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Display technologies — LCD, PDP, and OLED — Overview and explanation of differences in terminology

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

DISPLAY TECHNOLOGIES – LCD, PDP AND OLED – OVERVIEW AND EXPLANATION OF DIFFERENCES IN TERMINOLOGY

FOREWORD

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IEC 62728, which is a technical report, has been prepared by IEC technical committee 110: Flat panel display devices.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
110/301/DTR	110/320/RVC

Full information on the voting for the approval of this technical report 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.

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- withdrawn,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.

INTRODUCTION

Traditionally each display technology (LCD, PDP and OLED) has developed its standards independently. However because of the common applications for these technologies (e.g. TV), the differences in the terms and measurement methods used by the different technologies are causing confusion.

In 2007, TC110 decided to establish a study group to address these issues. This group decided to initially address the differences in terminology. Experts representing each working group (working group No.2: LCD, No.4: PDP, and No.5: OLED) agreed to work toward harmonizing their terminology standards at the maintenance time.

Cases were found where a standard term differed from International Electrotechnical Vocabulary (IEV), which is used by IEC for basic definitions.

In the case where agreement on harmonization could not be reached the study group decided to explain the reason for the disagreement.

This technical report explains the differences of the definitions for 10 terms and the reasons why they are different. It is expected that this report will help consumers to understand these differences and to use these technical terms without confusion.

DISPLAY TECHNOLOGIES – LCD, PDP AND OLED – OVERVIEW AND EXPLANATION OF DIFFERENCES IN TERMINOLOGY

1 Scope

This technical report explains differences in definitions of the terms used in the flat panel display field such as liquid crystal displays (LCD), plasma displays (PDP), and organic light emitting diode displays (OLED). The definitions of technical terms are individually specified in the different standards:

– Liquid crystal display: IEC 61747-1

– Plasma display: IEC 61988-1

– Organic light emitting diode display: IEC 62341-1-2.

This report explains the background and reasons for the differences, but does not introduce new definitions or terms.

2 Normative references

The following referenced documents are indispensable for the application 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 60050-845:1987, *International Electrotechnical Vocabulary. Lighting*

IEC 61747-1:1998, *Liquid crystal and solid-state display devices – Part 1: Generic specification*
Amendment 1 (2003)

IEC 61988-1:2003, *Plasma display panels – Part 1: Terminology and letter symbols*

IEC 62341-1-2:2007, *Organic light emitting diode displays – Part 1-2: Terminology and letter symbols*

3 Covered terms

In this document, explanations on the following terms are provided.

Term	Subclause
active area	4.2.1
addressing	4.2.2
aspect ratio	4.2.3
contrast ratio	4.2.4
luminance lifetime	4.2.5
luminous efficacy	4.2.6
luminous efficiency	4.2.7
quantum efficiency	4.2.8
screen area	4.2.1
viewing angle	4.2.10
viewing direction	4.2.10
viewing angle range	4.2.10

4 Explanation

4.1 General

Hereafter the standards of terms and definitions are indicated as [IEV] for IEC 60050-845:1987, [LCD] for IEC 61747-1:1998 (and Amendment 1:2003), [PDP] for IEC 61988-1:2003, and [OLED] for IEC 62341-1-2:2007, respectively.

Note that some definition texts were simplified by omitting Notes.

Each clause consists of:

– defined word(s)
– definition in the standard [IEV], [LCD], [PDP], or [OLED]
– issues, and
– explanation.

4.2 Items

4.2.1 active area screen area

Definition in [LCD]	Definition in [PDP]	Definition in [OLED]
active area part of a display screen area delimited by picture elements	**screen area** maximum image reproducing area of the device	**active area** area that has a display function on the substrate of an organic light emitting diode display
Issue		
“Active area” and “screen area” are often used with the same meaning but are defined differently for [LCD] and [PDP].		
Explanation		
“Active area” and “screen area” are often used with the same meaning. Sometimes “active area” can be regarded as only an area covered by “active” pixels, omitting non-active pixels. To avoid this ambiguity, PDP experts agreed to use the term “screen area” instead, which is more familiar in the market. Since “active area” has also been often used, a note “sometimes called as active area” was added to [PDP] standard for harmonization.		

4.2.2 addressing

Definition in [LCD]	Definition in [PDP]	Definition in [OLED]
addressing selecting the pixels in space and/or time for activation or deactivation	**addressing** setting or changing the state of a subpixel with an address pulse	
Issue		
“Addressing” is a basic action of the display. The definition of [LCD] and [PDP] could not be harmonized.		
Explanation		
Since addressing principles for LCD and PDP are quite different, the words for definition need to be different. For LCD, the word “activation” is most suitable to express how to fix the selected pixels to display an image. However this would not be a correct wording for a PDP. A PDP has inherent memory in each subpixel, and so the state of this memory must be altered. This is not an “activate” or “deactivate” operation. Most other display devices do not have this memory effect.		

4.2.3 aspect ratio

Definition in [LCD]	Definition in [PDP]	Definition in [OLED]
	aspect ratio ratio of screen width to screen height	**aspect ratio** ratio of active area width to active area height, for example 4:3 or 16:9
Issue		
Explanation		
See “active area” (4.2.1)		

4.2.4
contrast ratio

Definition in [LCD]	Definition in [PDP]	Definition in [OLED]
contrast ratio the ratio between the higher, L_H and lower, L_L luminances that define the feature to be detected, measured by contrast ratio *CR*, defined as: $CR = \frac{L_H}{L_L}$	**contrast ratio** ratio of white luminance to black luminance of the image, including light reflected from the display	**contrast ratio** ratio of white luminance to black luminance of the image, including light reflected from the display
Issue		
The definitions in [PDP] and [OLED] are already harmonized, however they are different from the definition in [LCD].		
Explanation		
Generally, the fundamental function of an LCD is the switching of two phases between bright and dark phases. This does not directly mean “white” and “black” because there are various types of LCD which cannot be simply regarded as white-black, for example “blue-mode” (white/blue) or “yellow-mode” (yellow/black). So it is suitable for [LCD] to define “contrast ratio” as the ratio between two fundamental phases. Since the current major applications for PDP and OLED are television or display monitor (including mobile), the colour of the highest luminance can be regarded as “white” and the lowest as “black” in most of these cases. So for PDP and OLED, it is suitable to define “contrast ratio” as the ratio between “white” and “black”.		

4.2.5
luminance lifetime

Definition in [LCD]	Definition in [PDP]	Definition in [OLED]
	luminance lifetime time period during which the device continues to function at 50% or more of its initial luminance	**luminance lifetime** elapsed time required for the luminance to decrease to a specified fraction of the initial luminance in operation
Issue		
[OLED] defines this word in a basic manner but [PDP] includes a specific number, “50 %”.		
Explanation		
In the PDP field, “luminance lifetime” has been widely used in specification sheets to express how long a product can maintain luminance larger than 50% (half) of the initial luminance. This is not used solely by PDPs but has also been used in various other fields such as lamps, CRTs, and phosphors. OLED technology is newly developed and OLED engineers want to use “luminance lifetime” carefully with other specific values of percentages (%) like 30 % or 75 %. The definition in [OLED] is more general and the one in [PDP] is more specific. “Luminance lifetime” in the PDP field always means 50 % luminance lifetime.		

4.2.6
luminous efficacy

Definition in [LCD]	Definition in [PDP]	Definition in [OLED]
	luminous efficacy incremental luminous flux (measured as the luminous flux of a white display minus the luminous flux of a black display) divided by the incremental power input applied to the sustain driver for operating the panel (measured as the white display power minus the black display power)	**luminous efficacy** total luminous flux from the display divided by the applied electric power
Issue		
The definition in [PDP] uses “incremental power” and excludes “circuitry power” from the efficacy calculation.		
Explanation		
For many years, improvement of luminous efficacy has been the most important subject for PDP engineers. They have carried out many experiments and written many papers. To focus on improvement of the luminous (discharge) efficiency of the PDP panel, they needed a metric that removed the power consumed by the circuitry since circuit power can be quite variable. This is done by subtracting the power consumed when a black image is displayed. There are now many papers using this definition of “luminous efficacy” and so changing it would cause great confusion. To make the meaning of the measurements clear, the PDP committee defined several types of PDP luminous efficacy, such as “panel luminous efficacy”, “module luminous efficacy”, and “power cord luminous efficacy”.		

4.2.7
luminous efficiency

Definition in [LCD]	Definition in [PDP]	Definition in [OLED]	Definition in [IEV]
	luminous efficiency efficiency of visible light produced only from the sustain power applied to the gas discharge		**luminous efficiency (of radiation) (*V*)** ratio of radiant flux weighted according to $V(\lambda)$ to the corresponding radiant flux $V = \frac{\int_0^\infty \Phi_{e,\lambda}(\lambda) \cdot V(\lambda) \cdot d\lambda}{\int_0^\infty \Phi_{e,\lambda}(\lambda) \cdot d\lambda} = \frac{K}{K_m}$
Issue			
The definition in [PDP] is not compliant with the definition in [IEV].			
Explanation			
In [IEV], a basic definition of “luminous efficiency” is provided. The definition is mainly used for radiation phenomena related to conversion from light to light. For example, conversion efficiency of a phosphor used in a PDP (UV light to visible light) can be handled with this formula. Note that this also assumes visible light for output light because the $V(\lambda)$;luminosity factor is multiplied. “Luminous efficiency” in [PDP] means the conversion efficiency from electrical power to visible light, and not light to light as for [IEV]. In most practical cases, the “luminous efficacy” metric is often used instead of “luminous efficiency” for quantitative purposes.			

4.2.8
quantum efficiency

Definition in [LCD]	Definition in [PDP]	Definition in [OLED]
	quantum efficiency measure of efficiency as a direct ratio of the output particles (quanta) to the input particles (quanta)	**quantum efficiency** ratio of the number of generated photons divided by the number of input photons or injected electric charges
Issue		
The definitions in [PDP] and [OLED] are slightly different and hard to harmonize.		
Explanation		
Basic meaning of “quantum efficiency” as defined in [PDP] is efficiency in the particle (quantum) basis. In many cases, this quantum is interpreted as a “photon” or “electron” as expressed in [OLED]. In the PDP field, “quantum efficiency” is normally used for phosphors, assuming photon (UV light) to photon (visible light) conversion. In the OLED field, the usage of “quantum efficiency” is related to phenomena called as “photoluminescence” (photon to photon) or “electroluminescence” (electron to photon).		

4.2.9
screen area
see active area

4.2.10
viewing angle
viewing direction
viewing angle range

Definition in [LCD]	Definition in [PDP]	Definition in [OLED]
viewing angle range the viewing angular direction range over which the visual specification is satisfied **viewing direction** direction or angle for viewing an LCD device		**viewing angle** NOTE See viewing direction **viewing angle range** range of viewing angle over which the visual specification is satisfied **viewing direction** direction or angle for viewing an organic light emitting diode display which is defined by the inclination angle θ and the azimuth φ
Issue		
There are many terms related to the performance of how wide an area in angle the display can produce a good image, like “viewing angle”, “viewing angle range” and “viewing direction”. The market uses the term “viewing angle”. There is a claim that the term “viewing angle” is not a correct wording for the meaning used in the market.		
Explanation		
There have been many discussions about “viewing angle”. Three terms related to “viewing angle” are defined in related standards such as: “viewing angle”, “viewing direction” and “viewing angle range”. Though the market often uses simple “viewing angle”, current [LCD] and [OLED] prefer not to use this term. The PDP committee is planning to define “viewing angle” as used in the market because denying the current usage of a word in the market will induce confusion. Careful usage of wording is necessary.		

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