# KEEN SIDE
electronics

## LCD MODULE

## MODULE NO. :

## KSET03507N-A40

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

| | | |
|---|---|---|
| Approved by | Checked by | Prepared by |
| | | |

# RECORDS OF REVISION

| Part Number | Revision | Revision Content | Revised on |
|---|---|---|---|
| KSET03507N-A40 | 1.0 | First issue | July. 9th, 2019 |
|  |  |  |  |

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## 1. General Specifications

| Feature | | Spec |
|---|---|---|
| Display Spec | Size | 3.5 inch |
| | Resolution | 320(RGB) x 480 |
| | Interface | RGB 24 bits |
| | Technology type | a-si TFT |
| | Pixel pitch(mm) | 0.153 x 0.153 |
| | Display colors | 262K |
| | TFT Driver IC: | ILI9488 |
| | Viewing Direction | IPS |
| Mechanical Characteristics | LCM(W x H x D )(mm) | 54.66 x 82.94 x 2.20(MAX) |
| | Active Area(mm) | 48.96 x 73.44 |
| | Weight (g) | TBD |
| | LED Numbers | 6 LEDS |

Note 1: Viewing direction for best image quality is different from TFT definition; there is a 180 degree shift.
Note 2: Requirements on Environmental Protection: RoHS.
Note 3: LCM weight tolerance:+/-5%.

## 2. Input/Output Terminals

| No. | Symbol | Description |
|---|---|---|
| 1 | XR | Touch Pane pin |
| 2 | YU | |
| 3 | XL | |
| 4 | YD | |
| 5 | GND | System Ground |
| 6 | VCC | Analog power supply |
| 7 | VCC | Analog power supply |
| 8 | FMARK | Frame head pulse |
| 9 | CS | Chip select input pin |
| 10 | RS | Data/Instruction selection pin |
| 11 | WR/SCL | Write control pin |
| 12 | RD | Read control pin |
| 13 | SDI | Serial data input pin and used for the DBI type C mode. |
| 14 | SDO | |
| 15 | RESET | This signal reset pin |
| 16 | GND | System Ground |
| 17-32 | DB0-DB15 | Data Bus |
| 33 | LED-A | Backlight LED Anode. |
| 34 | LED-K1 | Backlight LED cathode |
| 35 | LED-K2 | Backlight LED cathode |
| 36 | LED-K3 | Backlight LED cathode |
| 37 | GND | System Ground |
| 38 | IM0 | Interface Mode Select |
| 39 | IM1 | |
| 40 | IM2 | |

## 3. Absolute Maximum Ratings

| Item | Symbol | MIN | MAX | Unit | Remark |
|---|---|---|---|---|---|
| Supply Voltage | $V_{CI}$ | -0.3 | +4.6 | V | 2 |
| | IOVCC | -0.3 | +4.6 | V | 1 |
| Operating Temperature | $T_{OPR}$ | -20 | 70 | ℃ | |
| Storage Temperature | $T_{STG}$ | -30 | 80 | ℃ | |

Notes:

1. Make sure IOVCC ≥ GND

2. Make sure VCI ≥ GND.

## 4. Electrical Characteristics

### 4.1 Driving TFT LCD Panel
<div align="right">Ta = 25 °C</div>

| Item | Symbol | MIN | TYP | MAX | Unit | Remark |
|---|---|---|---|---|---|---|
| Digital Supply Voltage | IOVCC | 1.65 | 2.8 | 3.3 | V | |
| Analog Supply Voltage | VCI | 2.5 | 2.8 | 3.3 | V | |
| Logic High level input voltage | $V_{IH}$ | 0.7*IOVCC | - | IOVCC | V | |
| Logic Low level input voltage | $V_{IL}$ | 0 | - | 0.3* IOVCC | V | |
| Logic High level Output voltage | $V_{IH}$ | 0.7*IOVCC | - | IOVCC | V | |
| Logic Low level Output voltage | $V_{IL}$ | 0 | | 0.2* IOVCC | V | |

### 4.2. Driving Backlight
<div align="right">Ta = 25 °C,</div>

| Item | Symbol | MIN | TYP | MAX | Unit | Condition |
|---|---|---|---|---|---|---|
| Forward Current | $I_F$ | - | 90 | 120 | mA | |
| Forward Voltage | $V_F$ | 2.8 | 3.0 | 3.2 | V | IF=15*6mA |
| Backlight Power consumption | $W_{BL}$ | - | -- | 480 | mW | |
| Luminance for LCM | | - | 280 | -- | Cd/m$^2$ | |

Note: 1. the figure below shows the connection of backlight LED.
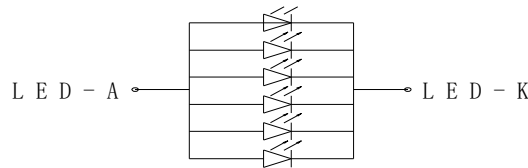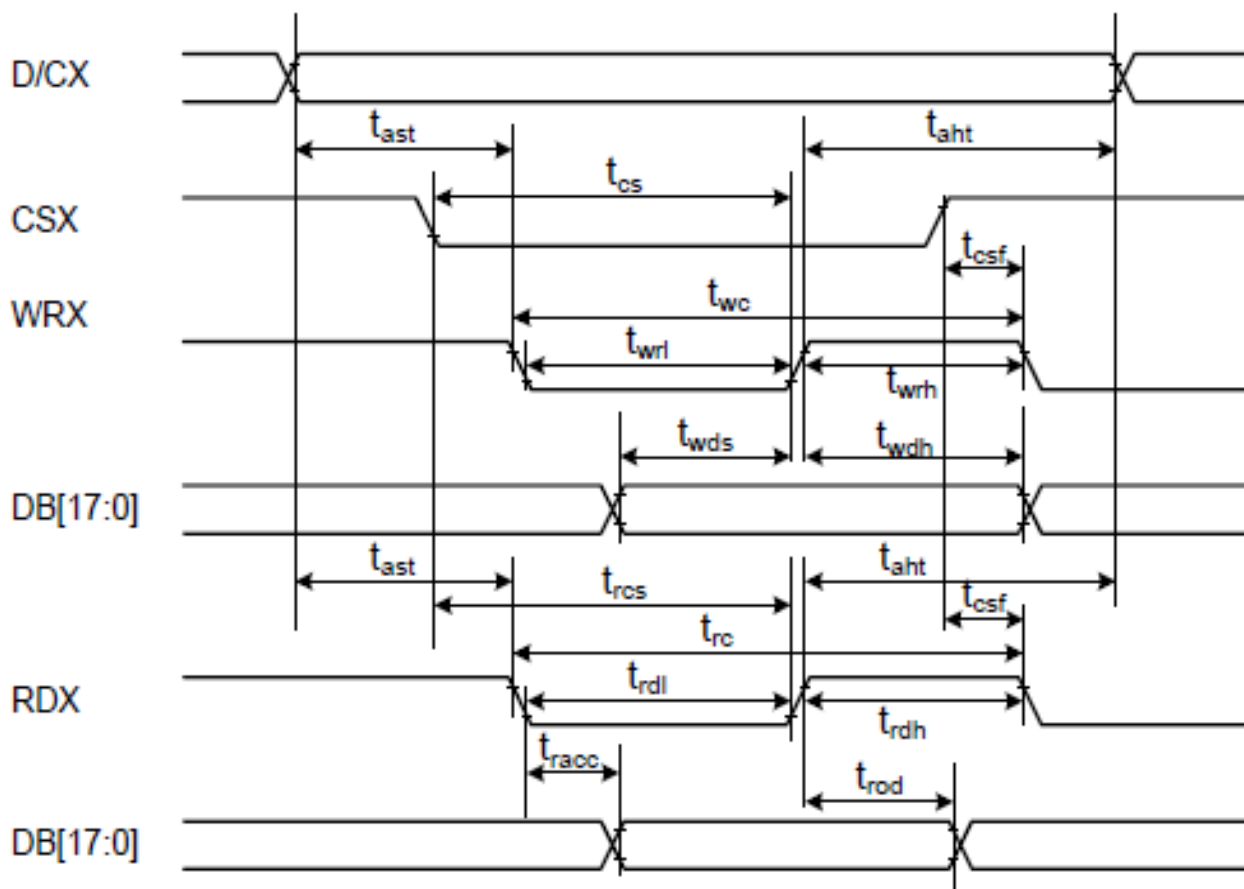


### 4.3 Block Diagram
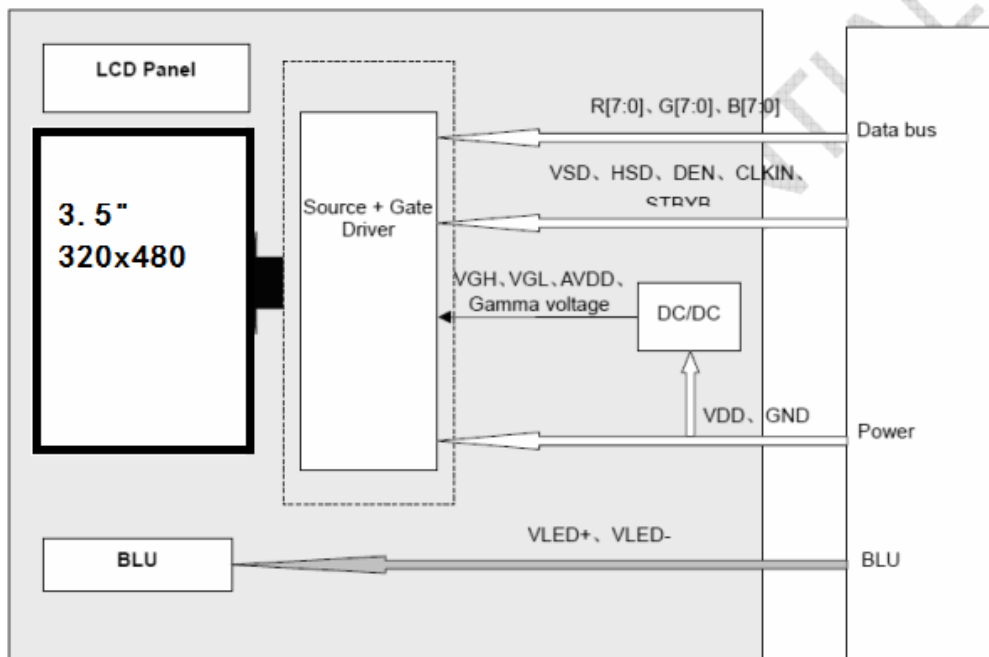
## 5. Timing Chart
### 5.1 DBI Type B (18/16/9/8 bit) Interface Timing Characteristics



| Signal | Symbol | Parameter | min | max | Unit | Description |
|---|---|---|---|---|---|---|
| D/CX | tast | Address setup time | 10 | - | ns | |
| | taht | Address hold time (Write/Read) | 10 | - | ns | |
| CSX | tcs | Chip Select setup time (Write) | 20 | - | ns | |
| | trcs | Chip Select setup time (Read) | 20 | - | ns | |
| | tcsf | Chip Select Wait time (Write/Read) | 20 | - | ns | |
| WRX | twc | Write cycle | 100 | - | ns | |
| | twrh | Write Control pulse H duration | 30 | - | ns | |
| | twrl | Write Control pulse L duration | 20 | - | ns | |
| RDX | trc | Read cycle | 450 | - | ns | |
| | trdh | Read Control pulse H duration | 250 | - | ns | |
| | trdl | Read Control pulse L duration | 170 | - | ns | |
| DB[17:0], DB[15:0], DB[8:0], DB[7:0] | twds | Write data setup time | 15 | - | ns | For maximum CL=30pF For minimum CL=8pF |
| | twdh | Write data hold time | 25 | - | ns | |
| | tracc | Read access time | 10 | 340 | ns | |
| | trod | Read output disable time | 10 | - | ns | |

Note: Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

Note: Ta = -30 to 70 °C, IOVCC=1.65V to 3.3V, VCI=2.5V to 3.3V, GND=0V

## 5.2 DBI Type C Interface Timing Characteristics
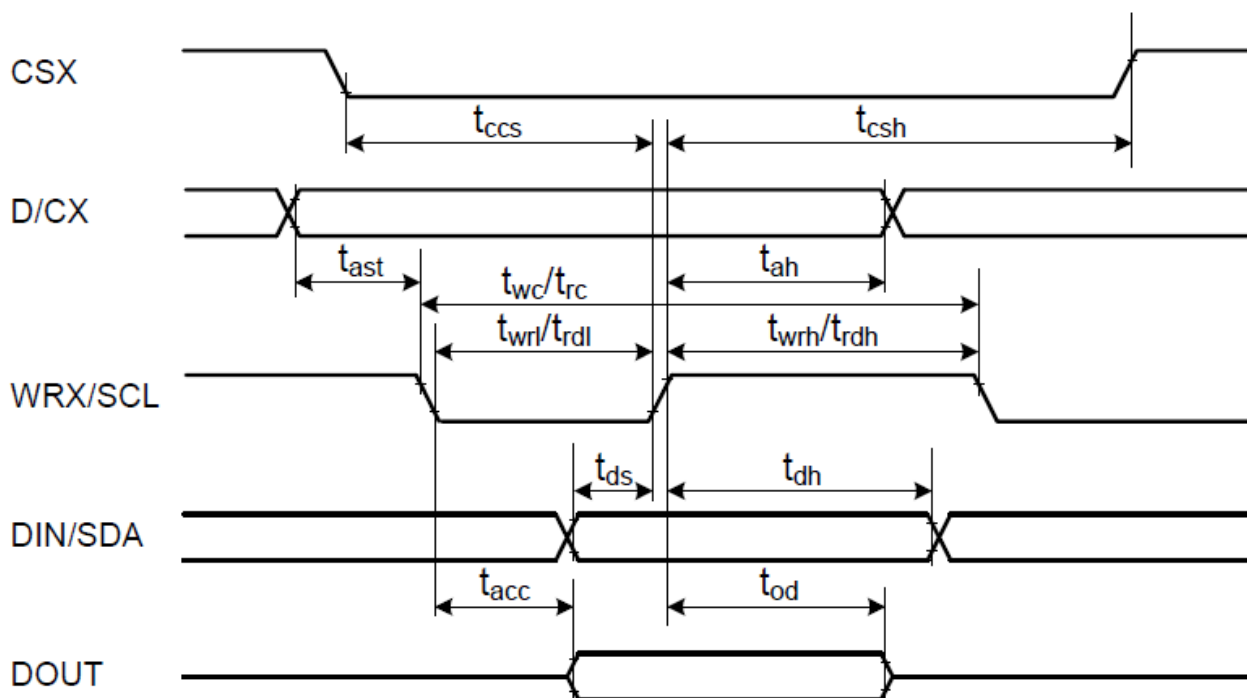


| Signal | Symbol | Parameter | Min. | Max. | Unit | Description |
|---|---|---|---|---|---|---|
| CSX | $t_{css}$ | Chip select setup time (Write) | 40 | - | ns | |
| | $t_{csh}$ | Chip select hold time (Write) | 40 | - | ns | |
| D/CX | $t_{as}$ | Address setup time | 10 | | ns | |
| | $t_{ah}$ | Address hold time (Write/Read) | 10 | | ns | |
| WRX/SCL (Write) | $t_{wc}$ | Write cycle | 100 | | ns | |
| | $t_{wrh}$ | SCL High duration (write) | 40 | | ns | |
| | $t_{wrl}$ | SCL Low duration (write) | 40 | | ns | |
| WRX/SCL (Read) | $t_{rc}$ | Read cycle | 300 | | ns | |
| | $t_{rdh}$ | SCL High duration (read) | 120 | | ns | |
| | $t_{rdl}$ | SCL Low duration (read) | 120 | | ns | |
| DIN/SDA (Driver IC) | $t_{ds}$ | Data setup time | 30 | | ns | |
| | $t_{dh}$ | Data hold time | 30 | | ns | |
| DOUT (Driver IC) | $t_{acc}$ | Access time | - | 110 | ns | |
| | $t_{od}$ | Output disable time | 10 | | ns | |

## 5.3 Tearing Effect Line Timings

The tearing effect signal is described below:
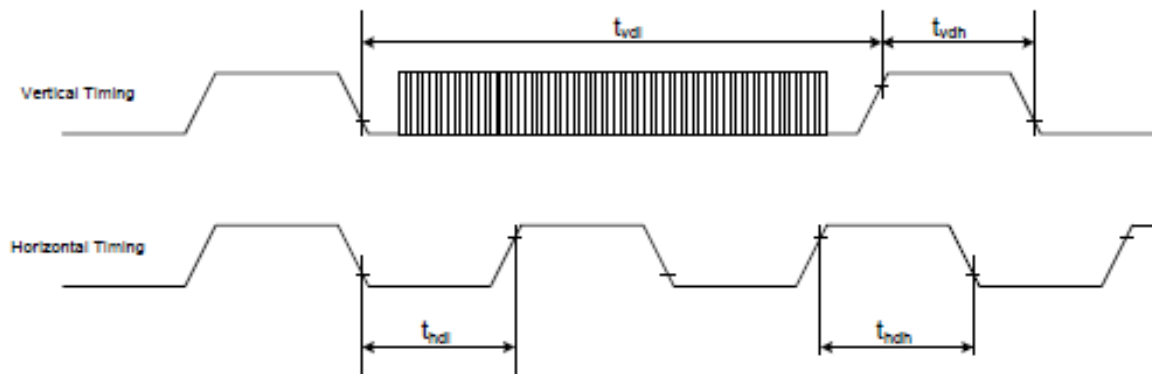


AC characteristics of Tearing Effect Signal (Frame Rate = 60.5Hz)

| Symbol | Parameter | Min. | Max. | Unit | Description |
|--------|-----------|------|------|------|-------------|
| $t_{vdl}$ | Vertical timing low duration | TBD | | ms | |
| $t_{vdh}$ | Vertical timing high duration | TBD | | us | |
| $t_{hdl}$ | Horizontal timing low duration | TBD | | us | |
| $t_{hdh}$ | Horizontal timing high duration | TBD | | us | |

Notes:

1. The timings in Table 8.3.1 apply when MADCTL B4=0 and B4=1

2. The signal's rise and fall times (tf, tr) are stipulated to be equal to or less than 15ns.
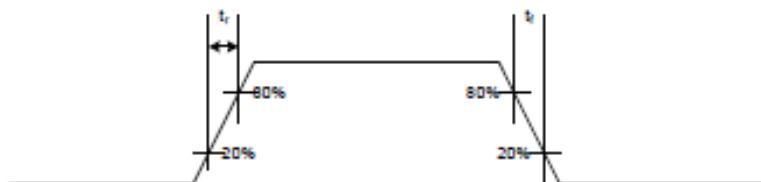


The Tearing Effect Output Line is fed back to the MCU and should be used as shown below to avoid Tearing Effect:

The Tearing Effect output line supplies to the MCU a Panel synchronization signal. This signal can be enabled or disabled by the set_tear_off(34h), set_tear_on(35h) commands. The mode of the Tearing Effect Signal is defined by the Parameter of the Tearing Effect Line On command. The signal can be used by the MCU to synchronize Frame Memory Writing when displaying video images.

| TEON (35h) | TELOM (35h, 1st bit) | TE signal Output |
|------------|----------------------|------------------|
| 0 | * | GND |
| 1 | 0 | TE (Mode 1) |
| 1 | 1 | TE (Mode 2) |

## 6. Optical Characteristics
### Optical specifications

| Items | | Symbol | Condition | Specifications Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio | | CR | θ =0 | 300 | 400 | - | - | |
| Response Time | | $T_R$ | 25℃ | - | 20 | 30 | ms | |
| | | $T_F$ | | - | 20 | 30 | ms | |
| Chromatics | Red | $X_R$ | | 0.611 | 0.613 | 0.615 | - | |
| | | $Y_R$ | | 0.333 | 0.335 | 0.337 | - | |
| | Green | $X_G$ | | 0.305 | 0.307 | 0.309 | - | |
| | | $Y_G$ | | 0.558 | 0.560 | 0.562 | - | Note |
| | Blue | $X_B$ | | 0.133 | 0.135 | 0.137 | - | |
| | | $Y_B$ | | 0.158 | 0.160 | 0.162 | - | |
| | White | $X_W$ | | 0.324 | 0.326 | 0.328 | - | |
| | | $Y_W$ | | 0.364 | 0.366 | 0.368 | - | |
| Viewing angle | Hor. | φR(3 o'clock) | Center CR≥10 | 70 | 80 | - | deg. | |
| | | φL(9 o'clock) | | 70 | 80 | - | | |
| | Ver. | θU(12 o'clock) | | 70 | 80 | - | | |
| | | θD(6 o'clock) | | 70 | 80 | - | | |
| Uniformity | | U | | 75 | 80 | | | |
| NTSC ratio | | | | | 50 | | % | |
| Luminance | | Lv | | 280 | -- | | cd/m$^2$ | |
| Hardness | | | | | 3H | | | |
| Operating life time | | | $I_{BL}$=90mA | -- | 50000 | | h | |

**Note 1: Definition of Contrast Ratio (CR):**

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L63 / L0

L63: Luminance of gray level 63

L0: Luminance of gray level 0

CR = CR (10)

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note 5.

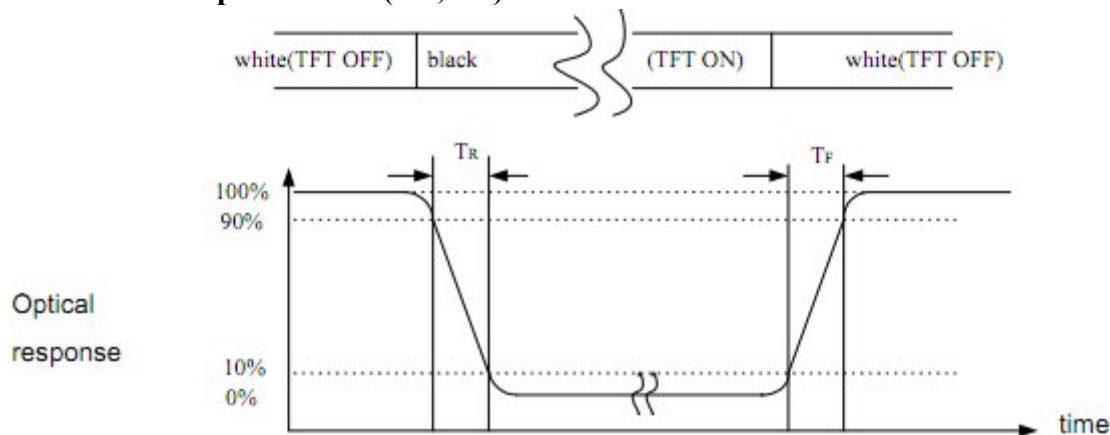**Note 2: Definition of Response Time (TR, TF):**
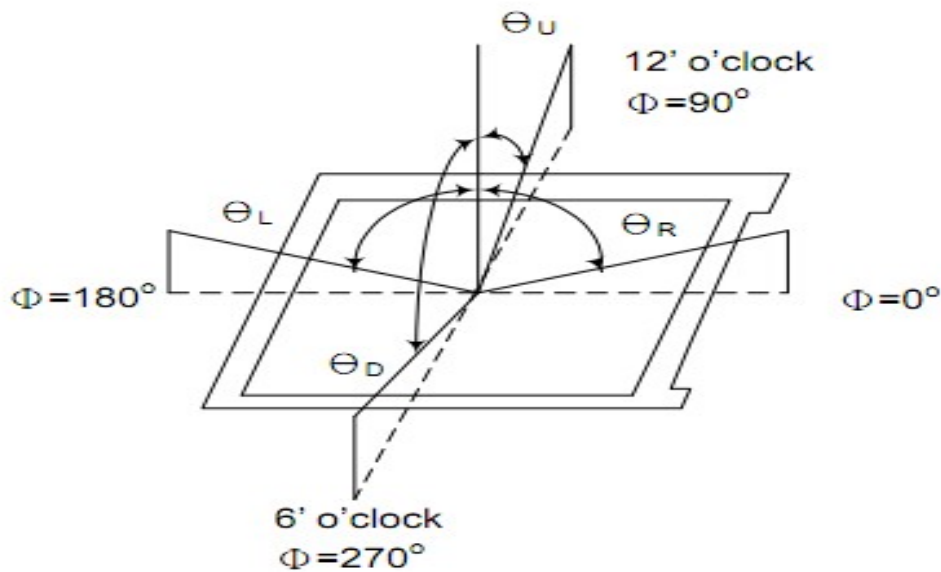


Figure 2

**Note 3: Viewing Angle:**



Figure 3

The above "Viewing Angle" is the measuring position with Largest Contrast Ratio; not for good image quality. View Direction for good image quality is 6 O'clock. Module maker can increase the "Viewing Angle" by applying Wide View Film.

**Note 4: Measurement Set-Up:**

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.
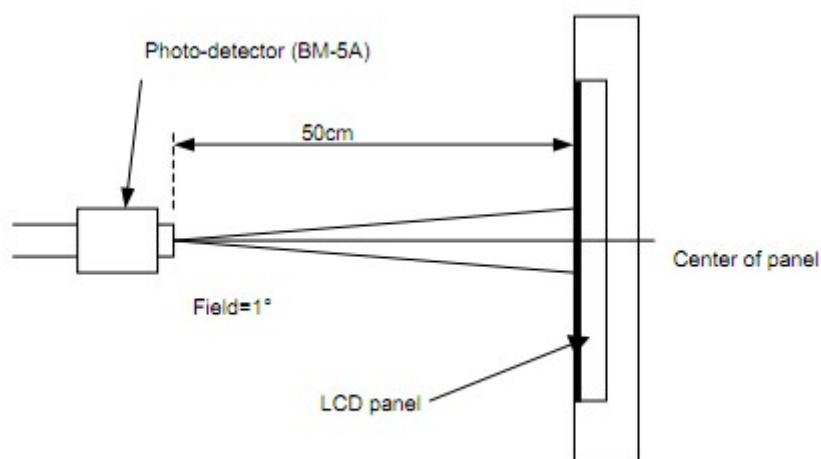


Figure 4

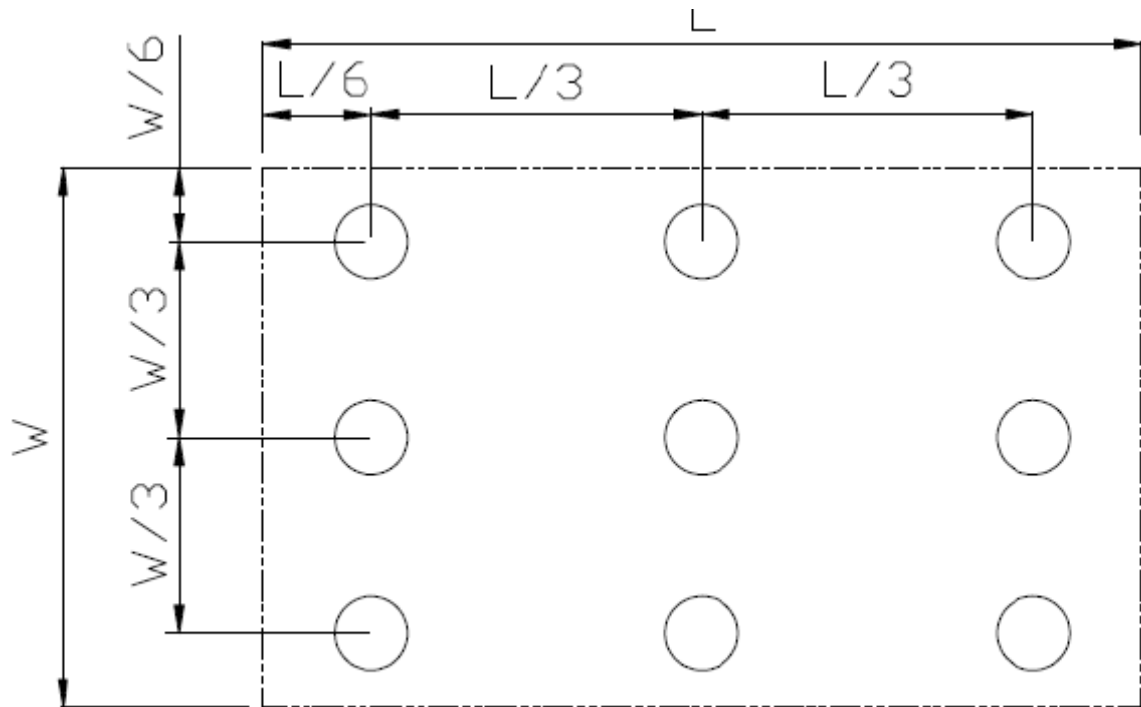**Note 5: Definition of colder chromaticity (CIE61747-1)**

Color coordinates measured at center point of LCD.

**Note 6: Definition of Luminance Uniformity**

Active area is divided into 9 measuring areas (Refer Fig.2) Every measuring point is placed at the center of each measuring area.

Luminance Uniformity(U) = Limn/Lmax

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



Fig. 2 Definition of uniformity

Lmax: The measured maximum luminance of all measurement position.

Lmin: The measured minimum luminance of all measurement position.
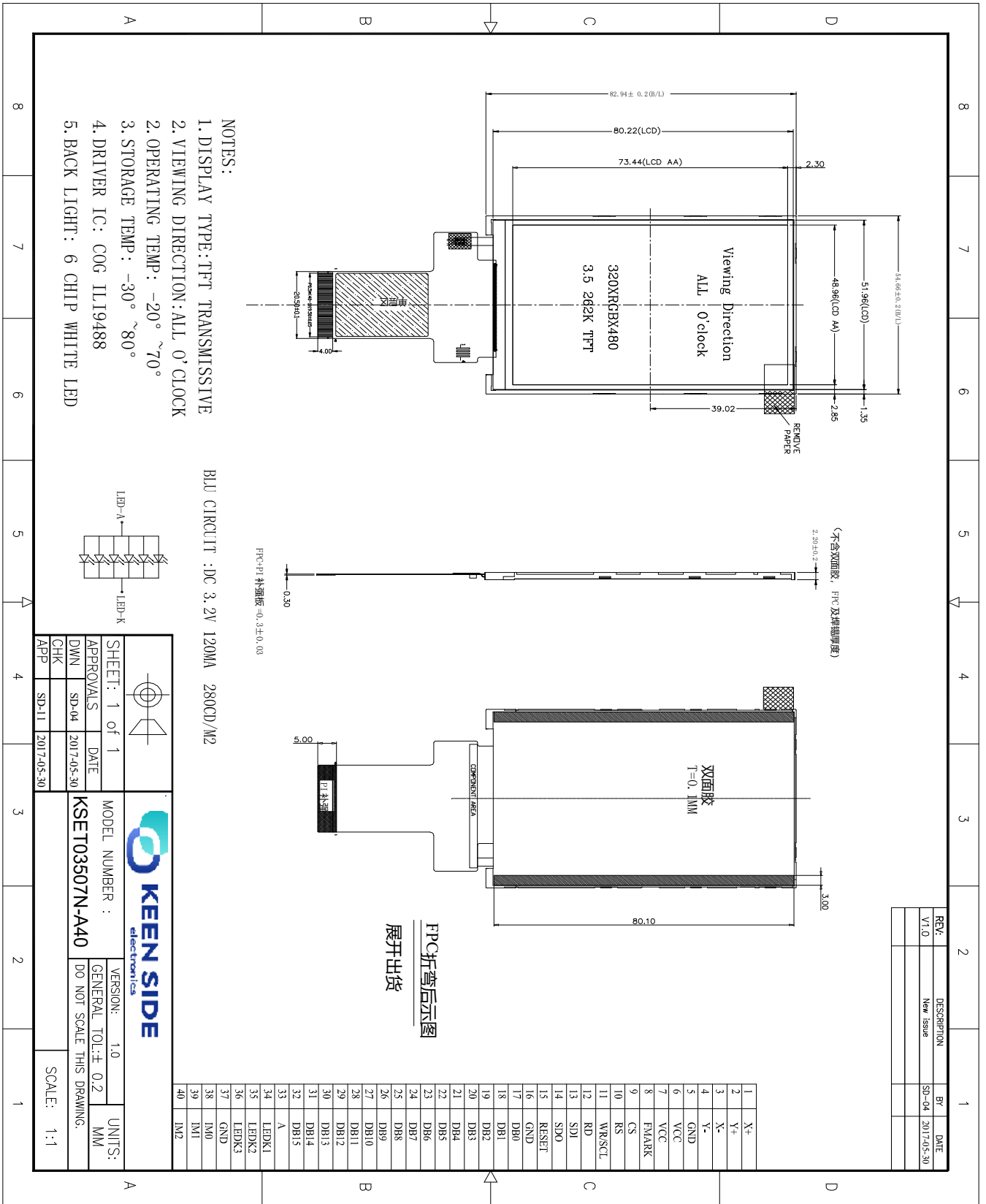
**Note 7: Definition of Luminance**

Measure the luminance of white state at chanter point.

## 7. Environmental / Reliability Tests

| No | Test Item | Condition | Remarks |
|---|---|---|---|
| 1 | High Temperature Opeartion | Ts= +70℃, 96hrs | Note 1 IEC60068-2-2, GB2423. 2-89 |
| 2 | Low Temperature Opeartion | 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= +70℃, 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) | -30℃  30 min ~ +80℃  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 (Operations) | 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/T2423.5-1998 |
| 10 | Package Drop Test | Height: 80 cm, 1 corner, 3 edges, 6 surfaces | IEC60068-2-32 GB/T2423.8-1995 |

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

2. Ta is the ambient temperature of sample.

## 8. Mechanical Drawing

## 9. Packing
 **Packing Method**

(1)

(2)

One empty bag

Put products onto the top

(3)

(4)

(5)

(6)

seal

bending tape

lable
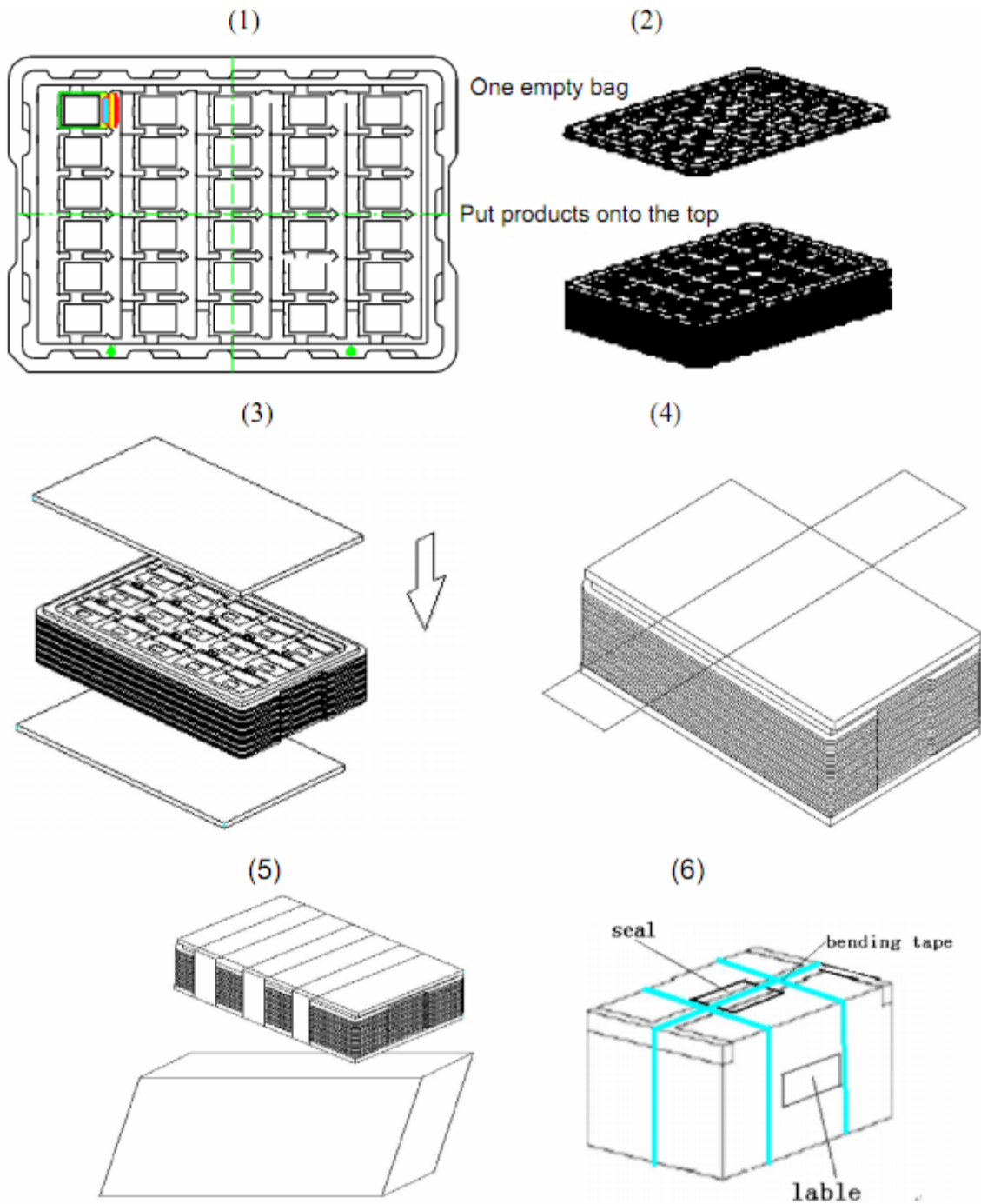
1. Put module into tray cavity:

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.