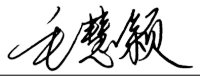
# PRODUCT SPECIFICATION

**CDTECH Model:** **S032BQ24EN**

**CUSTOMER Model:** -

**Description:** **3.2 ” TFT-LCD Module**

**Version:** **1.0**

| CDTECH | PREPARED BY | CHECKED BY | APPROVED BY |
|---|---|---|---|
| SIGNATURE |  |  | |
| DATE | 2024.3.16 | 2024.3.16 | 2024.3.16 |

| | SIGNATURE | DATE |
|---|---|---|
| CUSTOMER APPROVAL | | |

## Record of Revisions

| Version | Revise Date | Description | Page |
|---|---|---|---|
| 1.0 | 2024-3-5 | First Release | - |
| | 2024-3-11 | Add RTP pads | 18 |
| | 2024-3-13 | Add dimensions | 18 |
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# Contents

# 1. General Specifications

## 1.1 LCM General Information

| Item | Specification | Unit |
|---|---|---|
| LCD Size | 3.2 | inch |
| Number of Pixels | 240 (H) RGB x 320 (V) | pixels |
| Display Mode | Normally Black | - |
| Viewing Direction | Free | o' clock |
| Interface | MCU | - |
| Display Colors | 262K | colors |
| Outline Dimension | 52.60 (H) x 72.20 (V) x 3.50 (D) | mm |
| Active Area | 48.60 (H) x 64.80 (V) | mm |
| Pixel Pitch | 0.2025 (H) x 0.2025 (V) | mm |
| Driver IC | ST7789T3 | - |
| Operation Temperature | -20~70 | ℃ |
| Storage Temperature | -30~80 | ℃ |

Note1:Requirements on environmental protection RoHS compliant.

# 2. Absolute Maximum Ratings

| Item | Symbol | MIN. | MAX. | Unit | Note |
|---|---|---|---|---|---|
| Analog Supply voltage | VCI | -0.3 | 5.0 | V | Note 1 |
| Digital supply voltage | VDDI | -0.3 | 3.6 | V | Note 1 |

Note 1:Permanent damage may occur to the LCD module if beyond this specification.
Functional operation should be restricted to the conditions described under normal operating conditions.

# 3. Elecrical Characteristics

### 3.1 Recommended Operating Condition for TFT LCD

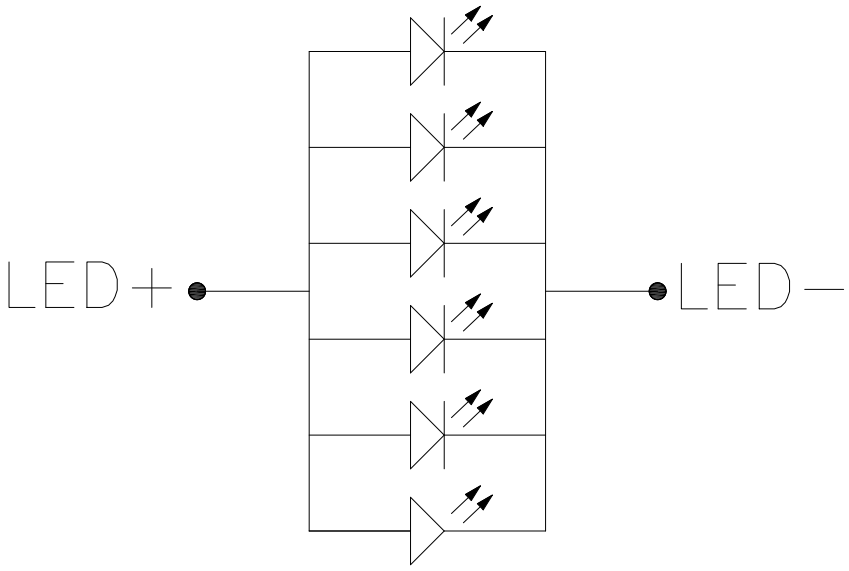
| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Analog Supply voltage | VCI | 2.5 | 2.8 | 3.3 | V | |
| Analog supply current | $I_{VCI}$ | - | TBD | - | mA | VCI=2.8V |
| Logic supply voltage | VDDI | 1.65 | 1.8 | 3.3 | V | |
| Logic supply current | $I_{VDDI}$ | - | TBD | - | mA | VDDI=1.8V |
| Logic input voltage | VIH | 0.7*VDDI | - | VDDI | V | |
| | VIL | GND | - | 0.3*VDDI | V | |

### 3.2 Recommended Driving Condition for Backlight

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Driving Current | $I_F$ | - | 120 | - | mA | |
| Driving Voltage | $V_F$ | 2.7 | - | 3.3 | V | |
| Power consumption | $W_{BL}$ | 0.324 | - | 0.396 | W | |
| LED Life-Time | N/A | 30,000 | - | - | Hours | Ta=25℃<br>Note 1 |

Note 1:LED lifetime is defined as the module brightness decay 50% of original brightness at Ta=25 degree, typical current.

Note 2:LED circuit :



# 4. Interface Pin Assignment

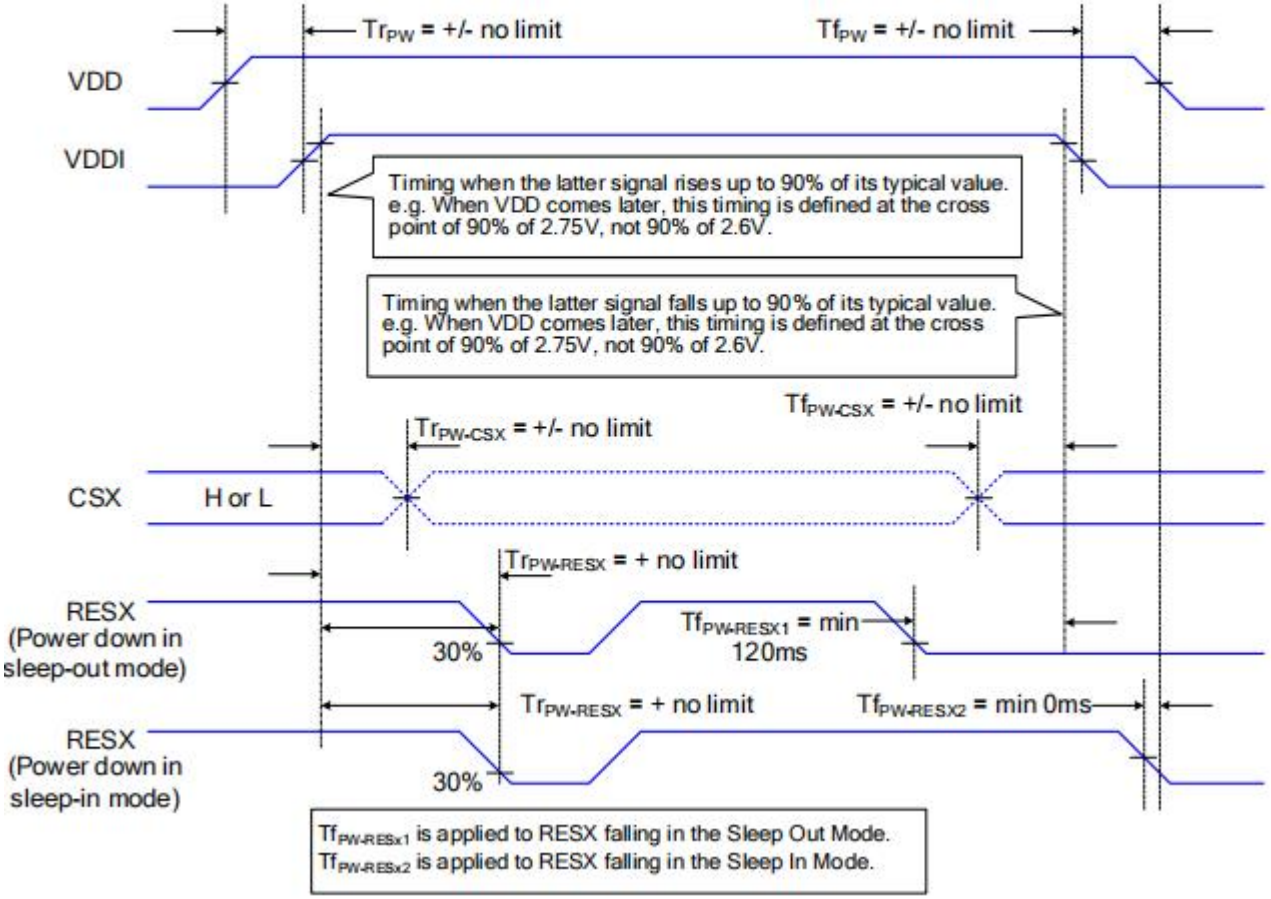
## 4.1 LCM Pin Assignment

<table>
<tr><th>No.</th><th>Symbol</th><th>Description</th></tr>
<tr><td>1</td><td>LED+A</td><td>Power for LED backlight (Anode)</td></tr>
<tr><td>2</td><td>LED-K</td><td>Power for LED backlight (Cathode)</td></tr>
<tr><td>3</td><td>GND</td><td>Ground</td></tr>
<tr><td>4</td><td>VCI</td><td>Power supply</td></tr>
<tr><td>5</td><td>VDDI</td><td>Power Supply</td></tr>
<tr><td>6</td><td>GND</td><td>Ground</td></tr>
<tr><td>7</td><td>RESET</td><td>Global reset pin</td></tr>
<tr><td>8</td><td>IM0</td><td rowspan="4">The MCU interface mode select
<table>
<tr><th>IM3</th><th>IM2</th><th>IM1</th><th>IM0</th><th>MPU Interface Mode</th><th>Data pin</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>80-8bit parallel I/F</td><td>DB[7:0]</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>80-16bit parallel I/F</td><td>DB[15:0]</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>80-9bit parallel I/F</td><td>DB[8:0]</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>80-18bit parallel I/F</td><td>DB[17:0],</td></tr>
<tr><td rowspan="2">0</td><td rowspan="2">1</td><td rowspan="2">0</td><td rowspan="2">1</td><td>3-line 9bit serial I/F</td><td>SDA: in/out</td></tr>
<tr><td>2 data lane serial I/F</td><td>SDA: in/out<br>WRX: in</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>4-line 8bit serial I/F</td><td>SDA: in/out</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>80-16bit parallel I/F II</td><td>DB[17:10],<br>DB[8:1]</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>80-8bit parallel I/F II</td><td>DB[17:10]</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>80-18bit parallel I/F II</td><td>DB[17:0],</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>80-9bit parallel I/F II</td><td>DB[17:9]</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>3-line 9bit serial I/F II</td><td>SDA: in/<br>SDO: out</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>4-line 8bit serial I/F II</td><td>SDA:in/<br>SDO: out</td></tr>
</table></td></tr>
<tr><td>9</td><td>IM1</td></tr>
<tr><td>10</td><td>IM2</td></tr>
<tr><td>11</td><td>IM3</td></tr>
<tr><td>12</td><td>CSX</td><td>Chip select input signal</td></tr>
<tr><td>13</td><td>WRX</td><td>Write enable in MCU parallel interface</td></tr>
<tr><td>14</td><td>RDX</td><td>Read enable in 8080 MCU parallel interface</td></tr>
<tr><td>15</td><td>DCX/SCL</td><td>Serial clock signal</td></tr>
<tr><td>16</td><td>SDA</td><td>Serial data input/output signal</td></tr>
<tr><td>17</td><td>SDO</td><td>Serial data output</td></tr>
<tr><td>18-35</td><td>DB0-DB17</td><td>DB0-DB17 are used as MCU parallel interface data bus</td></tr>
<tr><td>36</td><td>GND</td><td>Ground</td></tr>
<tr><td>37</td><td>YU（NC）</td><td>No connection</td></tr>
<tr><td>38</td><td>XL（NC）</td><td>No connection</td></tr>
<tr><td>39</td><td>YD（NC）</td><td>No connection</td></tr>
<tr><td>40</td><td>XR（NC）</td><td>No connection</td></tr>
</table>

# 5. Interface Characteristics

## 5.1 Power ON/OFF Sequence

The power on/off sequence is illustrated below



## 5.2 AC Characteristics

**8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus**

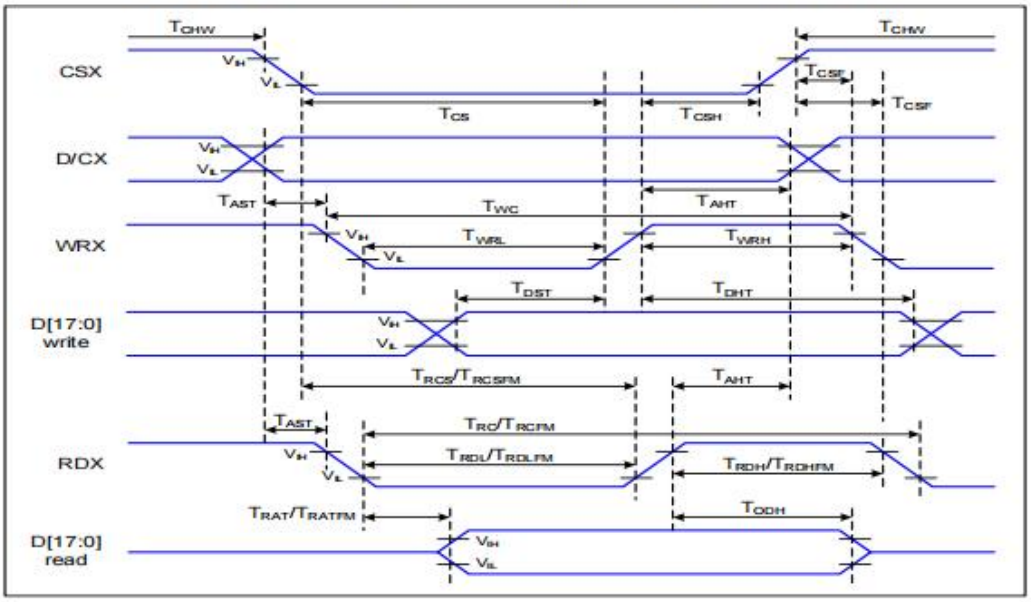



**Figure 1 Parallel Interface Timing Characteristics (8080-Series MCU Interface)**

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

| Signal | Symbol | Parameter | Min | Max | Unit | Description |
|---|---|---|---|---|---|---|
| D/CX | $T_{AST}$ | Address setup time | 0 | | ns | - |
| | $T_{AHT}$ | Address hold time (Write/Read) | 10 | | ns | |
| CSX | $T_{CHW}$ | Chip select "H" pulse width | 0 | | ns | - |
| | $T_{CS}$ | Chip select setup time (Write) | 15 | | ns | |
| | $T_{RCS}$ | Chip select setup time (Read ID) | 45 | | ns | |
| | $T_{RCSFM}$ | Chip select setup time (Read FM) | 355 | | ns | |
| | $T_{CSF}$ | Chip select wait time (Write/Read) | 10 | | ns | |
| | $T_{CSH}$ | Chip select hold time | 10 | | ns | |
| WRX | $T_{WC}$ | Write cycle | 66 | | ns | |
| | $T_{WRH}$ | Control pulse "H" duration | 15 | | ns | |
| | $T_{WRL}$ | Control pulse "L" duration | 15 | | ns | |
| RDX (ID) | $T_{RC}$ | Read cycle (ID) | 160 | | ns | When read ID data |
| | $T_{RDH}$ | Control pulse "H" duration (ID) | 90 | | ns | |
| | $T_{RDL}$ | Control pulse "L" duration (ID) | 45 | | ns | |
| RDX (FM) | $T_{RCFM}$ | Read cycle (FM) | 450 | | ns | When read from frame memory |
| | $T_{RDHFM}$ | Control pulse "H" duration (FM) | 90 | | ns | |
| | $T_{RDLFM}$ | Control pulse "L" duration (FM) | 355 | | ns | |
| D[17:0] | $T_{DST}$ | Data setup time | 10 | | ns | For CL=30pF |

| | | | | | | |
|---|---|---|---|---|---|---|
| | $T_{DHT}$ | Data hold time | 10 | | ns | |
| | $T_{RAT}$ | Read access time (ID) | | 40 | ns | |
| | $T_{RATFM}$ | Read access time (FM) | | 340 | ns | |
| | $T_{ODH}$ | Output disable time | 20 | 80 | ns | |

**Table 4 8080 Parallel Interface Characteristics**


**Figure 2 Rising and Falling Timing for I/O Signal**

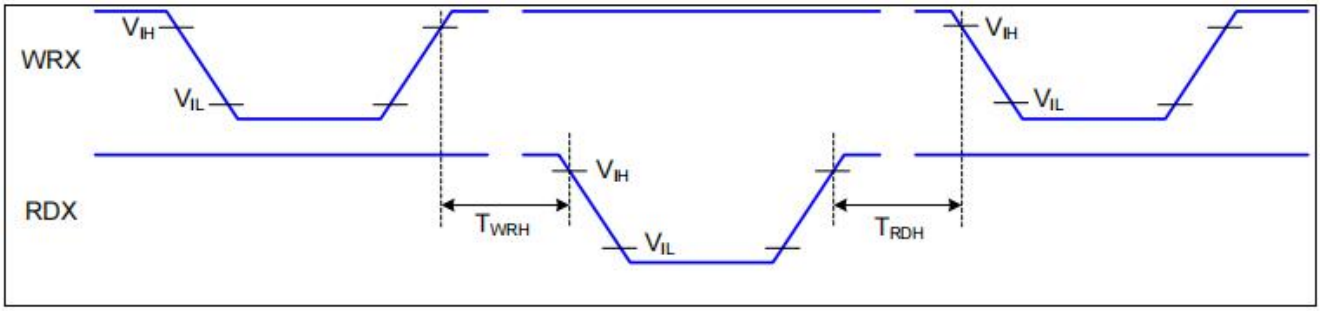



**Figure 3 Write-to-Read and Read-to-Write Timing**

*Note: The rising time and falling time (Tr, Tf) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.*

**Serial Interface Characteristics (3-line serial):**

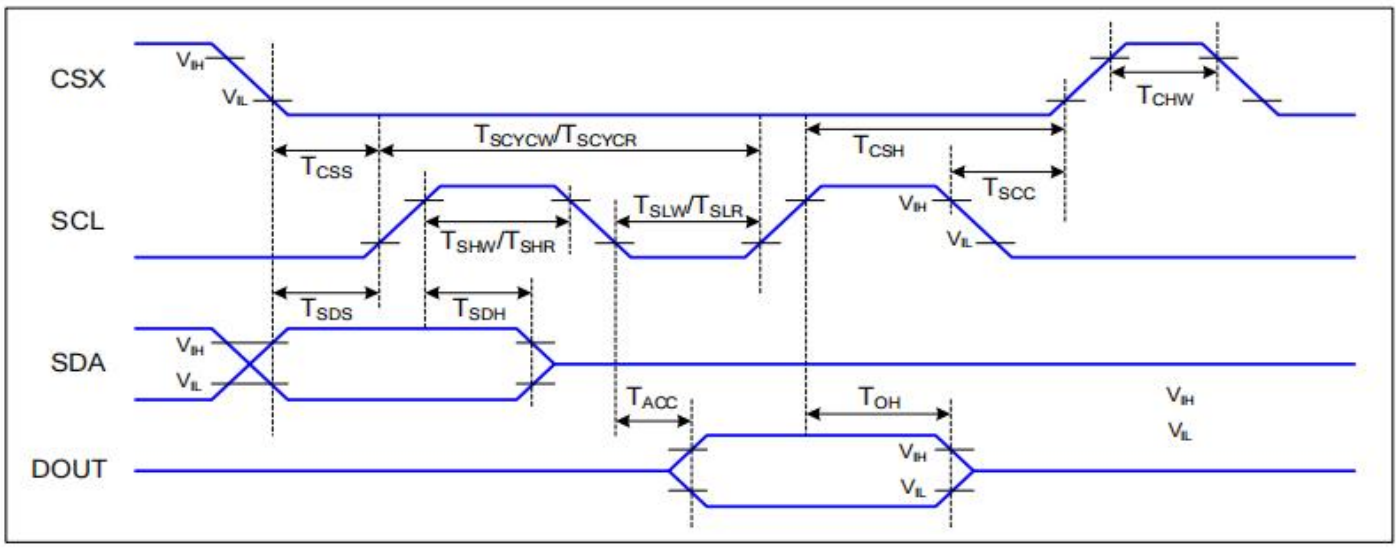



**Figure 4 3-line serial Interface Timing Characteristics**

*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**

**Serial Interface Characteristics (4-line serial):**

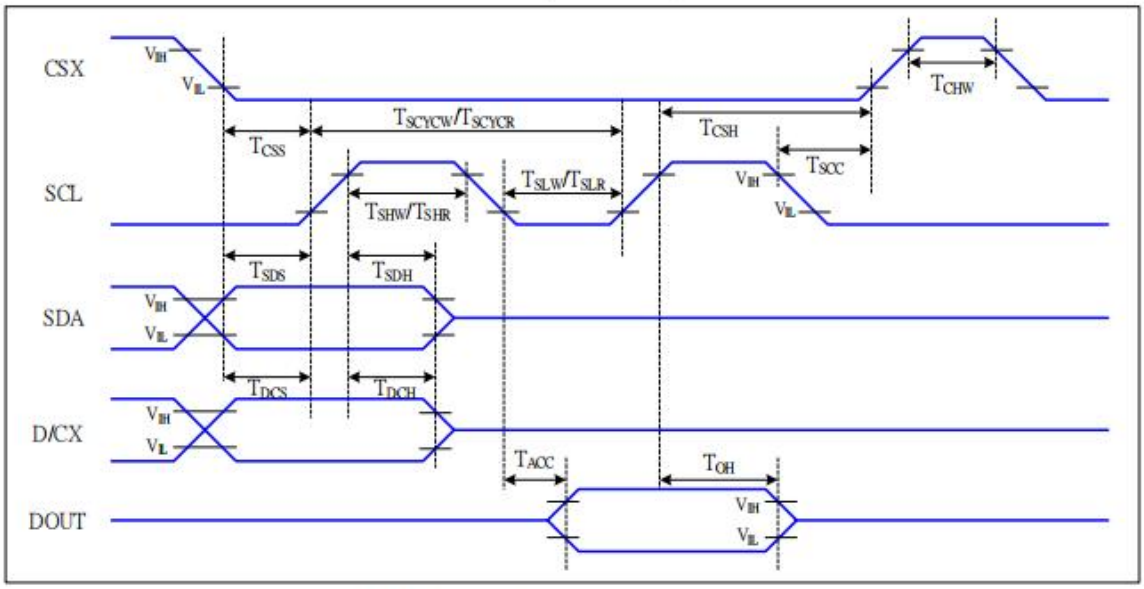



**Figure 5 4-line serial Interface Timing Characteristics**

*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**

**Reset Timing:**

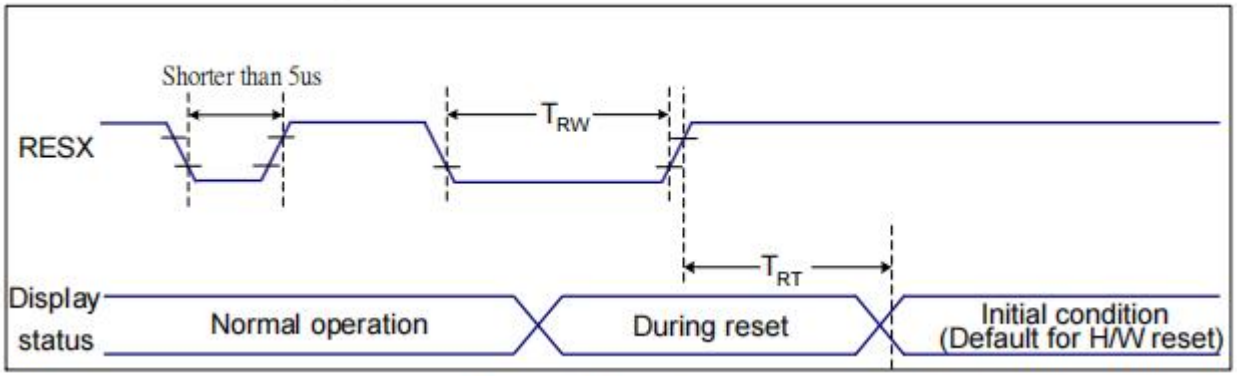



**Figure 7 Reset Timing**

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

| Related Pins | Symbol | Parameter | MIN | MAX | Unit |
|---|---|---|---|---|---|
| RESX | TRW | Reset pulse duration | 10 | - | us |
| | TRT | Reset cancel | - | 5 (Note 1, 5) | ms |
| | | | | 120 (Note 1, 6, 7) | ms |

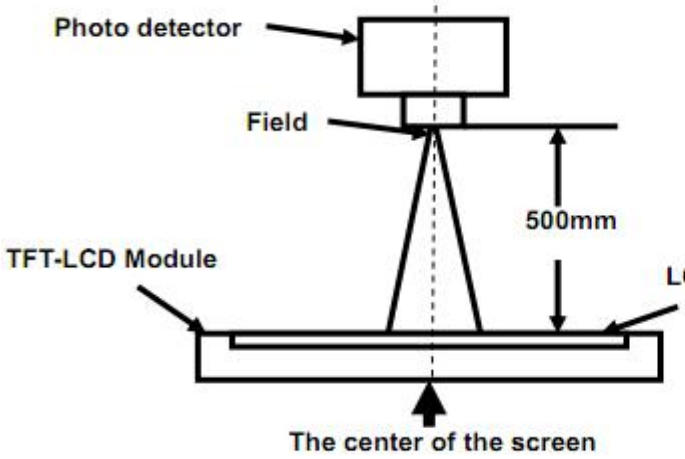
**Table 9 Reset Timing**

# 6. Optical Specifications

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Viewing Angle (CR≥10) B/L ON | $\theta_T$ | Φ=90°(12 o'clock) | - | 80 | - | deg | Note2 |
| | $\theta_B$ | Φ=270°(6 o'clock) | - | 80 | - | deg | Note2 |
| | $\theta_L$ | Φ=180°(9 o'clock) | - | 80 | - | deg | Note2 |
| | $\theta_R$ | Φ=0°(3 o'clock) | - | 80 | - | deg | Note2 |
| Response Time | $T_{ON}$ | Normal θ=Φ=0° | - | 15 | 17 | msec | Note4 |
| | $T_{OFF}$ | | - | 15 | 17 | msec | Note4 |
| Contrast Ratio | CR | | - | 1200 | - | - | Note1 Note3 |
| Color Chromaticity | $W_X$ | | TBD | TBD | TBD | - | Note1 Note5 |
| | $W_Y$ | | TBD | TBD | TBD | - | Note1 Note5 |
| Luminance | L | | 600 | 700 | - | cd/m² | Note1 Note7 |
| Luminance Uniformity | $Y_U$ | | 75 | 80 | - | % | Note1 Note6 |
| NTSC | - | | 60 | - | - | % | - |

Note 1:Definition of optical measurement system

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.




| Item | Photo detector | Field |
|---|---|---|
| Contrast Ratio | SR-3A | 1° |
| Luminance | | |
| Chromaticity | | |
| Lum Uniformity | | |
| Response Time | BM-7A | 2° |

**Fig 1**

Note 2: Definition of viewing angle range and measurement system.
viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80).

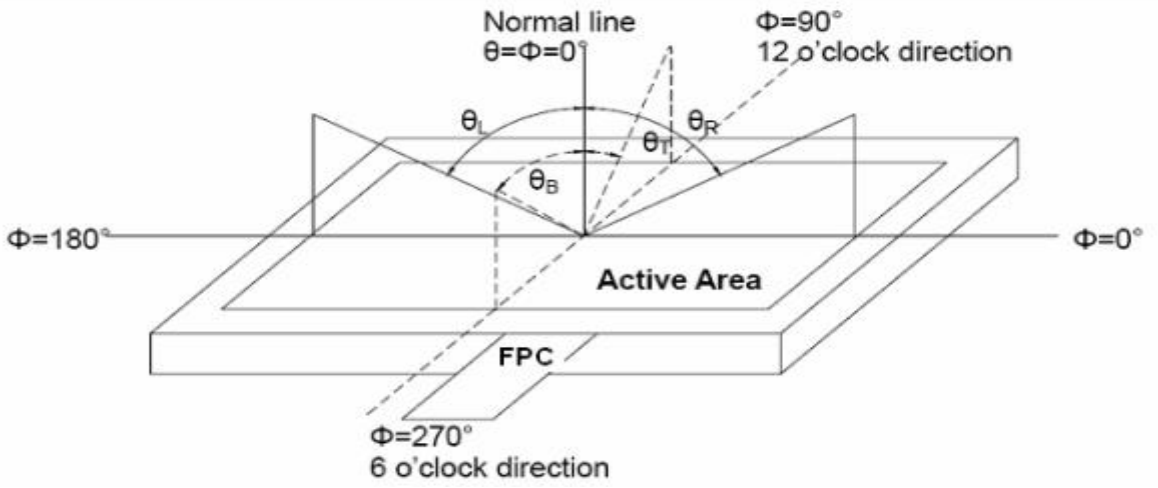


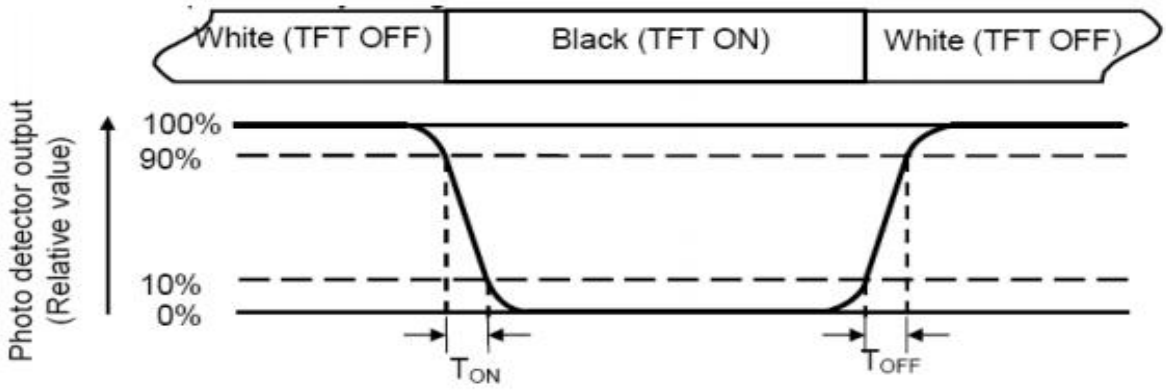

**Fig 2 Definition of viewing angle**

Note 3: Definition of contrast ratio

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Note 4: Definition of Response time

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




Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: 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.3-a/b

Note 7:Surface luminance is the luminance with all pixels displaying white.

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

For more information see FIG.3-a/b

Note 8: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 test spot position : see Figure a.

measurement instrument : TOPCON’s luminance meter SR-3A or BM-7 or compatible (see Figure 1).

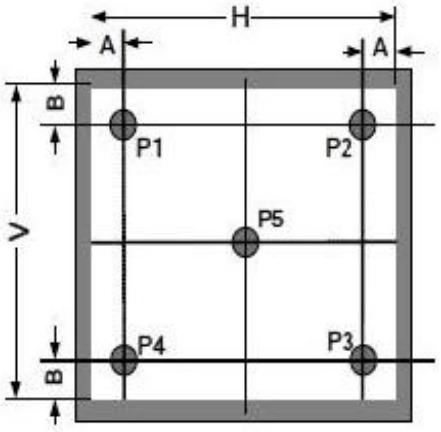



**Fig. 3-a Definition of points**

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 SR-3A or BM-7 or compatible (see Figure 1).

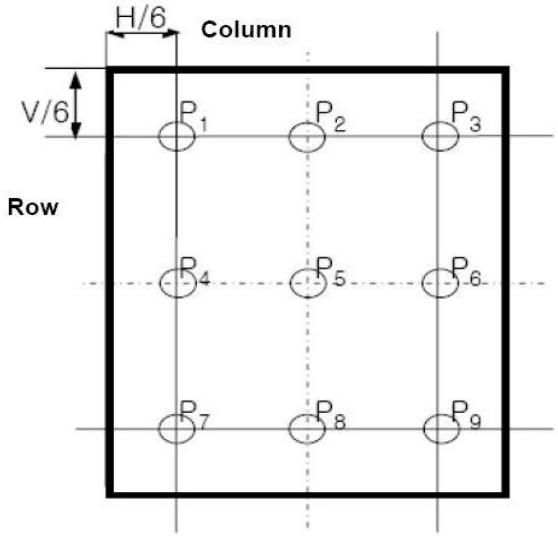



**Fig. 3-b Definition of points**

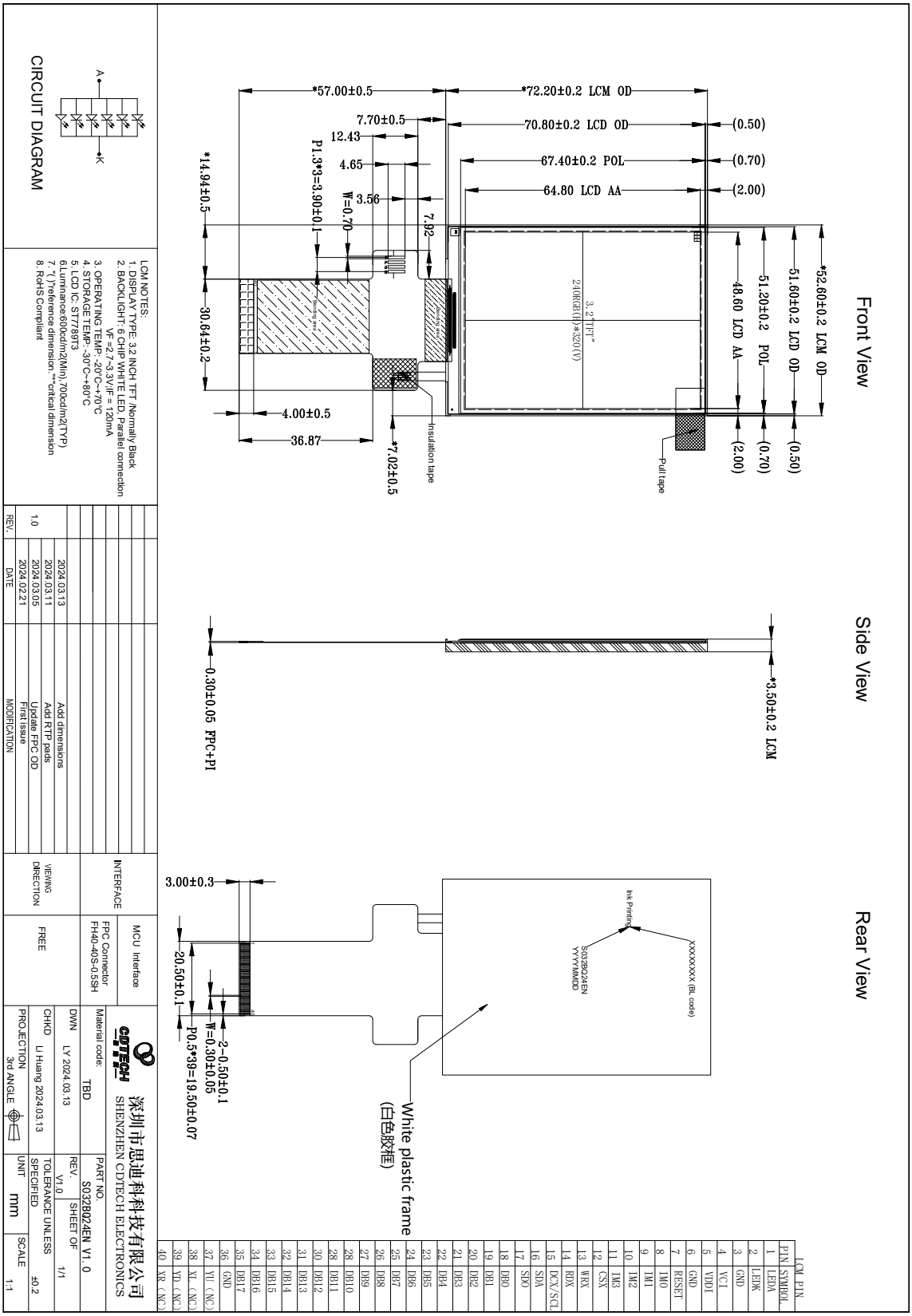
# 7. Reliability Test Items

| Test Item | Test Conditions | |
|---|---|---|
| High Temperature Storage | Ta= +80℃ | 96hrs |
| Low Temperature Storage | Ta= -30℃ | 96hrs |
| High Temperature Operation | Ta= +70℃ | 96hrs |
| Low Temperature Operation | Ta= -20℃ | 96hrs |
| High Temperature and Humidity Storage | Ta= +60℃, 90% RH | 96hrs |
| Thermal Shock (Non-operation) | -30℃/30 min ~ +80℃/30 min for 20 cycles<br>Start with cold temperature<br>end with high temperature | |
| Electro Static Discharge | Contact = ± 4 kV, class B<br>Air = ± 8 kV, class B<br>R=330Ω,C=150pF | |
| Vibration | Sweep: 10Hz~55Hz~10Hz<br>Stroke: 1.5mm<br>2 hrs for each direction of X .Y. Z. | |
| Mechanical Shock | 60G 6ms,±X,±Y,±Z<br>3 times for each direction | |
| Package Drop Test | Height: 60 cm<br>1 corner, 3 edges, 6 surfaces | |

Notes: The test result shall be evaluated after the sample has been left at room temperature and humidity for 2 hours without load. No condensation shall be accepted. The sample will not be accepted if appear these defects:

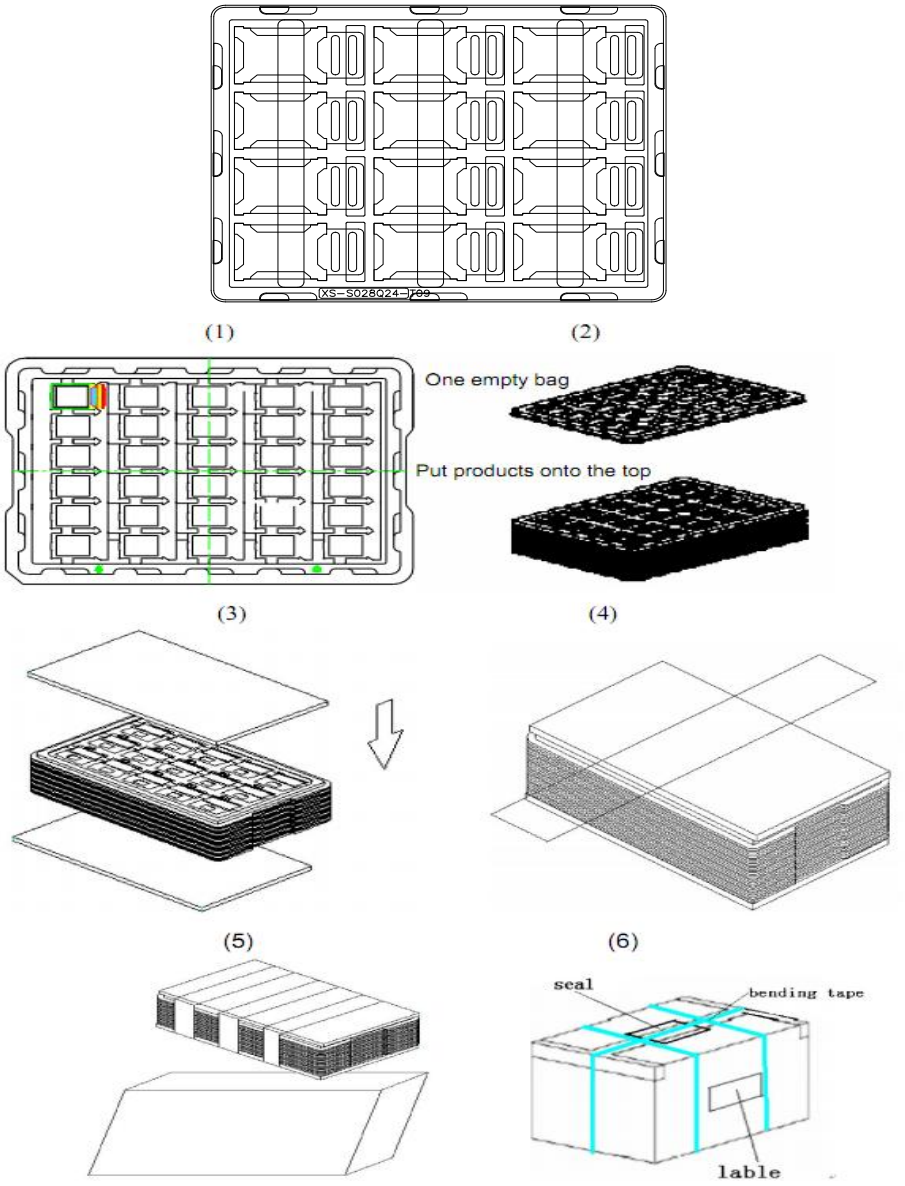
1). Air bubble in the LCD
2). Seal leak or Glass crack
3). Non display or abnormal display
4). Brightness reduction >50%

# 8. Mechanical Drawing



# 9. Packing

**Packing Method**




Steps:

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

# 10. Precautions for Use of LCD modules

## 10.1 Handling Precautions

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

10.1.2. 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.

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

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

10.1.5. 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

10.1.6. Do not attempt to disassemble the LCD Module.

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

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

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

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

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

10.1.8.4. 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.

## 10.2 Storage Precautions

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

10.2.2.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%

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

## 10.3 Transportation Precautions

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