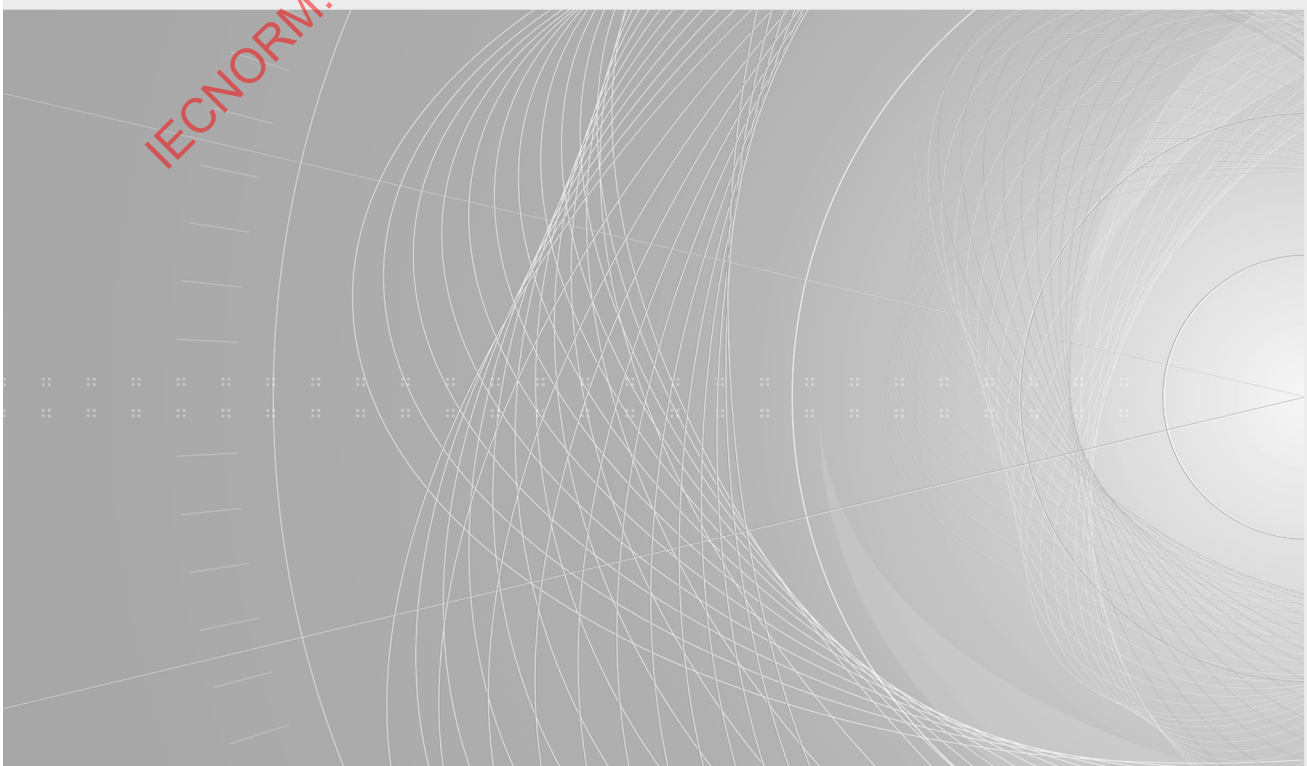
IEC 62629-13-1

Edition 1.0 2017-10

INTERNATIONAL STANDARD

3D display devices –
Part 13-1: Visual inspection methods for stereoscopic displays using glasses – Ghost image



IEC 62629-13-1:2017-10(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

IEC 62629-13-1

Edition 1.0 2017-10

INTERNATIONAL STANDARD

colour inside

3D display devices –
Part 13-1: Visual inspection methods for stereoscopic displays using glasses – Ghost image

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.120; 31.260

ISBN 978-2-8322-4867-6

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

3D DISPLAY DEVICES –

Part 13-1: Visual inspection methods for stereoscopic displays using glasses – Ghost image

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62629-13-1 has been prepared by IEC technical committee 110: Electronic display devices.

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

FDIS	Report on voting
110/896/FDIS	110/912/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62629 series, published under the general title *3D display devices*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

3D DISPLAY DEVICES –

Part 13-1: Visual inspection methods for stereoscopic displays using glasses – Ghost image

1 Scope

This part of IEC 62629 specifies the visual inspection methods of ghost image. This document is applicable to stereoscopic displays using glasses.

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 61747-30-1:2012, *Liquid crystal display devices – Part 30-1: Measuring methods for liquid crystal displays modules – Transmissive type*

IEC 61988-2-1:2012, *Plasma display panels – Part 2-1: Measuring methods – Optical and optoelectrical*

IEC 62341-6-3:2012, *Organic light emitting diode (OLED) displays – Part 6-3: Measuring methods of image quality*

IEC 62629-1-2, *3D display devices – Part 1-2: Terminology and letter symbols*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62629-1-2 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
ghost image
image artefact that the observer perceives due to the incomplete separation of the left and the right images occurring in the stereoscopic display using glasses

4 Standard visual inspection conditions

4.1 Environmental conditions

Visual inspection shall be carried out under the standard environmental conditions as follows:

– temperature: 25 °C ± 5 °C,

– relative humidity: 45 % to 75 %,
– pressure: 86 kPa to 106kPa.

When different environmental conditions are used, these shall be noted in the report.

4.2 Setup conditions

4.2.1 Standard visual inspection distance and standard observing point

The standard visual inspection distance shall be defined in the relevant specification by the manufacturer. The standard observing point shall be at the standard visual inspection distance from the screen on the centre line which is perpendicular to the screen and through the screen centre (see Figure 1). The standard observing point shall not change when the inspector carries out inspection for the various positions of the screen.

If the standard visual inspection distance is not available, the distance of $3V$ shall be used or the distance used shall be reported.

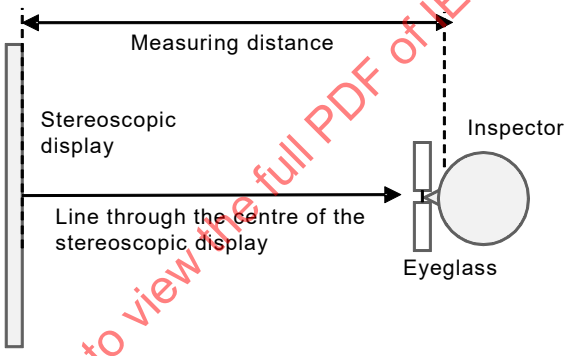


Figure 1 – Top view of standard visual inspection layout

4.2.2 Setup conditions of stereoscopic display

The 2D-3D mode selection of the stereoscopic display, if it exists, shall be set to stereo mode, 3D mode or related mode. When detailed mode settings are defined in the relevant specification, the mode settings shall be applied. Display setup such as gamma curve setting shall not be changed during the experiment.

4.2.3 Warm-up conditions of display modules and glasses

The display module and glasses for the visual inspection shall be warmed up to stabilize their characteristics. The warm-up conditions for the inspected display module shall comply with the conditions defined in each relevant specification of each display module, i.e. LCD, PDP, OLED, etc. (see IEC 61747-30-1:2012, 6.12, IEC 61988-2-1:2012, Clause 5 and IEC 62341-6-3:2012, Clause 5). The warm-up conditions of the glasses shall be defined in the relevant specification, if warm-up is needed.

4.3 Lighting conditions

Dark-room conditions shall be used as lighting conditions.

Illuminance shall be measured on nine positions of the screen of the stereoscopic display as shown in Figure 2. Illuminance shall be less than 1 lx.

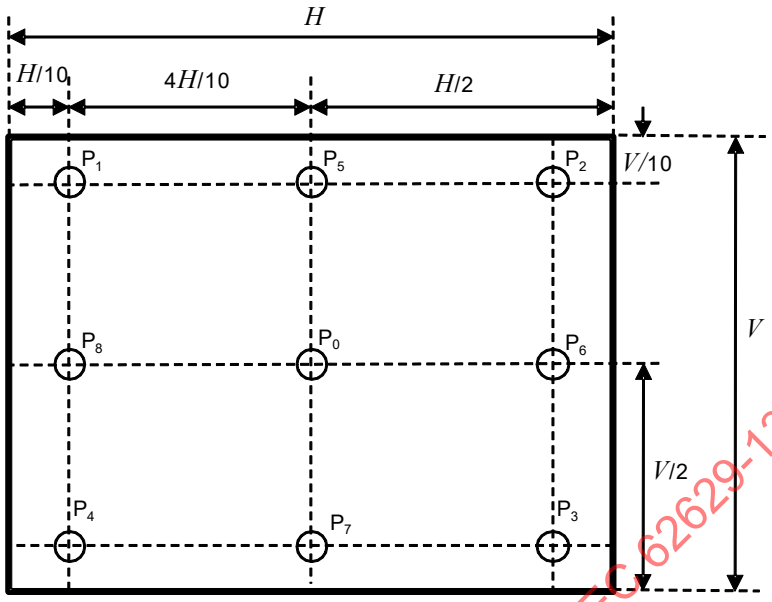


Figure 2 – Nine positions for the box patterns

4.4 Inspector conditions

The inspector shall have normal colour vision, visual acuity (optically corrected to) ≥ 1,0 in decimal notation and normal stereopsis as determined by a qualified eye care professional or physician using methods consistent with those defined by the International Council on Ophthalmology. For colour vision, the Ishihara test is recommended, and for visual acuity the Snellen test or Landolt C test is recommended. Relevant literature on these tests can be found in the Bibliography, see [1][1].

4.5 Input signals

4.5.1 Signal format and field frequency of input video signal

The signal format and the field frequency of applied input video signal shall be matched to the stereoscopic displays for the visual inspection. The applied signal format and its field frequency shall be noted in the report.

NOTE Some examples of signal formats are shown in Annex B.

4.5.2 Input signal pattern

An input signal pattern shall be used for the visual inspection at the grey levels of G_2 and G_1.

For the visual inspection at the grey levels of G_2 and G_1, the box pattern of Figure 3 consists of a part of an input signal pattern. H and V represent the horizontal width and the vertical height of the active area of the 3D display.

a) In the box pattern of Figure 3, grey bars of grey level G_b and height $V/40$ are located at the upper and lower side of the box pattern. The area of G_b is used for the visual inspection of ghost.

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

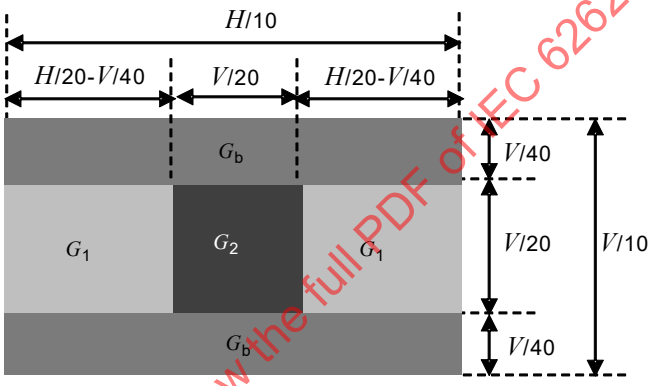
b) A square of size $V/20$ and of G_2 grey level is located beside the area of G_1 grey level.

c) For a 2D image, the position of this square of G_2 is located at the centre of the box pattern (see Figure 3(a)).

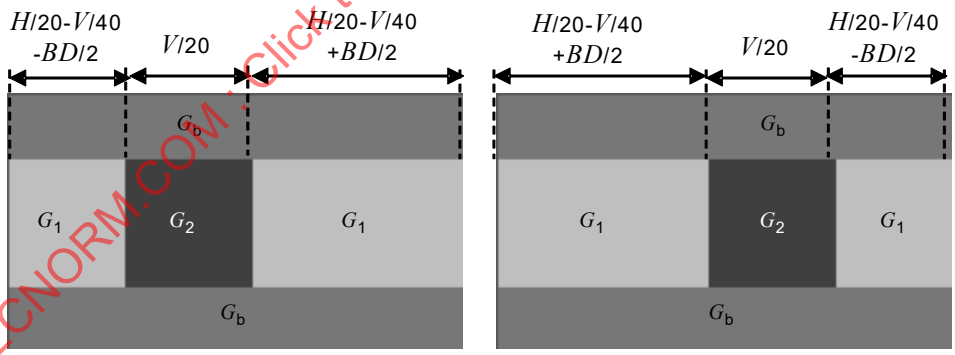
d) For a 3D image, the square box of G_2 grey level for the left view is horizontally shifted to the left side by (distance BD)/2 from the centre of the box pattern. Similarly, the square box of G_2 grey level for the right view is horizontally shifted to the right side by (distance BD)/2 (see Figure 3(b)).

The distance BD represents the amount of binocular disparity of this square of G_2 between the left and right input signal. Due to the distance BD, the inspector will perceive the depth of this square differently from that of the active screen. The distance BD of the input signal can be different, depending on the size of the active area of the display. The distance BD should be 2/3 arc degree.

NOTE 1 BD in 2/3 arc degree can be changed to length by the following formula: BD in length = visual inspection distance X tan [2/3 degree]. For example, at the visual inspection distance of 2 m, a BD of 2/3 arc degree is equivalent to 2,4 cm. If BD is too large, the inspector will not observe the stereoscopically fused image, but the double image.



(a) Box pattern with zero binocular disparity



(b) Box pattern for left view and right view with binocular disparity of BD

Figure 3 – Example of box pattern at G_1 and G_2

The input signal pattern of Figure 4 shall be used for the visual inspection of ghost at the grey levels of G_2 and G_1. The values of G_1 and G_2 are selected from nine, five, three or two values, which are equally divided levels including 0 and maximum grey levels. For an 8-bit grey scale display, the grey levels for nine values are 0, 31, 63, 95, 127, 159, 191, 223 and 255 (see Table 1). The grey levels for five values are 0, 63, 127, 191 and 255. The grey levels for three values are 0, 127 and 255. The grey levels for two values are 0 and 225. The same grey levels for G_1 and G_2 shall not be used.

Table 1 – Value of grey levels G_1 and G_2 for an 8-bit grey scale display

Divisions	Grey levels
9	0, 31, 63, 95, 127, 159, 191, 223, 255
5	0, 63, 127, 191, 255
3	0, 127, 255

1) In Figure 4, the box patterns of size $H/10$ by $V/10$ from Figure 3(b) are placed at the nine positions of P_0 to P_8 illustrated in Figure 2.
2) Gradation bars are located inside the active area of the screen to check the gradation smoothness. In increments of 8 grey steps for 256 levels, one gradation bar on the upper side consists of 17 different grey levels of 0, 7, 15, 23, …, 127. The other gradation bar at the lower side consists of 17 different grey levels of 127, 135, …, 255.

   NOTE 2 Gradation smoothness as seen by the visual inspector can be dependent on the uniformity characteristics of the screen. The gradation bar is selected to be positioned between the centre and the boundary of the screen.

3) The grey level of the background in Figure 4 is 87 grey which is 34 % of 255 grey levels.

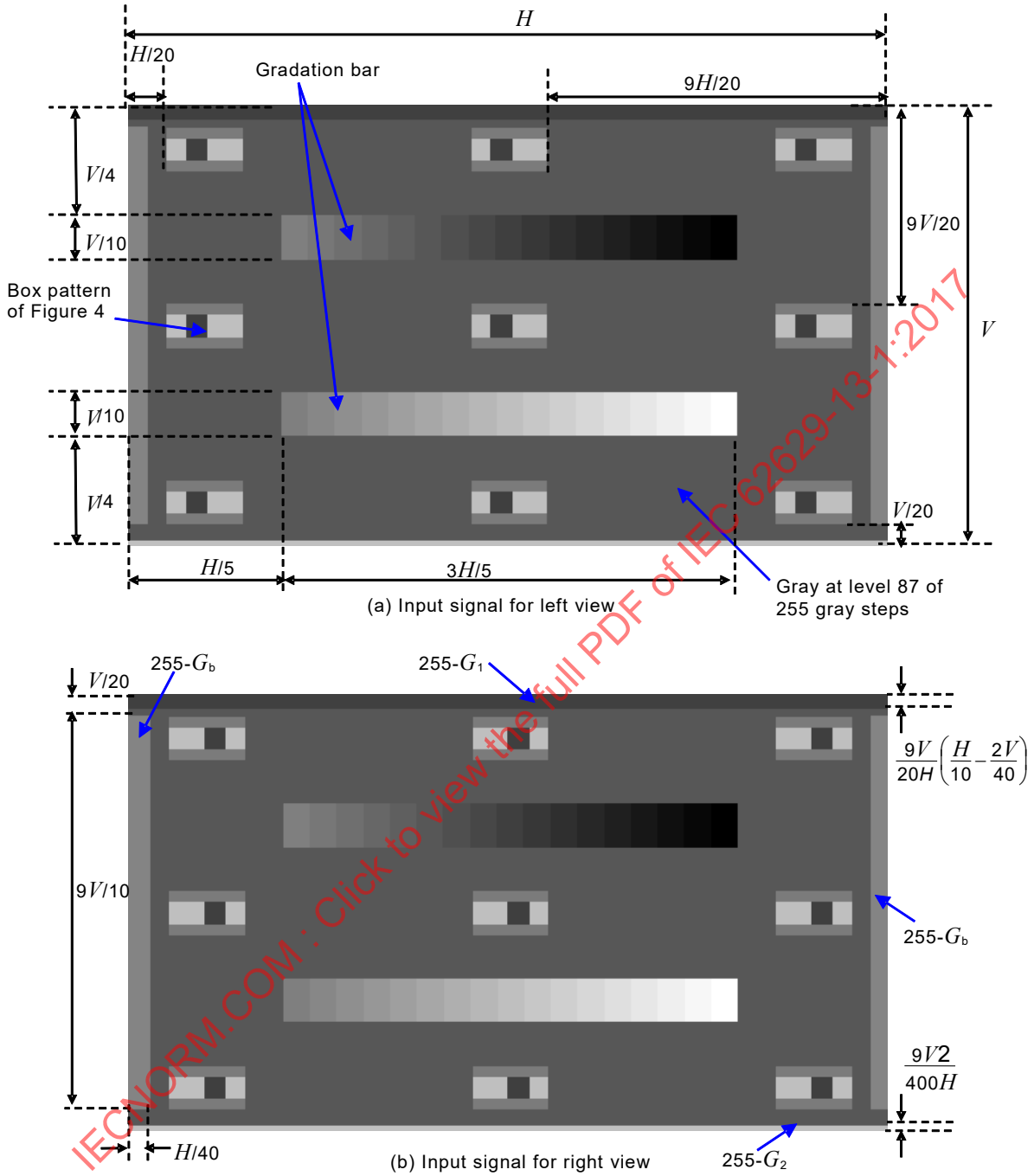


Figure 4 – Example of input signal for the visual inspection of ghost at G_2 and G_1

4) For the visual inspection of ghost, the G_b grey level of the grey bars will be changed in increments of 4 grey levels for the display of 256 grey levels. This shall be adjusted by the operator, the inspector, or automated as described in the visual inspection method procedure.

As there are nine box patterns in Figure 4, the areas occupied by the grey levels G_1, G_2 and G_b are $9V$ (H/10 – V/20) /20, $9V^2$/400 and $9HV$/200, respectively. The area of grey level of (255 – G_1) and $9V$ (H/10 – V/20)/20 is placed on the upper side of the input signal pattern of Figure 4. As the areas of (255 – G_1) and G_1 grey level are the same, the change of G_1 is compensated by the change of (255 – G_1) and does not affect the average picture signal level (APL). To keep APL constant, the area of grey level of (255 – G_2) and $9V^2$/400 is placed on the lower side of the input signal pattern. For the same purpose, the area of grey level of (255 – G_b) and $9HV$/200 is placed on each side of the input signal pattern. As the areas of grey levels of (255 – G_1), (255 – G_2) and (255 – G_b) are respectively the same as the area of grey levels of G_1, G_2 and G_b, the APL of the input signal is constant irrespective of the changes of G_1, G_2 and G_b.

The input signal pattern of Figure 5 shall be used for the visual inspection of a 2D image at the grey levels of G_2 and G_1. The layout of Figure 5 is equivalent to Figure 4 except that the box pattern of Figure 3(a) is placed at the nine positions of P_0~P_8 defined in Figure 2.

Figure 5 – Example of input signal for 2D image comparison

5 Visual inspection methods

5.1 Purpose

The purpose of this visual inspection is to determine the existence of the ghost. Visual inspection will be done by the inspector.

NOTE Measurement with a two-dimensional light measuring device (LMD) is described in Annex A.

5.2 Visual inspection equipment

The following equipment shall be used:

a) driving power source;

b) driving signal equipment for stereoscopic display using glasses; and

c) glasses compatible with the 3D display system to be worn by the inspector.

5.3 Visual inspection conditions

The standard visual inspection conditions shall be applied. Dark-room conditions shall be used as lighting conditions. The input signal of Figure 4 and Figure 5 with grey levels G_1 and G_2 as described in 4.5.2 shall be applied. Any stereoscopic display setting which controls the depth should be disabled. The inspector shall carry out the visual inspection based on the specified procedure and record the specified inspection condition in the inspection report.

5.4 Visual inspection procedure

5.4.1 Warm-up

The display module and glasses for visual inspection shall be warmed up to stabilize their characteristics.

5.4.2 Inspection of 2D artefact

As the unexpected image artefact occurring in a 2D image may be confused with 3D ghost, a 2D image with zero disparity (distance BD = 0) shall be checked.

a) The 2D input signal of Figure 5 as described in 4.5.2 (distance BD = 0) shall be applied.

b) The inspector wearing the required glasses for the stereoscopic display shall check whether intermediate brightness exists between the area of G_1 and G_2 of the box pattern of Figure 3(a).

c) If intermediate brightness exists between the area of G_1 and G_2 of the box pattern, the existence of a 2D artefact shall be noted in the report.

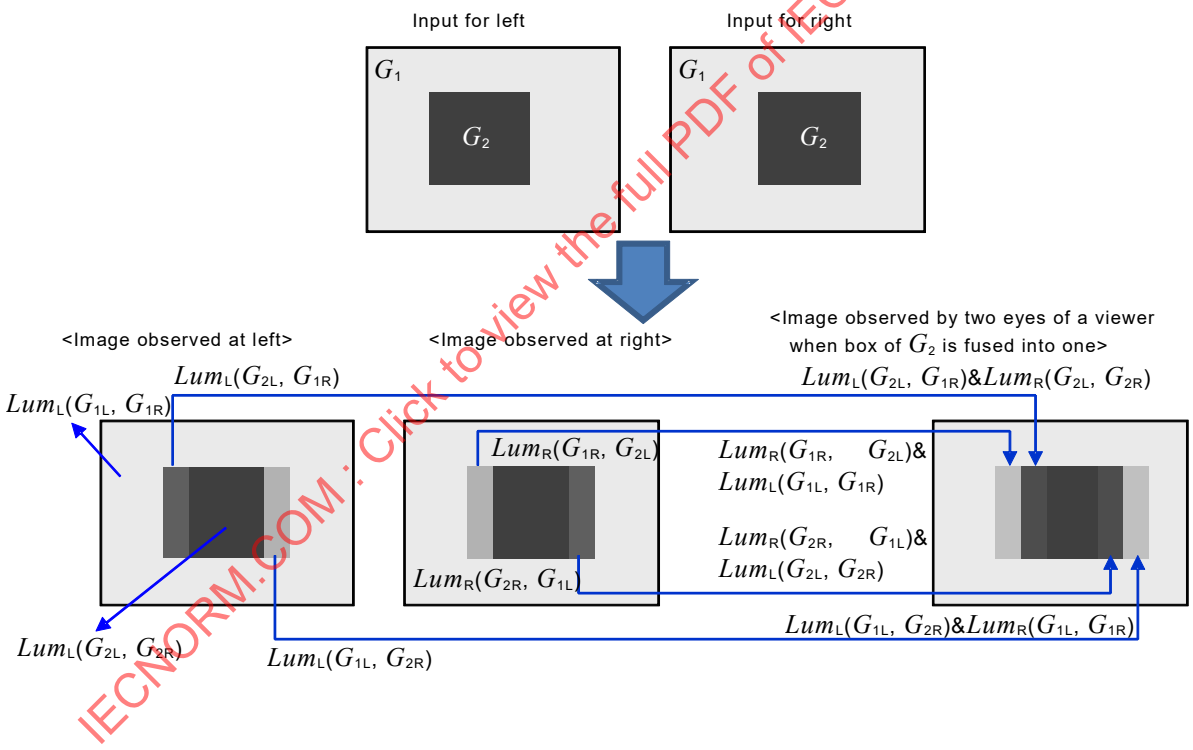


Figure 6 – Example of ghost artefact

5.4.3 Inspection of 3D ghost

During the inspection procedure, it shall be checked that the inspector observes the stereoscopically fused image, not the double image. If the inspector observes the double image, the amount of BD shall be reduced.

NOTE A double image would show a ghost image everywhere, whereas a stereoscopically fused image would show a ghost image only in the areas where there is a binocular disparity.

a) The input signal of Figure 4 with grey levels G_1 and G_2 shall be applied with the specified amount of BD. In Figure 4, the box patterns of size H/10 by V/10 from Figure 3(b) are placed at nine positions of P_0~P_8 as defined in Figure 2. In case of the measurement of five positions, ghost shall be inspected for the box patterns at the positions of P_0~P_4 using Figure 4. In case of the measurement of nine positions, ghost shall be inspected for the box patterns at the positions of P_0~P_8 using Figure 4.

b) The inspector wearing the required glasses for the stereoscopic display shall check the gradation smoothness by identifying each area of the gradation bar of eight grey steps in the input signal.

c) The change in G_b shall be adjusted by the operator, the inspector, or automated. In the case of the input signal of Figure 4 and the binocular observation of the inspector, ghost artefacts are located inside and outside the square box of grey level G_2 as illustrated in Figure 6.

d) As the input signals with different G_b are displayed, the inspector wearing the required glasses for the stereoscopic display shall check the condition that the ghost artefact outside the square box of grey level G_2 and the grey bar of grey level G_b are perceived to be of the same brightness as illustrated in Figure 7.

e) As the input signals with different G_b are displayed, the inspector wearing the required glasses for the stereoscopic display shall check the condition that the ghost artefact inside the square box of grey level G_2 and the grey bar of grey level G_b are perceived to be the of same brightness as illustrated in Figure 7.

f) The grey levels G_1 and G_2 of the input signal of Figure 4 and Figure 5 shall be changed and the above procedure will be repeated.

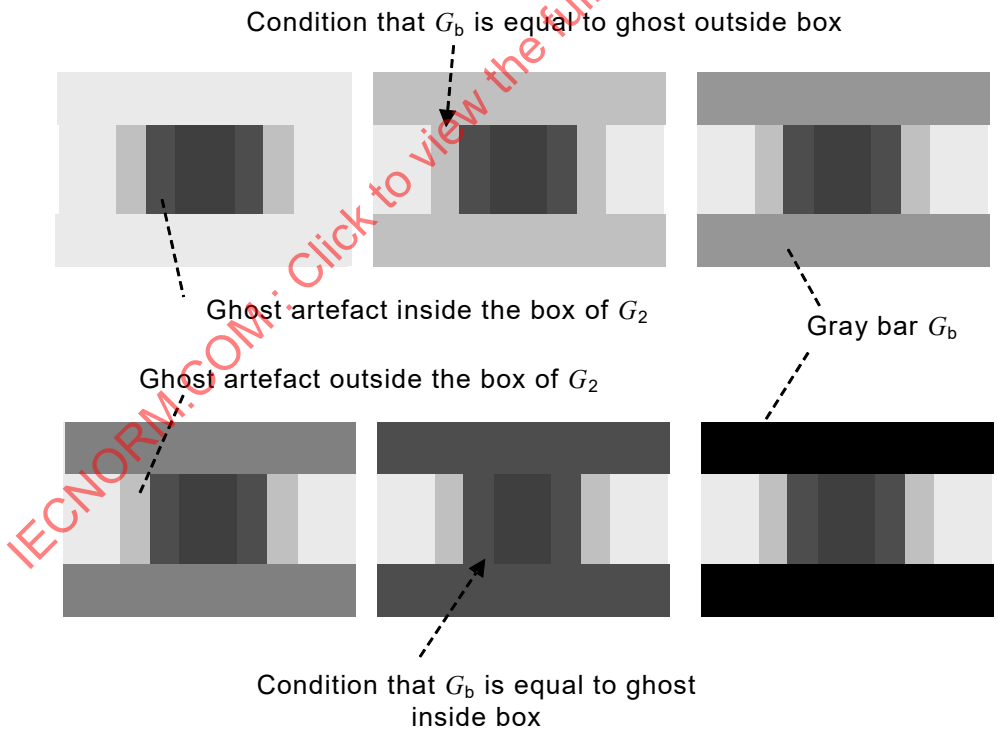


Figure 7 – Comparison of ghost artefact and bar of the different grey levels G_b in the box pattern

5.5 Report

In the visual inspection report, the following items shall be reported:

a) For the selected grey levels G_1 and G_2, the value of $G_{b,}$ for which the ghost artefact and grey bar are perceived to be of the same brightness, shall be reported for each position of five or nine positions of the input signal.

b) The visual inspection distance and binocular disparity distance BD shall be reported. If each step of the gradation bars in the input signal cannot be discerned, gradation smoothness will be noted as 'No' in the report.

c) If the existence of a 2D artefact is observed at the 2D input signal of Figure 5, this will be noted in the visual inspection report.

d) The applied signal format and signal frequency shall be reported.

Table 2 is an example of the visual inspection report.

Table 2 – Example of visual inspection report at nine positions for grey levels G_1 = 255 and G_2 = 0

		Positions								
G_1: 255	G_2: 0	P_0	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8
Inside artefact: G_b		0	4	4	4	4	4	0	4	0
Outside artefact: G_b		251	251	251	251	251	251	251	251	251
Visual inspection distance (cm):						Distance BD (mm):				
Existence of 2D artefact (Yes/ No)						G_b increment of input signal for visual inspection of ghost: each increment is 4 grey levels for the display of 256 grey levels				
Gradation smoothness (Yes/ No)										
Applied signal format:						Applied signal frequency:				

Annex A
(informative)

Measurement with two-dimensional light measuring device (LMD)

A.1 General

Annex A focuses on the visual inspection using a two-dimensional LMD. As an LMD can only measure the luminance seen by each eye, the result will not be equivalent to the visual inspection under the stereoscopic fusion.

A.2 Measuring conditions

The measuring conditions using the LMD should be the same as the visual inspection conditions for the inspector if not otherwise specified.

A.3 Measuring layout

The measuring layout is illustrated in Figure A.1. A two-dimensional LMD will be used where the field of view of the LMD is larger than the angle occupied by the active area of the stereoscopic display. One side of the glasses is placed in front of the LMD, and luminance should be measured through the left and right side of the glasses (see IEC 62629-12-1:2014, Clause 5 [3] for more information).

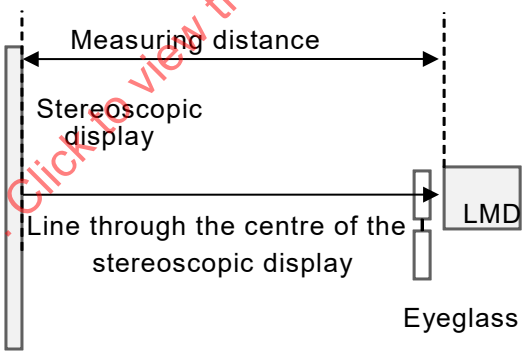


Figure A.1 – Top view of standard measuring layout using a two-dimensional LMD

A.4 Measuring method

a) The measured display module and glasses should be warmed up to stabilize their characteristics. The 2D input signal described in 4.5.2 (distance BD = 0) should be applied, and it should be checked that the artefact similar to ghost does not occur when the 2D signal is applied.

b) The input signal of five or nine box patterns with grey levels G_1 and G_2 should be applied with the specified amount of BD.

c) In the case of an input signal, ghost artefacts are located inside and outside the square box of grey level G_2.

d) As the input signals with different G_b are displayed, the two-dimensional LMD with the attached glasses should measure the two-dimensional luminance when the left glass is placed in front of the LMD and the right glass is placed in front of LMD, respectively. The two-dimensional spatial luminance will be measured at the given condition. The condition that the luminance of the grey bar G_b and of the ghost artefact outside the box of G_2 is measured to be the minimum difference, is determined from the two-dimensional luminance distribution.

e) The grey levels G_1 and G_2 of the input signal should be changed and the above procedure will be repeated (see Table A.1).

A.5 Report

In the measurement report, the value of G_b for which the ghost artefact and grey bar are measured to be the minimum difference, will be reported for each position. If gradation bars are not uniform, this will be noted in the report. From the RAW data of the two-dimensional spatial luminance distribution, the vertical luminance distribution can be obtained at the positions of the ghost artefact. From this, the value of G_b for which the ghost artefact and grey bar are measured to be the same brightness, will be determined.

Table A.1 – Example of measurement report, using the input signal of nine-box pattern, grey levels G_1 = 255 and G_2 = 0

		Positions								
G_1: 255	G_2: 0	P_0	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8
Left – inside: G_b		4	8	8	8	8	8	4	8	4
Left – outside: G_b		247	247	247	247	247	247	247	247	247
Right – inside: G_b		4	8	8	8	8	8	4	8	4
Right – outside: G_b		247	247	247	247	247	247	247	247	247
Measuring distance (cm):							Distance BD (mm):			
Existence of 2D artefact (Yes/No)							G_b increment of input signal for visual inspection of ghost: each increment is 4 grey levels for the display of 256 grey levels			
Gradation smoothness (Yes/No)										
Applied signal format:							Applied signal frequency:			