IEC 61988-2-4

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Plasma display panels –
Part 2-4: Measuring methods – Visual quality: Image artifacts

Panneaux d'affichage à plasma –
Partie 2-4: Méthodes de mesure – Qualité visuelle: Artéfacts d'image

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

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FOREWORD

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

FDIS	Report on voting
110/260/CDV	110/297/RVC

Full information on the voting for the approval on 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 the parts in the IEC 61988 series, under the general title *Plasma display panels*, can be found on the IEC website.

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

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- withdrawn,
- replaced by a revised edition, or
- amended.

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PLASMA DISPLAY PANELS –

Part 2-4: Measuring methods – Visual quality: Image artifacts

1 Scope

This part of IEC 61988 determines the measuring methods for characterizing the performance of plasma display panel (PDP) modules in the following areas:

a) viewing angle;

b) image streaking;

c) flicker;

d) moving picture resolution.

2 Normative references

The following referenced documents are indispensable for the application of these standards. For standards with explicit dates, only the edition cited applies. For standards references, the latest edition of the referenced standard (including any amendments) applies.

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60107-1:1997, *Methods of measurement on receivers for television broadcast transmissions – Part 1: General considerations – Measurements at radio and video frequencies*

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

IEC 61988-2-1:2002, *Plasma display panels – Part 2-1: Measuring methods – Optical*

IEC 61988-2-2:2003, *Plasma display panels – Part 2-2: Measuring methods – Optoelectrical*

CIE 15:2004, *Colorimetry, 3rd Edition*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61988-1, IEC 60068-1, and IEC 60107-1, as well as the following apply.

3.1
viewing angle
angular range over which a display can be viewed with acceptable specified visual performance

NOTE This document specifies two types of viewing angle regarding the viewing direction, such as horizontal and vertical.

3.2
half luminance viewing angle
viewing angle over which the luminance is equal or higher than half of the luminance measured at the angle perpendicular to the screen

3.3
half contrast viewing angle
viewing angle over which the contrast ratio is equal or higher than half of the contrast ratio measured at the angle perpendicular to the screen

3.4
10:1 contrast ratio viewing angle
viewing angle over which the contrast ratio is equal or higher than 10:1

3.5
colour viewing angle
viewing angle over which the chromaticity shift $\Delta(u',v')$ is equal or less than specified threshold value

3.6
image streaking
variance in luminance with changing vertical or horizontal line load

3.7
flicker
unintended but perceptible temporal periodic fluctuation in luminance

3.8
moving picture resolution
perceived number of picture lines for moving pictures on the display screen

NOTE Moving picture resolution is not determined only by the physical pixel number of the panel (termed "addressability"), but also by the moving picture performance in terms of motion artefacts. The resolution is expressed in picture line in the document and it can be easily converted to well-known TV-line.

3.9
modulation transfer function
MTF
ratio of the final to the initial signal amplitude as a function of spatial frequency

NOTE MTF is the magnitude part of optical transfer function (OTF).

3.10
limit resolution
maximum number of picture lines which observer can distinguish excepting spurious resolution

NOTE See Figure 7.

3.11
spurious resolution
phenomenon occurring at a spatial frequency higher than the limit resolution in which the observed pattern of the resolution chart is different from the original pattern

NOTE Spurious resolution is usually recognized as a change of the number of lines. For example four lines become three lines or five lines. See Figure 7.

4 Structure of measuring equipment

The system diagrams and/or operating conditions of the measuring equipment shall comply with the structure specified in each item.

5 Standard measuring conditions

5.1 General

The standard measuring conditions defined in IEC 61988-2-1 and IEC 61988-2-2 shall be used, and also the following conditions shall be applied.

5.2 Adjustment of PDP modules

For contrast adjustable PDP modules, adjust the contrast to the maximum value under the standard environmental conditions.

Automatic control functions such as auto-power control (APC), image sticking prevention mode, etc., by which the display luminance could change during the measurement shall be turned off or the activation of these functions shall be avoided by some measuring procedures described below.

When the displayed luminance could be changed by some automatic control functions included in the PDP module and turning off these functions is not convenient, a procedure using sequentially changing input images or a procedure using a turn-on, measure and turn-off sequence shall be applied.

For the procedure of sequentially changing input images, the input signals shall be changed just before the display luminance is changed and the measurement shall be carried out when the measured image is displayed. The input signal, except the measured image, should be any suitable signal that disables the automatic control functions mentioned above. For the procedure of using a turn-on, measure and turn-off sequence, the PDP module shall be sequentially turned off and turned on just before the displayed luminance is changed. The measurement shall be carried out when the measured image is displayed.

The displayed luminance of both procedures mentioned above usually remains constant for several minutes which is enough for a stable measurement with a light measurement device.

6 Measuring methods

6.1 Viewing angle

6.1.1 Purpose

The purpose of this method is to measure the horizontal and vertical viewing angle of half luminance, half contrast, 10:1 contrast ratio, and colour of the PDP modules.

6.1.2 Equipment

The following equipment shall be used:

a) driving power source;

b) driving signal equipment;

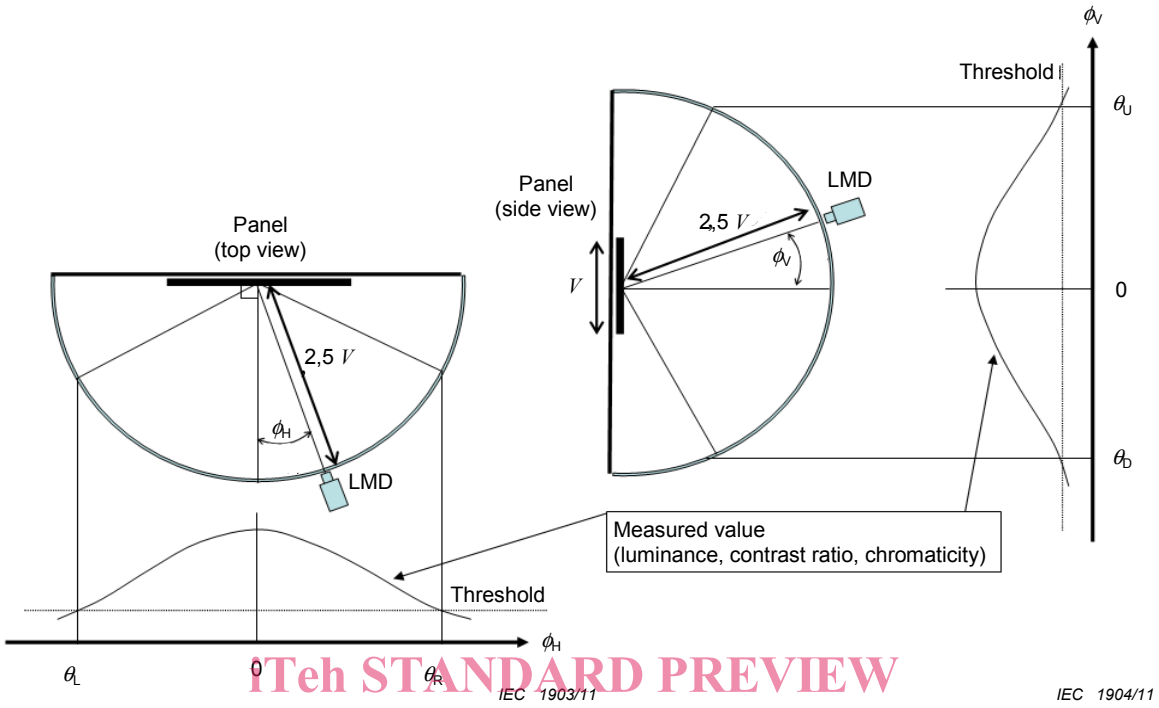
c) light measuring device (LMD);

d) angle measuring equipment.

6.1.3 Measuring equipment setup

Measurements shall be carried out with the measuring equipment setup shown in Figure 1. For the upward/downward arrangement of LMD, PDP module may be tilted instead of movement of LMD. Care shall be taken to avoid the influence of light from the surround. When a different measuring equipment setup is used, it shall be noted on the report. Figure 1 also

shows an example of measured results. Distance between the PDP module and LMD shall be set according to 5.3.3 of IEC 61988-2-1:2002.



(a) Horizontal viewing angle (b) Vertical viewing angle

Key

ϕ_H horizontal angle of the LMD to the screen (variable)

ϕ_L vertical angle of the LMD to the screen (variable)

θ_L left viewing angle

θ_R right viewing angle

θ_U upward viewing angle

θ_D downward viewing angle

V screen height

Threshold values are defined for each measuring item, e.g. half luminance, half contrast ratio etc.

Figure 1 – Measuring equipment setup and example of measuring results for horizontal and vertical viewing angles

6.1.4 Measuring method of half luminance viewing angle

6.1.4.1 Procedure

The measurement shall be carried out in following procedure:

a) arrange the light measuring device (LMD) which should be positioned as shown in Figure 1;

b) apply the 4 % window specified in IEC 61988-2-1 with the level of 100 % to the PDP module;

c) measure the luminance at the angle perpendicular to the screen;

d) change angle to the left or right using a goniometric positioning device such as a rotating platter and discrete angle gauge blocks to assure accurate angular alignments (±1°) between the direction of light measuring device and the screen perpendicular;

e) measure luminance in the screen centre at each angle;

f) find right viewing angle (θ_R) and left viewing angle (θ_L) where the luminance value is half of the luminance measured at the angle perpendicular to the screen;

NOTE The critical viewing angles, θ_R and θ_L are obtained by making plots of the measured values for each measurement angle.

g) calculate horizontal viewing angle θ_H as follows:

$$\theta_H = \theta_L + \theta_R$$

h) repeat a) to f) to measure the upward and downward viewing angles θ_U and θ_D similarly.

i) calculate vertical viewing angle θ_V as follows:

$$\theta_V = \theta_U + \theta_D.$$

6.1.4.2 Expression of results

An example of measured and calculated angle values is shown in Table 1.

Table 1 – Example of half luminance viewing angle

Half luminance viewing angle					
Horizontal			Vertical		
Left viewing angle	Right viewing angle	Horizontal viewing angle	Upward viewing angle	Downward viewing angle	Vertical viewing angle
θ_{L_LIMIT} degree	θ_{R_LIMIT} degree	θ_H degree	θ_{U_LIMIT} degree	θ_{D_LIMIT} degree	θ_V degree
85	85	170	85	85	170

6.1.5 Measuring method of half contrast viewing angle

6.1.5.1 Procedure

The measurement shall be carried out in following procedure:

a) apply appropriate test signals (see c)) to the PDP module;

b) arrange the luminance meter to measure the luminance at screen centre from the perpendicular direction;

c) make contrast ratio measurement specified in 6.3 of IEC 61988-2-1:2002, using 4 % window pattern at centre screen;

d) change angle to the left or right using a goniometric positioning device such as a rotating platter and discrete angle gauge blocks to assure accurate angular alignments (±1°) between the direction of light measuring device and the screen perpendicular;

e) measure contrast ratio in the screen centre at each angle;

f) find right viewing angle(θ_R) and left viewing angle(θ_L) which have half maximum contrast ratio value;

NOTE The critical viewing angles, θ_R and θ_L are obtained by making plots of the measured values for each measurement angle.

g) calculate horizontal viewing angle θ_H as follows:

$$\theta_H = \theta_L + \theta_R$$

h) repeat a) to f) to measure the vertical viewing angle similarly;

i) calculate vertical viewing angle θ_V as follows:

$$\theta_V = \theta_U + \theta_D.$$

6.1.5.2 Expression of results

An example of measured and calculated angle values is shown in Table 2.

Table 2 – Example of half contrast viewing angle

Half contrast viewing angle					
Horizontal			Vertical		
Left viewing angle	Right viewing angle	Horizontal viewing angle	Upward viewing angle	Downward viewing angle	Vertical viewing angle
θ_{L_LIMIT} degrees	θ_{R_LIMIT} degrees	θ_H degrees	θ_{U_LIMIT} degrees	θ_{D_LIMIT} degrees	θ_V degrees
85	85	170	85	85	170

6.1.6 Measuring method of 10:1 Contrast ratio viewing angle

6.1.6.1 General

10:1 contrast ratio is known as a criterion of contrast ratio for readability of letters or characters. So this 10:1 contrast ratio viewing angle specifies a viewing angle for simple readability of the display.

6.1.6.2 Procedure

The measurement shall be carried out in following procedure:

a) apply appropriate test signals (see c)) to the PDP module;

b) arrange the luminance meter to measure the luminance at screen centre from the perpendicular direction;

c) make contrast ratio measurement specified in 6.3 of IEC 61988-2-1:2002, using 4 % window pattern at centre screen;

d) change angle to the left or right using a goniometric positioning device such as a rotating platter and discrete angle gauge blocks to assure accurate angular alignments ($\pm 1^{o}$) between the direction of light measuring device and the screen perpendicular;

e) measure contrast ratio in the screen centre at each angle;

f) find right viewing angle(θ_R) and left viewing angle(θ_L) which have 10:1 contrast ratio value.

NOTE The critical viewing angles, θ_R and θ_L are obtained by making plots of the measured values for each measurement angle.

If the measured value is over 10:1 at all angles measured then note that the viewing angle is greater than the largest angle measured. The largest angle measured shall be noted on the report;

g) calculate horizontal viewing angle θ_H as follows:

$$\theta_H = \theta_L + \theta_R;$$

h) repeat a) to f) to measure the vertical viewing angle similarly;

i) calculate vertical viewing angle θ_V as follows:

$$\theta_V = \theta_U + \theta_D.$$

6.1.6.3 Expression of results

An example of measured and calculated angle values is shown in Table 3.

Table 3 – Example of 10:1 contrast ratio viewing angle

10:1 contrast ratio viewing angle					
Horizontal			Vertical		
Left viewing angle	Right viewing angle	Horizontal viewing angle	Upward viewing angle	Downward viewing angle	Vertical viewing angle
θ_{L_LIMIT} degrees	θ_{R_LIMIT} degrees	θ_H degrees	θ_{U_LIMIT} degrees	θ_{D_LIMIT} degrees	θ_V degrees
>85	>85	>170	>85	>85	>170
The largest measured angle is 85° for all directions.					

6.1.7 Measuring method of colour viewing angle

6.1.7.1 General

Colour viewing angles are determined for viewing angle directions, where chromaticity shift $\Delta(u',v')$ of white corresponding to the perpendicular values is smaller than 0, 01, or any other agreed-upon threshold value:

$$\Delta(u',v') = (\Delta u'^2 + \Delta v'^2)^{1/2}$$

where

$\Delta u' = u'_\varphi - u'_0$,

$\Delta v' = v'_\varphi - v'_0$,

(u'_φ, v'_φ): measured chromaticity (u', v') for each measurement angle φ,

(u'_0, v'_0): measured chromaticity (u', v') as a reference measured from perpendicular direction.

It is permitted to use the following chromaticity, after transforming x, y chromaticity coordinates to u', v' of chromatic value:

$u' = 4x / (3 - 2x + 12y)$;

$v' = 9y / (3 - 2x + 12y)$;

where x and y are CIE1931 chromaticity coordinates defined in CIE 15 and u' and v' are CIE 1976 UCS diagram coordinates defined in CIE 15.

6.1.7.2 Procedure

The measurement shall be carried out in following procedure:

a) apply the 4 % window specified in IEC 61988-2-1 with the level of 100 % as a test signal to the PDP module. Other colours can be used if desired;

b) arrange the light measuring device to measure colour at screen centre from the perpendicular direction;

c) measure perpendicular colour coordinate;

d) change angle to the left or right using a goniometric positioning device such as a rotating platter and discrete angle gauge blocks to assure accurate angular alignments (±1°) between the direction of light measuring device and the screen perpendicular;

e) measure colour coordinates in the screen centre at each angle;

f) find right viewing angle(θ_R) and left viewing angle(θ_L) which have $\Delta(u',v')$ in 0,01;

NOTE The critical viewing angles, θ_R and θ_L are obtained by making plots of the measured values for each measurement angle.

g) calculate horizontal viewing angle θ_H as follows:

$$\theta_H = \theta_L + \theta_R;$$

h) repeat a) to f) to measure the vertical viewing angle similarly;

i) calculate vertical viewing angle θ_V as follows:

$$\theta_V = \theta_U + \theta_D.$$

6.1.7.3 Expression of results

An example of measured and calculated angle values is shown in Table 4.

Table 4 – Example of colour viewing angle

Colour viewing angle					
Horizontal			Vertical		
Left viewing angle	Right viewing angle	Horizontal viewing angle	Upward viewing angle	Downward viewing angle	Vertical viewing angle
θ_{L_LIMIT} degrees	θ_{R_LIMT} degrees	θ_H degrees	θ_{U_LIMIT} degrees	θ_{D_LIMIT} degrees	θ_V degrees
85	85	170	85	85	170

6.2 Image streaking

6.2.1 Purpose

The purpose of this method is to measure the image streaking of the PDP modules.

6.2.2 Equipment

The following equipment shall be used:

a) driving power source;

b) driving signal equipment;

c) light measuring device.

6.2.3 Measuring method of image streaking

6.2.3.1 Preparation

The PDP modules shall be set in the standard measuring conditions in the dark room conditions.

6.2.3.2 Procedure

Two types of the test patterns, high and low average picture level (APL), as shown in Figure 2 and Figure 3 shall be applied to measure image streaking. The white area is level 100 % white and the black area is level 0 % black respectively in each figure of Figure 2 and Figure 3.

a) Apply pattern L1 and measure the luminance value L_{A1}, L_{B1} at the point P_{A1}, P_{B1} in Figure 2 (a).