



深圳市一众显示科技有限公司

SHEN ZHEN TEAM SOURCE DISPLAYTECH. CO, TD.

TFT-LCD Module Specification

Module NO.: TST215FHHT-DC1

Version: V1.0

APPROVAL FOR SPECIFICATION

APPROVAL FOR SAMPLE

| For Customer' s Acceptance: | |
|-----------------------------|---------|
| Approved by | Comment |
| | |

| Team Source Display: | | |
|----------------------|-------------|--------------|
| Presented by | Reviewed by | Organized by |
| | | |

| Version No. | Date | Content | Remark |
|-------------|------------|----------------|--------|
| V1.0 | 2025-12-09 | First Released | |
| | | | |

1.GENERAL DESCRIPTION

1.1 OVERVIEW

The specification is applied to 21.5” model TST215FHHT-DC1 using HKC Opencell in design. This TFT Liquid Crystal Display open cell supports 1920 x 1080 FHD mode with 16.7M (8bit) colors. This product is with driver ICs and a 30-pins-2ch-LVDS circuit board and built in backlight unit.

1.3 General Specifications

| Item | Specifications | Unit | Note |
|-----------------------|-------------------------------------|--------|--------|
| Screen Diagonal | 21.5 inch | [mm] | Note 1 |
| Active Area | 476.64(H) x 268.11(V) | [mm] | |
| Pixels H x V | 1920 x 1080 | | |
| Pixel Pitch | 0.08275(H) x 0.24825 (V) | [mm] | |
| Pixel Arrangement | R.G.B. Vertical Stripe | | |
| Driver Element | a-si TFT active matrix | | |
| Display Mode | Normally Black | | |
| Optical Response Time | 7ms (Typ., on/off) | [msec] | |
| Display Orientation | Signal input with“ABC” | | |
| Support Color | 16.7M colors (6bit with FRC) | | |
| Surface Treatment | Anti-Glare, Haze 25%,3H | | |
| Front bezel | Black painted | | |

1.4 Mechanical Specification

| Item | | Min | Typ | Max | Unit | Note |
|-------------|---------------|-----------|---------------|-----------|------|------|
| Weight | | -200 | 1700 | +200 | g | - |
| Module Size | Horizontal(H) | (TYP)-1.0 | 495.60 | (TYP)+1.0 | mm | 1 |
| | Vertical (V) | | 292.20 | | mm | |
| | Depth(D) | | 11.50 | | mm | |

Note 1: Please refer to the"outline dimension" for more information of back and front outline dimensions.

2. Absolute Maximum Ratings

2.1 Absolute Ratings of Environment

| Item | Symbol | Min. | Max. | Unit | Conditions |
|-----------------------|--------|------|------|-------|------------|
| Operating Temperature | TOP | 0 | +50 | [oC] | (1) |
| Operation Humidity | HOP | 5 | 90 | [%RH] | (2) |
| Storage Temperature | TST | -20 | +60 | [oC] | (3) |
| Storage Humidity | HST | 5 | 90 | [%RH] | (4) |

Note 1: With in Ta (25C)

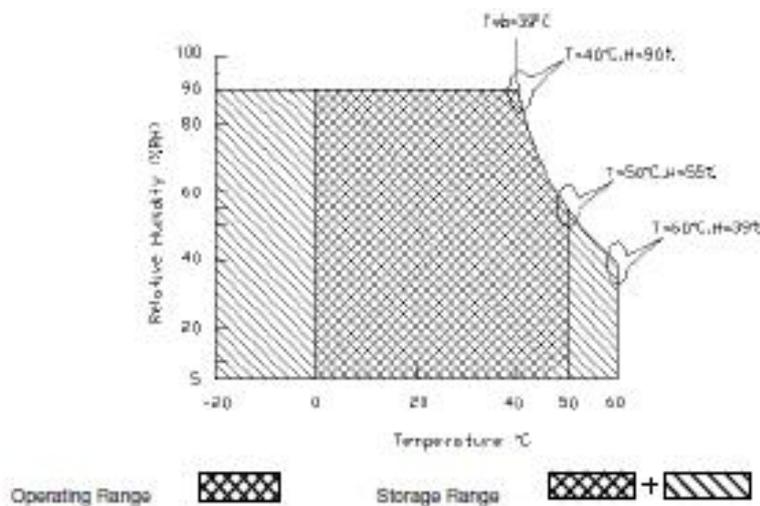
Note 2: Permanent damage to the device may occur if exceeding maximum values

Note 3: Temperature and relative humidity range are shown as the below figure.

1. 90% RH Max ($\leq 39^{\circ}\text{C}$)

2. Max wet-bulb temperature at 39

Note 4: Function Judged only



2.2 Absolute Maximum Ratings

| Item | Symbol | Min. | Max. | Unit | Conditions |
|----------------------|--------|------|------|------|------------|
| Power Supply Voltage | VCC | -0.3 | 6.0 | V | (1) |
| Input Signal Voltage | Vin | -0.3 | 3.6 | V | |

Note: (1) Within $T_a=25\pm 2^{\circ}\text{C}$

2.3 Backlight Unit

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|-----------------------|-----------|-------|------|-------|-----------|------|
| LED operation Voltage | V_{led} | 50.4 | - | 57.6 | V_{led} | |
| LED operation Current | I_{led} | - | 240 | - | mA | (1) |
| BackLight Power | P_{BL} | 12.10 | - | 13.82 | W | (1) |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal operating Conditions

3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Specifications

3.1.1 Power consumption

| Parameter | Symbol | Value | | | Unit | Note | |
|----------------------|-------------------|----------|------|--------|--------|---------------|-----|
| | | Min. | Typ. | Max. | | | |
| Power Supply Voltage | V_{CC} | 4.5 | 5 | 5.5 | V | (2) | |
| Rush Current | I_{RUSH} | - | - | (3) | A | (3) | |
| Power Supply Current | White Pattern | I_{CC} | - | (0.8) | (1.04) | A | (4) |
| | Horizontal Stripe | I_{CC} | - | (1.28) | (1.66) | A | |
| | Black Pattern | I_{CC} | - | (0.78) | (1.01) | A | |
| Power Consumption | P_{LCD} | | (4) | (5.2) | Watt | White Pattern | |

Note:

- (1) Ambient temperature: $25 \pm 2^{\circ}\text{C}$
- (2) The ripple voltage should be controlled under 10% of V_{CC} .
- (3) Measurement Conditions: V_{CC} rising time= $470\mu\text{s}$.

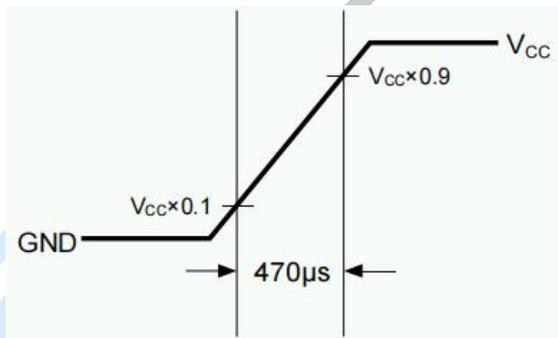


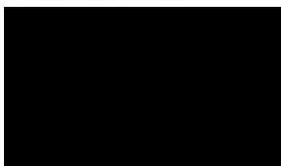
Fig.3.1 V_{CC} rising time condition

- (4) Measurement Conditions: $V_{CC} = 12\text{V}$, $T_a = 25 \pm 2^{\circ}\text{C}$, $F_v = 60\text{ Hz}$, whereas the test pattern is shown as below.

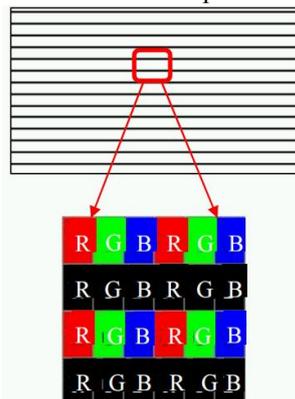
A. White Pattern



C. Black Pattern



B. Horizontal Strip

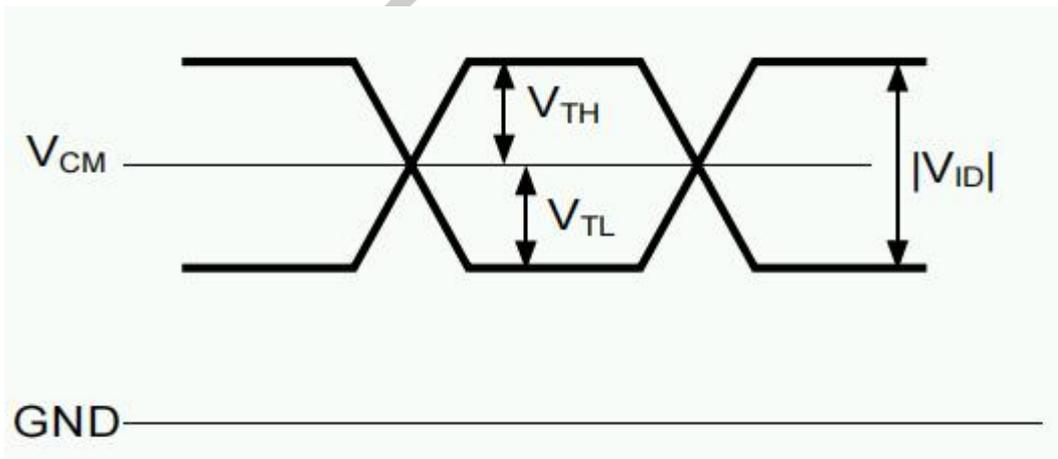


3.1.2 LVDS characteristics

| Parameter | | Symbol | Value | | | Unit | Note |
|----------------|---|------------|-------|------|------|------|------|
| | | | Min. | Typ. | Max. | | |
| LVDS Interface | Differential Input High Threshold Voltage | V_{TH} | +100 | - | - | mV | (1) |
| | Differential Input Low Threshold Voltage | V_{TL} | - | - | -100 | mV | |
| | Common Input Voltage | V_{CM} | 1.0 | 1.2 | 1.4 | V | |
| | Differential input voltage | $ V_{ID} $ | 200 | - | 600 | mV | |
| | Terminating Resistor | R_T | 80 | 100 | 120 | ohm | |
| CMOS Interface | Input High Threshold Voltage | V_{IH} | 2.7 | - | 3.3 | V | |
| | Input Low Threshold Voltage | V_{IL} | 0 | - | 0.6 | V | |

Note:

(1) The LVDS input signal has been defined as follows:



3.1.3 LVDS format

VESA Format: SELLVDS = L

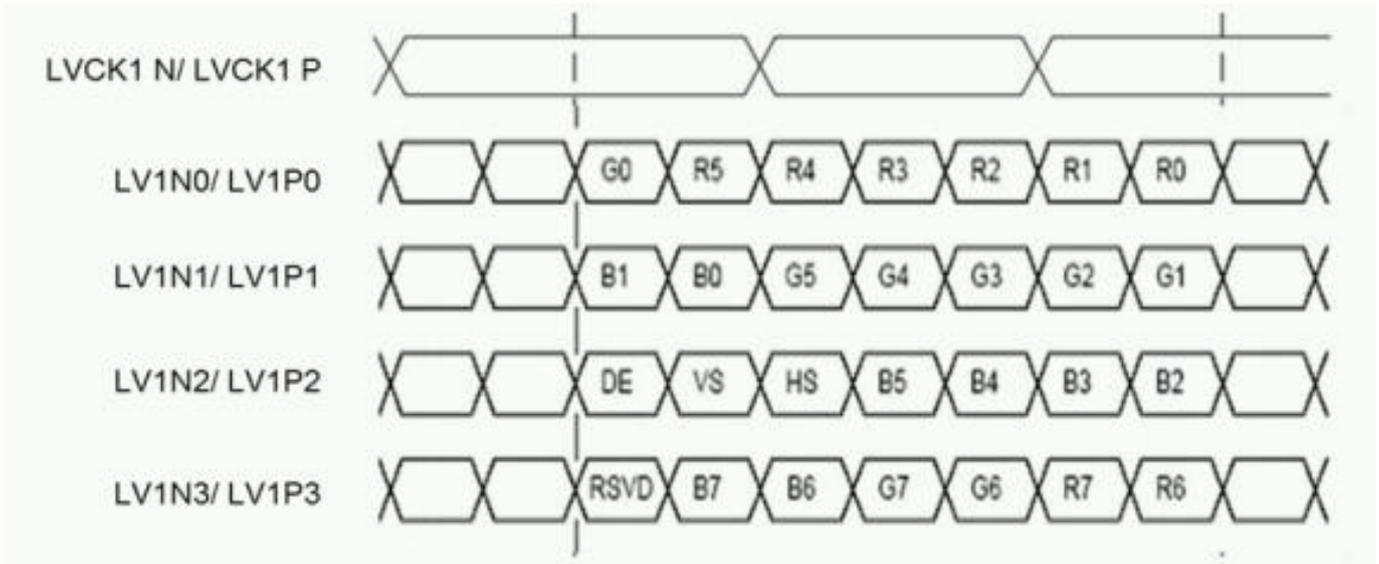


Fig 3.4 VESA format

4.0 INTERFACE CONNECTION.

4.1 Interface Pin Assignment

CN1: 3-10122314-0 (XDYT) or equivalent 1mm pitch 30 pin (1)

| PIN # | Symbol | DESCRIPTION | REMARK |
|-------|---------|-------------------------|--------|
| 1 | RXO0- | LVDS Odd Data (-) | |
| 2 | RXO0+ | LVDS Odd Data (+) | |
| 3 | RXO1- | LVDS Odd Data (-) | |
| 4 | RXO1+ | LVDS Odd Data (+) | |
| 5 | RXO2- | LVDS Odd Data (-) | |
| 6 | RXO2+ | LVDS Odd Data (+) | |
| 7 | GND | Power Ground | |
| 8 | RXOCLK- | LVDS Odd Clock (-) | |
| 9 | RXOCLK+ | LVDS Odd Clock (+) | |
| 10 | RXO3- | LVDS Odd Data (-) | |
| 11 | RXO3+ | LVDS Odd Data (+) | |
| 12 | RXE0- | LVDS Even Data (-) | |
| 13 | RXE0+ | LVDS Even Data (+) | |
| 14 | GND | Power Ground | |
| 15 | RXE1- | LVDS Even Data (-) | |
| 16 | RXE1+ | LVDS Even Data (+) | |
| 17 | GNG | Power Ground | |
| 18 | RXE2- | LVDS Even Data (-) | |
| 19 | RXE2+ | LVDS Even Data (+) | |
| 20 | RXECLK- | LVDS Even Clock (-) | |
| 21 | RXECLK+ | LVDS Even Clock (+) | |
| 22 | RXE3- | LVDS Even Data (-) | |
| 23 | RXE3+ | LVDS Even Data (+) | |
| 24 | NC | For HKC test only, WP | |
| 25 | NC | For HKC test only, SCL | |
| 26 | NC | For HKC test only, SDA | |
| 27 | NC | For HKC test only, Bist | |
| 28 | VDD | Power supply +5.0V | |
| 29 | VDD | Power supply +5.0V | |
| 30 | VDD | Power supply +5.0V | |

Note 1 : This pin should be connected with GND.

Note:

(1) Following finger shows the LVDS pin1 diagram.

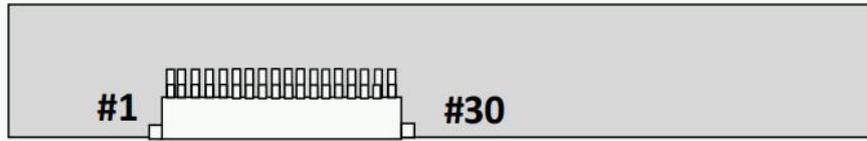
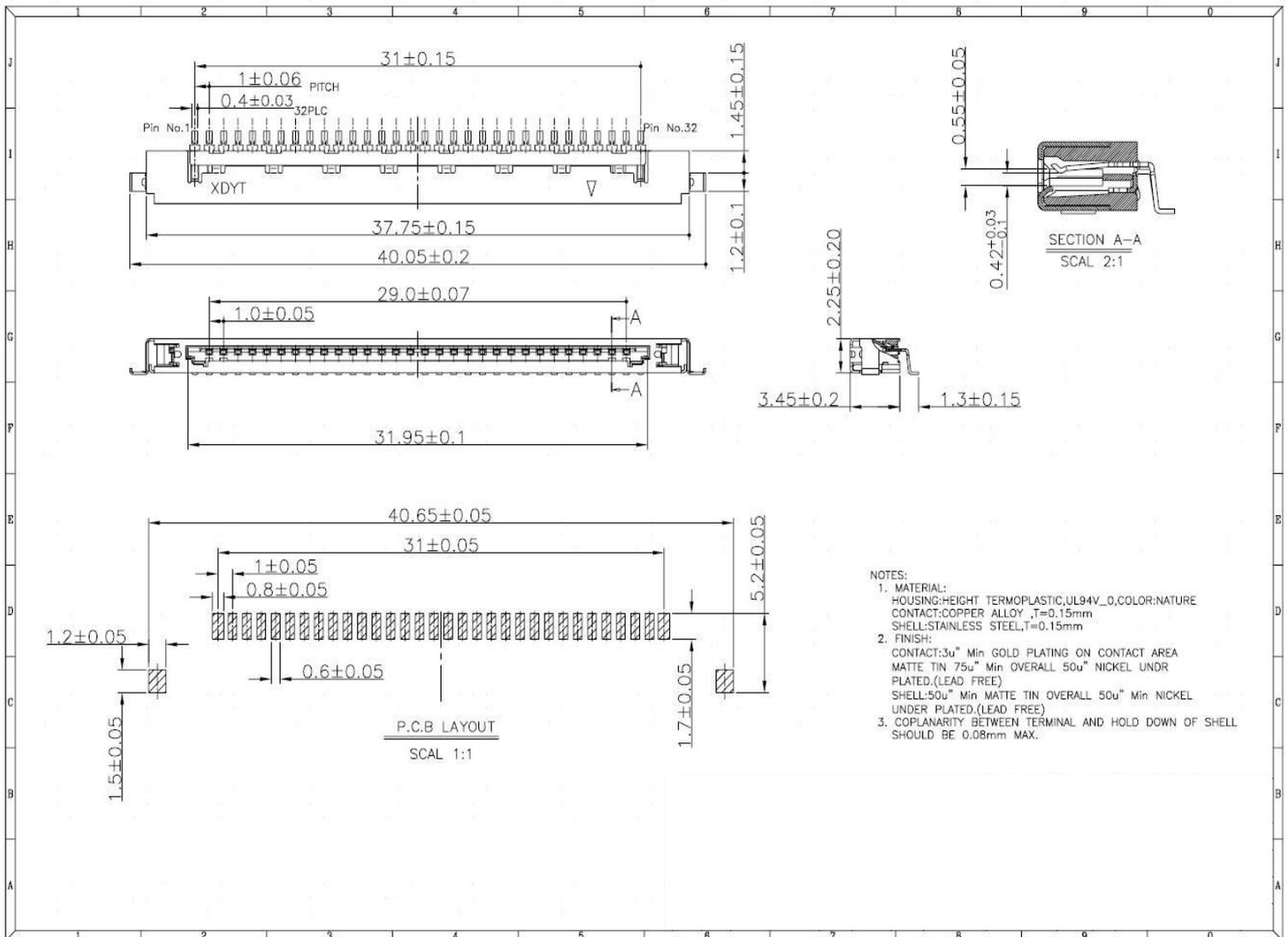


Fig. 3.5 LVDS connector direction sketch map

(2) For HKC used only, please leave it open.

Connector Drawing



4.2 Timing Spec.

The input signal timing specifications are shown as the following table and timing diagram.

| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|--------------------|--------------------------------------|-----------------------|---------------|-------|---------------|------------------------|-------------------------|
| LVDS Clock | Frequency | F_{clk} | 50 | 74.25 | 90 | MHz | (1) |
| | Input cycle to cycle jitter | $Trcl$ | — | — | 200 | ps | (2) |
| | Spread spectrum modulation range | F_{clk_mod} | $F_{clk}-2\%$ | — | $F_{clk}+2\%$ | MHz | (3) |
| | Spread spectrum modulation frequency | FSSM | — | — | 200 | KHz | |
| LVDS Receiver Data | Receiver Skew Margin | TRSM | -400 | - | 400 | ps | (4) |
| Vertical Term | Frame Rate | F | 48 | 60 | 76 | Hz | |
| | Total | T_V | 1094 | 1125 | 1836 | T_H | $T_V = T_{VD} + T_{VB}$ |
| | Active Display | T_{VD} | 1080 | | | T_H | |
| | Blank | T_{VB} | 14 | 45 | 756 | T_H | |
| Horizontal Term | Total | T_H | 1050 | 1100 | 1678 | T_{CLK} | $T_H = T_{HD} + T_{HB}$ |
| | Active Display | T_{HD} | 960 | | | T_{CLK} | |
| | Blank | T_{HB} | 90 | 140 | 718 | T_{CLK} | |

Note:

(1) Please make sure the range of pixel clock follows the following equations:

$$F_{clk(max)} \geq F_{max} \times T_V \times T_H$$

$$F_{min} \times T_V \times T_H \geq F_{clk(min)}$$

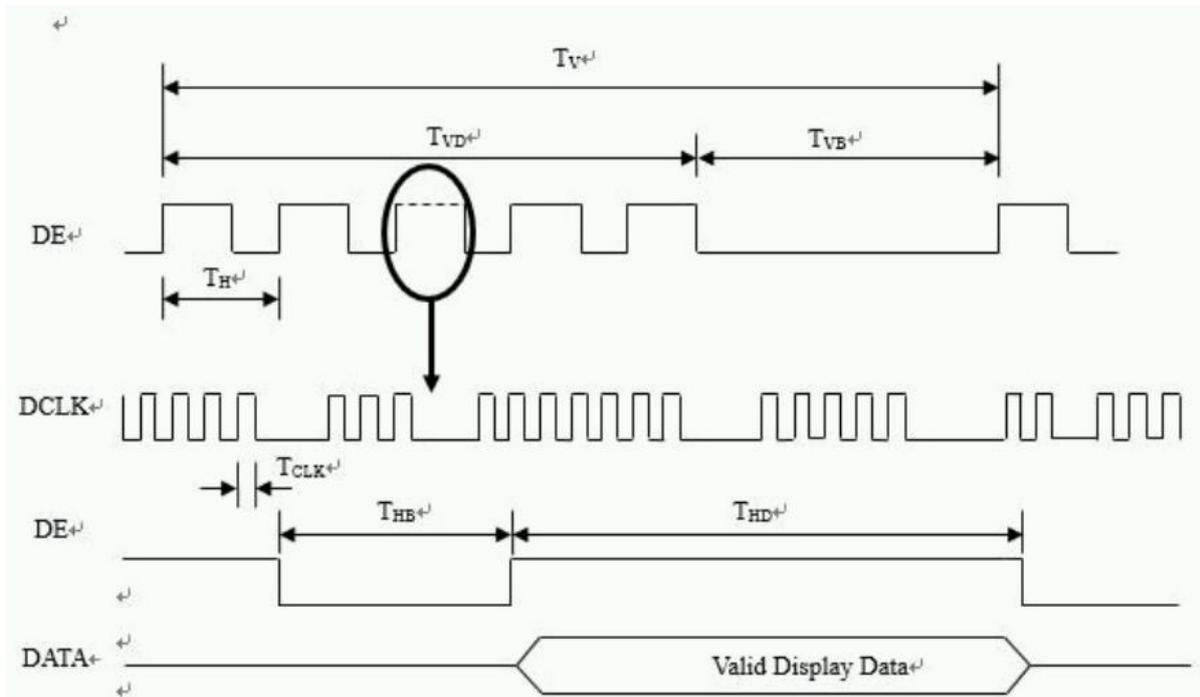


Fig 4.2 Signal timing diagram

(2)The input clock cycle-to-cycle is defined as below figures.

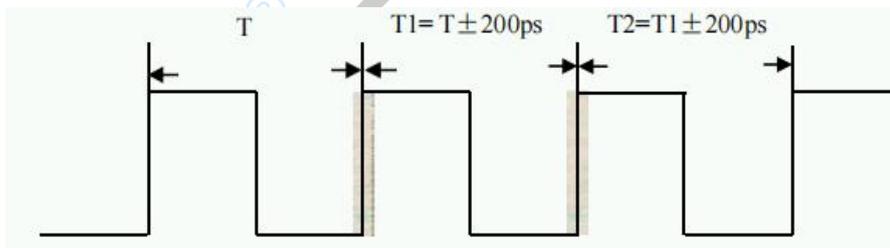


Fig 4.3 Jitter

(3) The SSCG (Spread Spectrum Clock Generator) is defined as the following figure. The LVDS SSM's suggestion is off by default, SOC board must test all validation if SOC board open the LVDS SSM.

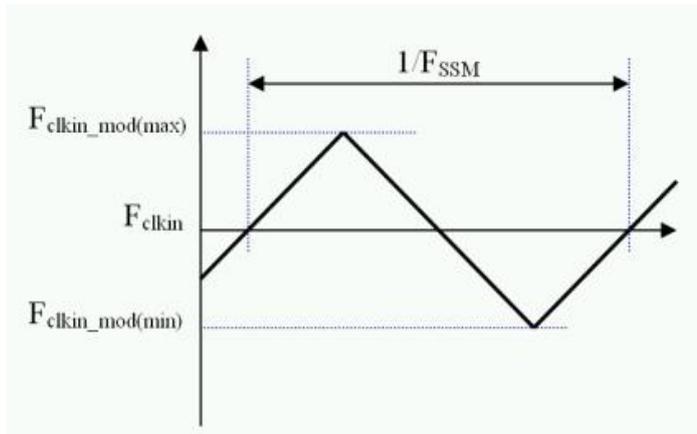


Fig 4.4

(4) The LVDS timing diagram and setup/hold time is defined and showed as the following figure.

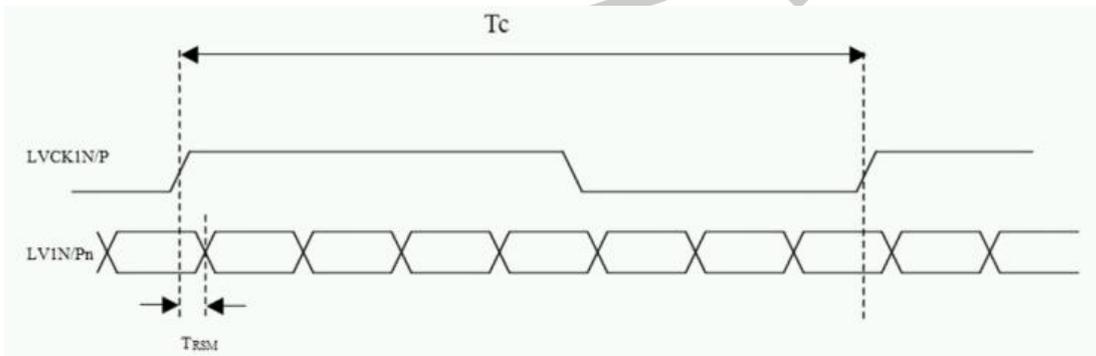


Fig 4.5 LVDS receive interface timing diagram

4.3 Backlight Electrical / Optical Characteristics

4.4.1 backlight connector

CN2 : PH 2.0 2P

| Pin# | Signal Name |
|------|-------------|
| 1 | VDD+ (Red) |
| 2 | VDD-(Black) |

4.4.2 LED Bar

| Parameter | Symbols | Min | Typ | Max | Unit |
|-------------------------------|---------|--------|-------|--------|------|
| Forward Voltage (one circuit) | VF | 2.8 | - | 3.2 | MHz |
| Reverse Current (one circuit) | IR | - | - | 10 | μA |
| Forward Current | IF | - | 90 | 120 | Ma |
| Chromaticity Coordinates | X | 0.268 | 0.279 | 0.285 | |
| | Y | 0.252 | 0.267 | 0.273 | |
| Lumen | ϕ | 20 | 22 | 24 | LM |
| Viewing Angle | 2θ1/2 | - | 120 | - | Deg. |
| Number Of LED | Pcs | - | 72 | - | Pcs |
| Operation Voltage(LB) | VLB | 50.4 | - | 57.6 | V |
| Operation Current(LB) | ILB | - | 240 | - | mA |
| Power Consumption | PLB | 12.096 | - | 13.824 | W |

5.0 POWER SEQUENCE

The power sequence specifications are shown as the following table and diagram

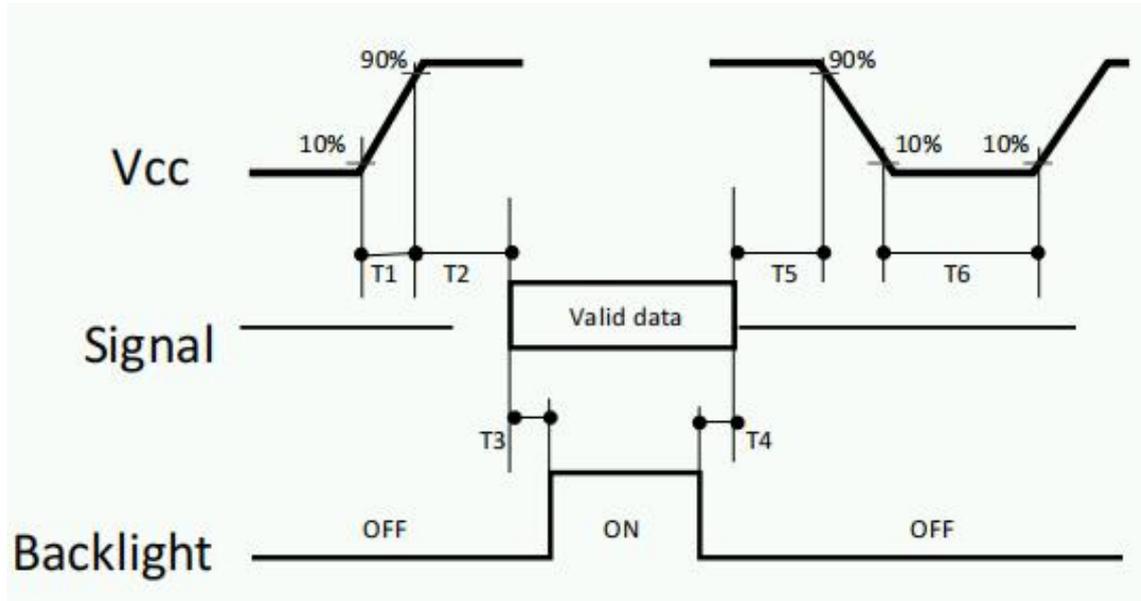


Fig5.0 Power on/off signal sequence

| Parameter | Values | | | Unit |
|-----------|--------|------|------|------|
| | Min. | Typ. | Max. | |
| T1 | 0.5 | - | 10 | ms |
| T2 | 0 | - | 50 | ms |
| T3 | 500 | - | - | ms |
| T4 | 100 | - | - | ms |
| T5 | 0 | - | 50 | ms |
| T6 | 1000 | - | - | ms |

Attention:

- (1) The supply voltage of the external system for the module input should be the same as the definition.
- (2) To avoid some abnormal display noise, we suggest "VCC" falling time to follow "T6" definition.
- (3) The product should be always operated within above ranges.
- (4) In case of VCC is off level, please keep the level of input signals on the low or keep high impedance.

5.2 Flicker Adjustment

Flicker must be optimized after module assembly and aging. Its patterns are as follow:
sub pixel checker under 50% gray level.

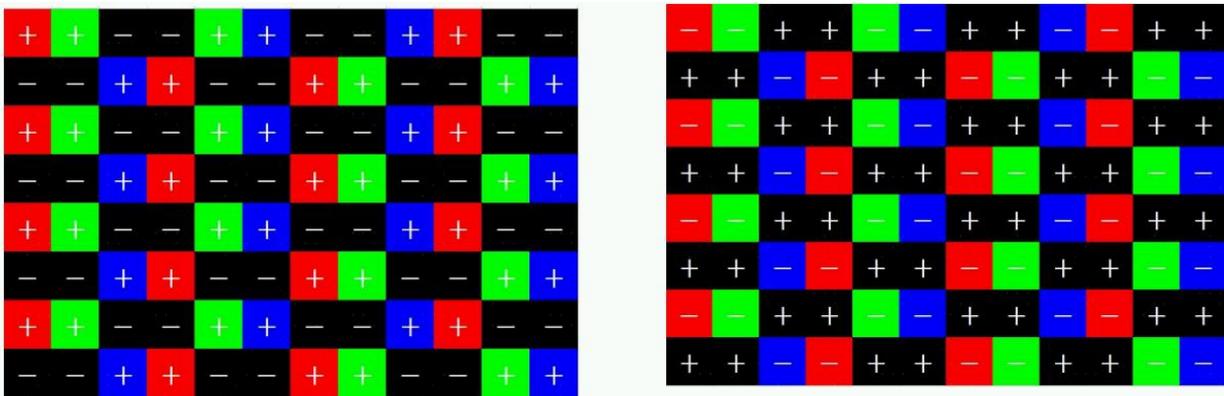


Fig5.2 Flicker pattern

5.3 Driver IC ESD Spec

If the LCD module is designed with the Plastic Bezel, we suggest ESD protection solutions should be applied to avoid IC damaged, as shown in Fig.3.12

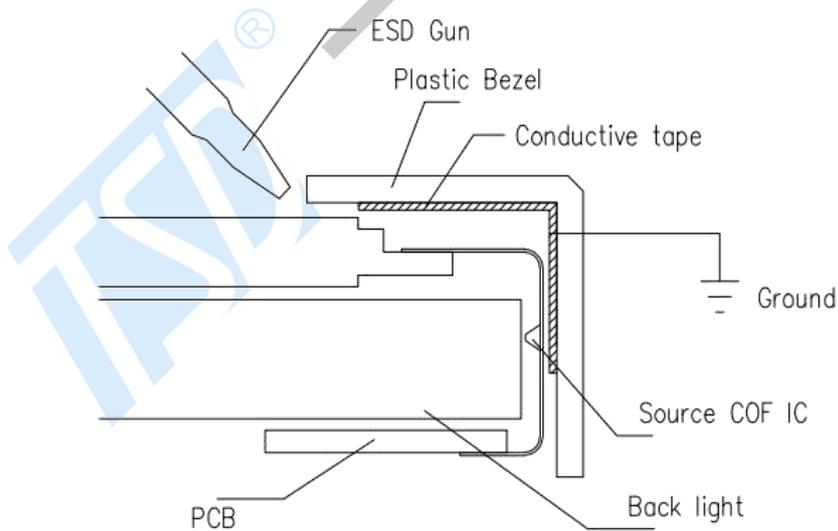


Fig5.3 Source COF IC ESD protection

6. Optical Specification

6.1 Test Condition

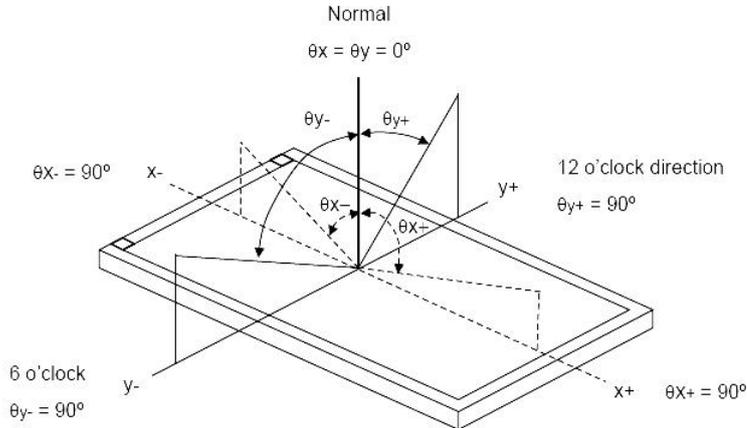
| Item | Symbol | Value | Unit |
|---------------------|---|---------|------|
| Ambient Temperature | Ta | 25 ± 2 | °C |
| Ambient Humidity | Ha | 50 ± 10 | %RH |
| Supply Voltage | Vcc | 5.0 | V |
| Input Signal | According to typical value in "3.Electrical characteristics | | |
| LED Input Voltage | V _{LED} | 51.5 | V |
| LED Input Current | I _{LED} | 240.0 | mA |
| Power Consumption | Pw | 12.4 | W |

6.2 Optical Characteristics

The relative measurement methods of optical characteristics are shown as below.
The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (5).

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Note | |
|---------------------------|----------------|--|----------------|---------------|-------|-------------------|--------|--------|
| Contrast Ratio | CR | θ _x =0,θ _y =0, viewing normal angle | 2000 | 3000 | — | — | — | |
| Response Time | Tr+Tf | | — | 7 | — | ms | Note 3 | |
| Brightness uniformity | BU | | 70 | 75 | — | — | Note 2 | |
| Center Luminance of White | Lc | | 330 | 350 | — | cd/m ² | — | |
| The color chromaticity | Red | | R _x | Typ. -0.03 | 0.638 | Typ. +0.03 | — | — |
| | | | R _y | | 0.331 | | — | — |
| | Green | | G _x | | 0.314 | | — | — |
| | | G _y | 0.617 | | — | | — | |
| | Blue | B _x | 0.156 | | — | | — | |
| | | B _y | 0.143 | | — | | — | |
| White | W _x | 0.295 | — | — | | | | |
| | W _y | 0.335 | — | — | | | | |
| Color Gamut | CG | | 68% | 72% | — | — | Note 2 | |
| Viewing Angle | Horizontal | θ _x + | CR ≥ 10 | 75 | 89 | — | Deg | Note 1 |
| | | θ _x - | | 75 | 89 | — | | |
| | Vertical | θ _y + | | 70 | 89 | — | | |
| | | θ _y - | | 70 | 89 | — | | |

Note 1: The definition of viewing angle



Note 2: Definition of luminance, CR measured positions and brightness uniformity

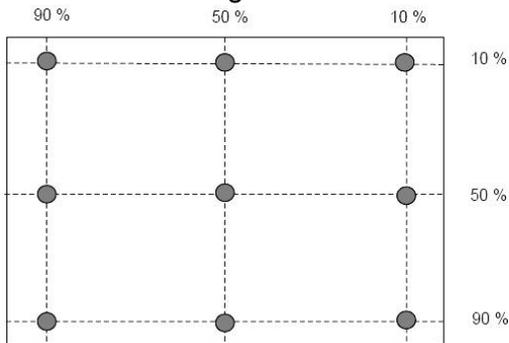
(a) Measure White luminance on the below 9 points and take the average value.

(b) CR : measures the same 9 points and take the average value. The Definition of Contrast Ratio is as follows :

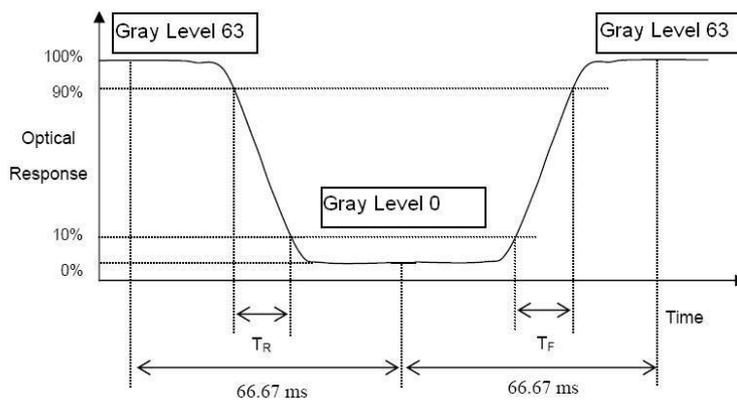
$$CR = \frac{ON(\text{white L254})\text{Luminance}}{OFF(\text{Black L0})\text{Luminance}}$$

(c) The definition of White Vibration

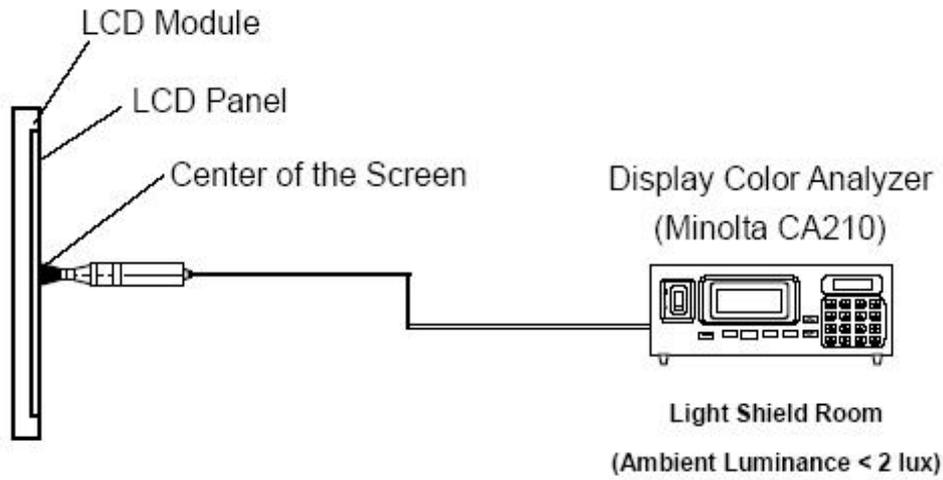
$$\frac{\text{The minimum brightness of 9 dot}}{\text{The maximum brightness of 9 dot}} \times 100\%$$



Note 3: Definition of Response Time (TR, TF):



Note 4: The measure method



- (a): The measurement point is the center of the active area except for the measurement of Luminance Uniformity
- (b): Photometer :CA-210

7. PRECAUTION

7.1 ASSEMBLY AND HANDLING PRECAUTIONS

- 1 Do not apply rough force such as bending or twisting to the module during assembly.
- 2 To assemble or install module into user's system can be in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- 3 It's not permitted to have pressure or impulse on the module because the LED panel and Backlight will be damaged.
- 4 Always follow the correct power sequence when LED module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
- 5 Do not pull the I/F connector in or out while the module is operating .
- 6 Do not disassemble the module.
Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very
- 7 soft and easily scratched.
- 8 It is dangerous that moisture come into or contacted the LED module, because moisture may damage LED module when it is operating.
- 9 High temperature or humidity may reduce the performance of module. Please store LED module within the specified stored conditions.
- 10 When ambient temperature is lower than 10 °C may reduce the display quality. For example, the response time will become slowly.

7.2 SAFETY PRECAUTIONS

- 1 It is dangerous that moisture come into or contacted the LED module, because the moisture may damage LED module when it is operating.
- 2 If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth, in case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- 3 After the module's end of life, it is not harmful in case of normal operation and storage.

Outline dimension

