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BSI Standards Publication

Electronic paper displays

Part 5-1: Legibility of EPD in spatial frequency

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National foreword

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Part 5-1: Legibility of EPD in spatial frequency

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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IEC TR 62679-5-1, which is a technical report, has been prepared by IEC technical committee 110: Electronic display devices.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
110/836/DTR	110/864A/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 62679 series, published under the general title *Electronic paper displays*, 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- withdrawn,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.

INTRODUCTION

A small device for an electronic paper display (EPD)[1] [1] was invented in 1997, and its first product as an electronic book was brought to the market in 2004. This product was the first electronic display which made human beings serious about reading letters and figures as well as those printed on a paper with ink. A definition of “electronic paper” was first given by N. K. Sheridon et al of PARC in 1998, as follows: Plane paper scatters light diffusely and efficiently, allowing for high contrast, high resolution images that can be viewed from broad angles without glare caused by specular reflection, in contrast, electronic display media can provide the extra benefits of reusability and easy integration into digital electronic systems. Electronic display media used in such a fashion can be called “electronic paper” [2]. For these reasons, the benchmark for estimation of EPD has always been printed paper.

The human action of reading is basically analysed through two subjective attributes, that is, legibility and readability. The legibility, as defined at 3.1.2, can be rated and analyzed by means of measuring optophysical or radiometric property of a certain pattern. This pattern is recognised by the retina as an aggregation of spatial frequencies. Legibility can be understood by analysing those kinds of spatial frequency. In 1967, the contrast sensitivity of the human eye for sinusoidal illuminance changes was measured as a function of spatial frequency [3]. As for readability, defined in 3.1.3, lot of human ergonomics tests and sophisticated statistical works are recommended with around a hundred human participants, to compare with printed paper, EPDs, and emissive displays; which will also require economical costs and expenditure of time. The readability of EPDs will be reported elsewhere.

IEC 62679 (all parts) specifies optical measuring methods for electronic paper displays (EPDs), but does not mention legibility and readability for EPDs, because there are no guidelines for measuring and estimating these elements in a practical fashion, especially under variation of optical environments.

This document offers permanent formulae to decide on the legibility level of EPD compared with paper, which will lead to specification of EPD with regard to the human action of reading. Legibility is one of the human actions of reading, which falls in the category of subjective assessments; on the other hand, the properties of EPDs fall in that of physical specifications, that is, objective assessments. The legibility in this document described by using a five-level rating system is revealed to show as a function of physical parameters.

In this document, legibility is suggested as having two essential parameters, that is, the spatial frequency, which can represent the complexity or size of a letter, font, or symbol, and the contrast, which shows brightness between a character and its background.

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1 Numbers in square brackets refer to the Bibliography.

ELECTRONIC PAPER DISPLAYS –

Part 5-1: Legibility of EPD in spatial frequency

1 Scope

This part of IEC 62679, which is a technical report, specifies the legibility in terms of contrast, spatial frequency, and reflection of the screen as a function of the physical parameters of an EPD. This legibility evaluation model is introduced through both subjective and objective assessments. The scope of this document is restricted to EPDs using segment, passive, and active matrixes with monochromatic type displays.

2 References

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply [16].

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/ [4]
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
contrast sensitivity test chart [5,6]
CSC
chart for measuring and quantifying visual sensitivity in terms of contrast sensitivity and spatial frequency response, which contains a multiplicity of grating patches whose contrast, in term of luminance, varies sinusoidally for differing spatial frequencies

Note 1 to entry CSC is sometimes used for diagnosis in ophthalmology clinics.

3.1.2
legibility
ability for unambiguous identification of single characters or symbols that may be presented in a non-contextual format

[SOURCE: ISO 9241-302:2008, 3.3.35] [7]

3.1.3
readability
characteristics of a text presentation on a display that affect performance when groups of characters are to be easily discriminated, recognized and interpreted

[SOURCE: ISO 9241-302:2008, 3.3.38] [7]