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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MEASURING METHODS OF TRANSPARENT LCD TERMINAL

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The text of this standard is based on the following documents:

XXX	Report on voting
100/XXX/XXX	100/XXX/XXX

Full information on the voting for the approval on this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The National Committees are requested to note that for this publication the stability date is 2018.

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

MEASURING METHODS OF TRANSPARENT LCD TERMINAL

1 Scope

This International Standard specifies the standard measurement conditions and measuring methods for determining the display properties and transparent properties of transparent liquid crystal display (LCD) terminal.

More specifically，this document focus on special items and test methods of transparent LCD terminal ,i.e Angle color deviation, Brightness uniformity.

2 Normative references

None

3 Terms, definitions, symbols and units

3.1 Transparent liquid crystal display (LCD) devices

Liquid crystal display devices which can show images on the screen and objects behind the screen.

3.2 Transparent liquid crystal display terminal

Transparent liquid crystal display （LCD）terminal is a system which include one or more transparent display device（s）, circuit system device, optical system device, mechanical system devices and input, output interface.

3.3 Display property

The representation of properties when the display panel showing images on the screen.

3.4 Transparent property

The representation of properties when the display panel showing objects behind the screen.

3.5 Transmittance

The percent of incident light that is able to pass through a material. The higher the transmittance value, the more transparent a material is.

3.6 Angle color deviation

This item specified a relationship between R/G/B color deviation and observation angle which through a transparent LCD terminal.

4 Measuring conditions

4.1 Standard measuring conditions

4.1.1 Standard measuring environmental conditions

Measurements shall be carried out under the standard environmental conditions:

- Temperature: 25 ºC ± 3 ºC,
- Relative humidity: 25 %RH to 85 % RH,
- Atmospheric pressure: 86 kPa to 106 kPa.

When different environmental conditions are used, they shall be noted in the measurement report.

4.1.2 Traditional optical measuring distance

The traditional optical test distance of transparent LCD terminal should be 1.5 times the screen height.

4.1.3 Measuring position in special light source setting

4.1.3.1 Light source in the top of transparent LCD terminal

Measuring point should be setted as P1 and P3. P1 is in screen center line with 1.5 times screen height, P3 is in P1 point downward vertical 45 degrees, 1.5 times the screen height point .as figure 1，figure7.

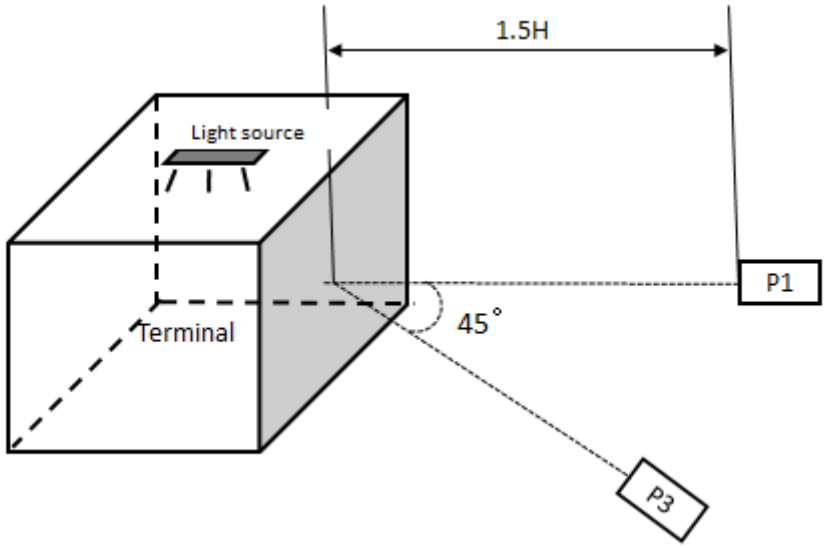


Figure 1

4.1.3.2 Light source in the bottom of transparent LCD terminal

Measuring point should be setted as P1 and P2. P1 is in screen center line with 1.5 times screen height, P2 is in P1 point upward vertical 45 degrees, 1.5 times the screen height point, as figure 2，figure 7.

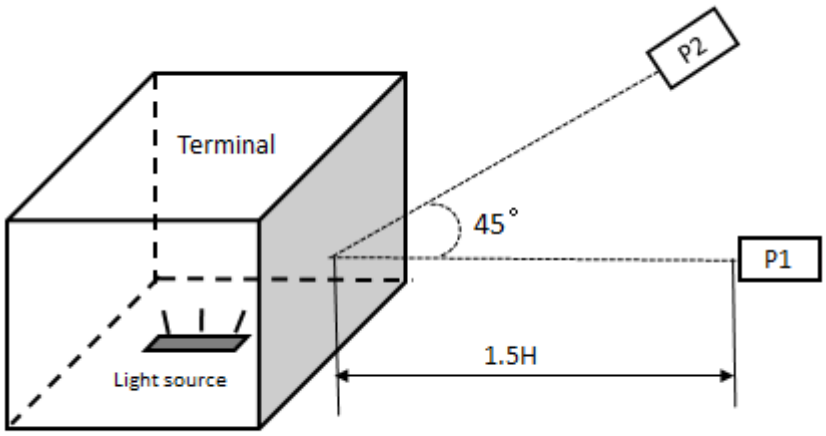


Figure 2

4.1.3.3Light source in the left inside of transparent LCD terminal

Measuring point should be setted as P1 and P4. P1 is in screen center line with 1.5 times screen height, P4 is in P1 point rightward horizontal 45 degrees, 1.5 times the screen height point as.figure 3，figure 6

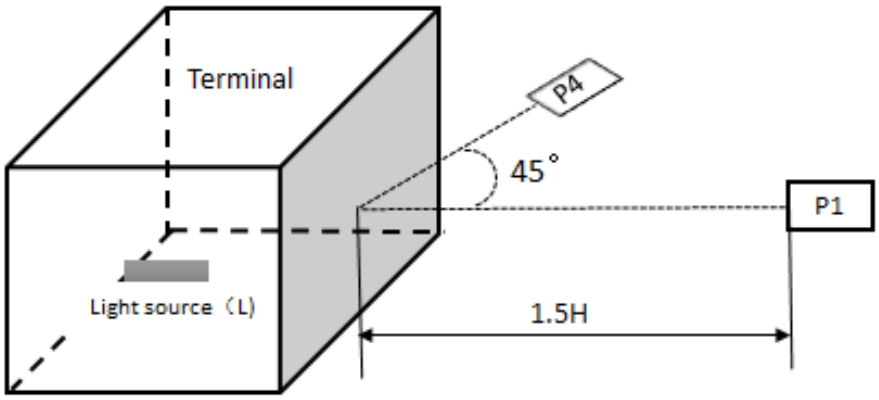


Figure 3

4.1.3.4. Light source in the right inside of transparent LCD terminal

Measuring point should be setted as P1 and P5. P1 is in screen center line with 1.5 times screen height, P5 is in P1 point leftward horizontal 45 degrees, 1.5 times the screen height point,as figure 4，figure 6.

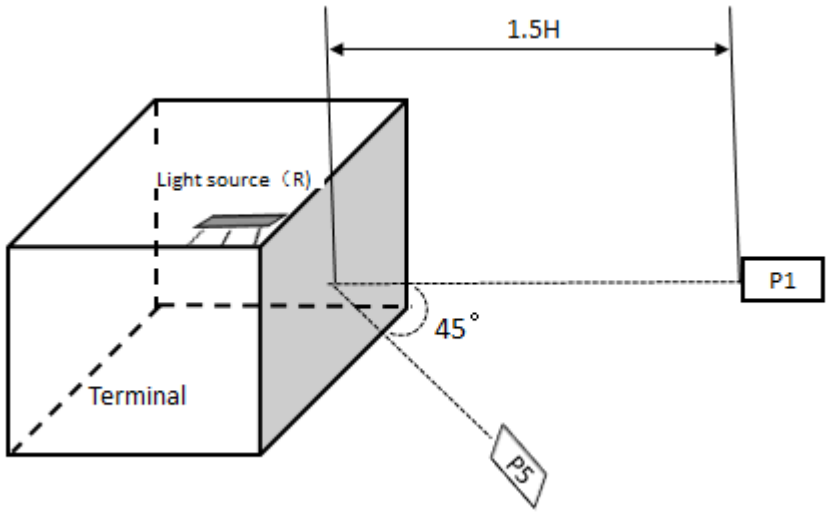


Figure 4

4.1.3.5 Light sources are in the top and bottom of transparent LCD terminal

Measuring points should be setted as P1,P3 and P2.

4.1.3.6 Light sources are in the left and right inside of transparent LCD terminal

Measuring points should be setted as P1,P5 and P4.

4.1.3.7 Light source in different side of transparent LCD terminal

All measure points in each side should be considered and measured.

5 Measuring methods of transparent LCD terminal angle color deviation

5.1 General

The purpose of this test is to measure the relationship between color deviation and observation angle through a transparent LCD terminal.

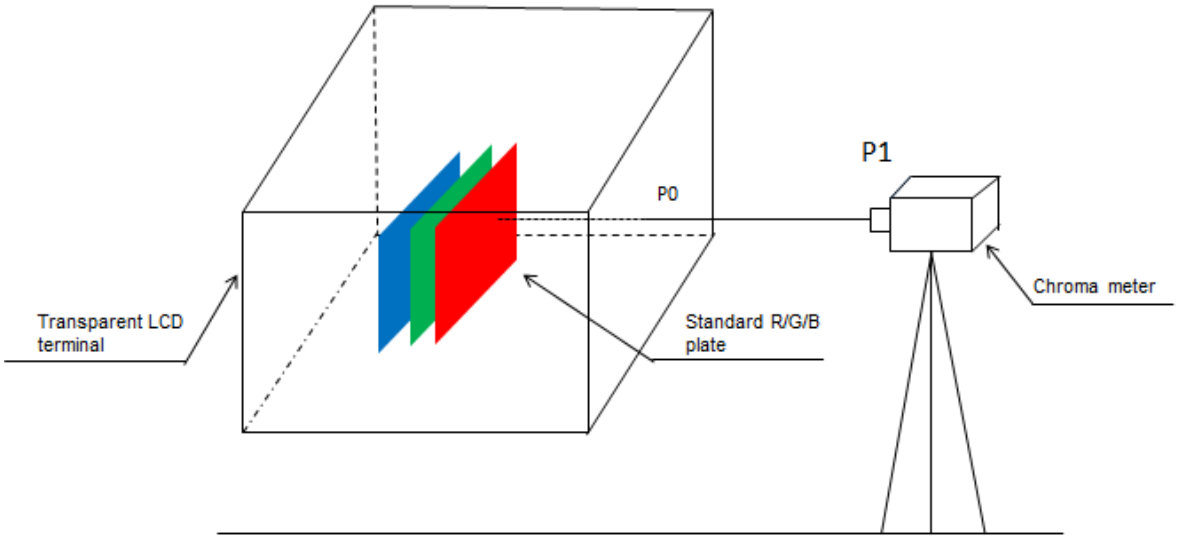
5.2 Test system

1) Standard red, green and blue color plates are used in this test.

2) The transparent terminal should be tested respectively in case with transparent LCD panel and without transparent LCD panel. （refer to figure5）

3) Colorimeter was placed in front of the terminal, and the testing distance is 1.5 times the screen height.

4) Colorimeter should be able to move in horizontal direction and keep a radius as 1.5 times the screen height, and keep the observation point P0 unchanged . （refer to figure 6） record chroma meter initial position as P1.


P1
P0
Chroma meter
Transparent LCD terminal
Standard R/G/B plate

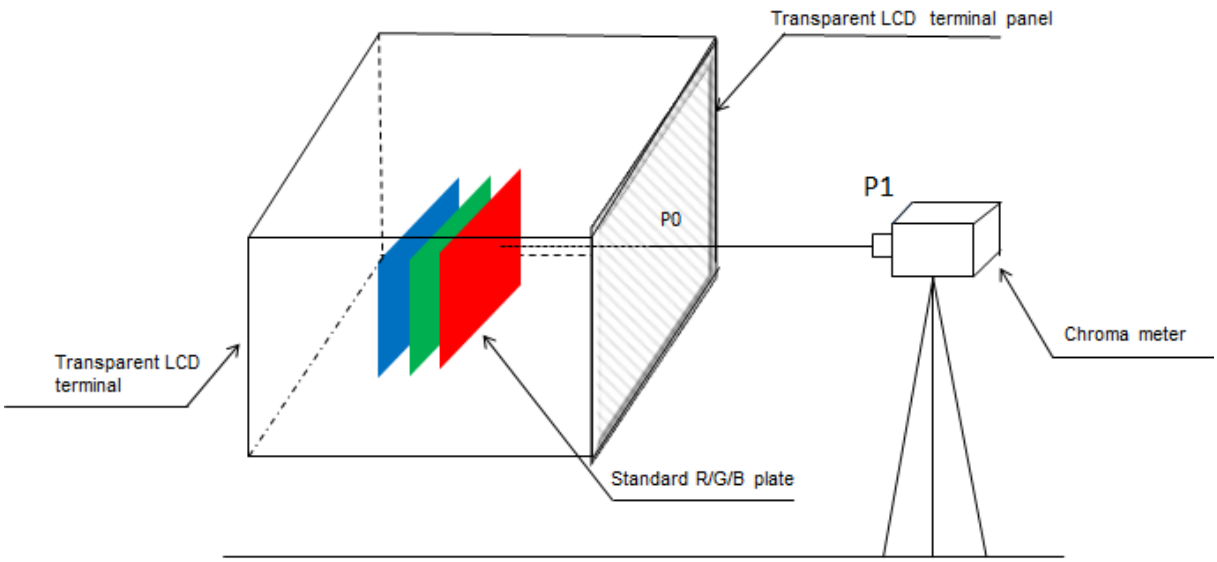

Transparent LCD terminal panel
P1
P0
Chroma meter
Transparent LCD terminal
Standard R/G/B plate

Figure 5

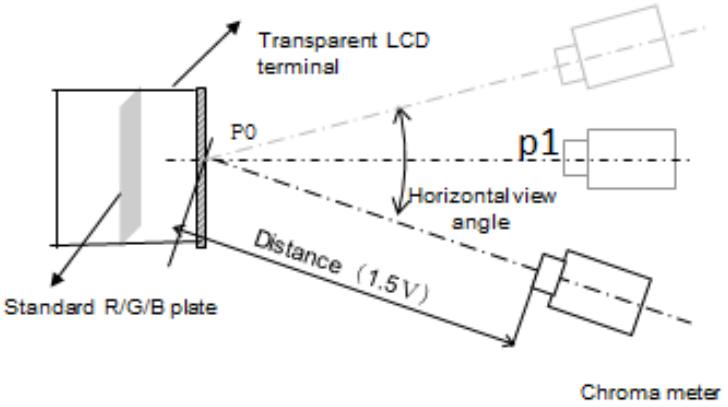


Figure 6 （Top view）

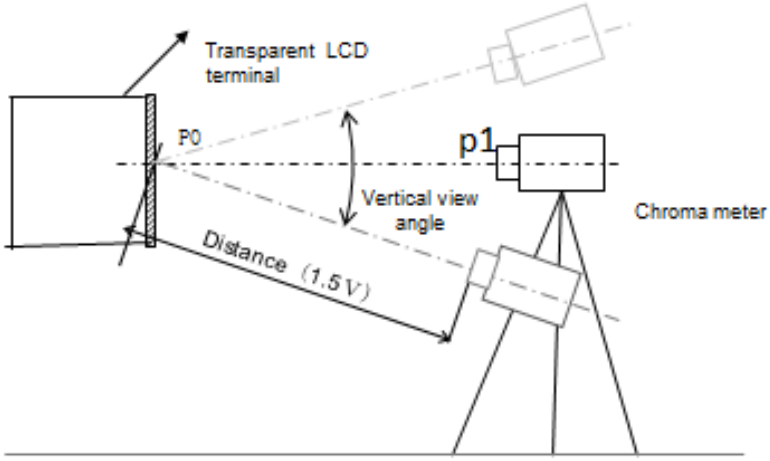


Figure 7 （horizontal view）

5.3 Test method and process

1) Put standard R/G/B plate into transparent LCD terminal respectively without transparent LCD panel，keep the standard color plate vertical and located as objects actual location, keep the center points of the color plates and the transparent LCD terminal screen P0 are on the same horizontal line.

2) Measure the color coordinates at P0 point in red（U_{R0},V_{R0}）/green（U_{G0},V_{G0}）/blue (U_{B0},V_{B0}) standard plates with the chroma meter.

3) Keep the red standard plate in terminal.

4) Move the chroma meter position horizontally starting from P1, measure each angle color coordinates (U_{RI},V_{RI}) in 5^0 step.（the range of $\pm 60^0$ is recommended）

5) Put transparent LCD panel into transparent LCD terminal and set the panel in fully transparent states.

6) Move the colorimeter position horizontally starting from P1, measure each angle color coordinates (U_{RI}’ ,V_{RI}’) in 5^0 step. （the range of $\pm 60^0$ is recommended）

7) Calculate the red horizontal deviation due to the change of viewing angle:

$\Delta U_R V_R = \sqrt{(U_{RI} - U_{RO})^2 + (V_{RI} - V_{RO})^2}$

8) Calculate transparent LCD terminal horizontal red deviation due to transparent panel in and off：

$$\Delta U_R^i V_R^i = \sqrt{(U_{RI}^i - U_{RO})^2 + (V_{RI}^i - V_{RO})^2}$$

9) Keep green standard plate in the terminal and repeated the step 4)—6) ,calculate green horizontal deviation due to the change of viewing angle

$\Delta U_G V_G = \sqrt{(U_{GI} - U_{GO})^2 + (V_{GI} - V_{GO})^2}$;

Calculate transparent LCD terminal horizontal green deviation due to transparent panel in and off :

$$\Delta U_G^i V_G^i = \sqrt{(U_{GI}^i - U_{GO})^2 + (V_{GI}^i - V_{GO})^2}$$

10) Keep blue standard plate in the terminal and repeated the step 4)—6) ,calculate blue horizontal deviation due to the change of viewing angle

$\Delta U_B V_B = \sqrt{(U_{BI} - U_{BO})^2 + (V_{BI} - V_{BO})^2}$;

Calculate transparent LCD terminal horizontal blue deviation due to panel in and off :

$$\Delta U_B^i V_B^i = \sqrt{(U_{BI}^i \quad U_{BO})^2 \mid (V_{BI}^i \quad V_{BO})^2}$$

I--- positive integer, represent the different horizontal angle.

6 Measuring methods of Transparent LCD terminal multi colors field angle test

6.1 General

The purpose of this test is to measure the image color field deviation in various observation angle through a transparent LCD terminal.

6.2 Test system

1）Colorimeter was placed in front of the terminal, and the testing distance is 1.5 times the screen height.

2）Colorimeter should be able to move in horizontal direction and keep a radius as 1.5 times the screen height, and keep the observation point P0 unchanged .

6.3 Test condition

9 colors field should be tested as below table 1

No	a) 0-255 range setting (analog interface)			b) 16-235range setting (digital interface)			Color sample
	R	G	B	R	G	B	
1	115	82	68	115	87	74	Dark Skin
2	194	150	130	183	145	128	Light Skin
3	56	61	150	64	69	145	Blue
4	70	148	73	76	143	79	Green
5	175	54	60	166	62	68	Red
6	231	199	31	214	187	43	Yellow
7	187	86	149	177	90	143	Magenta
8	8	133	161	23	130	154	Cyan
9	122	122	121	121	121	120	Grey

Table 1

6.4 Test method and process

1) Transparent LCD system setting: adjust brightness, color and ,contrast to standard states,

2) Input a dark skin signal according table 1 requirement, Measure the color coordinates at P0 point （u'_{01}， v'_{01}），

3) Move the chroma meter position horizontally starting from P1, measure each angle color coordinates （u'_{i1}， v'_{i1}），

4) Input other 8 colors field signal as table 1,measure P0 color coordinate （u'_{02}， v'_{02}）~（u'_{09}， v'_{09}），

5) Repeat process3)--4),measure horizontal color coordinations（u'_{i2}， v'_{i2}）~（u'_{i9}， v'_{i9}），

6) Calculate horizontal color deviation $\Delta u'_{ik} v'_{ik} = \sqrt{(u'_{ik} - u'_{0k})^2 + (v'_{ik} - v'_{0k})^2}$

i--positive integer, represent the different horizontal angle
k--1～9， represent 9 color field signal

7) Draw the relation curve between color field and observation angle in 9 field signals,

8) Find out the left and right angle position when the average color difference is in 0.020, horizontal color angle are the sum of left and right angle.

7 Measuring methods of Transparent LCD terminal brightness

7.1 General

The purpose of this test is to verify brightness compliance with the specifications where light source in any location in transparent LCD terminal.

7.2 Test signal and test condition

7.2.1 Test signal

Input a full white signal to transparent LCD terminal as figure 8, measure point is in screen center P0.

Figure 8

7.2.2 Test distance

Colorimeter should be able to move in horizontal and vertical direction and keep a radius as 1.5 times the screen height, keep the observation point P0 unchanged as figure 6,figure 7.

7.2.3 Transparent LCD terminal setting

Adjust terminal brightness ,color and contrast to standard or default states.

7.3 Test method and process

7.3.1 Light source in traditional location

Input a full white signal as figure 8 ,measure P0 brightness.

7.3.2 Light source in special location

7.3.2.1 Light source in the top of transparent LCD terminal

1) Input a full white signal as figure 8,

2) Measure P0 brightness in P1 and P3 ,mark as L1 and L3,transparent LCD terminal brightness is the average value of L1 and L3.

7.3.2.2 Light source in the bottom of transparent LCD terminal

1) Input a full white signal as figure8,

2）Measure P0 brightness in P1 and P2 ,mark as L1 and L2,transparent LCD terminal brightness is the average value of L1 and L2.

7.3.2.3 Light source in the left inside of transparent LCD terminal

1) Input a full white signal as figure8,

2) Measure P0 brightness in P1 and P4 ,mark as L1 and L4,transparent LCD terminal brightness is the average value of L1 and L4.

7.3.2.4 Light source in the right inside of transparent LCD terminal

1) Input a full white signal as figure 8,

2) Measure P0 brightness in P1 and P5 ,mark as L1 and L5,transparent LCD terminal brightness is the average value of L1 and L5.

7.3.2.5 Light souces both in the top and bottom of transparent LCD terminal

1) Input a full white signal as figure8,

2) Measure P0 brightness in P1 ,P2 and P3 ,mark as L1 ,L2and L3,transparent LCD terminal brightness is the average value of L1, L2 and L3.

7.3.2.6 Light sources both in the left and right inside of transparent LCD terminal

1) Input a full white signal as figure 8,

2) Measure P0 brightness in P1 ,P4 and P5 ,mark as L1 ,L4 and L5 ,transparent LCD terminal brightness is the average value of L1, L4 and L5.

7.3.2.7 Light source in any side of transparent LCD terminal

1) Input a full white signal as figure 8,

2) Measure P0 brightness in all points as rule 4.1.3.7 and mark as L1 ,L2 ...Li, transparent LCD terminal brightness is the average value of L1, L2... and Li

(i=1.2.3.4.5)