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# Product Specification

Part Name: 10.10 inch TFT Display Module

Customer Part ID:

Topovision Part ID: TVT1010D9E3

Ver: A

|             |
|-------------|
| Customer:   |
| Approved by |

|                                       |
|---------------------------------------|
| From: Topovision Technology Co., Ltd. |
| Approved by                           |

## Notes:

1. Please contact Topovision Technology Co., Ltd. before assigning your product based on this module specification
2. The information contained herein is presented merely to indicate the characteristics and performance of our products. No responsibility is assumed by Topovision Technology Co., Ltd. for any intellectual property claims or other problems that may result from application based on the module described herein.

## Record of Revision

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# 1. General Specifications

| No. | Item                  | Specification                | Remark   |
|-----|-----------------------|------------------------------|----------|
| 1   | LCD size              | 10.1 inch                    |          |
| 2   | Driver element        | a-Si TFT active matrix       |          |
| 3   | Resolution            | 1024(W) RGB x 600(H)         |          |
| 4   | Display mode          | Normally White, Transmissive |          |
| 5   | Dot pitch             | 0.2175 (w)x 0.2088(H)        |          |
| 6   | Active area           | 222.72(W) x 125.28(H) mm     |          |
| 7   | Module size           | 235(W) x143(H) x2.9(D) mm    | Note 1   |
| 8   | View direction        | 12                           | O' clock |
| 9   | Surface treatment     | Anti-Glare                   |          |
| 10  | Color arrangement     | RGB-stripe                   |          |
| 11  | Display colors        | 16.7M                        | colors   |
| 12  | Color gamut (C light) | 48.5%                        |          |
| 13  | Interface             | LVDS                         |          |
| 14  | Lcm power consumption | (2.9 W)                      | TYP.     |
| 15  | Driver IC             | HX8282-A14&HX8696-A01        |          |

Note 1: Refer to Mechanical Drawing.

## 2. Pin Assignment

FPC Connector is used for the module electronics interface. The recommended model is FH12A-40S-0.5SH manufactured by Hirose.

| Pin No | Symbol | I/O | Function                                                                                      | Remark |
|--------|--------|-----|-----------------------------------------------------------------------------------------------|--------|
| 1      | VCOM   | P   | Common Voltage                                                                                |        |
| 2      | VDD    | P   | Power Supply                                                                                  |        |
| 3      | VDD    | p   | Power Supply                                                                                  |        |
| 4      | NC     | -   | No connection                                                                                 |        |
| 5      | GRB    | I   | Global reset pin.                                                                             |        |
| 6      | STBYB  | I   | Standby mode control. Normally pull High.                                                     |        |
| 7      | GND    | P   | Ground                                                                                        |        |
| 8      | NIND0  | I   | -LVDS Differential Data Input                                                                 |        |
| 9      | PIND0  | I   | +LVDS Differential Data Input                                                                 |        |
| 10     | GND    | P   | Ground                                                                                        |        |
| 11     | NIND1  | I   | -LVDS Differential Data Input                                                                 |        |
| 12     | PIND1  | I   | +LVDS Differential Data Input                                                                 |        |
| 13     | GND    | P   | Ground                                                                                        |        |
| 14     | NIND2  | I   | -LVDS Differential Data Input                                                                 |        |
| 15     | PIND2  | I   | +LVDS Differential Data Input                                                                 |        |
| 16     | GND    | P   | Ground                                                                                        |        |
| 17     | NINC   | I   | -LVDS Differential Clock Input                                                                |        |
| 18     | PINC   | I   | +LVDS Differential Clock Input                                                                |        |
| 19     | GND    | P   | Ground                                                                                        |        |
| 20     | NIND3  | I   | -LVDS Differential Data Input                                                                 |        |
| 21     | PIND3  | I   | +LVDS Differential Data Input                                                                 |        |
| 22     | GND    | p   | Ground                                                                                        |        |
| 23     | NC     | -   | No connection                                                                                 |        |
| 24     | NC     | -   | No connection                                                                                 |        |
| 25     | GND    | P   | Ground                                                                                        |        |
| 26     | NC     | -   | No connection                                                                                 |        |
| 27     | NC     | -   | No connection                                                                                 |        |
| 28     | MODE   | I   | DE / SYNC mode select. Normally pull high.<br>When MODE=H, DE mode.<br>When MODE=L, SYNC mode |        |
| 29     | AVDD   | P   | Power for Analog Circuit                                                                      |        |

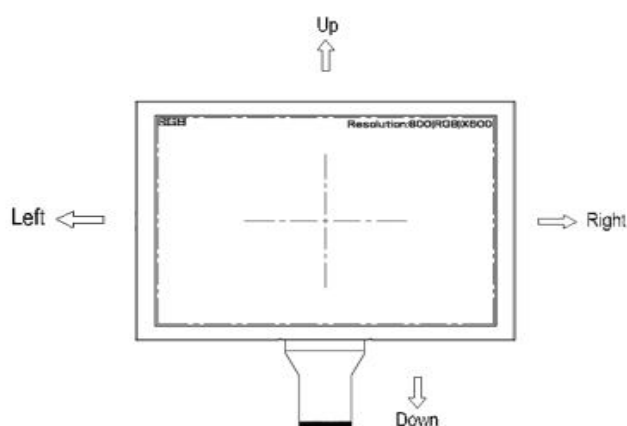
|    |      |   |                      |        |
|----|------|---|----------------------|--------|
| 30 | GND  | P | Ground               |        |
| 31 | LED- | P | LED Cathode          |        |
| 32 | LED- | P | LED Cathode          |        |
| 33 | L/R  | I | Left/right selection | Note 1 |
| 34 | U/D  | I | Up/down selection    | Note 1 |
| 35 | VGL  | P | Gate OFF Voltage     |        |
| 36 | NC   | - | No connection        |        |
| 37 | NC   | - | No connection        |        |
| 38 | VGH  | P | Gate ON Voltage      |        |
| 39 | LED+ | P | LED Anode            |        |
| 40 | LED+ | P | LED Anode            |        |

Note 1: input; 0: output; P: Power or Ground(0V).

Note 1: Selection of scanning mod

| Setting of scan control input |     | Scanning direction        |
|-------------------------------|-----|---------------------------|
| U/D                           | L/R |                           |
| GND                           | VDD | Up to down, left to right |
| VDD                           | GND | Down to up, right to left |
| GND                           | GND | Up to down, right to left |
| VDD                           | VDD | Down to up, left to right |

Note 2: Definition of scanning direction.Refer to the figure as below:



## 3. Operation Specifications

### 3.1. Absolute Maximum Ratings

(Note 1)

| Item                  | Symbol          | Values |      | Unit | Remark  |
|-----------------------|-----------------|--------|------|------|---------|
|                       |                 | Min.   | Max. |      |         |
| Power voltage         | VDD             | -0.3   | 5.0  | V    | TA=25°C |
|                       | AVDD            | 6.5    | 15   | V    |         |
|                       | VGL             | -20    | 0.3  | V    |         |
|                       | VGH             | -0.3   | 40   | V    |         |
| Operation Temperature | T <sub>OP</sub> | -20    | 70   | °C   |         |
| Storage Temperature   | T <sub>ST</sub> | -30    | 80   | °C   |         |

Note1 : The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

### 3.2. Typical Operation Conditions

Test condition: GND=0V, TA=25 °C

Note1

| Item                     | Symbol          | Values              |      |                     | Unit | Remark |
|--------------------------|-----------------|---------------------|------|---------------------|------|--------|
|                          |                 | Min.                | Typ. | Max.                |      |        |
| Power voltage            | VDD             | 3.0                 | 3.3  | 3.6                 | V    |        |
|                          | AVDD            | 8                   | 13   | 15                  | V    |        |
|                          | VGH             | -                   | 21   | -                   | V    |        |
|                          | VGL             | -                   | -8   | -                   | V    |        |
| Input signal voltage     | VCOM            | 3.0                 | 4.6  | 5.0                 | V    |        |
| Input logic high voltage | V <sub>IH</sub> | 0.9 V <sub>DD</sub> | -    | V <sub>DD</sub>     | V    |        |
| Input logic low voltage  | V <sub>IL</sub> | 0                   | -    | 0.1 V <sub>DD</sub> | V    |        |

### 3.3. Current Consumption

| Item                      | Symbol | Values |      |      | Unit | Remark |
|---------------------------|--------|--------|------|------|------|--------|
|                           |        | Min.   | Typ. | Max. |      |        |
| Voltage for LED Backlight | $V_L$  | 8.1    | 9.6  | 10.2 | V    | Note 1 |
| Current for LED Backlight | $I_L$  | -      | 240  | -    | mA   |        |
| LED life time             | -      | 20,000 | -    | -    | Hr   | Note 2 |

Note1:  $V_L=9.6V$ ,  $I_L=240mA$  (Backlight circuit: 3 series connection, 12 parallel connection), the ambient temperature is  $25^{\circ}C$ .

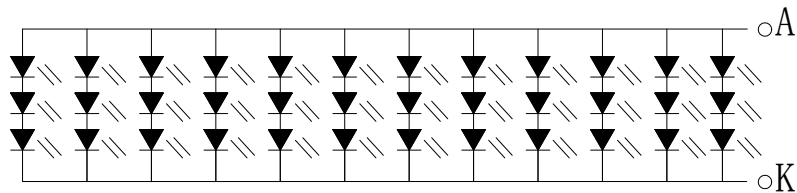
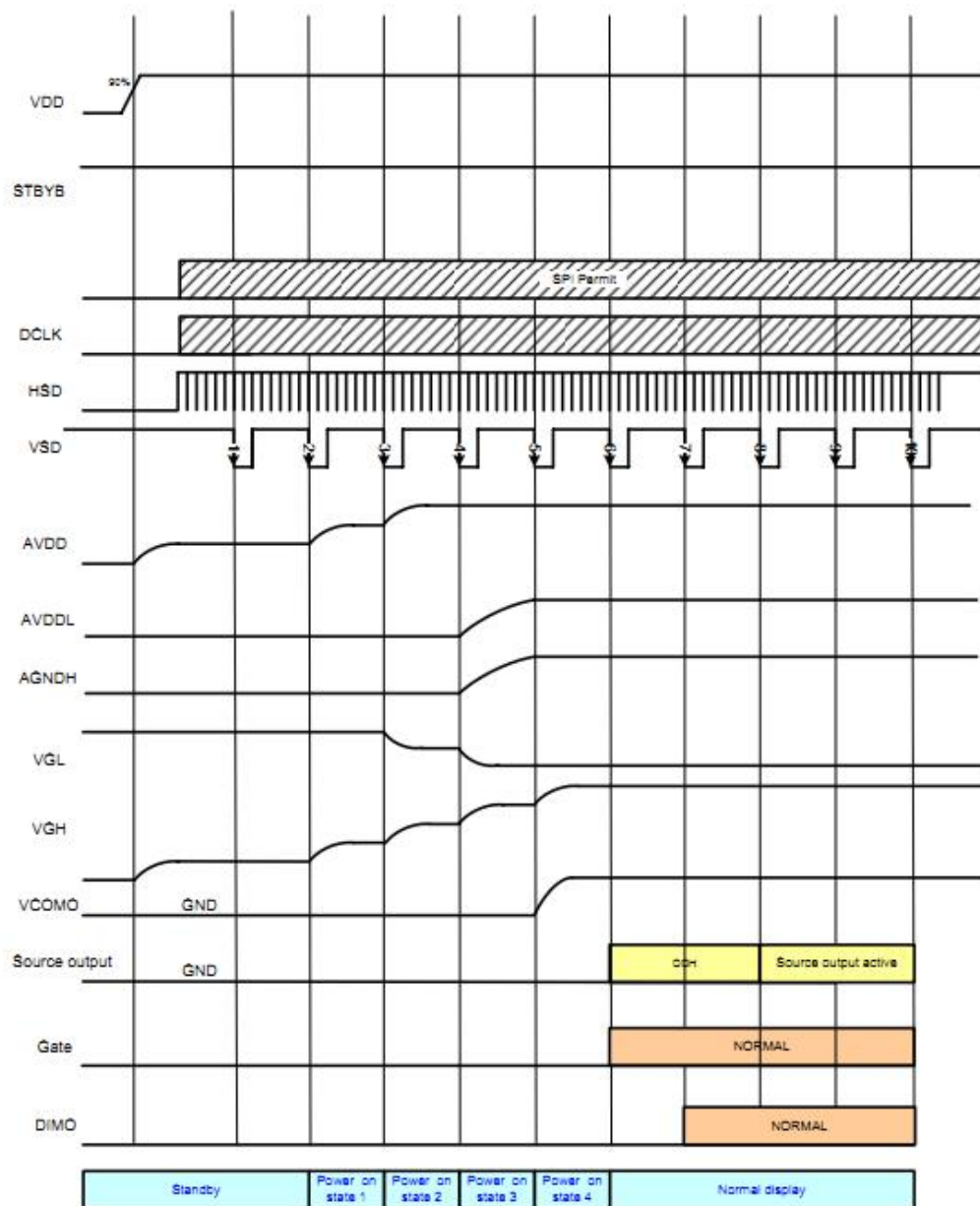


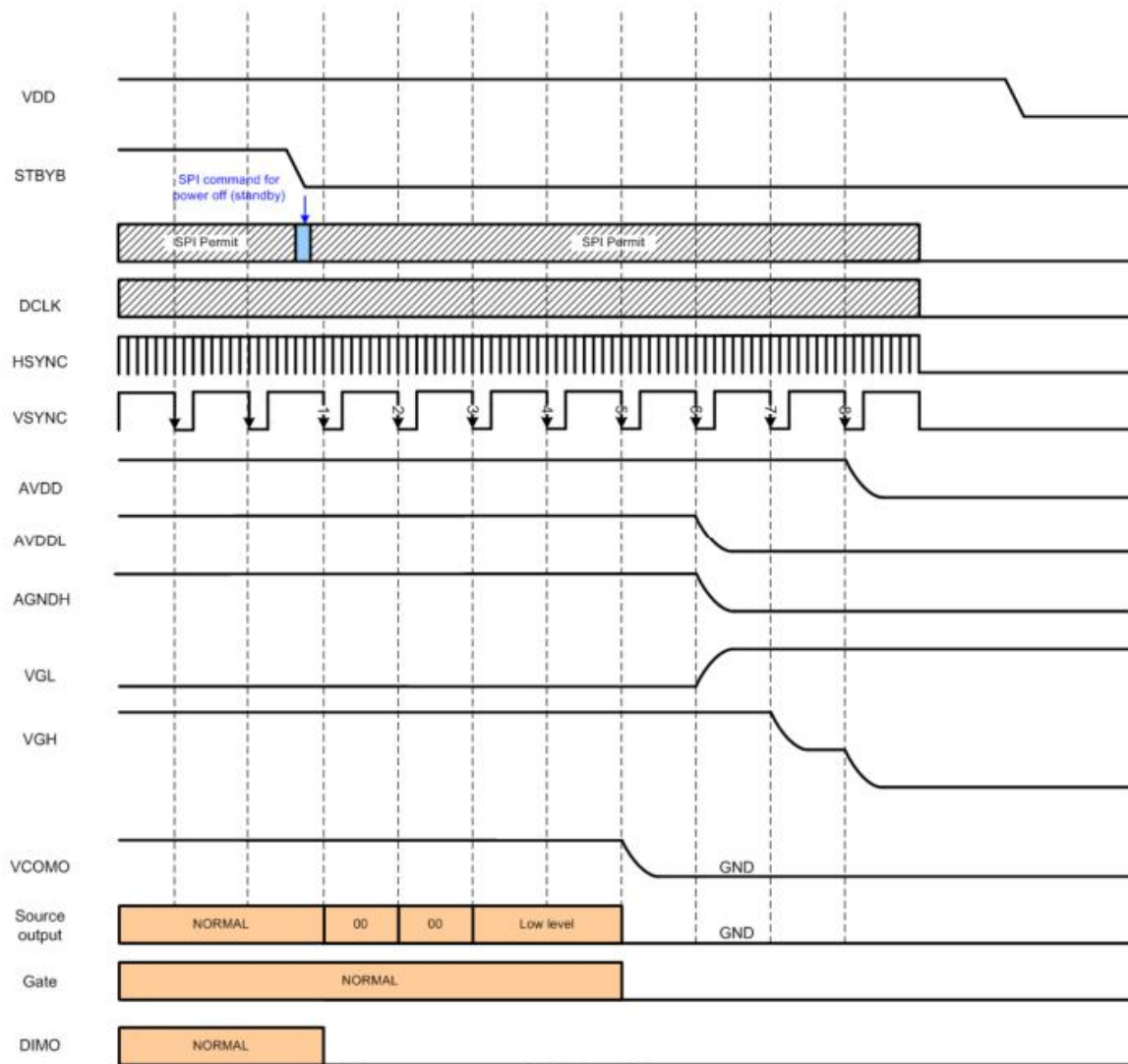
Fig. 3-1 LED test circuit diagram

Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at  $T_a=25^{\circ}C$  and 1/2 rated current. The LED lifetime could be decreased if operating  $I_L$  is larger than 240 mA.

### 3.4. Power Sequence



Power on timing sequence



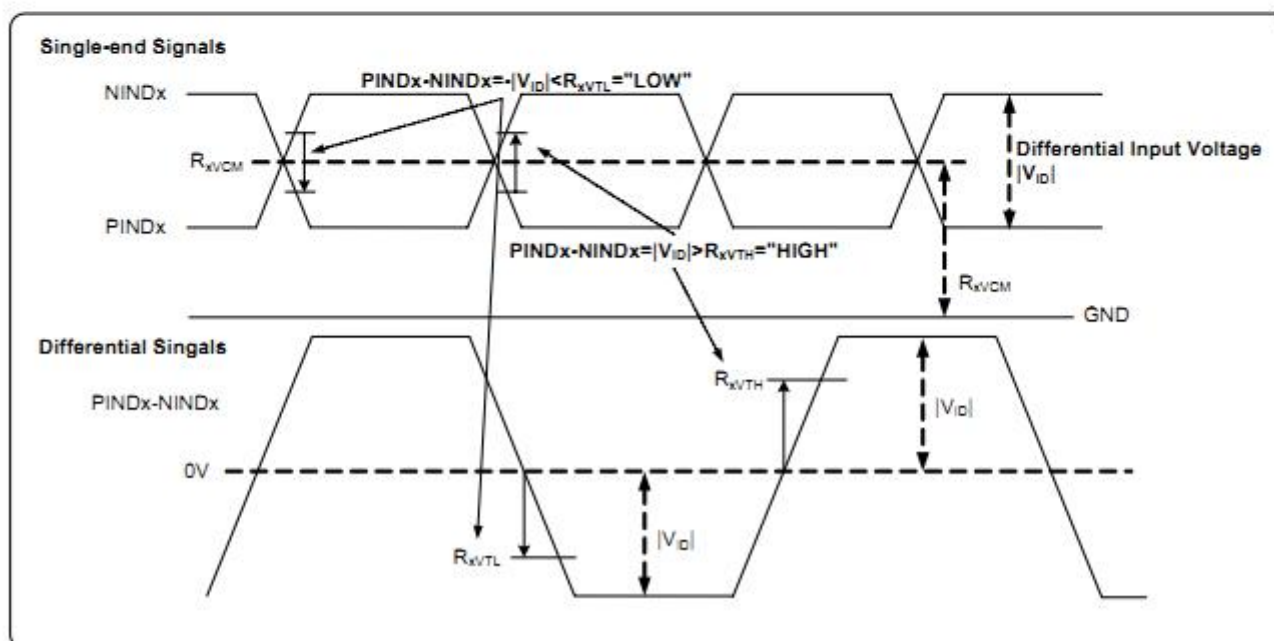
Power off timing sequence

## 3.5. LVDS Signal Timing Characteristics

LVDS mode DC electrical characteristics

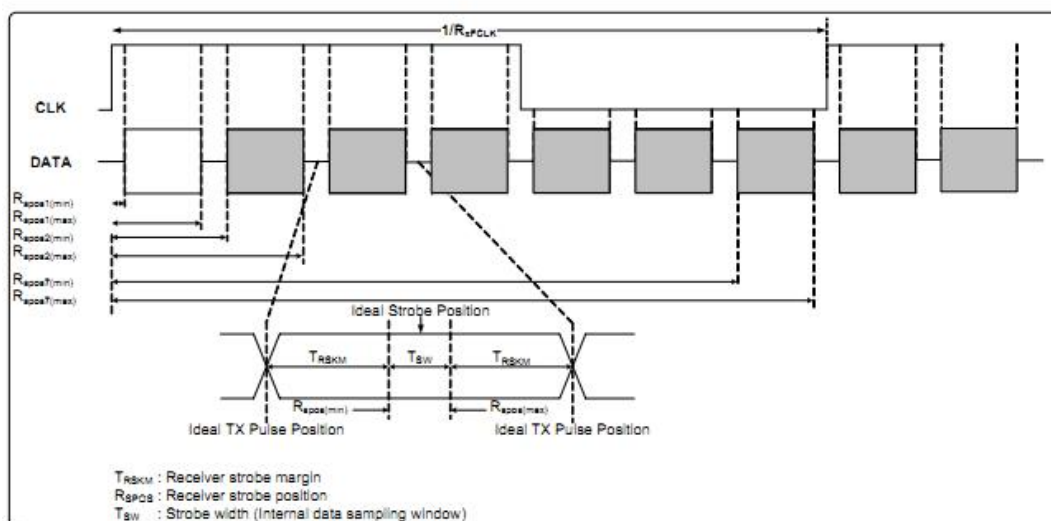
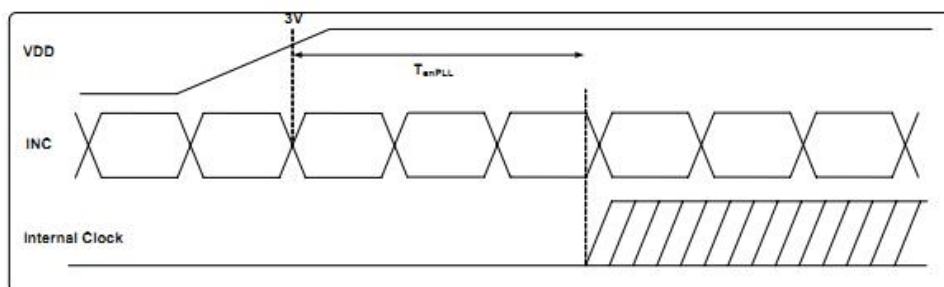
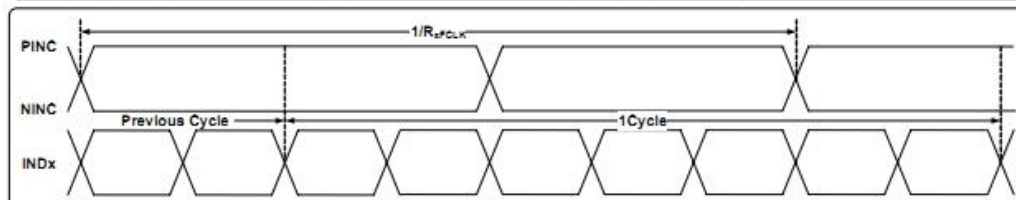
| Parameter                                 | Symbol         | Spec.        |      |                      | Unit    | Condition                         |
|-------------------------------------------|----------------|--------------|------|----------------------|---------|-----------------------------------|
|                                           |                | Min.         | Typ. | Max.                 |         |                                   |
| Differential input high Threshold voltage | $R_{XVTH}$     | -            | -    | +0.1                 | V       | $R_{XVCM}=1.2V$                   |
| Differential input low threshold voltage  | $R_{XVTL}$     | -0.1         | -    | -                    | V       |                                   |
| Input voltage range (singled-end)         | $R_{XVIN}$     | 0            | -    | $VDD-1.2+ V_{ID} /2$ | V       | -                                 |
| Differential input common Mode voltage    | $R_{XVCM}$     | $ V_{ID} /2$ | -    | $VDD-1.2$            | V       | -                                 |
| Differential input voltage                | $ V_{ID} $     | 0.2          | -    | 0.6                  | V       | -                                 |
| Differential input leakage Current        | $R_{V_{XILZ}}$ | -10          | -    | +10                  | $\mu A$ | -                                 |
| LVDS Digital Operating Current            | $I_{ddlvds}$   | -            | 15   | 30                   | mA      | $F_{clk}=65MHz, VDD=3.3V$         |
| LVDS Digital Stand-by Current             | $I_{stlvds}$   | -            | 10   | 50                   | $\mu A$ | Clock & all Functions are stopped |

Table 9.3: LVDS mode DC electrical characteristics



## LVDS mode AC electrical characteristics

| Parameter              | Symbol      | Min. | Spec. Typ.              | Max. | Unit    | Condition                                                |
|------------------------|-------------|------|-------------------------|------|---------|----------------------------------------------------------|
| Clock frequency        | $R_{XFCLK}$ | 20   | -                       | 71   | MHz     | -                                                        |
| Input data skew margin | $T_{RSKM}$  | 500  | -                       | -    | pS      | $ V_{ID} =400mV$<br>$R_{XVCM}=1.2V$<br>$R_{XFCLK}=71MHz$ |
| Clock high time        | $T_{LVCH}$  | -    | $4/(7 \cdot R_{XFCLK})$ | -    | ns      | -                                                        |
| Clock low time         | $T_{LVCL}$  | -    | $3/(7 \cdot R_{XFCLK})$ | -    | ns      | -                                                        |
| PLL wake-up time       | $T_{enPLL}$ | -    | -                       | 150  | $\mu s$ | -                                                        |



| Parameter            | Symbol     | Min. | Spec. Typ. | Max.    | Unit | Condition                        |
|----------------------|------------|------|------------|---------|------|----------------------------------|
| Modulation Frequency | $SSC_{MF}$ | 23   | -          | 93      | KHz  | -                                |
| Modulation Rate      | $SSC_{MR}$ | -    | -          | $\pm 3$ | %    | LVDS clock = 71MHz center spread |

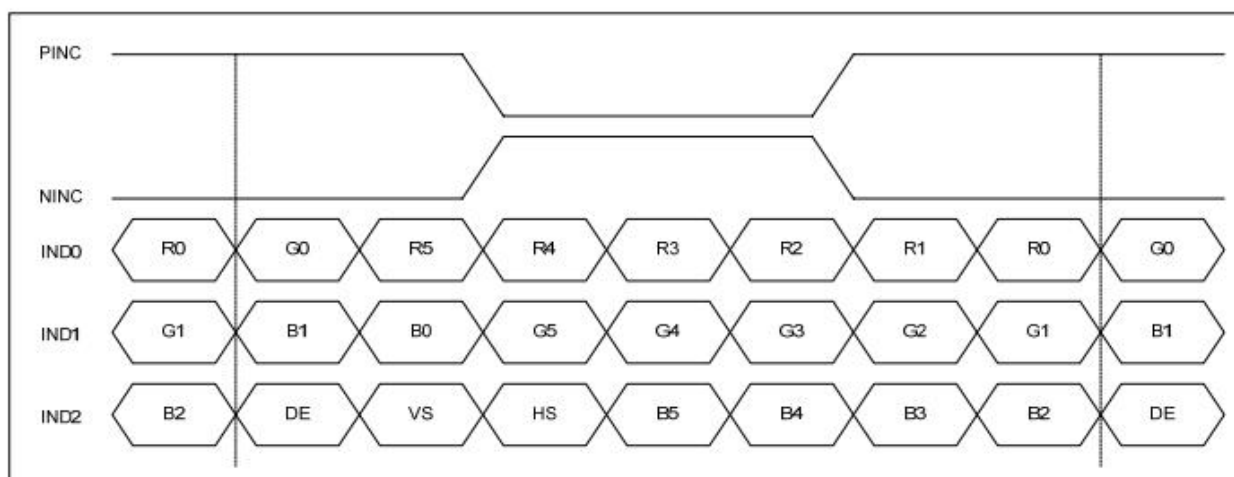


Figure 10.4: 6-bit LVDS input

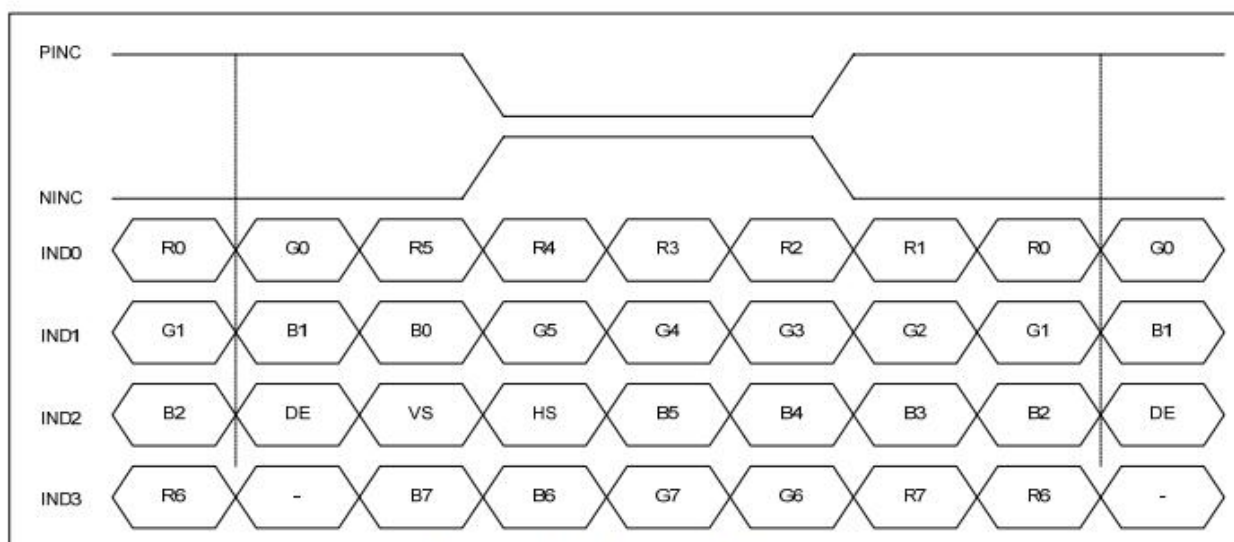


Figure 10.5: 8-bit LVDS Input

## Interface timing Parameter

| Item       |                         | Symbol   | min  | typ  | max  | UNIT |
|------------|-------------------------|----------|------|------|------|------|
| DCLK       | Frequency               | Fclk     | 40.8 | 51.2 | 67.2 | MHz  |
| Horizontal | Horizontal display area | Thd      | 1024 |      |      | DCLK |
|            | Horizontal period time  | Th       | 1114 | 1344 | 1400 | DCLK |
|            | Horizontal blanking     | Thb+Thfp | 90   | 320  | 376  | DCLK |
| Vertical   | Vertical display area   | Tvd      | 600  |      |      | H    |
|            | Vertical period time    | Tv       | 610  | 635  | 800  | H    |
|            | Vertical blanking       | Tvb+Tvfp | 10   | 35   | 200  | H    |

## &lt; DE mode &gt;

| Item                    | Symbol | min  | typ  | max  | UNIT |
|-------------------------|--------|------|------|------|------|
| Horizontal display area | thd    | 1024 |      |      | DCLK |
| DCLK frequency          | fclk   | 44.9 | 51.2 | 63   | MHz  |
| 1 Horizontal Line       | th     | 1200 | 1344 | 1400 | DCLK |
| HSYNC pulse width       | Thpw   | 1    | -    | 140  | DCLK |
| HSYNC back porch        | Thbp   | 160  | 160  | 160  | DCLK |
| HSYNC front porck       | thfp   | 16   | 160  | 216  | DCLK |

## &lt; HV mode Horizontal input timing &gt;

| Item                  | Symbol | min | typ | max | UNIT |
|-----------------------|--------|-----|-----|-----|------|
| Vertical display area | Tvd    | 600 |     |     | H    |
| VSYNC period time     | Tv     | 624 | 635 | 750 | H    |
| VSYNC pulse width     | Tvpw   | 1   | -   | 20  | H    |
| VSYNC back porch      | Tvbp   | 23  | 23  | 23  | H    |
| VSYNC front porck     | tvfp   | 1   | 12  | 127 | H    |

## &lt; HV mode Vertical input timing &gt;

## 4. Optical Specifications

| Item                            | Symbol       | Condition                           | Values |      |      | Unit              | Remark                     |
|---------------------------------|--------------|-------------------------------------|--------|------|------|-------------------|----------------------------|
|                                 |              |                                     | Min.   | Typ. | Max. |                   |                            |
| Viewing angle<br>(CR $\geq$ 10) | $\theta_L$   | $\Phi=180^\circ$<br>(9 o'clock)     | 60     | 70   | -    | degree            | Note 1                     |
|                                 | $\theta_R$   | $\Phi=0^\circ$ (3 o'clock)          | 60     | 70   | -    |                   |                            |
|                                 | $\theta_T$   | $\Phi=90^\circ$<br>(12 o'clock)     | 50     | 60   | -    |                   |                            |
|                                 | $\theta_B$   | $\Phi=270^\circ$<br>(6 o'clock)     | 60     | 70   | -    |                   |                            |
| Response time                   | TON+<br>TOFF | Normal<br>$\theta = \Phi = 0^\circ$ | -      | 25   | 50   | msec              | Note 2                     |
| Contrast ratio                  | CR           |                                     | 400    | 600  | -    | -                 | Note 3                     |
| Color<br>chromaticity           | WX           |                                     | 0.26   | 0.31 | 0.36 | -                 | Note 4<br>Note 5<br>Note 6 |
|                                 | WY           |                                     | 0.30   | 0.35 | 0.40 | -                 |                            |
| Luminance                       | L            |                                     | 250    | 300  | -    | cd/m <sup>2</sup> | Note 6                     |
| Luminance<br>uniformity         | YU           |                                     | 70     | 75   | -    | %                 | Note 7                     |
| Color Gamut                     | %            |                                     | 47     | 50   | -    |                   |                            |

The test systems refer to Note 2.

### Note 1: Definition of viewing angle range

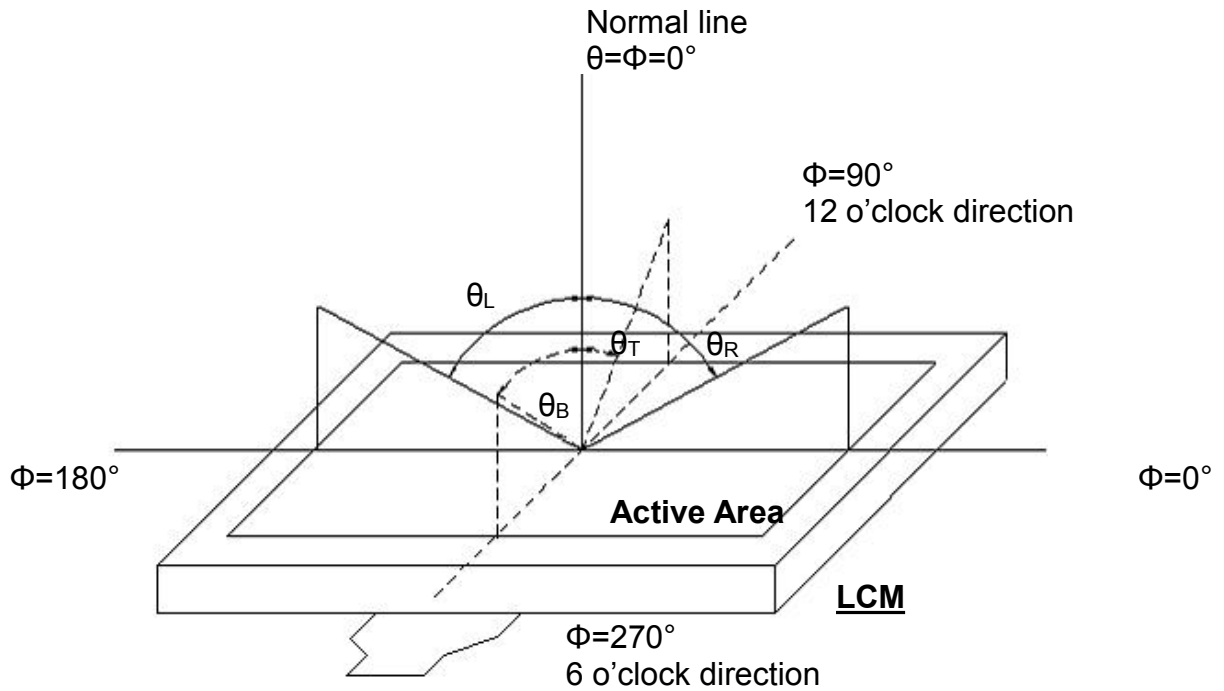


Fig. 4-2 Definition of viewing angle

### Note 2: Definition of Response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time ( $T_{ON}$ ) is the time between photo detector output intensity changed from 90% to 10%. And fall time ( $T_{OFF}$ ) is the time between photo detector output intensity changed from 10% to 90%.

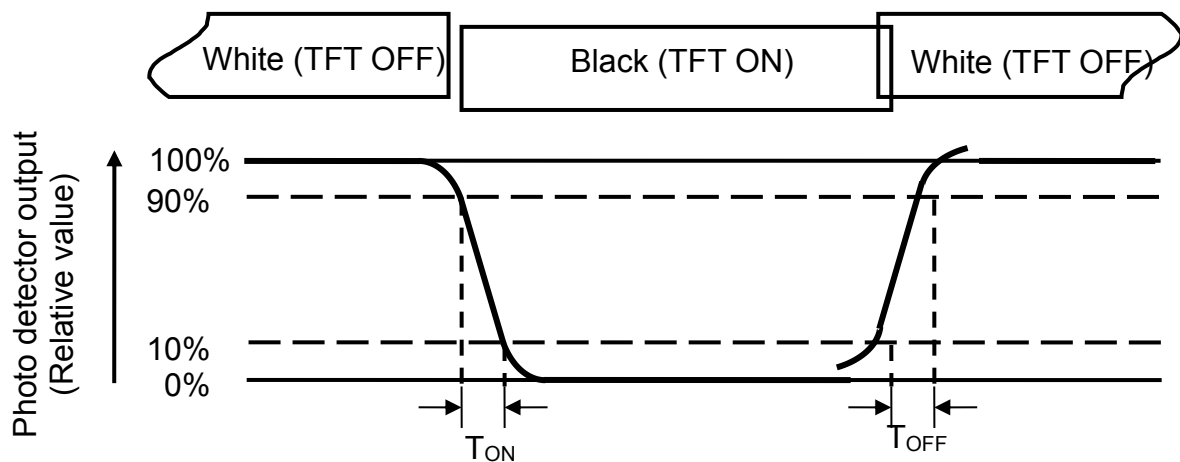


Fig. 4-3 Definition of response time

### Note 3: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

### Note 4: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 30 minutes operation, the optical properties are measured at the center point of the LCD screen. (Viewing angle is measured by ELDIM-EZ contrast/Height :1.2mm, Response time is measured by Photo detector TOPCON BM-7, other items are measured by BM-5A/ Field of view: 1° /Height: 500mm.) or CA-210.

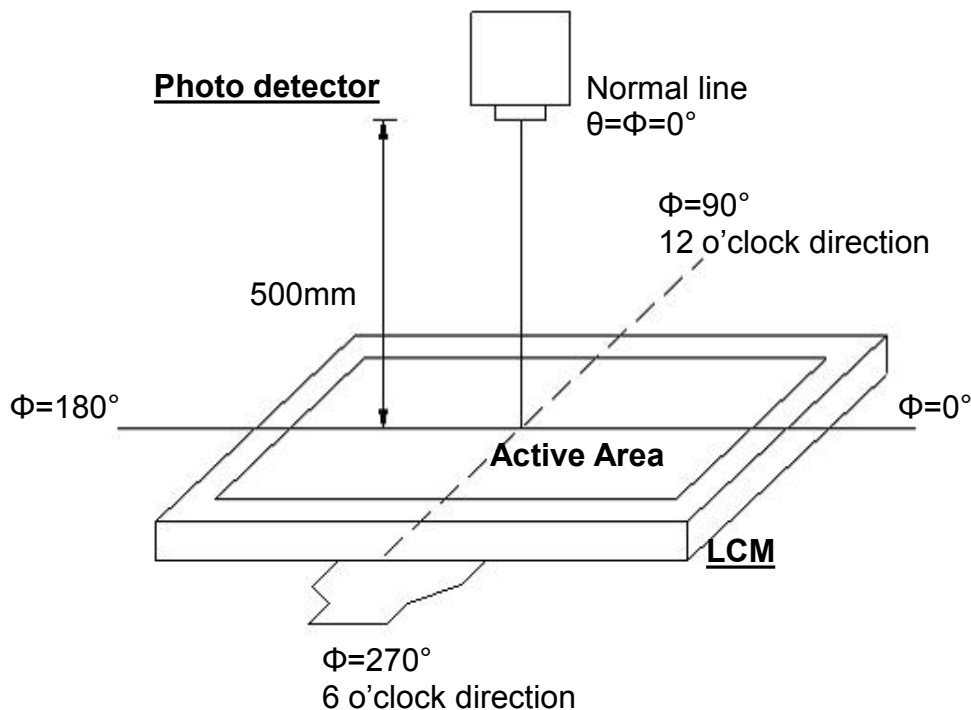


Fig. 4-4 Optical measurement system setup

### Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: All input terminals LCD panel must be ground while measuring the center area of the panel. The LED driving condition is  $I_L = 240\text{mA}$ .

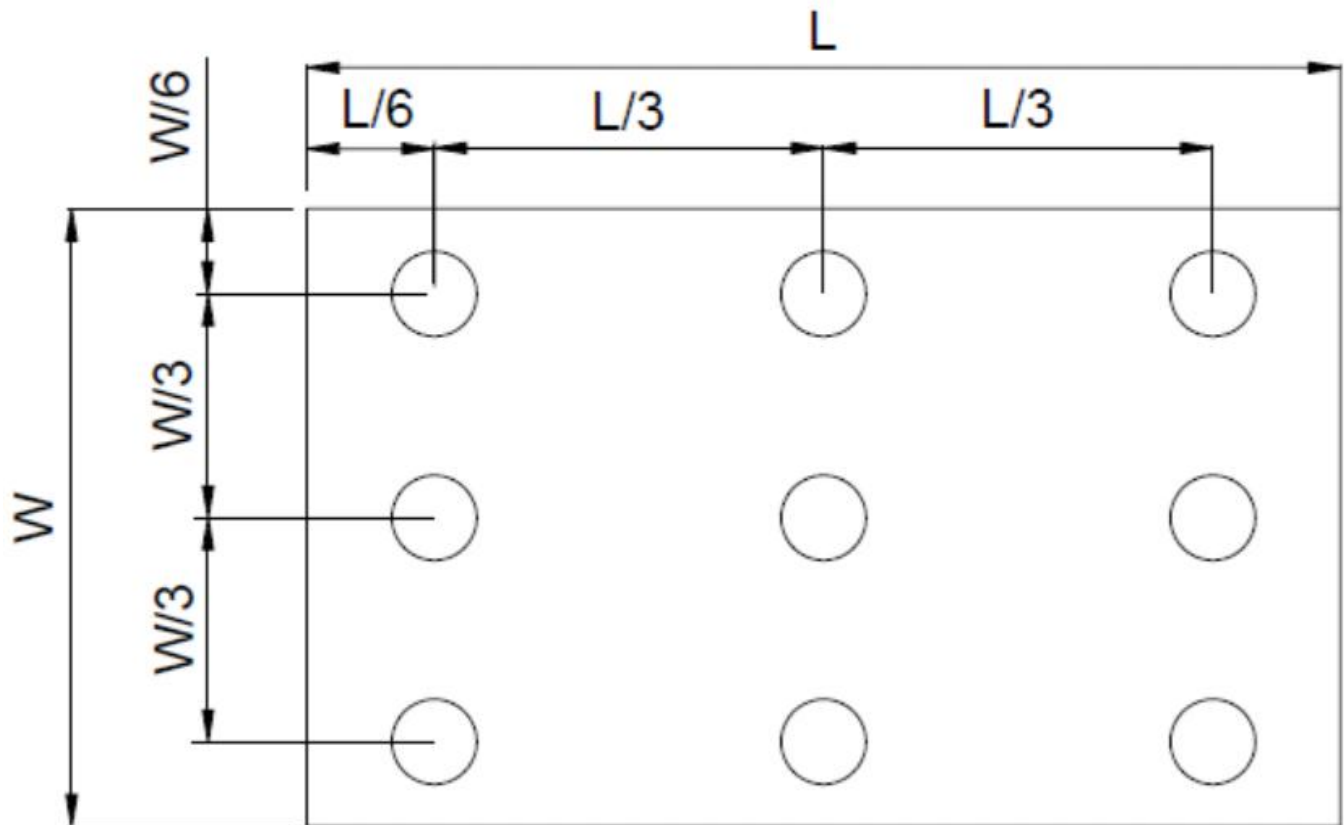
#### Note 7: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas(Refer to Fig. 4-5).

Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (Yu)} = \frac{B_{min}}{B_{max}}$$

L-----Active area length      W----- Active area width



B<sub>MAX</sub>: The measured maximum luminance of all measurement position.

B<sub>MIN</sub>: The measured minimum luminance of all measurement position.

## 5. Reliability Test Items

| Item                                     | Test Conditions                                                                                                                             | Criterion                     |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| High Temperature Storage                 | Ta = 80℃ 240hrs                                                                                                                             | Note 1, Note3, Note 4 ,Note5  |
| Low Temperature Storage                  | Ta = -30℃ 240hrs                                                                                                                            | Note 1, Note3, Note 4         |
| High Temperature Operation               | Ts = 70℃ 240hrs                                                                                                                             | Note 2, Note3, Note 4 , Note5 |
| Low Temperature Operation                | Ta =-20℃ 240hrs                                                                                                                             | Note 1, Note3, Note 4         |
| Operate at High Temperature and Humidity | +60℃, 90%RH 240hrs                                                                                                                          | Note3, Note 4 Note5           |
| Thermal Shock(non operation)             | -30℃/30 min ~ +80℃/30 min for a total 100 cycles, Start with cold temperature and end with high temperature.                                | Note3, Note 4 Note5           |
| Vibration Test                           | Sweep:10Hz~55Hz~10Hz 2G<br>2 hours for each direction of X. Y. Z.<br>(6 hours for total)                                                    |                               |
| Package Vibration Test                   | Random Vibration :<br>0.015G*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ<br>2 hours for each direction of X. Y. Z.<br>(6 hours for total) |                               |
| Package Drop Test                        | Height:60 cm<br>1 corner, 3 edges, 6 surfaces                                                                                               |                               |
| Electro Static Discharge                 | Contact=+/-4KV,<br>Air=+/-8KV,(R=330R,C=150pF), 1 sec,9point,10times/point;                                                                 |                               |

※Criterion:

Note 1: Ta is the ambient temperature of samples.

Note 2: Ts is the temperature of panel's surface.

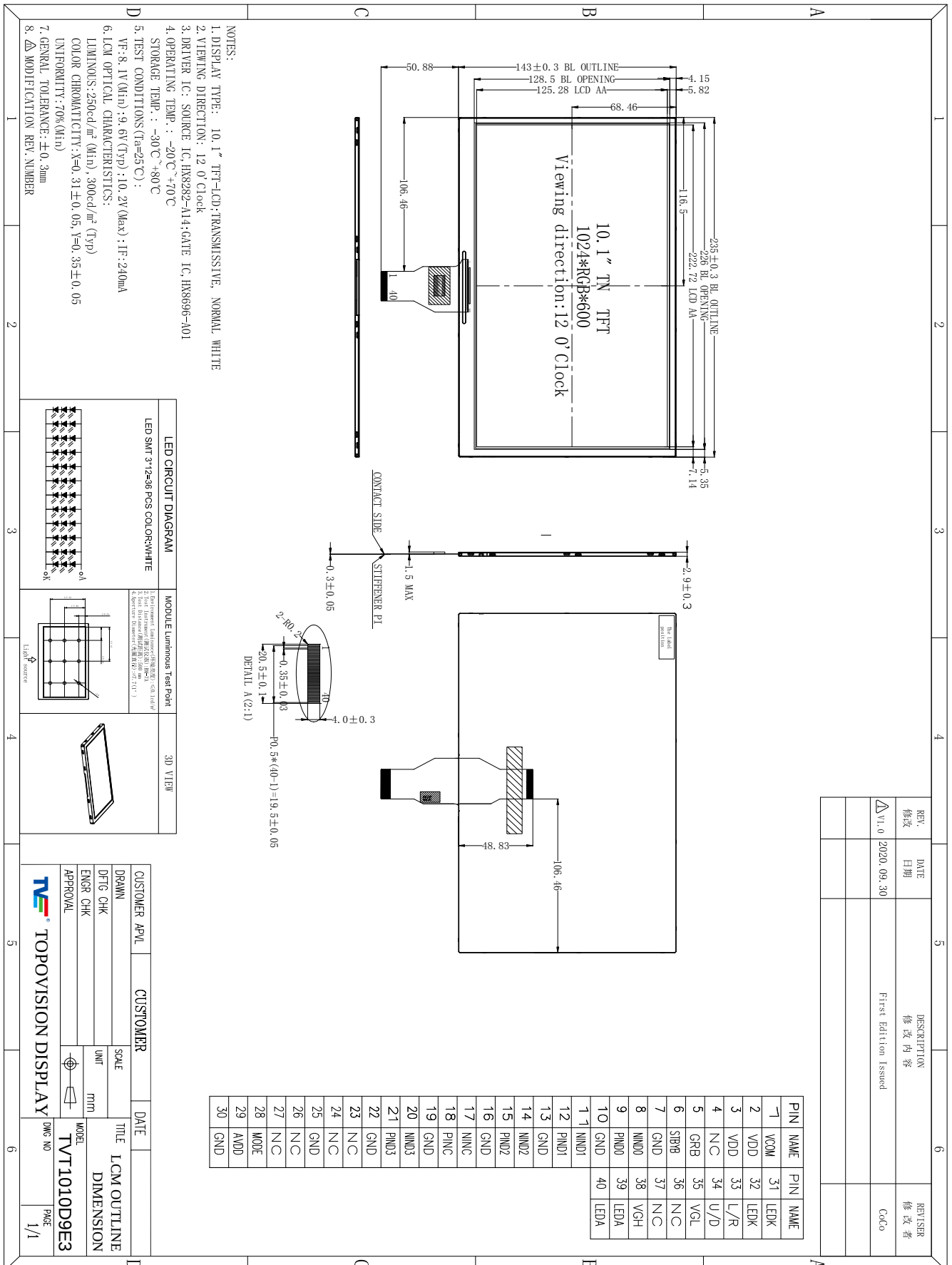
Note 3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.

Note 4: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

Note 5: A certain level of Mura (non-uniformity) of dark / black image will happen several days after high temperature testing (H.T.T.). There is a slowly part recovery over a long time (several months). Such a long exposure time like in H.T.T. will normally not happen in a real application. Therefore the test H.T.T. was introduced to simulate cycles with normal conditions in-between but with the same total exposure time what show a significant reduced Mura.

The root cause is related to tension generated due to different amount of shrinking in the stack of layers in the polarizer sheet. The effect is more significant on larger displays like this size. An investigation into alternative polarizer material showed that there is no better alternative currently available.

## 6. Mechanical Drawing



## 7. Package Drawing

TBD

## 8. General Precautions

### 8.1. Safety

Liquid crystal is poisonous. Do not put it in your mouth. If liquid crystal touches your skin or clothes, wash it off immediately by using soap and water.

### 8.2. Handling

1. The LCD panel is plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.

2. The polarizer attached to the display is easily damaged. Please handle it carefully to avoid scratch or other damages.

3. To avoid contamination on the display surface, do not touch the module surface with bare hands.

4. Keep a space so that the LCD panels do not touch other components.

5. Put cover board such as acrylic board on the surface of LCD panel to protect panel from damages.

6. Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where the condensation of dew occurs.

7. Do not leave module in direct sunlight to avoid malfunction of the ICs.

### 8.3. Static Electricity

1. Be sure to ground module before turning on power or operating module.

2. Do not apply voltage which exceeds the absolute maximum rating value.

### 8.4. Storage

1. Store the module in a dark room where must keep at  $25\pm 10^{\circ}\text{C}$  and 65%RH or less.

2. Do not store the module in surroundings containing organic solvent or corrosive gas.

3. Store the module in an anti-electrostatic container or bag.

### 8.5. Cleaning

1. Do not wipe the polarizer with dry cloth. It might cause scratch.

2. Only use a soft sloth with IPA to wipe the polarizer, other chemicals might permanent damage to the polarizer.