Background Statement for SEMI Draft Document 4671
New Standard: MEASUREMENT METHOD FOR AMBIENT CONTRAST OF LIQUID CRYSTAL DISPLAYS

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Background
Customers usually use LCDs in the bright environment, such as office, living room, etc. To evaluate the contrast of display devices under ambient light is more practical than in the dark environment. The results of ambient contrast measurements are affected by different illuminance, view angles, etc. Therefore, it is necessary to standardize the measurement method of ambient contrast in LCDs.

The results of this ballot will be adjudicated at the Taiwan Flat Panel Display Committee meeting scheduled on December 24, 2009 in Hsinchu.

If you have any questions, please contact to the Ambient Contrast Ratio Task Force co-leaders:
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SEMII Draft Document 4671
New Standard: MEASUREMENT METHOD FOR AMBIENT CONTRAST OF LIQUID CRYSTAL DISPLAYS

1 Purpose

1.1 Customers usually use LCDs in the bright environment, such as office, living room, etc. To evaluate the contrast of display devices under ambient light is more practical than in the dark environment. The results of ambient contrast measurements are affected by different illuminance, view angles, etc. Therefore, it is necessary to standardize the measurement method of ambient contrast in LCDs.

2 Scope

2.1 This standard is applicable to ambient contrast measurement for liquid crystal displays (LCDs).

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This standard is applicable to ambient contrast measurement for LCDs under diffuse lighting. The ambient contrast measurement under direct lighting does not include in this standard.

3.2 This standard is applicable to LCDs for indoor use.

4 Referenced Standards and Documents

4.1 JEITA Standards

ED2523 — Measuring methods for matrix reflective LCD modules

4.2 MIL Standards

MIL-L-85762A — Daylight legibility and readability inspection

4.3 VESA Standards

FPDM 2.0 308-2 — Ambient Contrast Ratio

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

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 LCD — Liquid Crystal Display

5.1.2 LMD — Light Measurement Device

5.1.3 DUT — Display Under Test

5.2 Definitions

5.2.1 Ambient contrast — the contrast of the display measured under ambient lighting conditions.

5.2.2 Sampling port — the port on the integrating sphere which light exits from and hits on the DUT, it confines the sampling area of the DUT.

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2 United States Military Standards, Available through the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099, USA. Telephone: 215.697.3321

3 Video Electronics Standards Association, 920 Hillview Ct., Suite 140, Milpitas, CA 95035, USA. Fax: 408.957.9277
5.2.3 *Measurement port* — the port on the integrating sphere which the beam of the LMD is aligned through it to focus on the surface of DUT.

5.2.4 *Specular port* — the port on the integrating sphere which is in the opposite side and symmetrical to the measurement port.

6 Summary of Method

6.1 Environment Conditions

- Temperature: 25± 3°C
- Humidity: 40% – 60% RH
- Illumination of surrounding: dark room ≤2 lux
- No reflection or low reflection objects of surroundings

6.2 Measurement Setup

6.2.1 A uniform diffuse-ambient light is provided by a light source with an integrating sphere to illuminate the screen of the display (see Figures 1 and 2). The integrating sphere has plural ports. The DUT is placed against the sampling port of the integrating sphere. The LMD is arranged to view the screen through the measurement port.

6.2.2 Only one measurement port is in use during the measurement. Measurement ports not in use have covers on them. The inner surfaces of covers are coated with standard white that should have the same reflection properties with the inner surface of the sphere.
6.3 Measurement Conditions

6.3.1 The luminance uniformity at the exit port of the integrating sphere is better than 95%.

6.3.2 The integrating sphere has one sampling port and at least two measurement ports. The angles from each centers of the two measurement ports to the normal of the DUT at least include ±8° (±2°).

6.3.3 The LMD is focused on the display surface.

7 Apparatus

7.1 Uniform Diffuse Light Source — Use a lamp with an integrating sphere to provide a uniform diffuse-ambient light. It is required that the light source can provide at least the maximum illuminance of 1000 lux on the surface of DUT.

7.2 Light Measurement Device

7.2.1 Luminance measurement — Use a luminance meter or spectroradiometer to measure the luminance. The accuracy of the luminance meter or spectroradiometer should be better than ±4% in full measurement range.

7.2.2 Illuminance Measurement — Use an illuminance meter to measure the illuminance on the surface of DUT. If the illuminance on the screen can not be measured with the illuminance meter directly, a diffuse white reflectance standard of known reflectance or a detector with known response to illuminance can be used.

8 Test Specimen

8.1 A display which can generate full-screen black and full-screen white (see Figure 3).
9 Preparation of Apparatus

9.1 Warm up the measuring equipment for a specified period of time to stabilize (according to the instruction manual of measuring equipment).

10 Calibration and Standardization

10.1 The LMD used for luminance and illuminance measurements should be calibrated and traced to the accreditation laboratory.

11 Procedure

11.1 Measurement with the specular port closed (see Figure 4).

11.1.1 Warm up the DUT for at least 40 minutes.

11.1.2 Measure the luminance of full-screen white \(L_{\text{w}}\) dark and full-screen black \(L_{\text{K}}\) dark under darkroom conditions.

11.1.3 Set up the integrating sphere and turn on its lamp (warm up for at least 30 minutes).

11.1.4 Measure the illuminance on the surface of DUT. The illuminance is adjusted to the required levels (200 lx and 500 lx are typical for a bright living room and an office environment) by controlling the intensity of the light source. It is important to keep the CCT of the light source stable during the illuminance adjustment.

11.1.5 Measure the luminance of full-screen white \(L_{\text{w}}\) and full-screen black \(L_{\text{K}}\). The illuminance should be kept stable during the measurement process.

11.2 Measurement with the specular port opened (see Figure 5).

11.2.1 Warm up the DUT for at least 40 minutes.

11.2.2 Measure the luminance of full-screen white \(L_{\text{w}}\) dark and full-screen black \(L_{\text{K}}\) dark under darkroom conditions.

11.2.3 Set up the integrating sphere and turn on its lamp (warm up for at least 30 minutes). Take out the cover of the specular port.

11.2.4 Measure the illuminance on the surface of DUT. The illuminance is adjusted to the required levels (200 lx and 500 lx are typical for a bright living room and an office environment) by controlling the intensity of the light source. It is important to keep the CCT of the light source stable during the illuminance adjustment.

11.2.5 Measure the luminance of full-screen white \(L_{\text{w}}\) and full-screen black \(L_{\text{K}}\). The illuminance should be kept stable during the measurement process.
12 Calculations or Interpretation of Results

12.1 The ambient contrast can be directly calculated by using Equation 1. Where $C_A$ is the symbol of ambient contrast, $L_W$ and $L_K$ are the luminance of full-screen white and full-screen black, respectively.

$$C_A = \frac{L_W}{L_K}$$

12.2 The ambient contrast can also be calculated by using the reflectance. The reflectance of full-screen white $\rho_w$ and full-screen black $\rho_k$ are derived by equation (2), and the ambient contrast $C_A$ is calculated by equation (3). It is recommended that the reflectance is measured at the illuminance $E_{01}$ not smaller than 1000 lx. In equation (3), $E_0$ is the desired illuminance (200 lx and 500 lx are typical for a bright living room and an office environment).

$$\rho_w = \left[ L_W - (L_W)_{dark} \right] \times \frac{\pi}{E_{01}}$$

$$\rho_k = \left[ L_K - (L_K)_{dark} \right] \times \frac{\pi}{E_{01}}$$

$$C_A = \frac{(L_W)_{dark} + \frac{\rho_w}{\pi} E_0}{(L_K)_{dark} + \frac{\rho_k}{\pi} E_0}$$

13 Reporting Results

13.1 The ambient contrast $C_A$ is reported with a specified viewing angle and illumination.

13.2 The reported results should be accompanied with the statements of measurement configurations with specular port opened or closed.

14 Related Documents

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