SEMI D31-0914
DEFINITION OF MEASUREMENT INDEX (DSEMU) FOR LUMINANCE MURA IN FPD IMAGE QUALITY INSPECTION

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1 Purpose

1.1 This Standard defines the index of measurement for mura in flat panel display (FPD) image quality inspection.

1.2 This Standard defines distance factor.

1.3 Based on the result of investigation for human eye's sensitivity to mura in ergonomics approach, this Standard proposes an index for level of mura by expressing the function of the major axis and contrast of mura.

2 Scope

2.1 This Standard is applicable to FPD excluding Cathode-ray tube (CRT) and head mount display (HMD). Applicable display sizes are from Type 10 (10 inch diagonal) to Type 100 (100 inch diagonal). Viewing distance ranges from 0.5 m to 5 m.

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 Mura to be measured is limited as below:

3.1.1 This Standard is not applicable to line defects narrower than 300 µm and pixel dot defects.

3.1.2 Background display is limited to monochrome displays/intermediate gray scale level. This Standard is not applicable to color background such as RGB and L0/L63 background.

4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI D57 — Definition of Measurement Index (VCT) for Mura in FPD Image Quality Inspection

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

5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *DSEMU* — distance-considered SEMI Mura

5.1.2 *JND* — just noticeable difference

5.2 *Definitions*

5.2.1 *distance-considered SEMI Mura (DSEMU)* — measurement index for distance-linked mura.

5.2.2 *just noticeable difference (JND)* — used in the field of Psychophysics; for a certain stimulus, the smallest change in stimulus (luminance, for example) where a difference can be perceived. Specifically, it is often used to indicate a statistical value where the probability of the difference being 'perceptible' is 50% and the probability of the difference 'not being perceptible' is 50%. This is also expressed as j.n.d. using lower case letters.

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6 DSEMU Definition

6.1 Under specific conditions, the below regressive relationship is shown between the major axis and contrast for human mura JND (refer to Related Information 1).

$$Cjnd = F(d)$$
$$= 2.2K\,(1/d^{0.33}) \quad (1)$$

where:

Cjnd = Contrast of mura at JND (Unit: %, relative to background [=100%]).

d = Major axis of mura at above contrast (Unit: mm).

6.1.1 In the above equation, contrast at JND is inversely proportional to the major axis powered by 0.33. In short, it indicates that as mura major axis gets shorter, darker muras are sensed.

6.2 For the subject mura, the mura level, DSEMU, is calculated using the below formula, from Equations R1-1, R1-2, R1-3, and R1-4.

$$DSEMU = |Cx| \,/\, Cjnd_{\,[d=dx]}$$
$$= |Cx| \,/\, F(dx)$$
$$= |Cx| \,/\, (2.2K\,(1 \,/\, dx^{0.33})) \quad (2)$$

where:

Cx = Average contrast of mura being measured (Unit: %, relative to background [=100%]).

dx = Major axis of mura being measured (Unit: mm).

K = Distance factor (Unit: m): $0.2D^2 - 0.2D + 1$.

D = Viewing Distance (Unit: m).

7 Notation

7.1 DSEMU is a comparison ratio between contrast of the measurement target and contrast at JND, and thus has no unit.

8 Test Methods

8.1 *Comparative Measurement and Direct Measurement* — The two methods for determining DSEMU levels on panels are comparative measurement and direct measurement.

8.1.1 *Comparative Measurement*

8.1.1.1 The comparative measurement method involves a panel and software which simulate DSEMU level, to which a person compares a mura on an actual panel, making adjustments, until a level which appears similar is determined. This is a method that is used in the actual production site easily using the DSEMU simulation panel as the variable level limit sample.

8.1.2 *Direct Measurement*

8.1.2.1 The direct measurement method captures the actual panel with a CCD camera, or the like, and is a method of measuring the DSEMU level of the mura section, making it possible to directly determine the DSEMU from the major axis and contrast of the mura section that is captured.

8.2 *Measurement Equipment*

8.2.1 DSEMU measurement consists of measurement of the major axis of Mura on the display surface and contrast measurement, and needs to be appropriately calibrated.

8.3 *Measurement Environment*

8.3.1 DSEMU measurement is conducted in a darkroom environment.

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8.4 *Display Conditions*

8.4.1 Background luminance for DSEMU measurement shall be 50 ± 5cd / m^2.

8.5 *Contrast Measurement*

8.5.1 The average contrast of the mura section shall be measured, and the contrast ratio of the mura section will be expressed as a percentage, while the background = 100%.

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