

SEMI D75-0118

TEST METHOD FOR COLOR REPRODUCTION AND PERCEPTUAL CONTRAST OF DISPLAY

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1 Purpose

- 1.1 This Standard specifies measurement conditions and methods for describing the visual color quality in three-dimensional color space, and the perceived contrast with perceptual parameters in color electronic display devices.
- 1.2 The CIE XYZ color space is derived from the experimental results and it has been used to set color performance of displays in CIE xy or $u'v'$ chromaticity diagram without brightness.
- 1.3 For measurement, setting test patterns based on Average Picture Level (APL) of IEC 62087:2011 are required, instead of full screen patterns, which are composed with small size of window box. The full screen patterns are not suitable for emissive displays which of luminance are adjusted with contents.
- 1.4 The contrast ratio has been widely used although the calculated value is dramatically changed by dark state luminance. This metric does not consider human visual characteristics. Therefore, it is more reliable to consider the perceptual indices.

2 Scope

- 2.1 This Standard is applicable to the color electronic display devices, except on the transparent display.
- 2.2 This Standard includes the measurement for physical data, analysis, and calculation methods which have perceptual factors.
- 2.3 The term 'perceptual' is subject to CIE 159 (CIECAM02, CIE Color Appearance Model 2002) in this Standard.

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 Limitations

- 3.1 Measurements are subject to errors or imprecision due to the user, environmental factors, and miscalibration of measurement system or measurement system limitations.
- 3.2 Results may vary with ambient illumination conditions or in the presence of uncontrolled stray light reflections.

4 Referenced Standards and Documents

4.1 CIE Standards¹

CIE 15.3 — Colorimetry

CIE 159 — CIECAM02

4.2 SID Standard²

Information Display Measurement Standard (IDMS)

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 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>

4.3 IEC Standards³

IEC 62341-6-2 — OLED Displays — Measuring Methods of Visual Quality and Ambient Performance

IEC 62087 — Methods of Measurement for the Power Consumption of Audio, Video and Related Equipment

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

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 *APL* — average picture level

5.1.2 *DUT* — device under test

5.1.3 *FOV* — field of view

5.1.4 *LMD* — light measurement device

5.1.5 *PCL* — perceptual contrast length

5.1.6 *VCRC* — volume color reproduction capability

5.2 Definitions

5.2.1 *brightness* — the attribute of a human visual sensation according to which an area appears to emit more or less light.

5.2.2 *color gamut boundary* — the outer surface determined by a color gamut form.

5.2.3 *perceptual contrast length* — the difference of black and white brightness of the screen.

5.2.4 *volume color reproduction capability* — the volume of the perceived color gamut obtained in three-dimensional color space which is composed of colorfulness, hue and brightness.

6 Standard Measurement Condition

6.1 Measuring Conditions

6.1.1 Environmental Conditions

6.1.1.1 In order to obtain accurate measured data, the following environmental conditions are required.

- Temperature: $25 \pm 2^\circ\text{C}$
- Humidity: 25% to 85% relative humidity
- Pressure: 86 kPa to 106 kPa
- Air flow: no wind
- Vibration/Shock: no influence

6.1.2 Ambient Conditions

6.1.2.1 Dark Room Condition

6.1.2.1.1 The luminance contribution from the background illumination shall be less than 0.01 cd/m^2 .

6.1.2.2 Ambient Illuminations

6.1.2.2.1 Uniform hemispherical diffuse light source.

³ International Electrotechnical Commission, 3 rue de Varembe, Case Postale 131, CH-1211 Geneva 20, Switzerland; Telephone: +41.22.919.02.11, Fax: +41.22.919.03.00, <http://www.iec.ch>

6.1.3 Measuring Equipment Conditions

6.1.3.1 In this Standard, a LMD such as spectral radiometer, at least from 380 nm to 780 nm wavelength ranges or a filter photometer shall be used.

6.1.3.2 The luminance accuracy of the instrument shall be within $\pm 2\%$. And the chromaticity accuracy of the instrument shall be below:

Table 1 Chromaticity Accuracy of the Instrument

x, y	± 0.002 (0.001 to 0.05 cd/m^2)
x	± 0.0015 (0.05 cd/m^2 or more)
y	± 0.001 (0.05 cd/m^2 or more)

6.1.3.3 The measuring distance could be set 400 mm or 500 mm. For the small size display, the distance can be calculated and set that an LMD should include over 500 pixels of display at 2 degrees FOV. The calculated distance should be noted in a report.

6.1.4 Viewing Direction

6.1.4.1 In the case of the uniform hemispherical diffuse illumination conditions, an integrating sphere, sampling sphere, or hemisphere shall be used. The configuration shall follow the standard $\text{di}/8^\circ$ to $\text{di}/10^\circ$ illumination/detection geometry, where di is the standard notation for diffuse. The basic viewing direction of this test is shown in Figure 1. However, for a specific case, other viewing directions, like perpendicular to the display can be used. The placement of the LMD should be located in front of the measurement port in the Figure 1. The lamp should have the light intensity at least from 380 nm to 780 nm range, continuously.

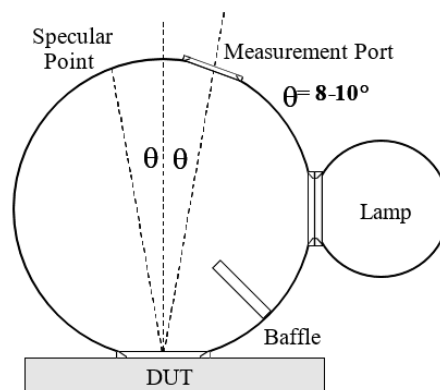


Figure 1
An Example of Measuring Configuration with Sampling Sphere

7 Summary of Test Method

7.1 Test Patterns

7.1.1 A centered window box occupying 4% to 40% of the screen area is used. The 100% intensity (e.g., 255 gray levels in 8 bits) for window box and the 40% intensity (e.g., 102 gray levels in 8 bits) for background are applied. One of the test patterns is shown in Figure 2. Because depending on the window size, the peak luminance would be changed, the window size should be reported.