

SEMI D76-0318

TEST METHOD FOR VIEWING ANGLE CHARACTERISTIC USING REFERENCE COLOR ON VISUAL DISPLAYS

This Standard was technically approved by the Flat Panel Display Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on December 13, 2017. Available at www.semiviews.org and www.semi.org in March 2018.

1 Purpose

- 1.1 The viewing angle characteristic of display panel is one of the most important components of image quality.
- 1.2 Even though there are several viewing angle measuring methods for luminance and color, they do not sufficiently deal with real world mixed colors for viewing angle.
- 1.3 A new viewing angle measuring method is suggested which evaluates the variation of mixed color using reference color patches based on CIELAB color difference metric.

2 Scope

- 2.1 This Standard is applicable to large screen flat panel display such as non-portable TV and monitor in a dark room.
- 2.2 The scope of the term 'viewing angle characteristic' is related to both luminance and color variation in this Standard.
- 2.3 This Standard defines only horizontal and vertical viewing angles for measurement.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards and Documents

3.1 CIE Standards¹

CIE — Standard Colorimetric System

CIE 15:2004 — Colorimetry

CIE 1931 — Color Space

CIE S 014-4/E:2006 — Colorimetry – Part 4: CIE 1976 L*a*b* Colour Spaces

3.2 SID Standard²

Information Display Measurement Standard (IDMS)

3.3 SMPTE Standard³

SMPTE 303M-2002 — Color Reference Pattern

3.4 ITU Standard⁴

ITU-R BT.709-5 — Parameter Values for the HDTV Standards for Production and International Programme Exchange

¹ Commission Internationale De L'eclairage (International Commission On Illumination), Kegelgasse 27, A-1030 Vienna/AUSTRIA. Telephone: +43.1.714.31.87.0. Fax: +43.1.714.31.87.18; <http://www.cie.co.at>

² The Society for Information Display, 1475 S. Bascom Ave. #114, Campbell, CA 95008-4006, USA. Telephone: +1.408.879.3901, Fax: +1.408.879.3833, <http://www.sid.org>

³ Society of Motion Picture and Television Engineers, 445 Hamilton Ave. Ste. 601, White Plains, NY, 10601-1827, USA. Telephone: +1.914.761.1100, Fax: +1.914.206.4216, <https://www.smpte.org>

⁴ International Telecommunication Union, Place des Nations, 1211 Geneva 20 Switzerland. Telephone: +41.22.730.5111, Fax: +41.22.733.7256, <https://www.itu.int>

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Terminology

4.1 Abbreviations and Acronyms

4.1.1 *APL* — average picture level

4.1.2 *DUT* — display under test

4.1.3 *FOV* — field of view

4.1.4 *LMD* — light measuring device

4.2 Definitions

4.2.1 *CIELAB* — a uniform color space defined by the CIE in 1976, officially known as CIE $L^*a^*b^*$. L^* stands for luminance, a^* is the red-green axis, and b^* is the blue-yellow axis

4.2.2 *color difference* — the Euclidean distance between two colors in a specific color space.

4.2.3 *measuring distance* — the distance between display screen center and front edge of LMD main body at the measuring location. In this measurement, it is recommended as 3 times of the screen height.

4.2.4 *viewing angle* — the horizontally and vertically inclination angle (degree) to the normal direction to the plane of the display surface. This Standard adopts right-handed x-y-z Cartesian coordinates with origin at the center of the screen.

5 Summary of Test Method

5.1 Measuring Conditions

5.1.1 Environmental Conditions

5.1.1.1 The following environmental conditions are required to make accurate measurement.

- Temperature: $25 \pm 2^\circ\text{C}$
- Humidity: 25% to 85% relative humidity
- Air Flow: no wind
- Dark Room: all measurements shall be carried out in a dark room normally under 1 lux

5.1.1.2 When any of these conditions is not met, they shall be noted on the report.

5.2 Measurement Setup

5.2.1 The measuring equipment shall consist of display under test (DUT), light measuring device (LMD), signal generator, and control PC (if used) as shown in Figure 1. For color viewing angle measurement, the measuring location is the center of effective screen area of the display.

5.2.2 Measuring Distance

5.2.2.1 It is recommended that the measuring distance of LMD is set to include over 500 pixels of display within two degrees field of view (FOV) in normal direction.

5.2.2.2 Generally, it is recommended to be same regardless of the resolution of display because the video content resolution and screen shape is various such as curved displays. If it is not three times of the screen height, the measuring distance should be noted on the report.

5.2.3 Viewing Direction

5.2.3.1 The viewing direction is specified by the horizontal θ_H and vertical φ_V as shown in Figure 2.

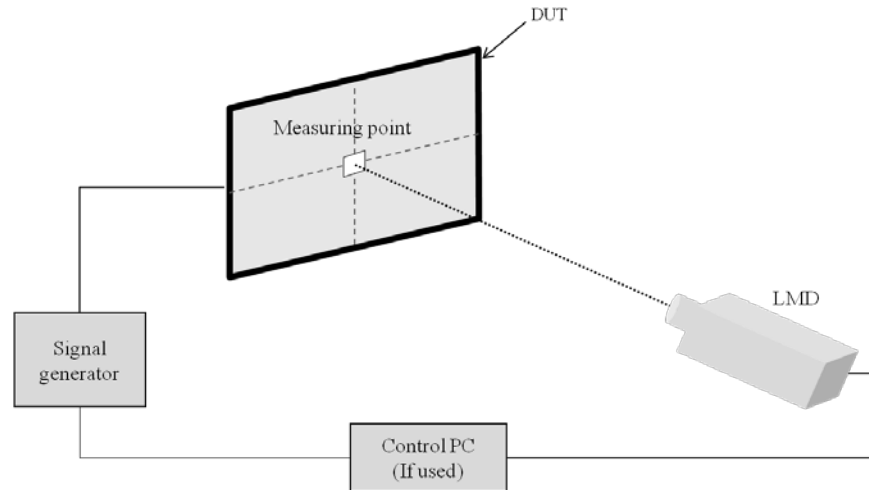


Figure 1
Measurement Setup

5.2.3.2 The horizontal and vertical viewing directions (θ_H , φ_V) are defined as θ_H (-60°, -45°, -30°, -15°, 0°, 15°, 30°, 45°, 60°) and φ_V (-10°, 0°, 10°), respectively, where (-) symbol means downward and sideways to the left.

5.2.4 Optical Measuring Devices

5.2.4.1 In this Standard, a LMD such as spectroradiometer or a filter photometer shall be used for photometric measurement.

5.2.4.2 It requires the photometric accuracy of the LMD within $\pm 2\%$ and chromaticity accuracy within ± 0.002 for x , y .

5.2.5 Warm-Up Time

5.2.5.1 Warm-up shall be achieved before measurement and it must ensure that the luminance approaches a stable value.

5.2.5.2 This warm-up time shall be longer than 30 minutes or follow the instructions determined by manufacturer.

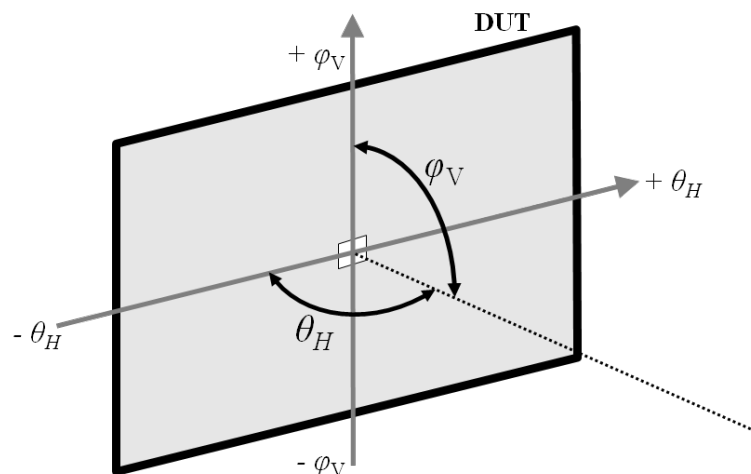


Figure 2
Horizontal and Vertical Viewing Angles Used in this Document