visual artefacts are imposed in some cases.

3.7.2
two-surface micro-prism reflector
unilateral or bilateral micro-prism with two light-reflecting surfaces usually fabricated on the light-guide plate or light-guide film or stick light

Note 1 to entry: Sometimes the "stick light" is called "light stick".

3.7.3
three-surface micro-prism light reflecting guide
micro-prismatic structure with three light reflecting surfaces fabricated on light collimating light-guide plate or light-guide film or stick light

3.7.4
stick light
stick lightguide
straight and slender lightguide which is a transparent optical medium with any geometrical cross-section, and an array of micro-structures for transforming a point source into a uniform line source that can be used in a backlight unit or a frontlight unit

3.7.5
stick light reflector
piece of metal or paper with a highly reflecting surface for covering the longitudinal sides (beside the light emerging surface) of the stick light

Note 1 to entry: Sometimes the "stick light reflector" is called "stick light-guide reflector".

3.7.6
stick light directivity
angular luminance distribution of a stick light used in a backlight unit or a frontlight unit

Note 1 to entry: Sometimes the "stick light directivity" is called "stick light-guide directivity".

3.7.7
anti-reflection coating
single or multi coating on the light-guide plate or light-guide film of a frontlight unit for reduction of undesired reflected light from ghost images when the frontlight unit is integrated into the reflective display

3.7.8
ghost image
result of undesired reflected light beside the main reflected light by the micro-structure, i.e., a visual artefact, in the prismatic light-guide plate or light-guide film used in a frontlight unit

Note 1 to entry: Refer to Note 1 in 3.7.1.

Note 2 to entry: A prismatic LGP has advantages and disadvantages. The advantage is the reflection of light toward the reflective display, and the disadvantage is the creation of artefacts in the displayed image.

3.8 Terms related to specifications

3.8.1
luminance uniformity
spatial luminance distribution
distribution of luminance measured at predefined point(s) on the display lighting unit

Note 1 to entry: For an example, see Figure A.5.

3.8.2
luminance evaluation area
infinitesimal area on a display lighting unit that is measured and used for evaluation of the luminance and luminance uniformity, usually defined as a 25-point measurement

3.8.3
chromaticity uniformity
variation of CIE 1976 $u'v'$ chromaticity on predefined points (spots) on a display lighting unit with respect to a pre-set location

3.8.4
spectrum power density homogenization
SPD homogenization
additive process of spectrum power densities in a display lighting unit for obtaining a chromaticity for a predefined white point at a pre-set area on a display lighting unit

3.8.5
spectrum power density mixing area
SPD mixing area
region of additively mixing different colours from quasi-monochromatic light sources in a display lighting unit in order to obtain a white point at a predefined area

3.8.6
directional chromaticity uniformity
variation in the CIE 1976 $u'v'$ chromaticity coordinates measured with changes in viewing direction at a defined location on a DLU

Note 1 to entry: Viewing direction is defined by the azimuthal angle and inclination with respect to the DLU surface normal.

3.8.7
spectral dependence of angular luminance distribution
variation in colour of viewing direction measured at a defined location on a DLU

Note 1 to entry: Viewing direction defined by the azimuthal angle and inclination with respect to the DLU normal.

3.8.8
chromaticity shift
change in chromaticity between two specified locations on the display lighting unit

3.8.9
backlight gamma characteristic
nonlinear operation (exponent of a power function) used to encode and decode luminance to adjust the amount of luminance on each block of the LC panel

3.8.10
luminous signal-to-noise ratio
luminous S/N ratio
<display lighting unit> ratio of desired luminance to undesired luminance in predefined viewing direction

3.8.11
stabilization time
<display lighting unit> time until a steady-state spectral power distribution (SPD) of a DLU is reached

Note 1 to entry: The steady-state criterion can be a maximum of 2 % temporal variation in luminance.

3.8.12
spectral radiance
$S_{DLU}(\lambda)$
<backlight unit> radiant flux per unit solid angle and unit area, measured using a spectrometer or an optical spectrum analyzer as the spectrum of light emerging from a unit area on a display lighting unit

Note 1 to entry: For an example, see Figure A.8.

3.8.13
incoherent light spread function
I-LSF
<backlight unit> three-dimensional or two-dimensional spatial luminance profile of a single circularly symmetric infinitesimal point or block (having x-axis or y-axis symmetry) in a block-wise backlight unit illuminated by one or more incoherent light sources such as a LED or diffused light of an LD

Note 1 to entry: For an example, see Figure A.9.

3.8.14
block-wise incoherent light spread function
<backlight unit> luminance profile of a block of a block-wise backlight unit illuminated by one or more incoherent light source(s) such as a LED or the diffused light of an LD

Note 1 to entry: For an example, see Figure A.10.

3.8.15
incoherent line spread function
<backlight unit> luminance profile of a linear block of a block-wise backlight unit illuminated by an incoherent line light source, such as a LED or the diffused light of an LD line array

3.8.16
incoherent optical transfer function
I-OTF
light transfer function
LTF
<backlight unit> spatial frequency response of a backlight unit of a block-wise backlight unit in response to an incoherent illuminating light source such as a LED or the diffused light of an LD

Note 1 to entry: Sometimes the "incoherent optical transfer function" is called "light transfer function" or "LTF".

3.8.17
monochromatic incoherent modulation transfer function
monochromatic incoherent MTF
<backlight unit> modulation transfer function of a backlight unit in response to a quasi-monochromatic point light source such as a LED or the diffused light of an LD

Note 1 to entry: The monochromatic incoherent MTF is expressed in spatially modulated light versus spatial frequency (line pair per millimetre).

3.8.18
chromatic incoherent light spread function
chromatic incoherent LSF
<backlight unit> incoherent light spread function of a backlight unit in response to a partially monochromatic point light source

3.9 Terms related to backlight dimming

3.9.1
Image-adaptive dimming
luminance dimming of one or several BLU blocks spatially corresponding to dark areas of the input image

Note 1 to entry: The purpose can be both power saving and local contrast enhancement at low spatial frequencies.

3.9.2
backlight ramp-up time
amount of time or number of video frames required for the backlight to increase from its lowest luminance level to its highest luminance level

3.9.3
backlight ramp-down time
amount of time or number of video frames required for the backlight to decrease from its highest luminance level to its lowest luminance level

3.9.4
zero-dimensional dimming
0-D dimming
global dimming
spatially uniform reduction of BLU luminance in response to the display input image

Note 1 to entry: Images with narrow histograms can be shifted to higher transmission levels and DUT output reduced accordingly to save power while maintaining luminance. Histogram compression gives a trade-off between power saving and image quality.

3.9.5
one-dimensional dimming
1-D dimming
line dimming
spatially uniform reduction of BLU luminance in response to the display input image, in which the histogram analysis and BLU dimming are limited to a horizontal (or alternatively a vertical) BLU block

3.9.6
two-dimensional dimming
2-D dimming
spatially uniform reduction of BLU luminance in response to the display input image, in which the histogram analysis and BLU dimming are limited to an image region corresponding to individual BLU blocks

Note 1 to entry: Sometimes "2-D dimming" is referred as "local dimming", "block dimming" or "full-array local dimming (FALD)".

3.9.7
three-dimensional dimming
3-D dimming
spatially uniform reduction of BLU luminance in response to the display input image, in which the histogram analysis and BLU dimming are done separately for the colour channels in addition to individual BLU blocks

3.9.8
backlight resolution
number of addressable blocks or segments in a locally dimmable DLU

Note 1 to entry: A DLU includes the number of blocks or segments (not the number of mini-LEDs) in a local dimming type DLU that can display the luminance of an image that is input to an LC panel or device.

3.9.9
optical noise
<backlight unit> unintentional light that leaks from a block to adjacent blocks in one- and two-dimensionally divided backlight units

3.9.10
block-wise optical signal-to-noise ratio
block-wise optical S/N ratio
<display lighting unit> ratio of desired luminance to undesired luminance per block

Note 1 to entry: For an example, see Figure A.9.

Note 2 to entry: This is the ratio of the optimum amount of light which is transmitted from a block to adjacent blocks for the purpose of smoothing and qualifying the front-of-screen on the display in a one- or two-dimensionally divided backlight unit to the amount of light on the segment or block under evaluation.

3.9.11
crosstalk
<backlight unit> amount of light that leaks from a block to adjacent blocks or segments (optical noise) in a one- or two-dimensionally divided backlight unit, causing independently displayed block image degradation on the LC device

Note 1 to entry: Refer to Figure A.9 and Figure A.11.

Note 2 to entry: The measurement of crosstalk is performed by applying a checkerboard pattern in which the "ON" (white) and "OFF" (black) segments are created as shown in Figure A.11. The luminance at the centre of the "OFF" segment is measured by expanding the "OFF" segment pattern by 1 %. This gives the amount of the light that is leaking from the neighbouring segments to the OFF segment.

3.9.12
halo
circle of bright light that surrounds a(n) (bright) object

Note 1 to entry: A "halo" refers to a bright or hazy ring of light that surrounds an object or figure, often caused by optical effects or atmospheric conditions, for example, a halo around the moon in a dark night.

3.9.13
halo effect
<liquid crystal display> display artefact that occurs when light from an isolated bright image on the LC screen bleeds into darker areas surrounding the image

Note 1 to entry: The halo effect is also known as "blooming". This is a shortcoming of a backlit LCD with local dimming.

3.10 Terms related to photoluminescent materials

3.10.1
quantum dot
QD
highly efficient nanoscale semiconductor materials comprised of a core, shell, and ligands, capable of down-converting or generating narrowband light output at specific wavelengths determined by the size of the nanocrystal

3.10.2
quantum confinement effect
size-dependent electrical and optical properties of a semiconducting nanocrystal that exhibit size-dependent emission characteristics where the size of the quantum dot determines the wavelength of light it emits

Note 1 to entry: This effect arises from the discretization of electronic energy states, confining the electrons in a material within a very small space.

3.10.3
quantum dot backlight unit
QD–BLU
backlight using monochromatic source, typically blue, in combination with quantum dots to achieve narrow-band R, G, and B peaks for wider colour gamut

Note 1 to entry: Edge-lit and direct-lit backlight unit structures with quantum dot components are shown in Figure B.1 and Figure B.2, respectively.

3.10.4
quantum dot film
QD film
film construction typically having three layers consisting of an upper barrier film, a middle QD matrix material layer containing quantum dots dispersed in polymer, and a lower barrier film

Note 1 to entry: Certain new "air-stable" QD films do not require the barrier films.

Note 2 to entry: For an example, see Figure B.1.

3.10.5
quantum-dot diffuser plate
QD-DP
diffuser plate infused with quantum dot used in direct-lit backlight unit

Note 1 to entry: For an example, see Figure B.2.

3.10.6
quantum dot glass tube
glass tube encapsulated QD which is pumped with an LD or LED array of blue light

Note 1 to entry: The quantum dot glass tube approaches are no longer in use.

3.10.7
quantum dot rail
QD rail
QD capillary
glass rail or capillary encapsulated QD which is pumped with a LED array of blue light

Note 1 to entry: The QD rail is used between an array of blue LEDs and LGP.

Note 2 to entry: The QD rail approaches are no longer in use.

3.10.8
edge ingress
visual appearance change over a small area of the QD film edge caused by water or oxygen exposure, or both, through an exposed edge

Note 1 to entry: The darkening of the ingress region is caused by the oxidation of the QDs due to oxygen diffusion from the open edge.

3.10.9
perovskite film
three-layer colour enhancement quantum confinement film used in LCD BLU to achieve a wide colour gamut and enhanced luminance value

Note 1 to entry: The perovskite film is structured with an active layer of perovskite quantum confinement material as the middle layer and top and bottom barrier layers. The film is pumped by a magenta or cyan light source. The film is positioned on the BLU below the LC panel.

3.10.10
anti-wet layer
structured surface of a BLU optical component such as film for eliminating the optical coupling that can destroy the function of the display lighting unit or the display uniformity

Note 1 to entry: Sometimes an "anti-wet layer" is applied to the back surface of an optical film to avoid an interference between two optical components that degrades the displayed image.

3.11 Terms related to DLU luminance

3.11.1
angular luminance distribution
<display lighting unit> luminance distribution of an illuminating plane area or display lighting unit that is measured at zenith angles of 0° to 90° and azimuthal angles of 0° to 360°

Note 1 to entry: For an example, see the spherical coordinate system shown in Figure A.6.

Note 2 to entry: Sometimes the "angular luminance distribution" is called the "directional luminance distribution".

3.11.2
angular luminance variation
<display lighting unit> variation of luminance with zenith (θ) or azimuth (φ) angles on the illuminating surface of a display lighting unit, that is, L_v (θ, φ, x_i, y_i, z_i), where the coordinates of an arbitrary point are at (x_i, y_i, z_i) on the backlight unit and (θ, φ) are the light cone extends with respect to the centre axis deviated from the surface normal of the display lighting unit

Note 1 to entry: Sometimes "directional luminance variation" is used instead of "angular luminance variation".

Note 2 to entry: For an example, see Figure A.6.

3.11.3
angular luminance uniformity
<display lighting unit> angular luminance, L_v (θ, φ, x_i, y_i, z_i), variation of an infinitesimal area around a point (x_i, y_i, z_i) on a display lighting unit

4 Letter symbols (quantity symbols/unit symbols)

The letter symbols for DLUs are shown in Table 1.

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

Term	Symbol	Unit
Arbitrary luminance of a point	L_{vi}	cd/m^2
Maximum luminance	L_{vM}	cd/m^2
Minimum luminance	L_{vm}	cd/m^2
Average luminance	L_{va}	cd/m^2
Centre luminance	L_{vc}	cd/m^2
Luminance uniformity	U	%
Angular luminance variation	$L_v\,(x, y;\ \theta, \varphi)$	cd/m^2
Solid angle	Ω	sr
Chromaticity uniformity	$\Delta u'v'$	
Relative spectral radiance of a display lighting unit	$S_{DLU}(\lambda)$	
LED forward driving current	I_F	mA

Annex A
(informative)

Supplementary figures

Figure A.1 to Figure A.11 provide examples of various terms defined in the document.

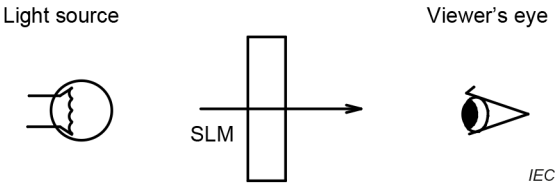
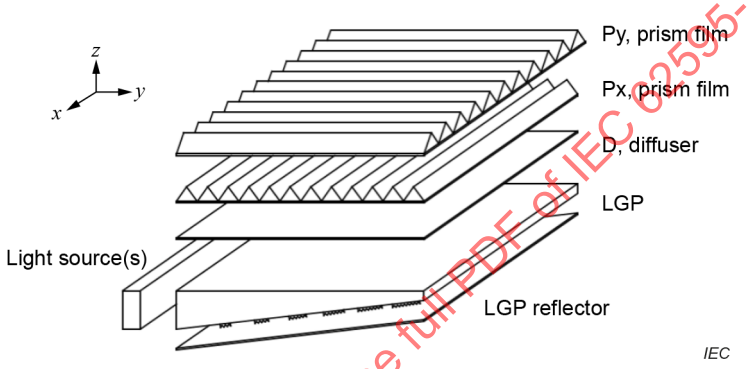
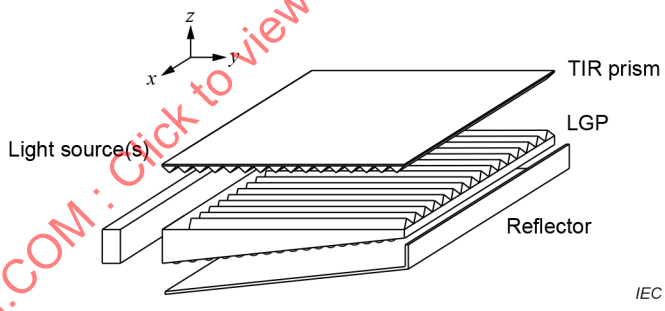


Figure A.1 – Backlighting concept for transmissive and transflective LCDs



a) Example of conventional edge-lit backlight unit with arbitrary light sources



b) Edge-lit backlight unit with TIR prism (an inverted prism with TIR characteristic) and a micro-featured light guide plate

Figure A.2 – Examples of edge-lit backlight units

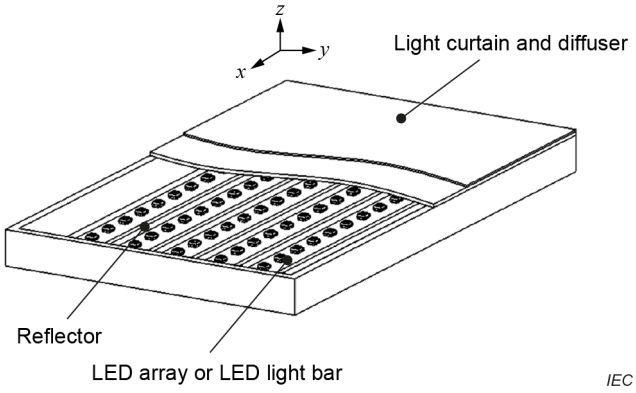


Figure A.3 – Example of a direct-lit backlight unit with LED light bars

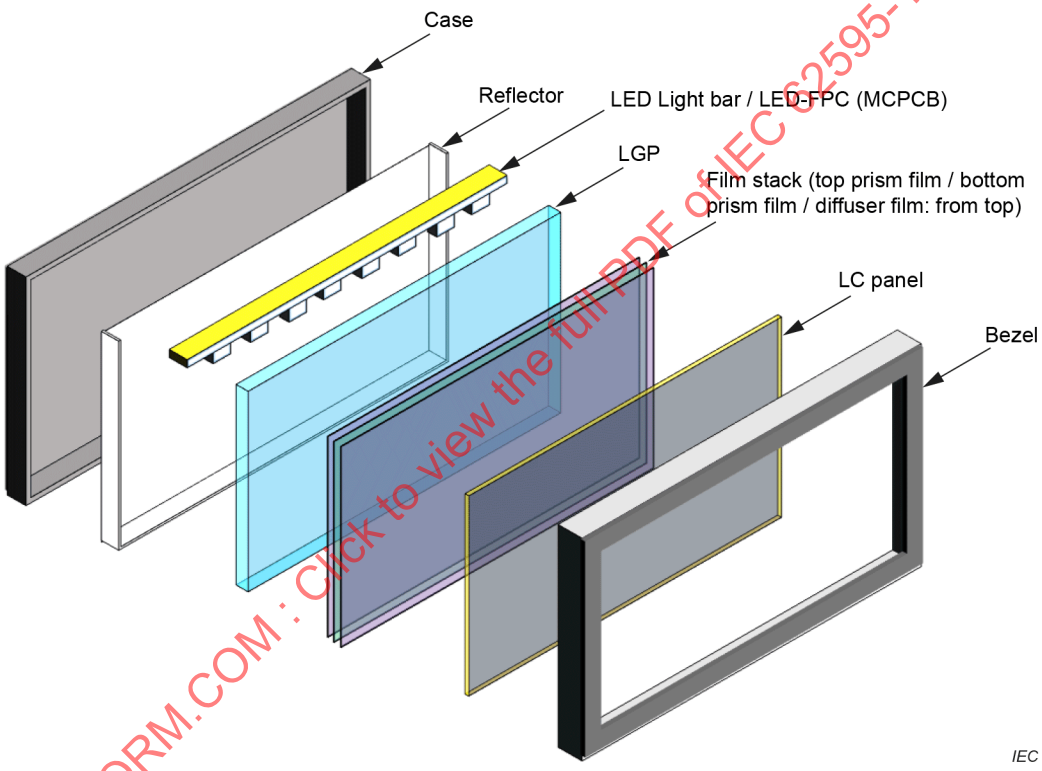
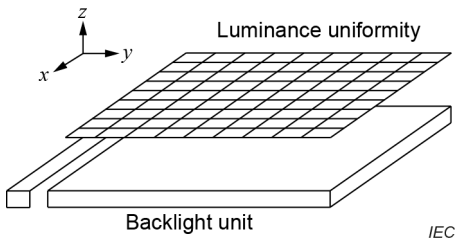
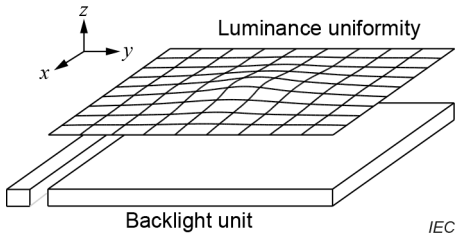


Figure A.4 – Visual definition of the terms related to passive optical components such as bezel and case for an LCD

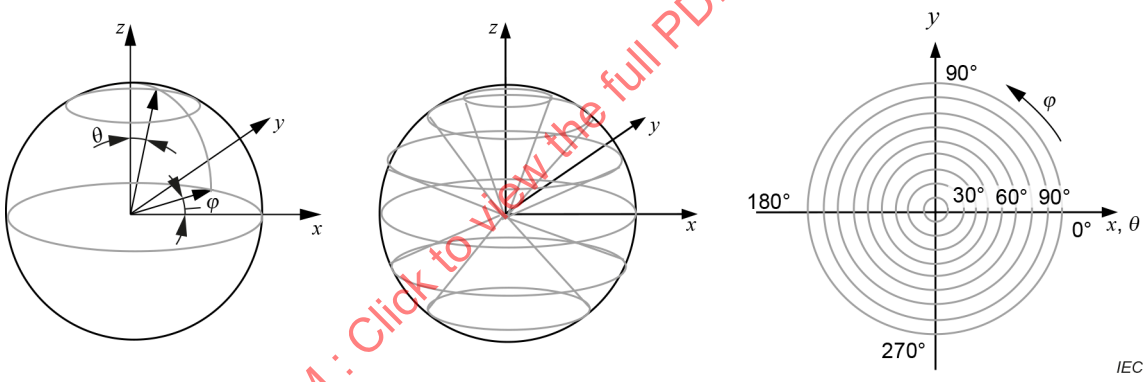


a) Backlight unit with highly uniform spatial luminance uniformity



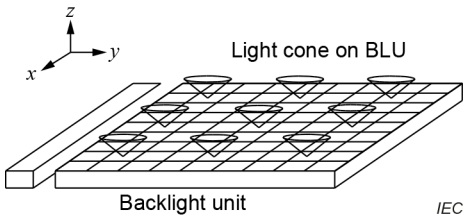
b) Backlight unit with a low profile Gaussian luminance uniformity

Figure A.5 – Luminance uniformity on a backlight unit



NOTE The angular luminance distribution of the backlight unit is evaluated in the spherical coordinate system where φ is the azimuth angle (0° to 360°) and θ is the zenith angle (0° to 180°).

Figure A.6 – Spherical coordinate system for evaluation of the angular or directional luminance distribution



NOTE The light cone is slightly different due to the propagating light distribution (along the y-axis) in the LGP/LGF or light shaping medium.

Figure A.7 – Light cone on an edge-lit backlight unit

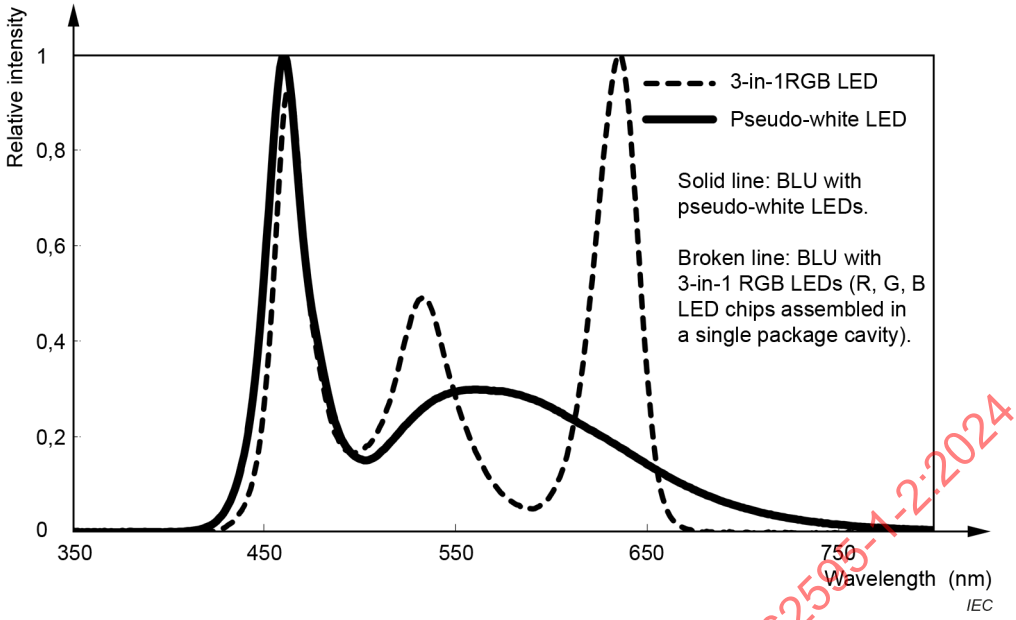
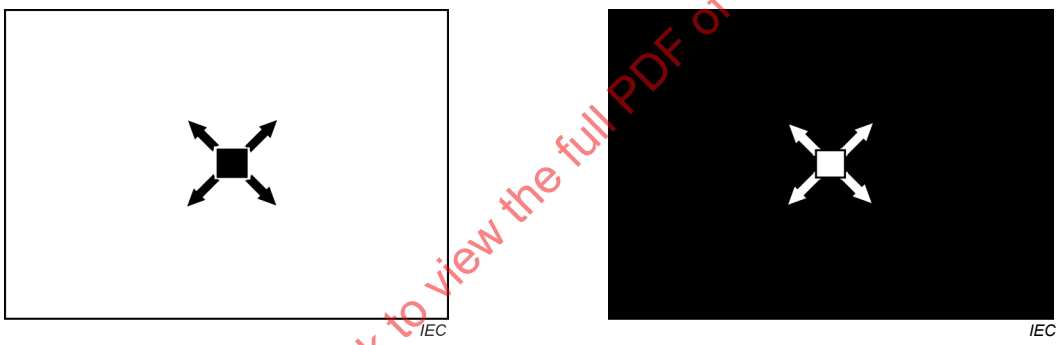


Figure A.8 – Examples of spectral power distribution of a display lighting unit

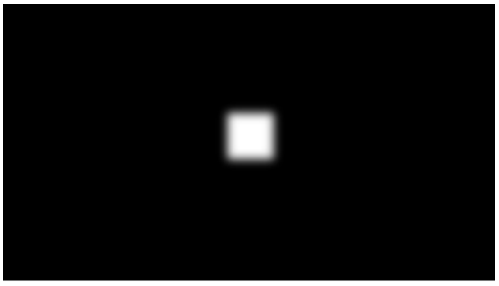


a) **White segments are "ON" and the black segment (centre) is "OFF"**

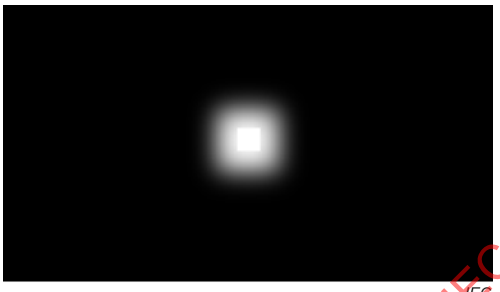
b) **Black segments are "OFF" and the white segment (centre) is "ON"**

NOTE The white and black blocks show the "ON" and "OFF" conditions, applied to all blocks.

Figure A.9 – Incoherent light spread function for evaluation of optical characteristics of a block in a block-wise dynamic backlight unit



a) Incoherent light spread function (with a narrow angular luminance cone) of a block in a block-wise backlight unit

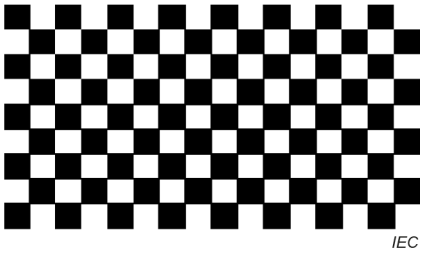


b) Slightly wide incoherent light spread function of a block in a block-wise backlight unit with slightly wide angular luminance cone compared to a)

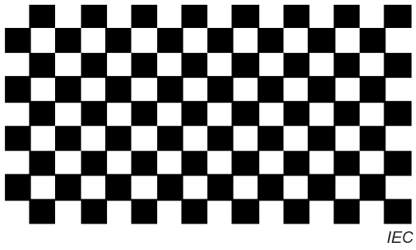
c) Incoherent light spread function of a block in a block-wise backlight unit with a wide angular luminance cone

NOTE The angular luminance cones are widened from a) to c).

Figure A.10 – Light spread functions of three BLUs with different optical structures



a) **Checkerboard pattern (positive)**



b) **Checkerboard pattern (negative)**

NOTE 1 Each block of the backlight unit is equal to the block of the checkerboard pattern. The crosstalk or optical S/N ratio can be evaluated by switching the blocks.

NOTE 2 The incoherent light spread function is used to evaluate the characteristics of a dynamic BLU and especially the leakage light from each block to the neighbouring blocks.

Figure A.11 – Checkerboard pattern for evaluation of the luminance uniformity in a BLU