IEC TR 62595-1-5

Edition 1.0 2022-12

TECHNICAL REPORT

colour inside

Display lighting unit – Part 1-5: Electrical signal interface of LED BLU

IEC TR 62595-1-5:2022-12(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 31.120; 31.260

ISBN 978-2-8322-6269-6

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DISPLAY LIGHTING UNIT –

Part 1-5: Electrical signal interface of LED BLU

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IEC TR 62595-1-5 has been prepared by IEC technical committee 110: Electronic displays. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
110/1445/DTR	110/1465A/RVDTR

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 Technical Report 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/standardsdev/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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
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- replaced by a revised edition, or
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DISPLAY LIGHTING UNIT –

Part 1-5: Electrical signal interface of LED BLU

1 Scope

This part of IEC 62595, which is a Technical Report, provides information for the future standardization of the electrical signal interface of LED backlight units for liquid crystal display television sets, which include control signals, control data and LED driver interface. This document only provides information about 2-D local dimming LED backlight units, with or without local boosting.

NOTE All values and parameters of this document are examples.

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 62595-1-2:2016, *Display lighting unit – Part 1-2: Terminology and letter symbols*

3 Terms, definitions, and abbreviated terms

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

3.1.1
local dimming
manipulation of luminance over an area of a two-dimensionally divided backlight unit in response to the image that is going to be displayed on the LC device at the same area

Note 1 to entry: In this document, "local dimming" refers to 2-D dimming.

[SOURCE: IEC 62595-1-2:2016,3.7.4, modified – in the terms “block dimming, two-dimensional dimming and 2-D dimming” have been removed, the term “(spatially)” has been deleted in the definition and Note 1 to entry has been added.]

3.1.2
local boosting
<LED backlight unit> dynamic and location-specific increase to peak luminance across the backlight unit in response to image content

3.1.3
LED driver unit
circuit board providing driving current to the LED backlight unit

3.1.4
video processing unit
circuit board including video decoder, scalar, and deinterlacing for video signal from input devices

Note 1 to entry: The input devices are, for example, TV set-top box, over the top (OTT) set-top box, disc player.

3.1.5
LED matrix
2-D array LED light sources in the LED light board

3.1.6
LED strings, pl.
LED strip light sources in the LED light bar

3.2 Abbreviated terms

AM	active matrix
BLU	backlight unit
IC	integrated circuit
I^2C	inter-integrated circuit
LCD	liquid crystal display
LED	light emitting diode
MOSI	master output slave input
OTT	over the top
PSU	power supply unit
PWM	pulse-width modulation
SCL	serial clock (for I^2C)
SCLK	serial clock (for SPI)
SDA	serial data
SoC	system on chip
SPI	serial peripheral interface
TCON	timing controller
VPU	video processing unit
VSYNC	vertical synchronization signal

4 Electrical interfaces configuration

4.1 General

One of the current hot topics of LCD-TV sets is how to improve image quality and reduce power consumption. Local dimming technology can improve the image quality and reduce power consumption by controlling the luminance of backlight, so it has been widely studied in LCD-TVs for nearly two decades [1] [2][1]. LCD-TV sets with local dimming LED backlight units are currently on the market, quickly becoming the medium- and high-end products of major TV brands. At the same time, with the application of local dimming technology, the electrical signal

[1] Numbers in square brackets refer to the Bibliography.

interfaces between various units of LCD-TV sets, especially the electrical signal interfaces of LED BLU, become more complicated. Figure 1 shows an example of an LCD-TV interface signal flow chart, in which the electrical signal interfaces of LED BLU refer to the interfaces between a VPU, LED driver unit and LED BLU.

This document intends to provide information for the future standardization of the electrical signal interface of LED BLU for LCD-TV sets. The basic configuration of LED blocks is introduced in 4.2. The overview of the interface function is described in 4.3. The electrical characteristics and interface definition of the signal interface of LED BLU are introduced in Clause 5 with examples.

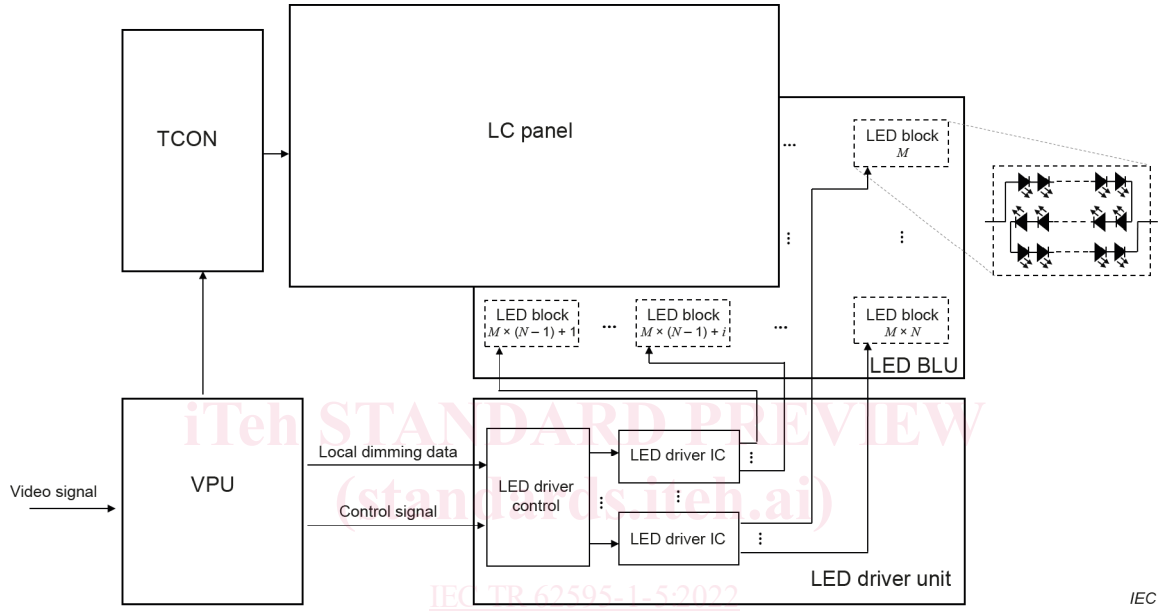

Figure 1 – LCD-TV interface signal flow chart

4.2 Basic configuration of LED blocks

A LED BLU with local dimming is divided into multiple independent LED blocks, and the luminance of each LED block can be adjusted in accordance with the image contents of the corresponding region to achieve the best image quality for an LCD-TV set. Therefore, the LED blocks configuration in the detailed specification of the LED BLU is specified to ensure the LED driver unit and VPU have the same understanding regarding the physical location of LED blocks, and the LED driver IC can accurately control each LED block to achieve luminance adjustment. As examples, there are two basic modes for the LED blocks configuration: normal mode and reverse mode, as shown in Table 1 and Table 2.

Table 1 – Address map of the normal mode LED blocks (N rows, M columns)

1	2	…	M
M + 1	M + 2	…	M × 2
M × 2+1	M × 2 + 2	…	M × 3
…	…	…	…
M × (N – 1) + 1	M × (N – 1) + 2	…	M × N

Table 2 – Address map of the reverse mode LED blocks (N rows, M columns)

$M \times N$	…	$M \times (N - 1) + 2$	$M \times (N - 1) + 1$
…	…	…	…
$M \times 3$	…	$M \times 2 + 2$	$M \times 2 + 1$
$M \times 2$	…	$M + 2$	$M + 1$
M	…	2	1

4.3 Overview of interface function

As shown in Figure 1, the VPU receives a video signal and generates the local dimming data and control signal to the LED driver control of the LED driver unit. The LED driver control of the LED driver unit then encodes the local dimming data and control data to the LED driver IC of the LED driver unit. Finally, the LED driver IC controls the LED blocks to realise the luminance adjustment of the LED BLU.

For dynamic backlight with local dimming, in order to ensure local dimming works properly, the function of the electrical signal interfaces of the LED BLU is specified in the detailed specification of the LED BLU. As an example, Table 3 shows the basic interface function for local dimming, in which local dimming data and control signal interfaces use SPI and I^2C communication protocol, respectively.

Table 3 – Interface function

Signal		Description
Local dimming data	VSYNC	Synchronization signal from VPU
	SCLK	Local dimming serial clock
	MOSI	Local dimming serial data from VPU
Control signal	PWM	Global dimming signal from SoC
	SCL	I^2C clock
	SDA	I^2C data

Global dimming mentioned in Table 1 is sometimes referred to as 0-D dimming, and it is the modulation benchmark for the luminance of the dynamic backlight with local dimming. The luminance of each LED block depends on different local dimming algorithms, but this is outside the current scope of this document.

To further improve the contrast of the LCD-TV, local boosting technology can be applied in the local dimming of LED BLU [3]. Figure 2 shows an example of the effect on luminance of LED BLU with local boosting. Assuming that a display image is shown in Figure 2 (left), for the central full white display region, and comparing this with local dimming LED BLU without local boosting, LED BLU with local boosting can achieve higher backlight luminance (see Figure 2, right), thus obtaining higher image contrast.

Local dimming generally works with local boosting, which does not necessarily change the interface configuration while reflecting different electrical characteristics. Similarly, there are many different local boosting algorithms currently used for local dimming LED BLU, but this is also outside the current scope of this document.