深圳市思迪科科技有限公司
SHENZHEN CDTECH ELECTRONICS

# Product Specification

| | |
|---|---|
| **Model Name** | S015HQ01HN |
| **Description** | TFT LCD Module<br>1.5" QVGA<br>240(RGB)x240Dots |
| **Date** | 2021/09/29 |
| **Version** | 1.0 |

| **Approved by/Date** | **Check by/Date** | **Prepared by/Date** |
|---|---|---|
| ZHP 2021/09/29 | HZX 2021/09/29 | ZWF 2021/09/29 |

| **Customer Approval** | |
|---|---|
| | |
| **Date** | |

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# 1. Record of Revision

| Rev | Issued Date | Description | Editor |
|---|---|---|---|
| 1.0 | 2021/8/21 | First Release. | ZWF |
| | 2021/9/29 | Update the drawing | ZWF |
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## 2. General Specifications

| Feature | | Spec |
|---|---|---|
| Characteristics | Size | 1.54 inch |
| | Resolution | 240(horizontal)*240(Vertical) |
| | Interface | SPI+RGB |
| | Connect type | Ziff 0.5mm |
| | Display Colors | 262K |
| | Technology type | a-Si |
| | Pixel pitch (mm) | 0.116*0.116 |
| | Pixel Configuration | R.G.B.-Stripe |
| | Display Mode | Normally White |
| | Driver IC | ST7789V2 |
| | CTP Driver IC | - |
| | Viewing Direction | full view |
| Mechanical | LCM (W x H x D) (mm) | 31.42*34.00*2.03 |
| | Active Area(mm) | 27.72*27.72 |
| | With /Without TSP | Without CTP |
| | Weight (g) | TBD |
| | LED Numbers | 3 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 | LEDK | LED Cathode K |
| 2 | LEDA | LED Anode A |
| 3 | GND | Power Ground |
| 4 | VDD | Interface I/O Power supply ( 2.8V-3.3V) |
| 5-6 | NC | No connect |
| 7-12 | R0-R5 | Data bus |
| 13-14 | NC | No connect |
| 15-20 | G0-G5 | Data bus |
| 21-22 | NC | No connect |
| 23-28 | B0-B5 | Data bus |
| 29 | GND | Power Ground |
| 30 | DCLK | t clock signal input. Latching input data at its rising edge. |
| 31 | VPP(NC) | No connect |
| 32 | HSYNC | Horizontal sync input. Negative polarity. |
| 33 | VSYNC | Vertical sync input. Negative polarity.. |
| 34 | DE | Data enable input. Active high to enable the input data bus under “DE Mode.” |
| 35 | NC | No connect |
| 36 | GND | Power Ground |
| 37 | SPI-CLK | clock for 4 line serial interface |
| 38 | SPI-DATA | Serial input signal |
| 39 | SPI-CS | Chip select pin |
| 40 | SPI-RST | Reset signal pin |

# 4. Absolute Maximum Rating

**Driving TFT LCD Panel**

| Item | Symbol | MIN | MAX | Unit | Remark |
|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | 2.5 | 4.8 | V | |
| Input Voltage | IOVCC | 1.65 | 3.3 | V | |
| Operating Temperature | $T_{OPR}$ | -20 | 70 | ℃ | |
| Storage Temperature | $T_{STG}$ | -30 | 80 | ℃ | |

# 5. Electrical characteristics

## 5.1 ELECTRICAL CHARACTERISTICS

| Item | | Symbol | MIN | TYP | MAX | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Analog Supply Voltage | | $V_{CC}$ | 2.5 | 2.8 | 3.3 | V | |
| Logic Signal Input /Output Voltage | | IOVCC | 1.65 | 1.8 | 3.3 | V | |
| Input Signal Voltage | Low Level | $V_{IL}$ | VSS | - | 0.3x IOVCC | V | |
| | High Level | $V_{IH}$ | 0.7x IOVCC | - | IOVCC | V | |
| TFT Common Electrode | | $V_{COMH}$ | 2.5 | - | 5 | V | |
| TFT Gate ON Voltage | | $V_{GH}$ | 10 | - | 16 | V | |
| TFT Gate ON Voltage | | $V_{GL}$ | -10 | - | -5 | V | |

## 5.3 LED Driving Conditions

| Item | Symbol | MIN | TYP | MAX | Unit | Remark |
|---|---|---|---|---|---|---|
| Forward Current | $I_F$ | - | 60 | - | mA | |
| Forward Voltage | $V_F$ | 2.7 | - | 3.4 | V | |
| Backlight Power consumption | $W_{BL}$ | 0.16 | - | 0.20 | W | |
| LED Lifetime | | - | 25000 | - | Hrs | |

Note 1: Each LED: IF =60 mA, VF =2.7-3.4V.
Note 2: Optical performance should be evaluated at Ta=25℃ 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.

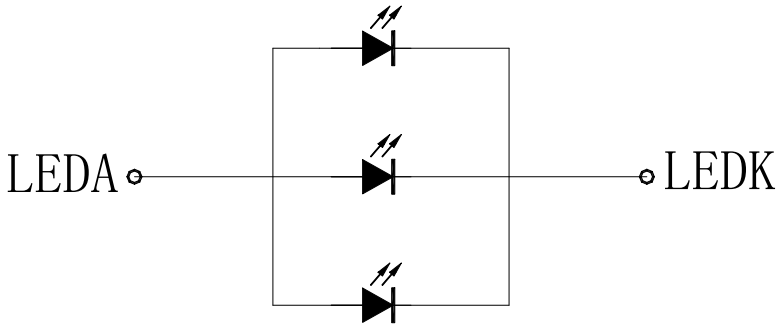



Figure: LED connection of backlight(Constant Current)

# 6.Interface Timing

## 6.1 Serial Interface Characteristics (3-line serial):

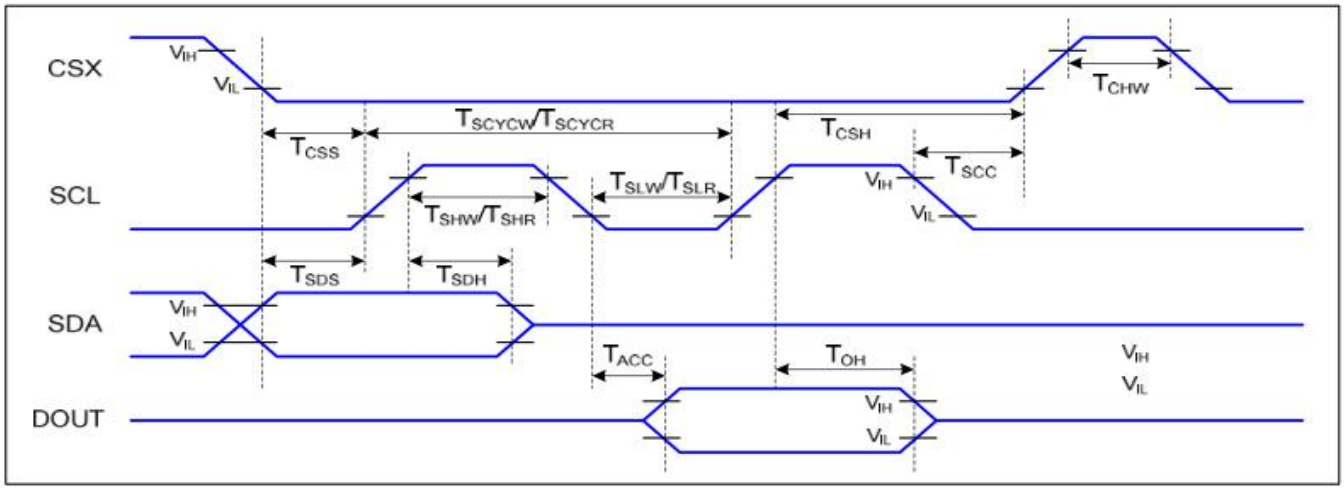



**Figure 4 3-line serial Interface Timing Characteristics**

*VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃*

| Signal | Symbol | Parameter | Min | Max | Unit | Description |
|---|---|---|---|---|---|---|
| CSX | $T_{CSS}$ | Chip select setup time (write) | 15 | | ns | |
| | $T_{CSH}$ | Chip select hold time (write) | 15 | | ns | |
| | $T_{CSS}$ | Chip select setup time (read) | 60 | | ns | |
| | $T_{SCC}$ | Chip select hold time (read) | 65 | | ns | |
| | $T_{CHW}$ | Chip select "H" pulse width | 40 | | ns | |
| SCL | $T_{SCYCW}$ | Serial clock cycle (Write) | 16 | | ns | |
| | $T_{SHW}$ | SCL "H" pulse width (Write) | 7 | | ns | |
| | $T_{SLW}$ | SCL "L" pulse width (Write) | 7 | | ns | |
| | $T_{SCYCR}$ | Serial clock cycle (Read) | 150 | | ns | |
| | $T_{SHR}$ | SCL "H" pulse width (Read) | 60 | | ns | |
| | $T_{SLR}$ | SCL "L" pulse width (Read) | 60 | | ns | |
| SDA (DIN) | $T_{SDS}$ | Data setup time | 7 | | ns | |
| | $T_{SDH}$ | Data hold time | 7 | | ns | |
| DOUT | $T_{ACC}$ | Access time | 10 | 50 | ns | For maximum CL=30pF |
| | $T_{OH}$ | Output disable time | 15 | 50 | ns | For minimum CL=8pF |

**Table 5 3-line serial Interface Characteristics**

## 6.2 Serial Interface Characteristics (4-line serial):

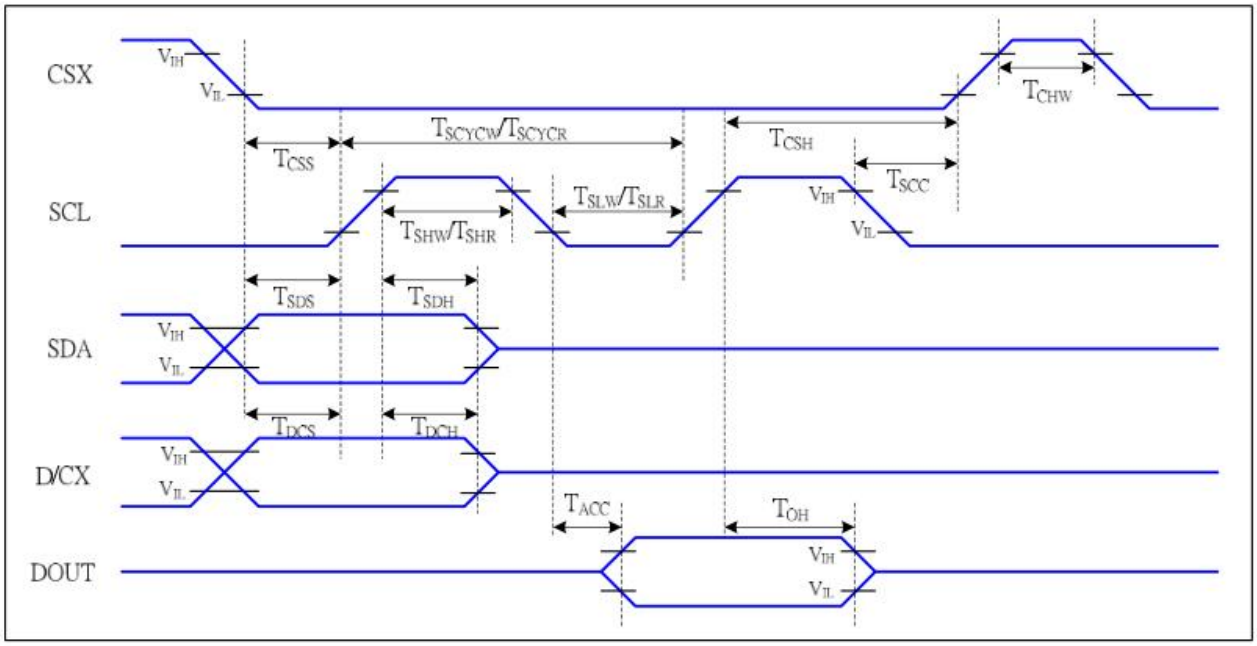



**Figure 5 4-line serial Interface Timing Characteristics**

*VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃*

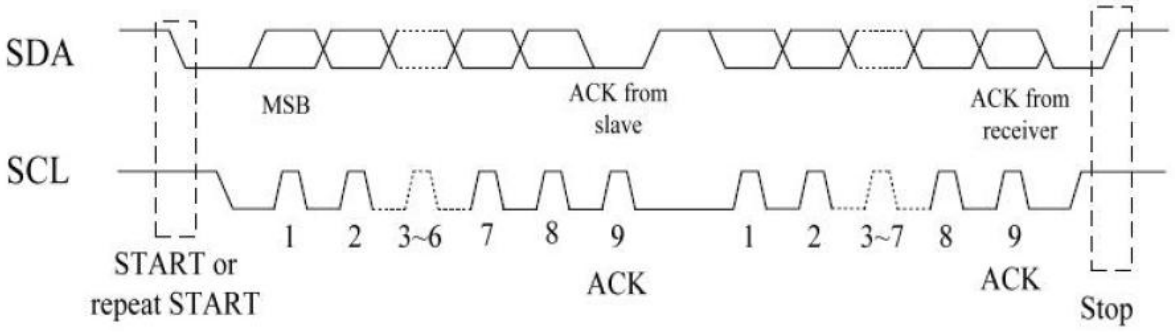
| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|---|---|---|---|---|---|---|
| CSX | $T_{CSS}$ | Chip select setup time (write) | 15 | | ns | |
| | $T_{CSH}$ | Chip select hold time (write) | 15 | | ns | |
| | $T_{CSS}$ | Chip select setup time (read) | 60 | | ns | |
| | $T_{SCC}$ | Chip select hold time (read) | 65 | | ns | |
| | $T_{CHW}$ | Chip select "H" pulse width | 40 | | ns | |
| SCL | $T_{SCYCW}$ | Serial clock cycle (Write) | 16 | | ns | -write command & data ram |
| | $T_{SHW}$ | SCL "H" pulse width (Write) | 7 | | ns | |
| | $T_{SLW}$ | SCL "L" pulse width (Write) | 7 | | ns | |
| | $T_{SCYCR}$ | Serial clock cycle (Read) | 150 | | ns | -read command & data ram |
| | $T_{SHR}$ | SCL "H" pulse width (Read) | 60 | | ns | |
| | $T_{SLR}$ | SCL "L" pulse width (Read) | 60 | | ns | |
| D/CX | $T_{DCS}$ | D/CX setup time | 10 | | ns | |
| | $T_{DCH}$ | D/CX hold time | 10 | | ns | |
| SDA (DIN) | $T_{SDS}$ | Data setup time | 7 | | ns | |
| | $T_{SDH}$ | Data hold time | 7 | | ns | |
| DOUT | $T_{ACC}$ | Access time | 10 | 50 | ns | For maximum CL=30pF |
| | $T_{OH}$ | Output disable time | 15 | 50 | ns | For minimum CL=8pF |

**Table 6 4-line serial Interface Characteristics**

## 6.3 Capacitive touch panel Specification

I2C

The I2C is always configured in the Slave mode. The data transfer format is shown in Figure 2-4.



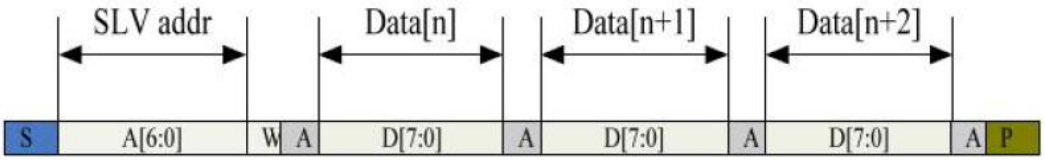




*Figure 2-5 I2C master write, slave read*

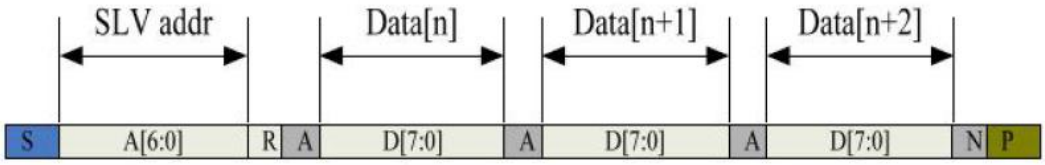



*Figure 2-6 I2C master read, slave write*

Table 2-1 lists the meanings of the mnemonics used in the above figures.

**Table 2-1 Mnemonics Description**

| Mnemonics | Description |
|---|---|
| S | I2C Start or I2C Restart |
| A[6:0] | Slave address<br>A[6:4]: 3'b011<br>A[3:0]: data bits are identical to those of I2CCON[7:4] register. |
| W | 1'b0: Write |
| R | 1'b1: Read |
| A(N) | ACK(NACK) |
| P | STOP: the indication of the end of a packet (if this bit is missing, S will indicate the end of the current packet and the beginning of the next packet) |

I2C Interface Timing Characteristics is shown in Table 2-2.

**Table 2-2 I2C Timing Characteristics**

| Parameter | Min | Max | Unit |
|---|---|---|---|
| SCL frequency | 0 | 400 | KHz |
| Bus free time between a STOP and START condition | 1.3 | | us |
| Hold time (repeated) START condition | 0.6 | | us |
| Data setup time | 100 | | ns |
| Setup time for a repeated START condition | 0.6 | | us |
| Setup Time for STOP condition | 0.6 | | us |

### 6.4 RGB Interface Characteristics:

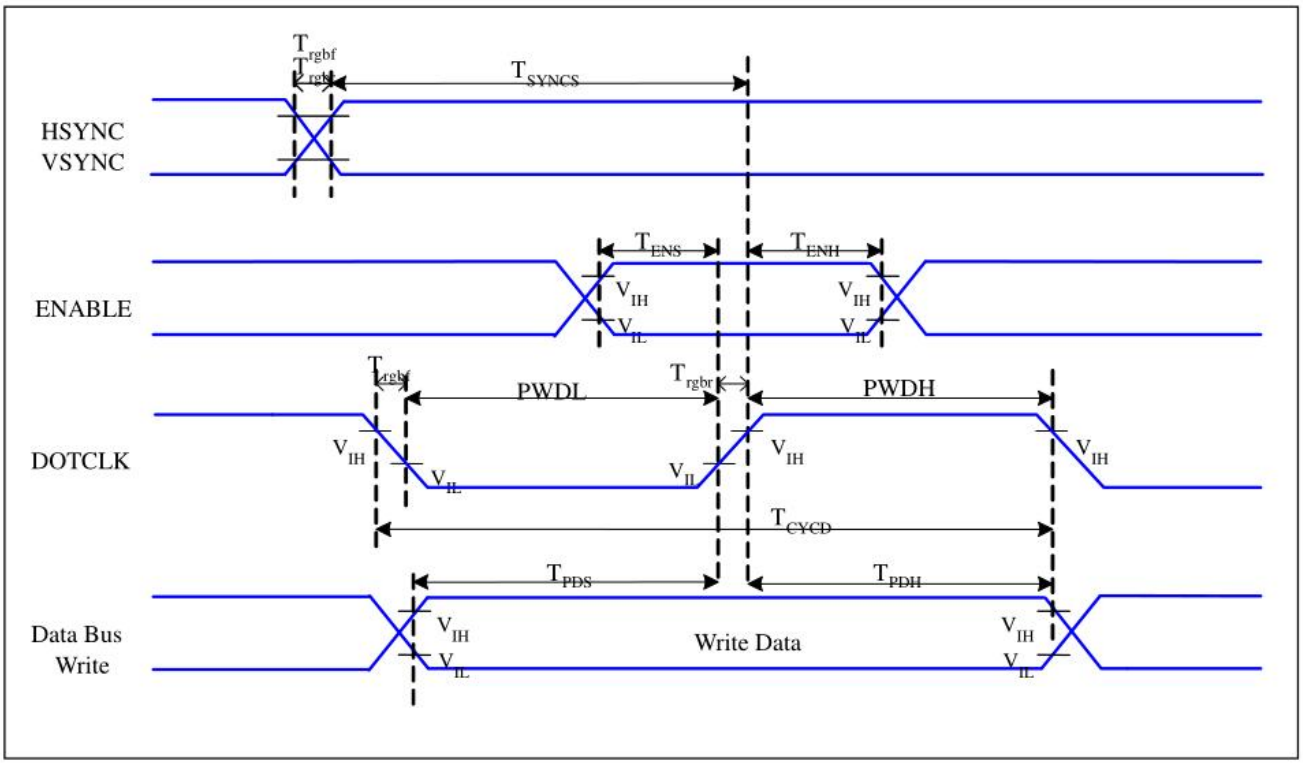



**Figure 6 RGB Interface Timing Characteristics**

*VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃*

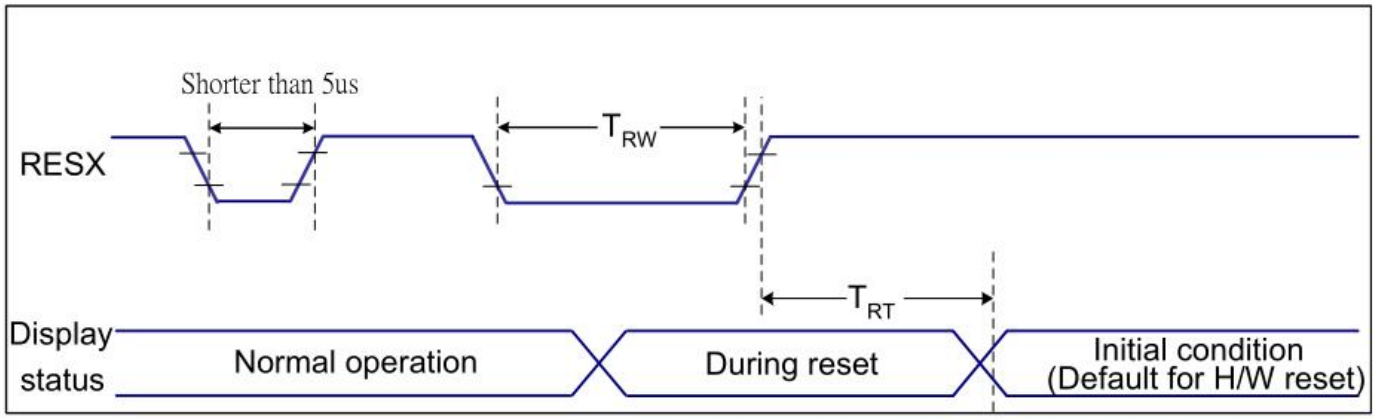
| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|---|---|---|---|---|---|---|
| HSYNC, VSYNC | $T_{SYNCS}$ | VSYNC, HSYNC Setup Time | 30 | - | ns | |
| ENABLE | $T_{ENS}$ | Enable Setup Time | 25 | - | ns | |
| | $T_{ENH}$ | Enable Hold Time | 25 | - | ns | |
| DOTCLK | PWDH | DOTCLK High-level Pulse Width | 60 | - | ns | |
| | PWDL | DOTCLK Low-level Pulse Width | 60 | - | ns | |
| | $T_{CYCD}$ | DOTCLK Cycle Time | 120 | - | ns | |
| | Trghr, Trghf | DOTCLK Rise/Fall time | - | 20 | ns | |
| DB | $T_{PDS}$ | PD Data Setup Time | 50 | - | ns | |
| | $T_{PDH}$ | PD Data Hold Time | 50 | - | ns | |

**Table 7 18/16 Bits RGB Interface Timing Characteristics**

| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|---|---|---|---|---|---|---|
| HSYNC, VSYNC | $T_{SYNCS}$ | VSYNC, HSYNC Setup Time | 35 | - | ns | |
| ENABLE | $T_{ENS}$ | Enable Setup Time | 35 | - | ns | |
| | $T_{ENH}$ | Enable Hold Time | 35 | - | ns | |
| DOTCLK | PWDH | DOTCLK High-level Pulse Width | 35 | - | ns | |
| | PWDL | DOTCLK Low-level Pulse Width | 35 | - | ns | |
| | $T_{CYCD}$ | DOTCLK Cycle Time | 80 | - | ns | |
| | Trghr, Trghf | DOTCLK Rise/Fall time | - | 10 | ns | |
| DB | $T_{PDS}$ | PD Data Setup Time | 35 | - | ns | |
| | $T_{PDH}$ | PD Data Hold Time | 35 | - | ns | |

**Table 8 6 Bits RGB Interface Timing Characteristics**

## 6.5 Reset Timing:



## 7.Optical Characteristics

| Items | | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark | Note |
|---|---|---|---|---|---|---|---|---|---|
| Response time | | Tr+Tf | - | - | 30 | 40 | ms | FIG.1 | Note4 |
| Contrast Ratio | | CR | | 900 | 700 | - | - | FIG.2 | Note1 |
| Surface luminance | | LV | θ =0° | 400 | 500 | - | cd/m2 | FIG.2 | Note2 |
| Luminance uniformity | | Yu | θ =0° | 80 | - | - | % | FIG.2 | Note3 |
| NTSC | | - | θ =0° | - | 80 | - | % | FIG.2 | Note5 |
| Viewing angle | | θ Cr>10 | $\theta_T$ | - | 80 | - | deg | FIG.3 | Note6 |
| | | | $\theta_B$ | - | 80 | - | deg | FIG.3 | |
| | | | $\theta_L$ | - | 80 | - | deg | FIG.3 | |
| | | | $\theta_R$ | - | 80 | - | deg | FIG.3 | |
| Chromaticity | Red | $R_X$ | θ =0° ∅=0° Ta=25° | 0.562 | 0.612 | 0.662 | - | FIG.2 CIE1931 | Note5 |
| | | $R_Y$ | | 0.277 | 0.327 | 0.377 | - | | |
| | Green | $G_X$ | | 0.284 | 0.334 | 0.384 | - | | |
| | | $G_Y$ | | 0.486 | 0.536 | 0.586 | - | | |
| | Blue | $B_X$ | | 0.087 | 0.137 | 0.187 | - | | |
| | | $B_Y$ | | 0.100 | 0.150 | 0.200 | - | | |
| | White | $W_X$ | | 0.270 | 0.320 | 0.370 | - | | |
| | | $W_Y$ | | 0.293 | 0.343 | 0.393 | - | | |

**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 base 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.

Lv = Average Surface Luminance with all white pixels(P1,P2,P3, ......,Pn)

**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.

$$YU = \frac{\text{Minimum surface luminance with all white pixels (P1,P2,P3,.....,Pn)}}{\text{Maximum surface luminance with all white pixels (P1,P2,P3,.....,Pn)}}$$

**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 (Tr) is the time between photo detector output intensity changed from 90% to 10%. And fall time (Tf) 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 base on Autronic-Melchers's ConoScope or DMS series Instruments or compatible.

**FIG.1.The definition of response Time**

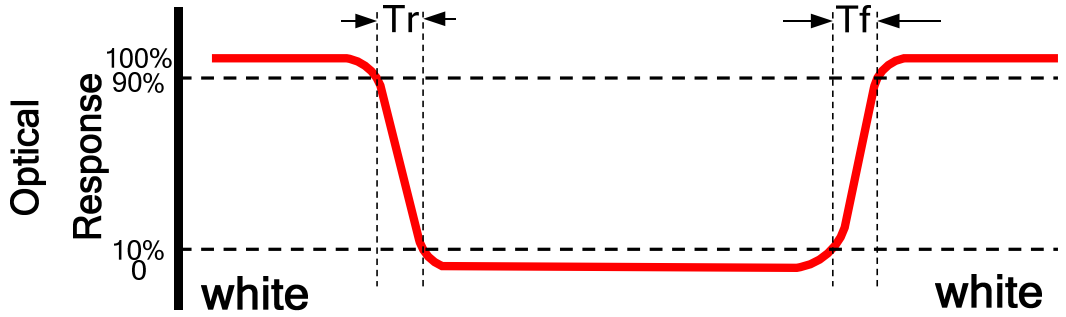



**FIG.2. Measuring method for contrast ratio, surface luminance, luminance uniformity, CIE (x,y) chromaticity**

Size : S≤5"(see Figure a) A : 5 mm B : 5 mm
H,V : Active area
Light spot size ∅=5mm(BM-5) or ∅=7.7mm (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).

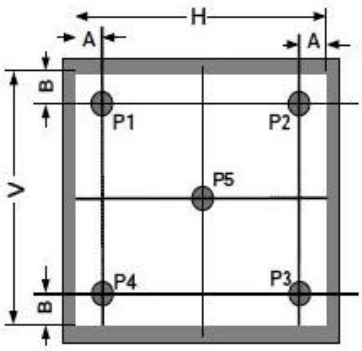



Figure a

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

Light spot size ∅=5mm(BM-5) or ∅=7.7mm (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).

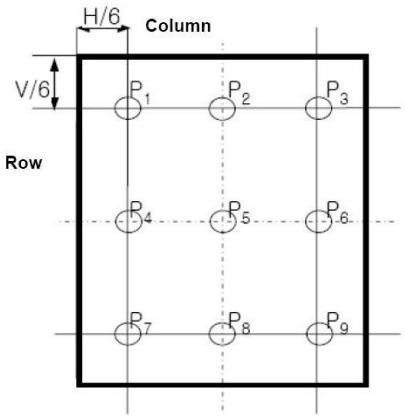



Figure b

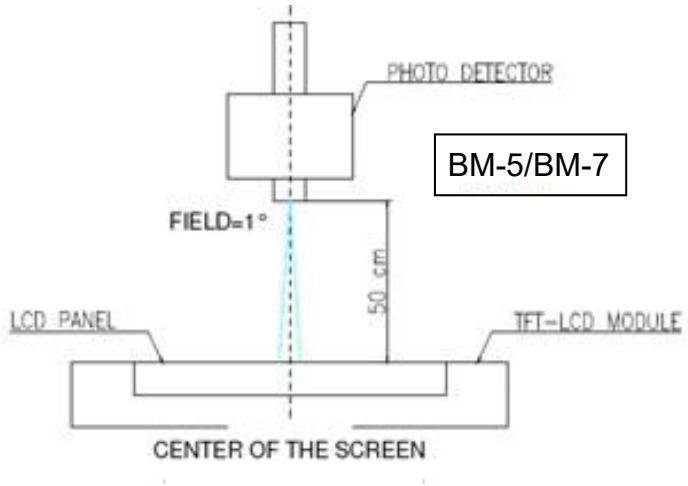
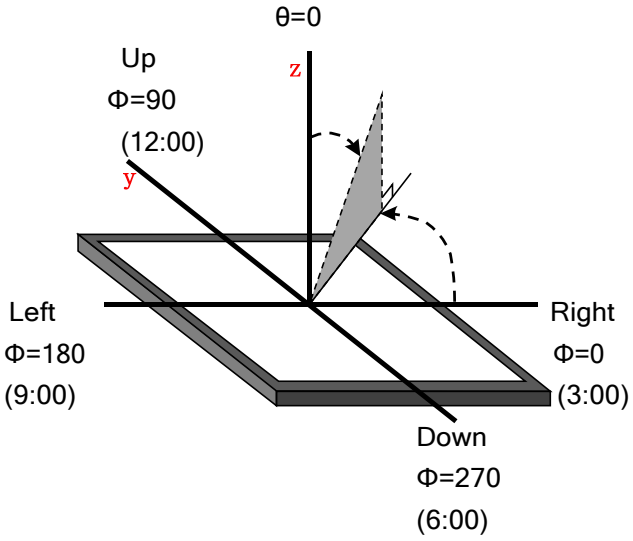



Figure c

**FIG.3.The definition of viewing angle**

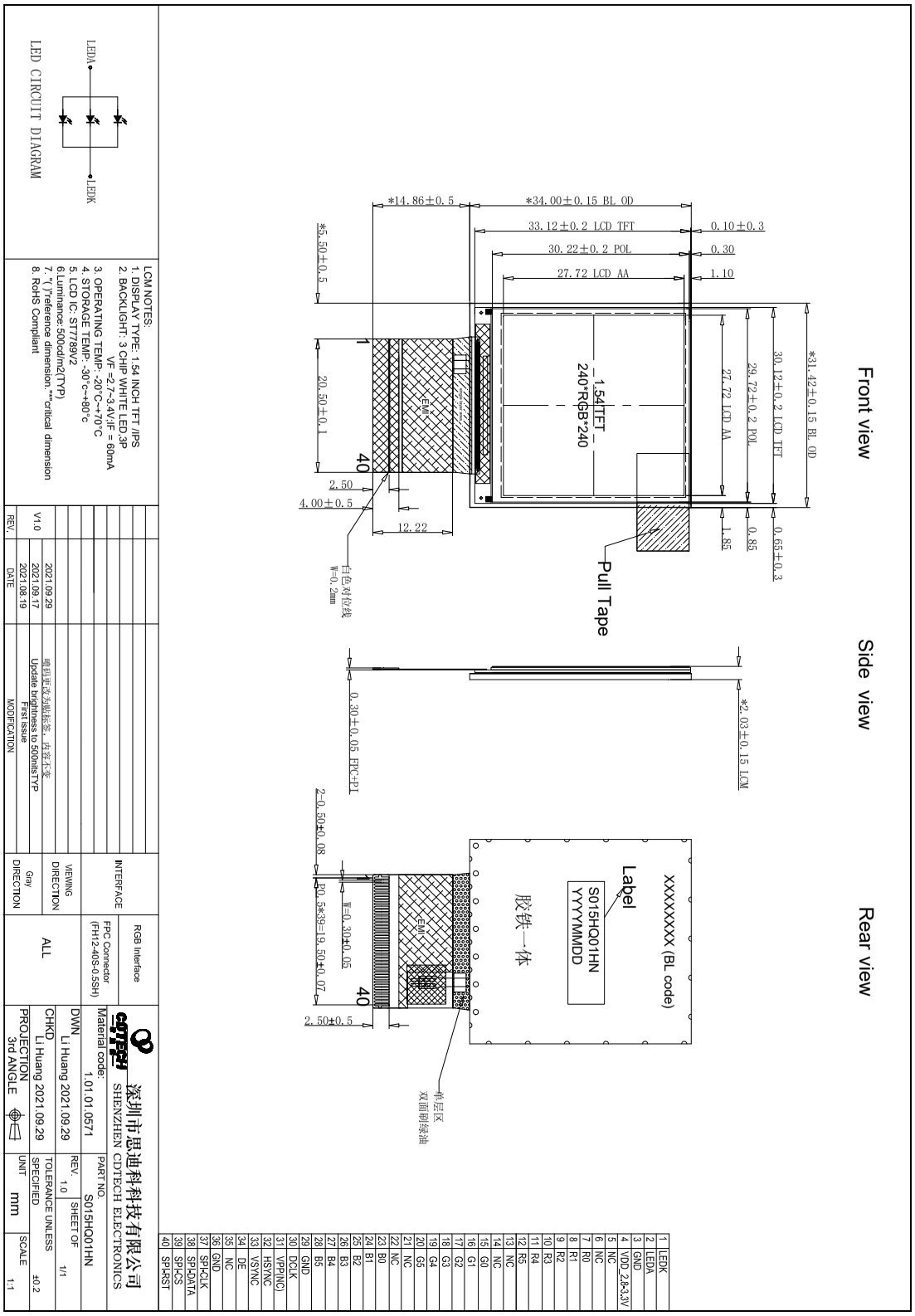


## 8.Environmental / Reliability Tests

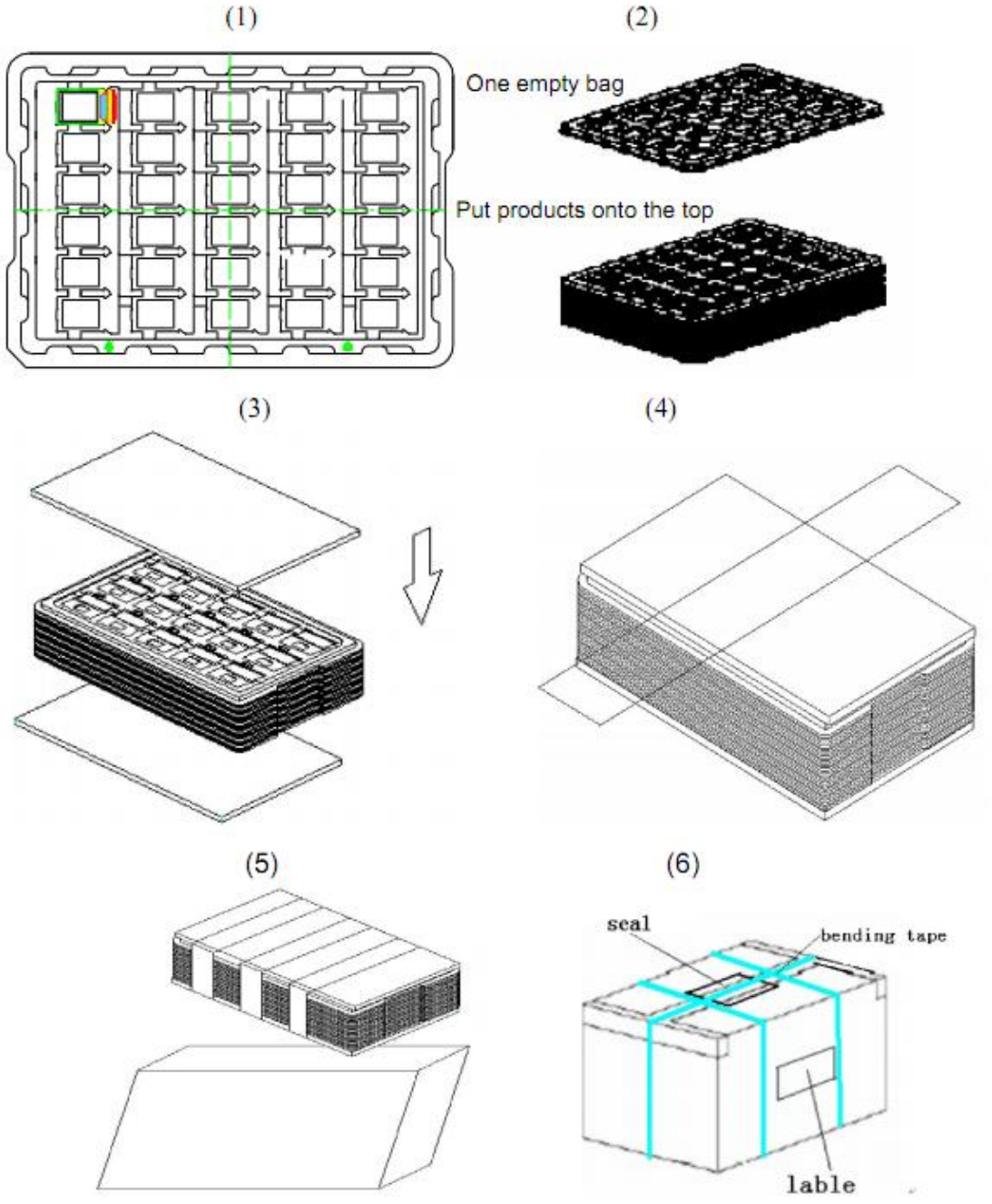
| No | Test Item | Condition | Remarks |
|---|---|---|---|
| 1 | High Temperature Operation | Ts= +70℃, 96hrs | Note 1 IEC60068-2-2, GB2423. 2-89 |
| 2 | Low Temperature Operation | Ta= -20℃, 96hrs | Note 2 IEC60068-2-1 GB2423.1-89 |
| 3 | High Temperature Storage | Ta= +80℃, 96hrs | IEC60068-2-2 GB2423. 2-89 |
| 4 | Low Temperature Storage | Ta= -30℃, 96hrs | IEC60068-2-1 GB/T2423.1-89 |
| 5 | High Temperature & Humidity Storage | Ta= +60℃, 90% RH max,96 hours | IEC60068-2-3 GB/T2423.3-2006 |
| 6 | Thermal Shock (Non-operation) | -20℃ 30 min ~ +60℃ 30 min Change time: 5min, 30 Cycle | Start with cold temperature, end with high temperature IEC60068-2-14, GB2423.22-87 |
| 7 | Electro Static Discharge (Operation) | C=150pF, R=330 Ω, 5 points/panel Air:±8KV, 5 times; Contact: ±4KV, 5 times; (Environment: 15℃ ~ 35℃, 30% ~ 60%, 86Kpa ~ 106Kpa) | IEC61000-4-2 GB/T17626.2-1998 |
| 8 | Vibration (Non-operation) | Frequency range: 10~55Hz, Stroke: 1.mm Sweep: 10Hz~55Hz~10Hz 2 hours for each direction of X .Y. Z. (package condition) | IEC60068-2-6 GB/T2423.5-1995 |
| 9 | Shock (Non-operation) | 60G 6ms, ± X, ±Y , ± Z 3 times for each direction | IEC60068-2-27 GB/T2423.5-1995 |
| 10 | Package Drop Test | Height: 100 cm, 1 corner, 3 edges, 6 surfaces | IEC60068-2-32 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




1. Put module into tray cavity:
2. Tray stacking
3. Put 1 cardboard under the tray stack and 1 cardboard above:
4. Fix the cardboard to the tray stack with adhesive tape:
5. Put the tray stack into carton.
6. Carton sealing with adhesive tape.

# 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℃ ～ 40℃ 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.

LCD Warranty Time: 1 year