



IEC 62629-62-11

Edition 1.0 2022-11

INTERNATIONAL STANDARD



**3D display devices –
Part 62-11: Measurement methods for virtual-image type – Optical**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.120; 31.260

ISBN 978-2-8322-6006-7

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

| | |
|------------------------------------------------------------------------------------|----|
| FOREWORD..... | 5 |
| 1 Scope..... | 7 |
| 2 Normative references | 7 |
| 3 Terms, definitions, and abbreviated terms | 7 |
| 3.1 Terms and definitions..... | 7 |
| 3.2 Abbreviated terms..... | 8 |
| 4 Measurement systems | 8 |
| 4.1 Measuring device..... | 8 |
| 4.2 Measuring setup | 9 |
| 4.2.1 Eye-box and virtual image plane | 9 |
| 4.2.2 Determination of the eye-box..... | 9 |
| 4.2.3 Measuring configuration for geometric property | 11 |
| 4.2.4 Test image and denotation for the captured test image | 12 |
| 5 Common measurement applied for 3D virtual-image geometry..... | 13 |
| 5.1 General..... | 13 |
| 5.2 Position estimation of measuring points | 13 |
| 6 Measurement method for the geometry property of the virtual image plane..... | 16 |
| 6.1 Measurement of virtual image distance | 16 |
| 6.1.1 Conditions | 16 |
| 6.1.2 Procedures | 16 |
| 6.1.3 Reports..... | 16 |
| 6.2 Measurement of look down/over angle | 17 |
| 6.2.1 Conditions | 17 |
| 6.2.2 Procedures | 17 |
| 6.2.3 Reports..... | 17 |
| 6.3 Measurement of field of view..... | 18 |
| 6.3.1 Conditions | 18 |
| 6.3.2 Procedures | 18 |
| 6.3.3 Reports..... | 19 |
| 7 Measurement methods for the geometric distortion of the virtual image plane..... | 19 |
| 7.1 General..... | 19 |
| 7.2 Measurement of static distortion | 19 |
| 7.2.1 Conditions | 19 |
| 7.2.2 Procedures | 20 |
| 7.2.3 Reports..... | 20 |
| 8 Measurement method for the distance between a user and a 3D virtual object..... | 21 |
| 8.1 General..... | 21 |
| 8.2 Measurement method | 21 |
| 8.2.1 Conditions | 21 |
| 8.2.2 Procedures | 21 |
| 8.2.3 Reports..... | 22 |
| 9 Measurement methods for luminance and chromaticity | 22 |
| 9.1 General..... | 22 |
| 9.2 Measurement for luminance drop over the eye-box | 22 |
| 9.2.1 Conditions | 22 |
| 9.2.2 Procedures | 23 |

| | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----|
| 9.2.3 | Reports..... | 25 |
| 9.3 | Measurement of the luminance and chromaticity for the virtual-image plane | 25 |
| 9.3.1 | Conditions | 25 |
| 9.3.2 | Procedures | 26 |
| 9.3.3 | Reports..... | 28 |
| Annex A (informative) Comparison of measurement items between the conventional 3D display and the virtual-image type 3D display | | 29 |
| Annex B (informative) Comparison of the optical-property measurement methods for virtual images | | 31 |
| Annex C (informative) Additional information for geometric property measurement of 3D virtual images using imaging LMDs..... | | 34 |
| C.1 | General..... | 34 |
| C.2 | Reasons for the necessity of using three imaging LMDs..... | 34 |
| C.3 | Geometric calibration process for the imaging LMDs..... | 35 |
| Annex D (informative) Measurement for static crosstalk..... | | 38 |
| D.1 | General..... | 38 |
| D.2 | Preparations | 38 |
| D.3 | Procedures | 39 |
| D.4 | Reports..... | 42 |
| Bibliography..... | | 43 |
| Figure 1 – Geometric relationship between an eye-box and a virtual-image plane..... | | 9 |
| Figure 2 – Configuration for determination of the eye-box | | 10 |
| Figure 3 – Measuring setup for geometric property | | 11 |
| Figure 4 – Test image with nine measuring points (top) and the three corresponding images captured by three imaging LMDs (bottom)..... | | 12 |
| Figure 5 – Denotation for each of the three corresponding images captured by three imaging LMDs..... | | 13 |
| Figure 6 – Geometric relationship of the black circle of P_{11} in the test image, two imaging LMDs, and the captured P_{11} (indicated by m_{11}^L and m_{11}^R) by the two imaging LMDs of LMD_L and LMD_R | | 15 |
| Figure 7 – Denotation for the black circle indicated by P_{11} (i and $j = 1$) in the three corresponding images captured by three imaging LMDs..... | | 15 |
| Figure 8 – Measuring condition for the virtual image distance | | 16 |
| Figure 9 – Measuring conditions for look down and look over angles | | 17 |
| Figure 10 – Measuring conditions for field of view (FOV) | | 19 |
| Figure 11 – Measuring conditions for evaluating static distortion..... | | 20 |
| Figure 12 – Measuring conditions for the distance of the 3D virtual object | | 21 |
| Figure 13 – Three images captured by three imaging LMDs for the 3D virtual object located at the back of the virtual plane..... | | 22 |
| Figure 14 – Measuring location representation in the eye-box..... | | 23 |
| Figure 15 – Measuring condition for luminance and chromaticity from the centre point in the eye-box | | 25 |
| Figure A.1 – Example of 3D displays..... | | 29 |
| Figure B.1 – Illustration of the measurement concept applied for this documenta..... | | 32 |
| Figure B.2 – Illustration of the measurement concept applied for ISO 9241-305:2008, 6.11.1 [5] | | 33 |

| | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Figure B.3 – Illustration of the measurement concept applied for SAE J 1757-2 [3] | 33 |
| Figure C.1 – Limit in the determination of the location of a 3D virtual object using two imaging LMDs | 34 |
| Figure C.2 – Determination of the location of a 3D virtual object using three imaging LMDs | 35 |
| Figure C.3 – World, imaging LMD and 2D image (pixel) coordinates for calibration | 37 |
| Figure D.1 – Example of luminance profile created by four perspective images | 38 |
| Figure D.2 – Measuring layout for the 3D crosstalk of a 3D HUD | 39 |
| Figure D.3 – Example of luminance angular profile for 21 perspective images | 41 |
| Table 1 – Example of reported specification of an imaging LMD | 8 |
| Table 2 – Example of measurement results for the average of luminance drop for white colour over the eye-box shown in Figure 14 | 25 |
| Table 3 – Example of measurement results for white (black) luminance, contrast, uniformity of white (black) luminance, and chromaticity coordinates in the measurement configuration of Figure 15 | 28 |
| Table A.1 – Comparison of measurement items | 30 |
| Table B.1 – Comparison of the optical-property measurement methods for virtual images | 32 |
| Table D.1 – Example of measurement results for 3D crosstalk value | 42 |

INTERNATIONAL ELECTROTECHNICAL COMMISSION

3D DISPLAY DEVICES –

Part 62-11: Measurement methods for virtual-image type – Optical

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.

IEC 62629-62-11 has been prepared by IEC technical committee 110: Electronic displays. It is an International Standard.

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

| Draft | Report on voting |
|---------------|------------------|
| 110/1459/FDIS | 110/1473/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/standardsdev/publications.

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 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.

IMPORTANT – The "colour inside" logo on the cover page of this document 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 62-11: Measurement methods for virtual-image type – Optical

1 Scope

This part of IEC 62629 specifies the standard measuring conditions and measurement methods for determining the optical properties of the image created by 3D display devices and virtual-image optics such as head-up displays. The virtual image refers to an image in which the 3D visual information is superimposed with the outside world. Eye-wear type displays are however beyond the scope of this document.

NOTE The meaning of a virtual image in optics is in general an image formed when the outgoing rays from a point on an object always diverge. With regard to display application, a virtual image can be interpreted according to a real viewing case. When an image is viewed, even though there is no physical display (monitor, TV, screen), in front of a person's eyes, it is called virtual image.

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 amendment-s) applies.

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