



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

FC	FOREWORD				
1	1 Scope				
2	2 Normative references				
3	Terms, definitions, and abbreviated terms				
	3.1	Terms and definitions			
	3.2	Abbreviated terms			
4	Meas	surement systems	8		
	4.1	Measuring device	8		
	4.2	Measuring setup			
	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	Com	mon measurement applied for 3D virtual-image geometry	13		
	5.1	General	13		
	5.2	Position estimation of measuring points	13		
6	Meas	surement 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				
	6.2	Measurement of look down/over angle			
	6.2.1				
	6.2.2				
	6.2.3	•			
	6.3	Measurement of field of view			
	6.3.1				
	6.3.2				
7	6.3.3				
7		surement methods for the geometric distortion of the virtual image plane			
	7.1	General			
	7.2	Measurement of static distortion			
	7.2.1 7.2.2				
	7.2.2				
8		surement method for the distance between a user and a 3D virtual object			
8.1 General					
	8.2	Measurement method			
	8.2.1				
	8.2.2				
	8.2.3				
9		surement methods for luminance and chromaticity			
-	9.1 General				
	9.2	Measurement for luminance drop over the eye-box			
	9.2.1				
	9.2.2				

9.2.3 Reports	
9.3 Measurement of the luminance and chromaticity for the virtual-image plane	
9.3.1 Conditions	
9.3.2 Procedures	
9.3.3 Reports Annex A (informative) Comparison of measurement items between the conventional	28
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	
D.3 Procedures	
D.4 Reports	
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	
Figure 3 – Measuring setup for geometric property	
Figure 4 – Test image with nine measuring points (top) and the three corresponding images captured by three imaging LMDs (bottom)	
Figure 5 – Denotation for each of the three corresponding images captured by three imaging LMDs	
Figure 6 – Geometric relationship of the black circle of P <sub>11</sub> in the test image, two	
imaging LMDs, and the captured P <sub>11</sub> (indicated by $m_{11}^L$ and $m_{11}^R$ ) by the two imaging	
LMDs of LMD <sub>L</sub> and LMD <sub>R</sub>	15
Figure 7 – Denotation for the black circle indicated by $P_{11}$ ( <i>i</i> and <i>j</i> = 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	
Figure 15 – Measuring condition for luminance and chromaticity from the centre point in the eye-box	
Figure A.1 – Example of 3D displays	
Figure B.1 – Illustration of the measurement concept applied for this documenta	
Figure B.2 – Illustration of the measurement concept applied for ISO 9241-305:2008,	
6.11.1 [5]	33

– 4 – IEC 62629-62-11:2022 © IEC 2022

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	00
measurement configuration of Figure 15	
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 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 virtualimage 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