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TECHNICAL REPORT

colour inside

Electronic displays – Part 2-4: Transparent displays – Overview of application scenarios

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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IEC TR 62977-2-4, 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
110/972/DTR	110/988A/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 62977 series, published under the general title *Electronic displays*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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- withdrawn,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.

ELECTRONIC DISPLAYS –

Part 2-4: Transparent displays – Overview of application scenarios

1 Scope

This part of IEC 62977, which is a Technical Report, provides a comprehensive overview of application scenarios for transparent displays of the two major display technologies (liquid crystal (LC) and organic light emitting diode (OLED) displays) and introduces the observation and illumination aspects that are taken into account for the establishment of appropriate measurement methods.

This document only considers direct view displays, it does not include projection displays (eye-projection and projection to screens.)

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms, definitions and abbreviated terms 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 Terms and definitions

3.1.1
AR
augmented reality
overlay of real objects and scenes with artificial visual information

3.1.2
intended visual information
visual information to be presented intentionally

Note 1 to entry: Visual information that is not intended can sometimes be observed, for example reflection of ambient images.

3.1.3
unwanted contributions from ambient light
visual information that is unintentionally generated (by e.g. reflection of ambient light sources) and superimposed over the intended visual information, thus creating disturbing visual effects

3.1.4
on-screen contrast
contrast created by the display screen by emission or absorption (transmission), including the background light transmitted and reflected light, when measured in an ambient lighting environment

3.1.5
through-screen contrast
contrast of the object or scene behind the transparent display, mainly affected by the transmissive properties of the transparent display screen, which can also include the background reflected light and transmitted light outside the regular direction when measured in an ambient lighting environment

3.2 Abbreviated terms

AR augmented reality

CIE Commission Internationale de l'Eclairage (International Commission on Illumination)

LC liquid crystal

LCD liquid crystal display

OLED organic light emitting diode

TBLU transparent back-light unit

TDS transparent display screen

VR virtual reality

4 Application scenarios

4.1 General

Transparent displays are considered, for example, for advertising purposes (shop-windows and showcases, also in combination with touch-screens) and for other similar applications (e.g. refrigerator doors) where real scenes and objects are overlaid with additional visual information just as in the case of augmented reality (AR). In airplanes and automobiles head-up displays are used to present visual information on top of the surrounding scenery. Those head-up displays, however, use projection optics to display visual information at a certain distance in front of the observer, so usually no refocusing is required.

Transparent displays may also be realized by a reflective or transmissive screen on which visual information is being projected, but this case is not considered in this document.

4.2 Performance aspects

Two cases have to be distinguished for the performance of transparent displays:

1) on-screen performance with visual information generated by emission (OLED display) or transmission (LC display),
2) through-screen (see-through) performance with objects or a scenery located behind the transparent display screen.

NOTE 1 RGB-LCDs with colour filters have transmittance levels in the range of 5 % up to 25 % (RWGWBW), so the objects and the scene behind the display are usually illuminated with high intensity to be sufficiently visible.

NOTE 2 Scattering of the transparent display can cause excessive haze, which reduces contrast. In addition, pixel fill-factor effects can cause blurring of objects or the scene behind the screen (blurring means spatial low-pass filtering).

On-screen performance of transparent displays is generally hampered by the mixing of the scene behind the display with the visual information content shown on the display.

Transparent display screens realized with LCDs can comprise a transparent back-light unit or, alternatively, they can simply utilize available ambient illuminance and thus do not include a back-light.

4.3 Application cases

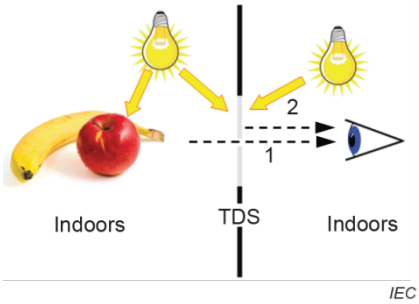
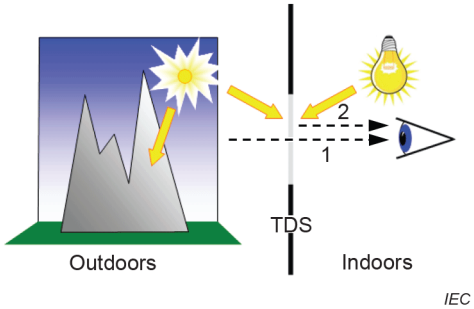
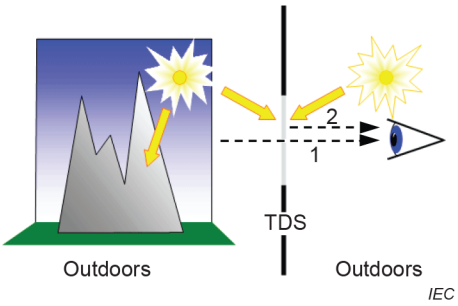
Table 1 illustrates four typical application cases for transparent displays (case 1 through 4). Each case contains two illumination sources, one on the side of the observer and one behind the transparent display screen. The light source on the side of the object or the scene provides illumination for the objects, and the scenery and light reflected by those is transmitted by the TDS and seen by the observer. At the same time, light from this source that is directly transmitted or reflected by the TDS can reduce contrast and colour saturation of the objects and the scenery behind the TDS, thus negatively affecting the intended visual information. Additionally, light reflected by the light source that is located on the side of the observer can also contribute to a deterioration of the intended visual information.

Outdoor illuminance levels are typically two orders of magnitude higher than indoor illuminance levels (Table 1, cases 3 and 4), thus possibly contributing high levels of unwanted reflected light and correspondingly a high degree of degradation of contrast and colour saturation.

The focus of the observer can be on the transparent display screen for observation of on-screen information or on the objects or scenery behind that display for observation of through-screen information.

Objects behind the TDS are illuminated by a light source, and parts of the reflected light are transmitted by the TDS (case 1) and are seen by the observer. This is the intended visual information. Light from both sources (behind and in front of the TDS) that is directly transmitted and/or reflected by the TDS is added to the intended visual information (case 2) and reduces contrast and colour saturation.

Table 1 – Application cases

1		Indoor showcase seen through a transparent display by an indoor observer (e.g. refrigerator)
2		Outdoor objects or scene seen through a transparent display by an indoor observer
3		Indoor showcase seen through a transparent display by an outdoor observer
4		Outdoor objects or scene seen through a transparent display by an outdoor observer

4.4 Intended visual information and unwanted contributions from ambient light

4.4.1 General

Visual information is provided to the observer by contrast, which is given by the difference of two adjacent areas with respect to luminance and/or chromaticity.

4.4.2 Visual information on screen

The first set of visual information is generated on a transparent display by lateral modulation of light by the processes of light emission (OLED) or absorption of transmitted light (LCD). This is the "on-screen" case.