

## Product Specification

|                    |                                                       |
|--------------------|-------------------------------------------------------|
| <b>Model Name</b>  | S058HWV04HS                                           |
| <b>Description</b> | Standard LCD Module<br>5.8" WVGA<br>800(RGB)x320 Dots |
| <b>Date</b>        | 2019/3/27                                             |
| <b>Version</b>     | 1.0                                                   |

|                             |                          |                             |
|-----------------------------|--------------------------|-----------------------------|
| <b>Approved<br/>by/Date</b> | <b>Check<br/>by/Date</b> | <b>Prepared<br/>by/Date</b> |
| ZHP 2019/3/27               | HZX 2019/3/27            | Yigui.Han 2019/3/27         |

| Customer Approval |  |
|-------------------|--|
|                   |  |
| <b>Date</b>       |  |

## Table of Contents

|                                                     |           |
|-----------------------------------------------------|-----------|
| <b>1. Record of Revision .....</b>                  | <b>3</b>  |
| <b>2. General Specifications .....</b>              | <b>4</b>  |
| <b>3. Input/OutputTerminals .....</b>               | <b>5</b>  |
| <b>4. Absolute Maximum Rating .....</b>             | <b>8</b>  |
| <b>5. Electrical Characteristics.....</b>           | <b>8</b>  |
| <b>6. Interface Timing.....</b>                     | <b>12</b> |
| <b>7. Optical Characteristics .....</b>             | <b>16</b> |
| <b>8. Environmental / Reliability Tests .....</b>   | <b>20</b> |
| <b>9. Mechanical Drawing .....</b>                  | <b>21</b> |
| <b>10. Packing .....</b>                            | <b>22</b> |
| <b>11. Precautions for Use of LCD modules .....</b> | <b>23</b> |

## 1. Record of Revision

| Rev | Issued Date | Description    | Editor    |
|-----|-------------|----------------|-----------|
| 1.0 | 2019/3/27   | First Release. | Yigui.Han |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |
|     |             |                |           |

## 2. General Specifications

|                 | Feature                  | Spec                          |
|-----------------|--------------------------|-------------------------------|
| Characteristics | Size                     | 5.8 inch                      |
|                 | Resolution               | 800(horizontal)*320(Vertical) |
|                 | Interface                | RGB-24bit                     |
|                 | Connect type             | Connector                     |
|                 | Display Colors           | 16.2M                         |
|                 | Technology type          | a-Si                          |
|                 | Pixel pitch (mm)         | 0.1719 x 0.1607               |
|                 | Pixel Configuration      | R.G.B.-Stripe                 |
|                 | Display Mode             | Normally White                |
|                 | Viewing Direction        | 12 O'clock                    |
|                 | Gray Inversion Direction | 6 O'clock                     |
| Mechanical      | LCM (W x H x D) (mm)     | 154.40*63.34*3.5              |
|                 | Active Area(mm)          | 137.52 x51.44                 |
|                 | With /Without TSP        | Without TSP                   |
|                 | Weight (g)               | TBD                           |
|                 | LED Numbers              | 24 LEDs                       |

Note 1: Requirements on Environmental Protection: RoHs

Note 2: LCM weight tolerance: +/- 5%

## 3. Input/Output Terminals

### LCD PIN-MAP

| No.   | Symbol | Description                                                                                                                                                              |
|-------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | AGND   | System Ground                                                                                                                                                            |
| 2     | AVDD   | Analog power                                                                                                                                                             |
| 3     | VCC    | Power supply for logic operation                                                                                                                                         |
| 4~11  | R0~R7  | Data bus                                                                                                                                                                 |
| 12~19 | G0~G7  | Data bus                                                                                                                                                                 |
| 20~27 | B0~B7  | Data bus                                                                                                                                                                 |
| 28    | DOTCLK | Pixel clock signal                                                                                                                                                       |
| 29    | DE     | Data Enable                                                                                                                                                              |
| 30    | HSD    | Horizontal Sync signal                                                                                                                                                   |
| 31    | VSD    | Vertical Sync signal                                                                                                                                                     |
| 32    | MODE3  | DE/SYNC mode select. Normally pull high<br>H: DE mode. L: HSD/VSD mode                                                                                                   |
| 33    | RSTB   | Global reset pin. Active low to enter reset state.<br>Suggest to connecting with an RC reset circuit for stability.<br>Normally pull high. (R=47K $\Omega$ , C=1 $\mu$ ) |
| 34    | STBYB  | Standby mode, normally pull high<br>STBYB="1", normal operation<br>STBYB="0", timing control, source driver will turn off, all output are high-Z                         |
| 35    | SHLR   | Left or Right Display Control                                                                                                                                            |
| 36    | VCC    | Digital Power                                                                                                                                                            |
| 37    | UPDN   | Up / Down Display Control                                                                                                                                                |
| 38    | GND    | Digital Ground                                                                                                                                                           |
| 39    | AGND   | Analog Ground                                                                                                                                                            |
| 40    | AVDD   | Analog Power                                                                                                                                                             |
| 41    | VCOM   | Common Voltage                                                                                                                                                           |
| 42    | DITH   | Dithering setting<br>DITH="H" 6bit resolution(last 2 bit of input data truncated) (default setting)<br>DITH="L" 8bit resolution                                          |

|       |     |                                    |
|-------|-----|------------------------------------|
| 43,44 | NC  | Not connect                        |
| 45    | V10 | Gamma correction voltage reference |
| 46    | V9  | Gamma correction voltage reference |
| 47    | V8  | Gamma correction voltage reference |
| 48    | V7  | Gamma correction voltage reference |
| 49    | V6  | Gamma correction voltage reference |
| 50    | V5  | Gamma correction voltage reference |
| 51    | V4  | Gamma correction voltage reference |
| 52    | V3  | Gamma correction voltage reference |
| 53    | V2  | Gamma correction voltage reference |
| 54    | V1  | Gamma correction voltage reference |
| 55    | NC  | Not connect                        |
| 56    | VGH | Positive Power for TFT             |
| 57    | VCC | Digital Power                      |
| 58    | VGL | Negative Power for TFT             |
| 59    | GND | Digital Ground                     |
| 60    | NC  | Not connect                        |

## BL PIN-MAP

| No. | Symbol | Description            |
|-----|--------|------------------------|
| 1   | LEDA   | Backlight LED Anode    |
| 2   | LEDK   | Backlight LED Cathoder |

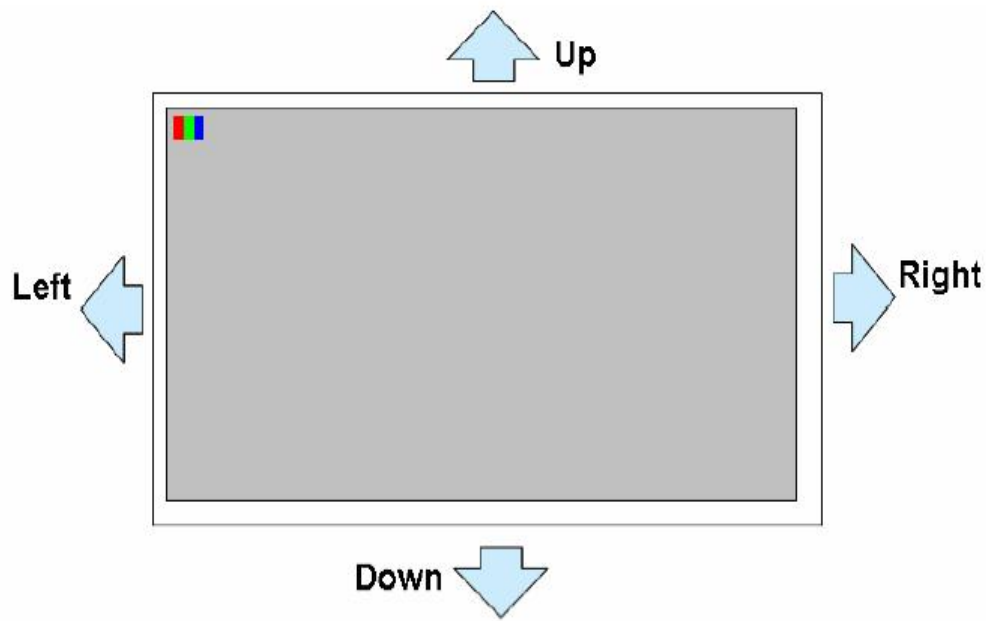
【Note1】 Mating connector: HIROSE, FH28-60S-0.5SH, 60pin,pitch = 0.5mm

【Note2】 SHLR: left or right setting

UPDN: up or down setting

| SHLR | UPDN | Data shifting                 |
|------|------|-------------------------------|
| DVDD | GND  | Left→Right , Up→Down(default) |
| GND  | GND  | Right→Left , Up→Down          |
| DVDD | DVDD | Left→Right , Down→Up          |
| GND  | DVDD | Right→Left , Down→Up          |

Definition of scanning direction.



## 4. Absolute Maximum Rating

| Item                  | Symbol    | MIN  | MAX | Unit | Remark |
|-----------------------|-----------|------|-----|------|--------|
| Supply Voltage        | $V_{DD}$  | -0.5 | 5.0 | V    |        |
| Operating Temperature | $T_{OPR}$ | -20  | 70  | °C   |        |
| Storage Temperature   | $T_{STG}$ | -30  | 80  | °C   |        |

## 5. Electrical Characteristics

### 5.1 TFT LCD Module

| Item                    | Symbol | Min.    | Typ.   | Max.      | Unit | Note              |
|-------------------------|--------|---------|--------|-----------|------|-------------------|
| Supply Voltage          | Vcc    | 3.0     | 3.3    | 3.6       | V    |                   |
|                         | VGH    | 12      | 15     | 23        | V    |                   |
|                         | VGL    | -12     | -7     | -5        | V    |                   |
|                         | AVDD   | 9.9     | 10     | 10.1      | V    |                   |
| VCOM                    | VCOMin | -       | 3.4    | -         | V    |                   |
| Input signal voltage    | ViH    | 0.7 Vcc | -      | Vcc       | V    | Note (1)          |
|                         | ViL    | 0       | -      | 0.3 Vcc   | V    |                   |
| Current of power supply | IDD    | -       | 12.37  | -         | mA   | Vcc =3.3V         |
|                         | IADD   | -       | 13.599 | -         | mA   | AVDD=10 V (Black) |
|                         | IGH    | -       | 0.099  | -         | mA   | VGH=15V           |
|                         | IGL    | -       | 0.371  | -         | mA   | VGL= -7V          |
| Input level of V1~V5    | Vx     | AVDD/2- |        | AVDD-0.1- | V    |                   |
| Input level of V6~V10   | Vx     | 0.1-    |        | AVDD/2-   | V    |                   |

Note (1): HSYNC, VSYNC, DE, Digital Data

Note (2): Be sure to apply the power voltage as the power sequence spec.

Note (3): DGND=AGND=0V,)

## 5.2 AC Characteristics

| Item                    | Symbol | Min. | Typ. | Max. | Unit | Note |
|-------------------------|--------|------|------|------|------|------|
| DCLK cycle time         | Tcph   | 25   |      |      | ns   |      |
| DCLK frequency          | fclk   |      | 30   | 40   | MHz  |      |
| DCLK pulse duty         | Tcwh   | 40   | 50   | 60   | %    |      |
| VSD setup time          | Tvst   | 8    |      |      | ns   |      |
| VSD hold time           | Tvhd   | 8    |      |      | ns   |      |
| HSD setup time          | Thst   | 8    |      |      | ns   |      |
| HSD hold time           | Thhd   | 8    |      |      | ns   |      |
| Data setup time         | Tdsu   | 8    |      |      | ns   |      |
| Data hold time          | Tdhd   | 8    |      |      | ns   |      |
| DE setup time           | Tesu   | 8    |      |      | ns   |      |
| DE hold time            | Tehd   | 8    |      |      | ns   |      |
| Horizontal display area | thd    |      | 800  |      | Tcph |      |
| HSD period time         | th     |      | 928  |      | Tcph |      |
| HSD pulse width         | thpw   | 1    | 48   |      | Tcph |      |
| HSD back porch          | thb    |      | 88   |      | Tcph |      |
| HSD front porch         | thfp   |      | 40   |      | Tcph |      |
| Vertical display area   | tvd    |      | 480  |      | th   |      |
| VSD period time         | tv     |      | 525  |      | th   |      |
| VSD pulse width         | tvpw   |      | 3    |      | th   |      |
| VSD back porch          | tvb    |      | 32   |      | th   |      |
| VSD front porch         | tvfp   |      | 13   |      | th   |      |

## 5.3 LED Driving Conditions

| Item                        | Symbol   | MIN | TYP   | MAX  | Unit | Remark |
|-----------------------------|----------|-----|-------|------|------|--------|
| Forward Current             | $I_F$    | -   | 160   | -    | mA   |        |
| Forward Voltage             | $V_F$    | 8.6 | 9.6   | 10.6 | V    |        |
| Backlight Power consumption | $W_{BL}$ | -   | 1.536 | -    | W    |        |
| LED Lifetime                |          | -   | 30000 | -    | Hrs  |        |

Note 1: Each LED:  $I_F = 20 \text{ mA}$ ,  $V_F = 3.2 \pm 0.2 \text{ V}$ .

Note 2: Optical performance should be evaluated at  $T_a = 25^\circ \text{C}$  only.

Note 3: If LED is driven by high current, high ambient temperature & humidity condition. The life Time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

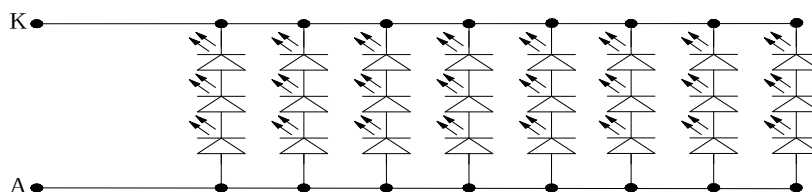
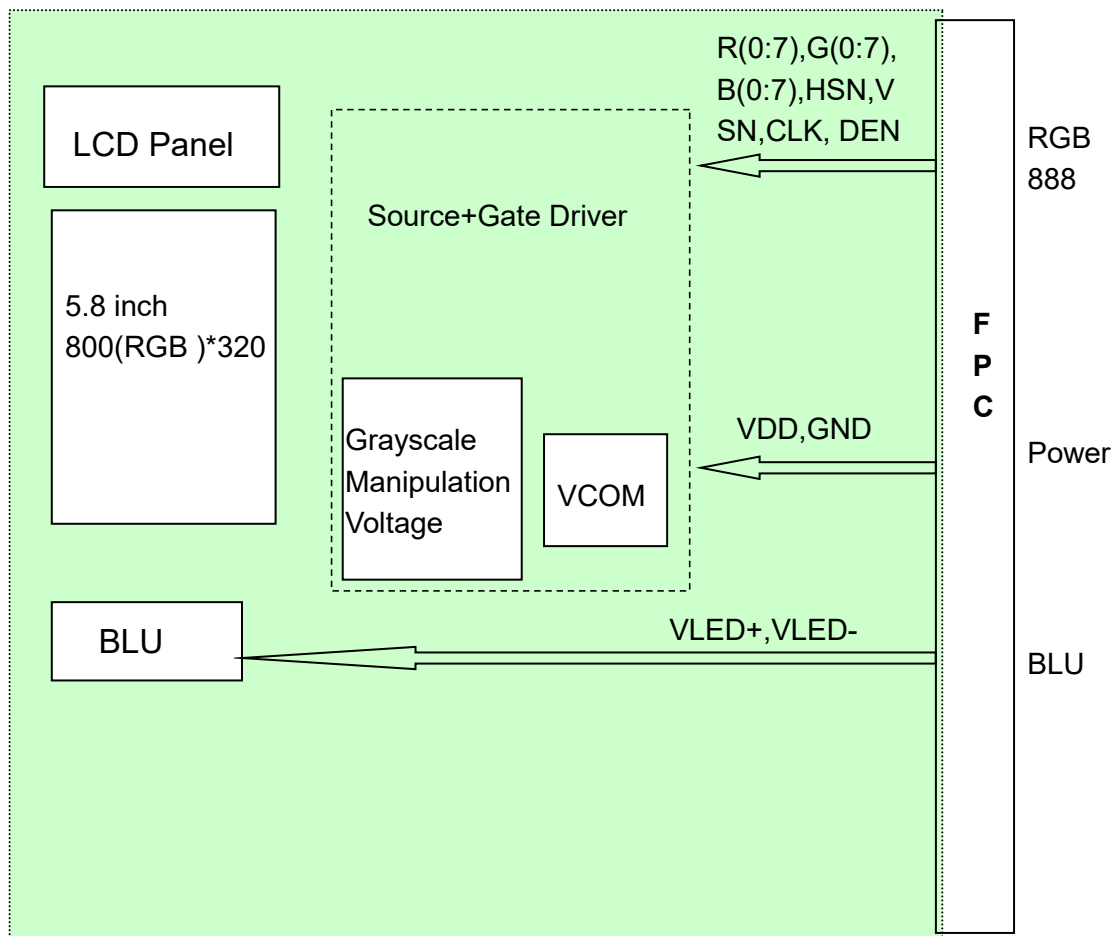


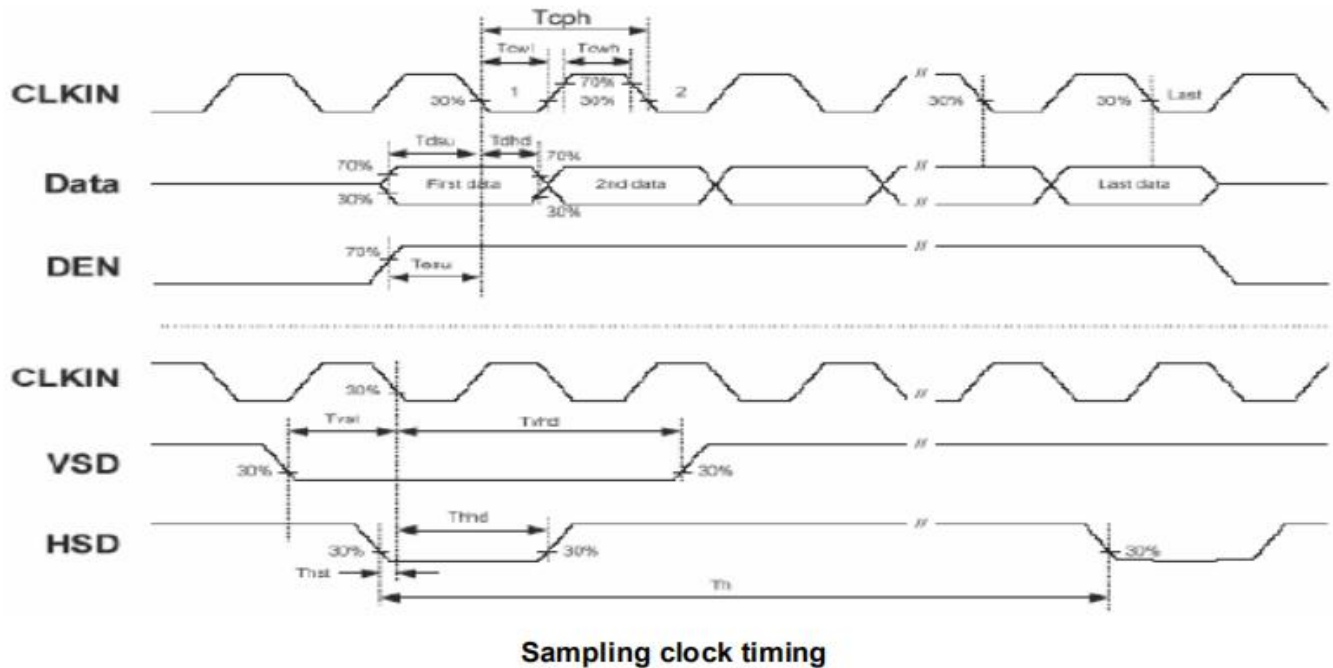
Figure: LED connection of backlight(Constant Current)

## 5.4 Block Diagram

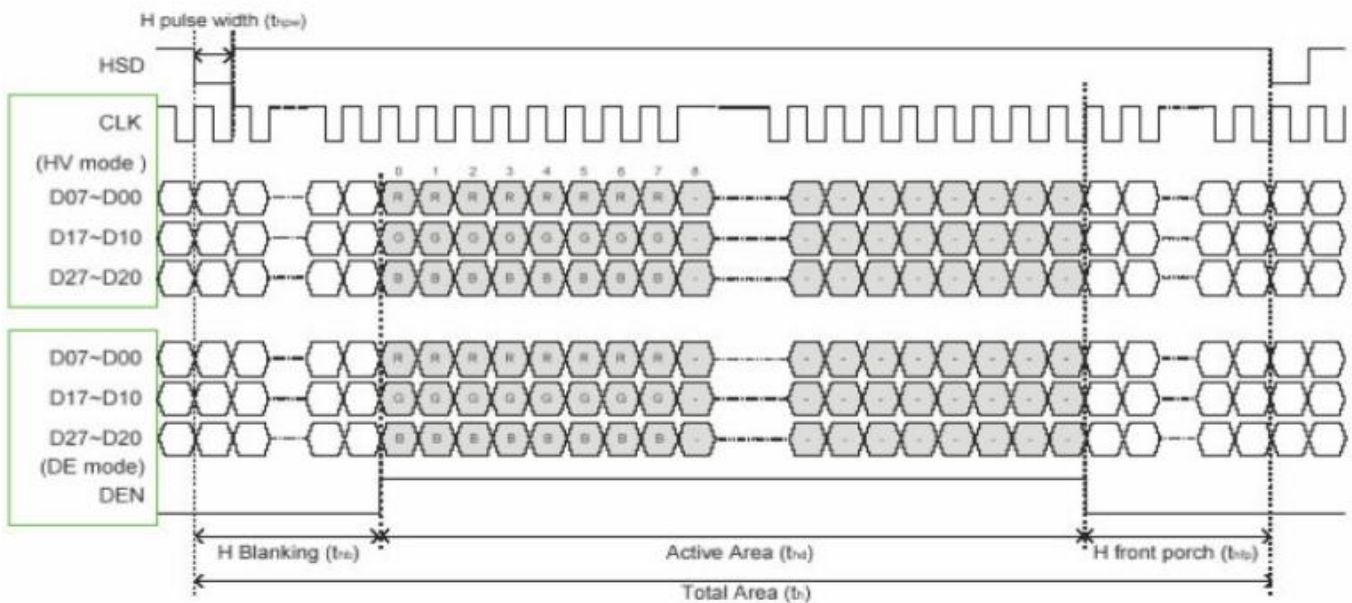


## 6. Interface Timing

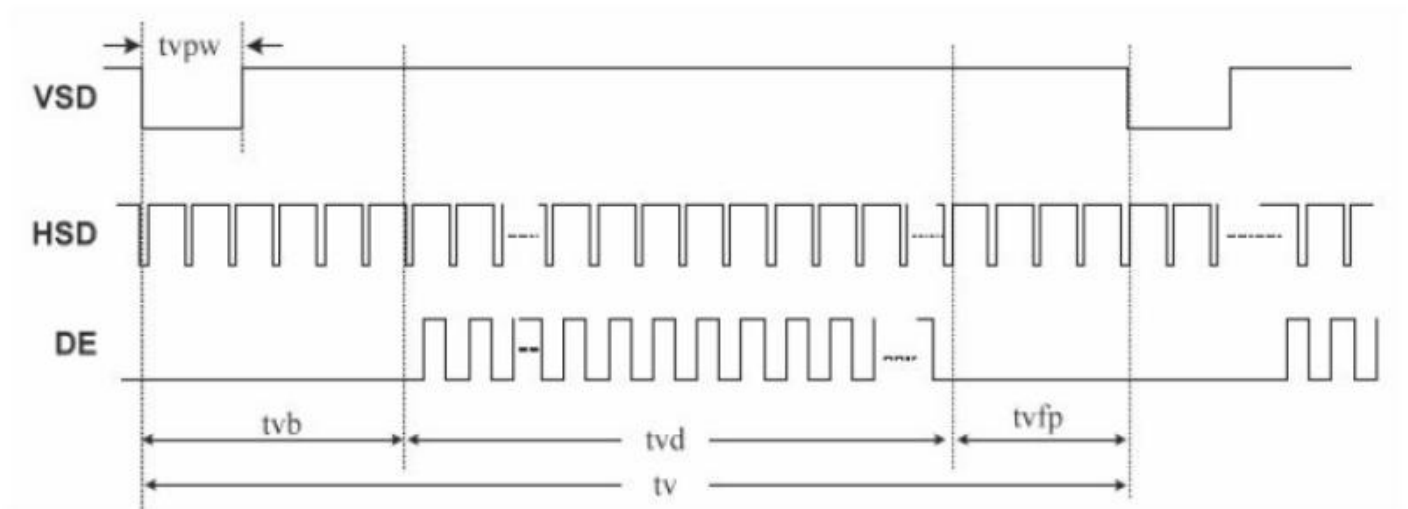
### 6.1 Timing Diagram of Interface Signal



#### Horizontal input timing

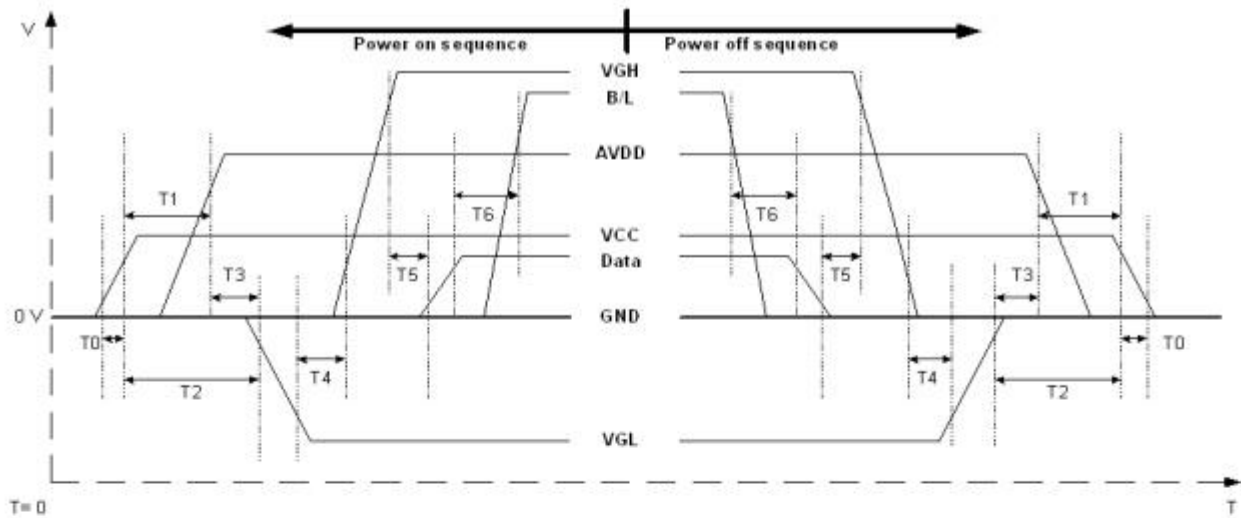


## Vertical Input timing

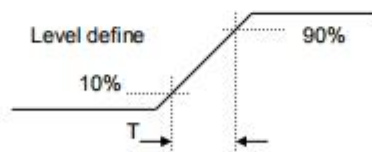


## Vertical timing

## 6.2 Power Sequence



| Item | Min. | Typ. | Max. | Unit |
|------|------|------|------|------|
| T0   | 0.5  | --   | 20   | msec |
| T1   | 16   |      |      | msec |
| T2   | 20   |      |      | msec |
| T3   | 0    |      |      | msec |
| T4   | 20   |      | --   | msec |
| T5   | 20   |      |      | msec |
| T6   | 50   |      |      | msec |

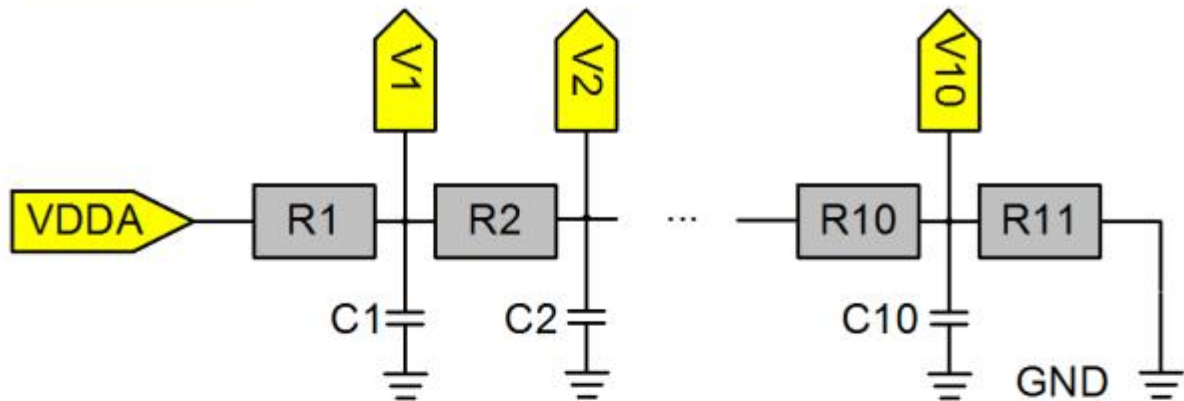


Power On Sequence: VCC-> AVDD -> VGL -> VGH -> Data -> B/L

Power Off Sequence: B/L-> Data -> VGH -> VGL -> AVDD -> VCC

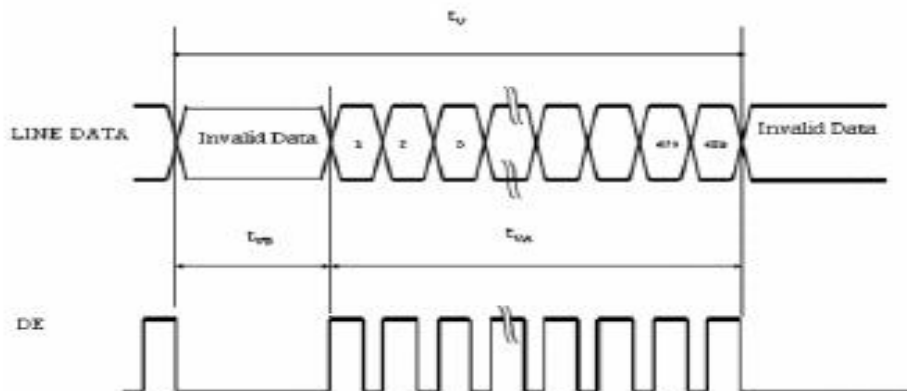
Notes: Data include R0~R7, G0~G7, B0~B7, HSD, VSD, DCLK, SHLR, UPDN, DE MODE, RSTB, STBYB, SHLR, UPDN, DITH

## 6.3 Gamma Circuit



| Gamma volt.(V) |        | Gamma Res.(Ω) |       | Gamma Cap.(μF) |       |
|----------------|--------|---------------|-------|----------------|-------|
| VDDA           | 10.000 | R1            | 71.5  | C1             | ≥ 4.7 |
| V1             | 9.389  | R2            | 221.0 | C2             | ≥ 4.7 |
| V2             | 7.499  | R3            | 40.2  | C3             | ≥ 4.7 |
| V3             | 7.155  | R4            | 34.0  | C4             | ≥ 4.7 |
| V4             | 6.865  | R5            | 150.0 | C5             | ≥ 4.7 |
| V5             | 5.582  | R6            | 54.9  | C6             | ≥ 4.7 |
| V6             | 5.113  | R7            | 205.0 | C7             | ≥ 4.7 |
| V7             | 3.360  | R8            | 48.7  | C8             | ≥ 4.7 |
| V8             | 2.944  | R9            | 56.2  | C9             | ≥ 4.7 |
| V9             | 2.463  | R10           | 237.0 | C10            | ≥ 4.7 |
| V10            | 0.437  | R11           | 51.1  |                |       |

Vertical timing :



## 7. Optical Characteristics

| Items                      |         | Symbol         | Condition                                        | Min. | Typ. | Max. | Unit              | Remark           | Note  |
|----------------------------|---------|----------------|--------------------------------------------------|------|------|------|-------------------|------------------|-------|
| Transmittance<br>(With PZ) |         | T              | -                                                | 3.77 | 4.1  | -    | ms                | FIG.1            | Note4 |
| Contrast Ratio             |         | CR             |                                                  | 480  | 600  | -    | -                 | FIG.2            | Note1 |
| Surface<br>luminance       |         | LV             | $\theta = 0^\circ$                               | 450  | 500  | -    | cd/m <sup>2</sup> | FIG.2            | Note2 |
| Response<br>Time           | Rising  | TR             | $\theta = 0^\circ$                               |      | 2    | 4    | msec              | FIG.2            | Note3 |
|                            | Falling | TF             |                                                  |      | 6    | 12   |                   |                  |       |
| NTSC                       |         | -              | $\theta = 0^\circ$                               | -    | 50   | -    | %                 | FIG.2            | Note5 |
| Viewing angle              |         | $\theta_T$     | Center<br>CR $\geq 10$                           | -    | 65   | -    | deg               | FIG.3            | Note6 |
|                            |         | $\theta_B$     |                                                  | -    | 55   | -    | deg               | FIG.3            |       |
|                            |         | $\theta_L$     |                                                  | -    | 65   | -    | deg               | FIG.3            |       |
|                            |         | $\theta_R$     |                                                  | -    | 65   | -    | deg               | FIG.3            |       |
| Chromaticity               | Red     | R <sub>X</sub> | $\theta = 0^\circ$<br>$\phi = 0^\circ$<br>Ta=25° | TBD  | TBD  | TBD  | -                 | FIG.2<br>CIE1931 | Note5 |
|                            |         | R <sub>Y</sub> |                                                  | TBD  | TBD  | TBD  | -                 |                  |       |
|                            | Green   | G <sub>X</sub> |                                                  | TBD  | TBD  | TBD  | -                 |                  |       |
|                            |         | G <sub>Y</sub> |                                                  | TBD  | TBD  | TBD  | -                 |                  |       |
|                            | Blue    | B <sub>X</sub> |                                                  | TBD  | TBD  | TBD  | -                 |                  |       |
|                            |         | B <sub>Y</sub> |                                                  | TBD  | TBD  | TBD  | -                 |                  |       |
|                            | White   | W <sub>X</sub> |                                                  | TBD  | TBD  | TBD  | -                 |                  |       |
|                            |         | W <sub>Y</sub> |                                                  | TBD  | TBD  | TBD  | -                 |                  |       |

**Note1. Definition of contrast ratio**

Contrast ratio(Cr) is defined mathematically by the following formula. For more information see FIG.2.

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

For contrast ratio, Surface Luminance, Luminance uniformity and CIE, the testing data is based on TOPCON's BM-5 or BM-7 photo detector or compatible.

**Note2. Definition of surface luminance.**

Surface luminance is the luminance with all pixels displaying white. For more information see FIG.2.

$L_v$  = Average Surface Luminance with all white pixels( $P_1, P_2, P_3, \dots, P_n$ )

**Note3. Definition of luminance uniformity**

The luminance uniformity in surface luminance is determined by measuring luminance at each test position 1 through n, and then dividing the maximum luminance of n points luminance by minimum luminance of n points luminance. For more information see FIG.2.

$$YU = \frac{\text{Minimum surface luminance with all white pixels } (P_1, P_2, P_3, \dots, P_n)}{\text{Maximum surface luminance with all white pixels } (P_1, P_2, P_3, \dots, P_n)}$$

**Note4. Definition of response time**

The response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time ( $T_r$ ) is the time between photo detector output intensity changed from 90% to 10%. And fall time ( $T_f$ ) is the time between photo detector output intensity changed from 10% to 90%.

For additional information see FIG1.

**Note5. Definition of color chromaticity (CIE1931)**

CIE (x,y) chromaticity, The x,y value is determined by screen active area center position P5. For more information see FIG.2.

**Note6. Definition of viewing angle**

Viewing angle is the angle at which the contrast ratio is greater than 10. Angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG.3.

For viewing angle and response time testing, the testing data is based on Autronic-Melchers' s ConoScope or DMS series Instruments or compatible.

FIG.1.The definition of response Time

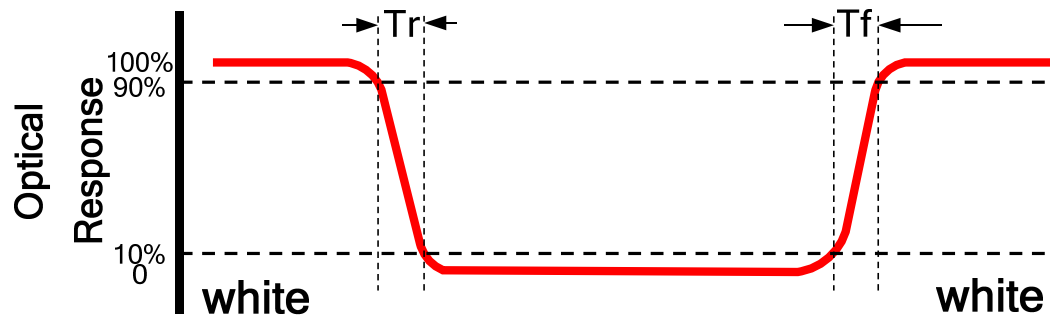


FIG.2. Measuring method for contrast ratio, surface luminance,

luminance uniformity, CIE (x,y) chromaticity

Size :  $S \leq 5"$  (see Figure a) A : 5 mm B : 5 mm

H,V : Active area

Light spot size  $\phi = 5\text{mm}$  (BM-5) or  $\phi = 7.7\text{mm}$  (BM-7) 50cm distance or compatible distance from the LCD surface to detector lens.

test spot position : see Figure a.

measurement instrument : TOPCON's luminance meter BM-5 or

BM-7 or compatible (see Figure c).

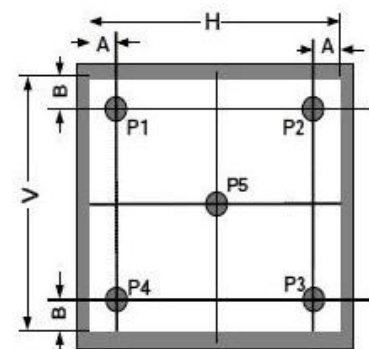


Figure a

Size :  $5" < S \leq 12.3"$  (see Figure b) H,V : Active area

Light spot size  $\phi = 5\text{mm}$  (BM-5) or  $\phi = 7.7\text{mm}$  (BM-7) 50cm distance or compatible distance from the LCD surface to detector lens.

test spot position : see Figure b.

measurement instrument : TOPCON's luminance meter BM-5 or

BM-7 or compatible (see Figure c).

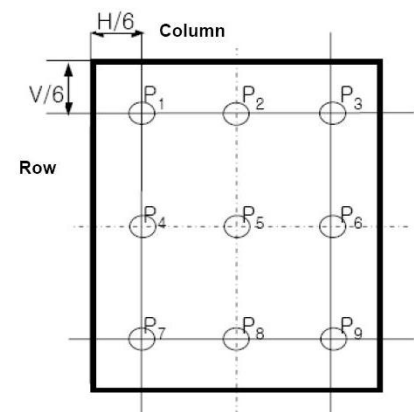


Figure b

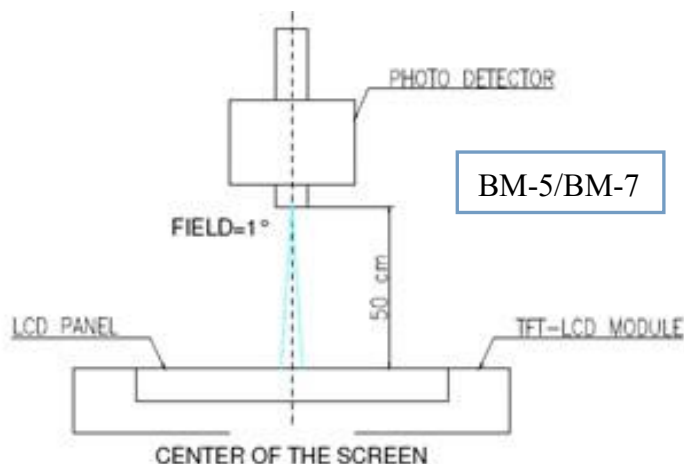
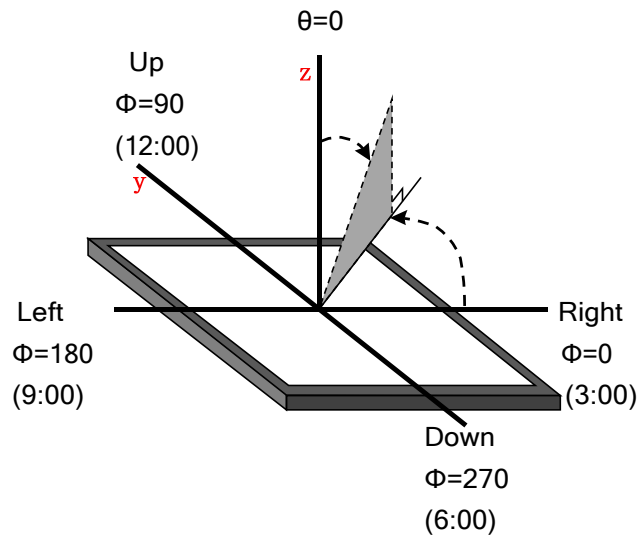


Figure c

FIG.3.The definition of viewing angle



## 8. Environmental / Reliability Tests

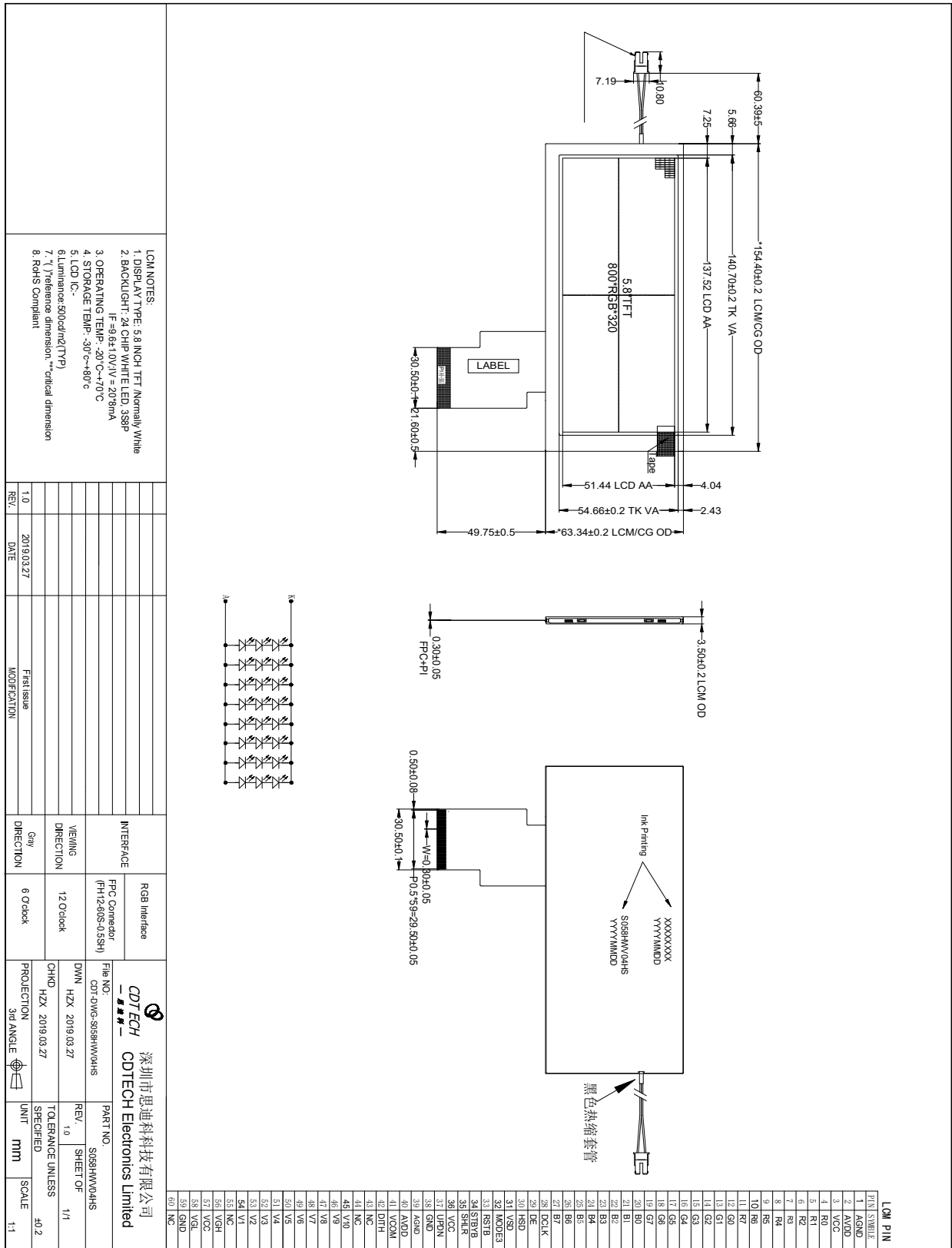
| No | Test Item                            | Condition                                                                                                                            | Remarks                                                                                  |
|----|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 1  | High Temperature Operation           | Ts= +70°C, 96hrs                                                                                                                     | Note 1<br>IEC60068-2-2,<br>GB2423. 2-89                                                  |
| 2  | Low Temperature Operation            | Ta= -20°C, 96hrs                                                                                                                     | Note 2 IEC60068-2-1<br>GB2423.1-89                                                       |
| 3  | High Temperature Storage             | Ta= +80°C, 120hrs                                                                                                                    | IEC60068-2-2<br>GB2423. 2-89                                                             |
| 4  | Low Temperature Storage              | Ta= -30°C, 120hrs                                                                                                                    | IEC60068-2-1<br>GB/T2423.1-89                                                            |
| 5  | High Temperature & Humidity Storage  | Ta= +60°C, 90% RH max,120 hours                                                                                                      | IEC60068-2-3<br>GB/T2423.3-2006                                                          |
| 6  | Thermal Shock (Non-operation)        | -20°C 30 min ~ +60°C 30 min<br>Change time: 5min, 30 Cycle                                                                           | Start with cold temperature, end with high temperature<br>IEC60068-2-14,<br>GB2423.22-87 |
| 7  | Electro Discharge (Operation) Static | C=150pF, R=330 Ω, 5 points/panel<br>Air:±8KV, 5 times; Contact: ±4KV, 5 times; (Environment: 15°C ~ 35°C, 30% ~ 60%, 86Kpa ~ 106Kpa) | IEC61000-4-2<br>GB/T17626.2-1998                                                         |
| 8  | Vibration (Non-operation)            | Frequency range: 10~55Hz, Stroke: 1mm Sweep: 10Hz~55Hz~10Hz<br>2 hours for each direction of X .Y. Z. (package condition)            | IEC60068-2-6<br>GB/T2423.5-1995                                                          |
| 9  | Shock (Non-operation)                | 60G 6ms, ± X, ±Y , ± Z<br>3 times for each direction                                                                                 | IEC60068-2-27<br>GB/T2423.5-1995                                                         |
| 10 | Package Drop Test                    | Height: 80 cm, 1 corner, 3 edges, 6 surfaces                                                                                         | IEC60068-2-32<br>GB/T2423.8-1995                                                         |

Note: 1. Ts is the temperature of panel's surface.

2. Ta is the ambient temperature of sample.

3. The size of sample is 5pcs.

## 9. Mechanical Drawing



## 10. Packing

TBD

## 11. Precautions for Use of LCD modules

### 11.1 Handling Precautions

11.1.1. The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

11.1.2. If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

11.1.3. Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

11.1.4. The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

11.1.5. If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketene
- Aromatic solvents

11.1.6. Do not attempt to disassemble the LCD Module.

11.1.7. If the logic circuit power is off, do not apply the input signals.

11.1.8. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

11.1.8.1. Be sure to ground the body when handling the LCD Modules.

11.1.8.2. Tools required for assembly, such as soldering irons, must be properly ground.

11.1.8.3. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

11.1.8.4. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

### 11.2 Storage Precautions

11.2.1. When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

11.2.2. The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0°C ~ 40°C      Relatively humidity: ≤80%

11.2.3. The LCD modules should be stored in the room without acid, alkali and harmful gas.

## 11.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.