

TECHNICAL REPORT



3D display devices – Part 51-1: Generic introduction of aerial display

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.120

ISBN 978-2-8322-8286-1

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

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms, definitions and abbreviated terms	7
3.1 Terms and definitions.....	7
3.2 Abbreviated terms.....	7
4 Aerial display technologies	8
4.1 General.....	8
4.2 Principle	9
4.3 Variations of optical components	12
4.3.1 Convex lens.....	12
4.3.2 Dual micro-lens arrays (MLAs).....	12
4.3.3 Dihedral-corner-reflector array (DCRA).....	12
4.3.4 Dual slit-mirror arrays (SMAs).....	13
4.3.5 Retro-reflector (RR).....	14
4.4 Variations of the real image	15
4.4.1 General	15
4.4.2 Aerial 3D display	15
4.4.3 Aerial light-field display.....	16
4.4.4 Multiple aerial-image generation.....	17
4.5 Key optical elements.....	17
4.6 Applications	17
5 Performance characteristics and specifications.....	18
5.1 General.....	18
5.2 Optical performance.....	18
5.2.1 Items related to conventional image quality	18
5.2.2 Items related to resolution	18
5.2.3 Items related to floating distance	18
5.2.4 Items related to viewing direction range.....	18
5.3 Other considerations.....	19
5.3.1 Discontinuous defect	19
5.3.2 Pseudo image.....	19
5.3.3 Light use efficiency of optical component.....	19
5.3.4 Latency.....	19
6 Issues concerning optical measurement methods	19
6.1 Optical measurement equipment.....	19
6.2 Optical measurement conditions	19
7 Standardization strategy.....	19
Annex A (informative) Example of resolution measurement.....	20
Bibliography.....	22
Figure 1 – Essentials of aerial display in the strict sense	9
Figure 2 – Typical structures of aerial display	11
Figure 3 – Observation of an aerial image from different directions	12

Figure 4 – Observation of an aerial image by placing a screen at different distances	12
Figure 5 – DCRA	13
Figure 6 – Converging lights using a DCRA	13
Figure 7 – Dual SMAs	13
Figure 8 – Converging light using dual SMAs	14
Figure 9 – RR	14
Figure 10 – Converging light using an RR	15
Figure 11 – Optical system to form two-layered aerial images for depth-fused 3D display	16
Figure 12 – Optical system to form an aerial light-field image with AIRR	16
Figure 13 – Optical system to form multiple images in the air by use of a single light source	17
Figure A.1 – Schematic diagram showing CTF calculation from intensity distribution	20
Figure A.2 – Experimental setup to obtain intensity distribution of the aerial image	21
Figure A.3 – Examples of formed aerial images	21
Figure A.4 – Measured CTF for aerial images formed by use of AIRR, SMA, and DCRA	21
Table 1 – Classification of displays that show an image in mid-air	8

INTERNATIONAL ELECTROTECHNICAL COMMISSION

3D DISPLAY DEVICES –**Part 51-1: Generic introduction of aerial display**

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.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a Technical Report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 62629-51-1, which is a Technical Report, has been prepared by IEC technical committee 110: Electronic displays.

The text of this Technical Report is based on the following documents:

Draft TR	Report on voting
110/1178/DTR	110/1190/RVDTR

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 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.

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.

INTRODUCTION

This document intends to gather technical information on aerial displays, and to clarify the relationship to normative aspects of the standardization in this technology area.

3D DISPLAY DEVICES –

Part 51-1: Generic introduction of aerial display

1 Scope

This part of IEC 62629, which is a Technical Report, provides general information for the standardization of aerial displays. This document includes an overview of the technology, critical performance characteristics, issues of optical measurements, and other information.

2 Normative references

There are no normative references in this document.