



深圳市一众显示科技有限公司

SHEN ZHEN TEAM SOURCE DISPLAY TECH. CO, TD.

# TFT-LCD Module Specification

**Module NO.:** TST150XR01

**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        | 2018-05-30 | Initial Release |        |
|             |            |                 |        |

## REVISION STATUS

[illegible]

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## 1. OVERVIEW

**TST150XR01** is 15.0" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs ,control circuit and LED backlight. By applying 8 bit digital data (6 bit+HFRC) ,1024×768,16.7M-color images are displayed on the 15.0" diagonal screen. Input power voltage is 3.3V for LCD driving. Converter for backlight is included in this module.

General specifications are summarized in the following table:

| ITEM                            | SPECIFICATION                                         |
|---------------------------------|-------------------------------------------------------|
| Display Area (mm)               | 304.128(H)x228.096(V) (15.0-inch diagonal)            |
| Number of Pixels                | 1024(H) x 768 (V)                                     |
| Pixel Pitch (mm)                | 0.297 (H) x 0.297 (V)                                 |
| Color Pixel Arrangement         | RGB vertical stripe                                   |
| Display Mode                    | Normally White (TN)                                   |
| Number of Colors                | 16.7M ( 6 Bit+HFRC )                                  |
| Brightness (cd/m <sup>2</sup> ) | 450 cd/m                                              |
| Response Time (ms)              | 8 (typ) / 15 (max)                                    |
| Optimum Viewing Direction       | 6 o'clock (Max. contrast ratio, Gray level inversion) |
| Contrast Ratio                  | 700:1(typ) / 500:1(min)                               |
| Viewing Angle ( CR ≥ 10)        | 160(typ) / 140(min) (H) ; 140(typ) / 120(min) (V)     |
| Power Consumption (W)           | TBD                                                   |
| Interface connection            | LVDS                                                  |
| Module Size (mm)                | 326.5 (H) × 253.5 (V) × 11 (D)                        |
| Module Weight (g)               | TBD                                                   |
| Backlight Unit                  | LED (White LED)                                       |
| Surface Treatment               | Anti-Glare                                            |

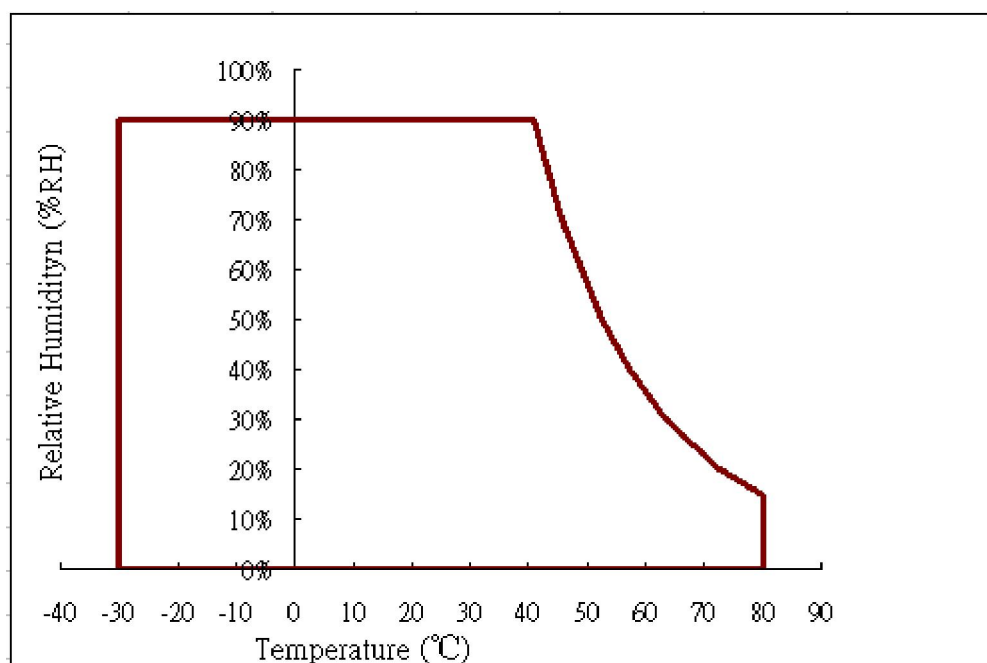
## 2. ABSOLUTE MAXIMUM RATINGS

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

| ITEM                                    | SYMBOL  | MIN. | MAX. | UNIT | REMARK         |
|-----------------------------------------|---------|------|------|------|----------------|
| Power Supply Voltage for LCD            | VCC     | 0    | 4    | V    |                |
| Logic Input Voltage                     | DVDD    | 0    | 4    | V    |                |
| Backlight Power Supply Voltage          | VLED    | 0    | 14   | V    |                |
| Backlight ON-OFF Voltage                | LED_EN  | 0    | 7    | V    |                |
| Backlight Dimming Control Input Voltage | LED_PWM | 0    | 7    | V    |                |
| Operation Temperature                   | Top     | -30  | 80   | °C   | 1). 2). 3). 4) |
| Storage Temperature                     | Tstg    | -30  | 80   | °C   | 1). 2). 3). 4) |

[Note]

- 1)The relative temperature and humidity range are as below sketch, 90%RHMax.(Ta
- 2).The maximum wet bulb temperature  $\leq 39^{\circ}\text{C}$ (Ta  $> 40^{\circ}\text{C}$ ) and without dewing.
- 3).If you use the product in an environment which over the definition of temperature and humidity too long to effect the result of eye-etching.
- 4).If you operate the product in normal temperature range, the center surface of front side panel should be under  $80^{\circ}\text{C}$



### 3. ELECTRICAL CHARACTERISTICS

#### 3.1 TFT LCD

Ta=25°C

| ITEM                                  |                            | SYMBOL | MIN               | TYP      | MAX                     | UNIT | Remark                              |
|---------------------------------------|----------------------------|--------|-------------------|----------|-------------------------|------|-------------------------------------|
| LCD Power Voltage                     |                            | Vcc    | 3.0               | 3.3      | 3.6                     | V    |                                     |
| LCD Power Current                     |                            | Icc    | -                 | (330)    | (TBD)                   | mA   | *1)                                 |
| LCD Inrush Current                    |                            | Inrush |                   |          | 2                       | A    | *4)                                 |
| Logic input voltage<br>LVDS:IN+ · IN- | Common Mode Voltage        | VCM    | $\frac{ VID }{2}$ | -        | $2.4 - \frac{ VID }{2}$ | V    | Logic Input Voltage (LVDS: IN+,IN-) |
|                                       | Differential Input Voltage | VID    | 200               | -        | 600                     | mV   | *2)                                 |
|                                       | Threshold Voltage(High)    | VTH    | -                 | -        | 100                     | mV   |                                     |
|                                       | Threshold Voltage(Low)     | VTL    | -100              | -        | -                       | mV   |                                     |
| 1 Data time                           |                            | UI     | -                 | tclk*1/7 | -                       | tclk | *3)                                 |
| LVDS clock to data skew               |                            | tskew  | -                 | -        | 300                     | ps   |                                     |
| input data eye width                  |                            | teyw   | 1409              | -        | -                       | ps   |                                     |
| Logic Input Voltage                   | LVDS IN+                   |        | 0.7*DVDD          | -        | DVDD                    | V    | Logic Input Voltage                 |
|                                       | LVDS IN-                   |        | GND               | -        | 0.3*DVDD                | V    |                                     |
| Power consumption                     |                            | P      |                   | (TBD)    | (TBD)                   | W    |                                     |

[Note]

1).TYP. specification : Gray-level test Pattern (TYP Freq. @3.3V)

MAX. specification : Black test Pattern (MAX Freq. @3.0V)

The current is root mean square value (RMS)

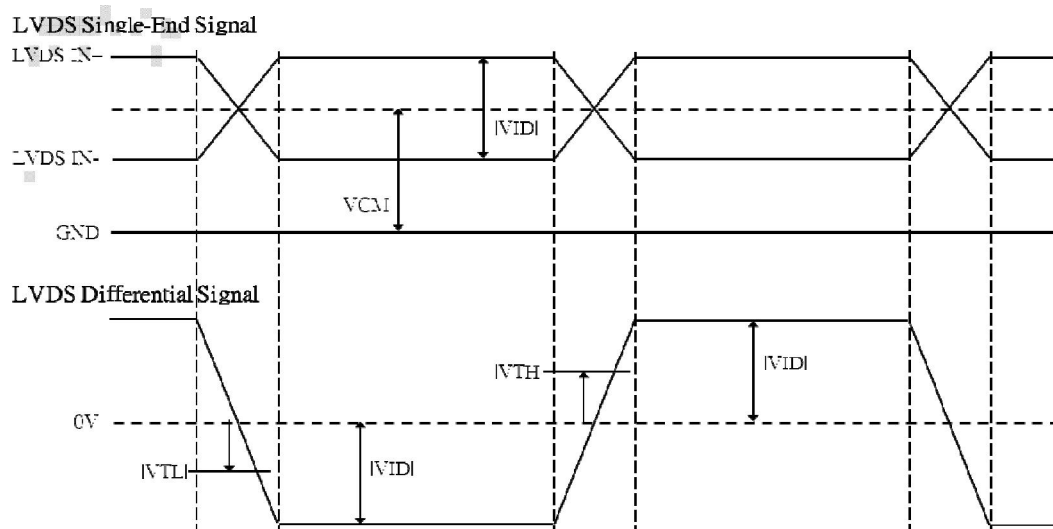


Gray-level Pattern



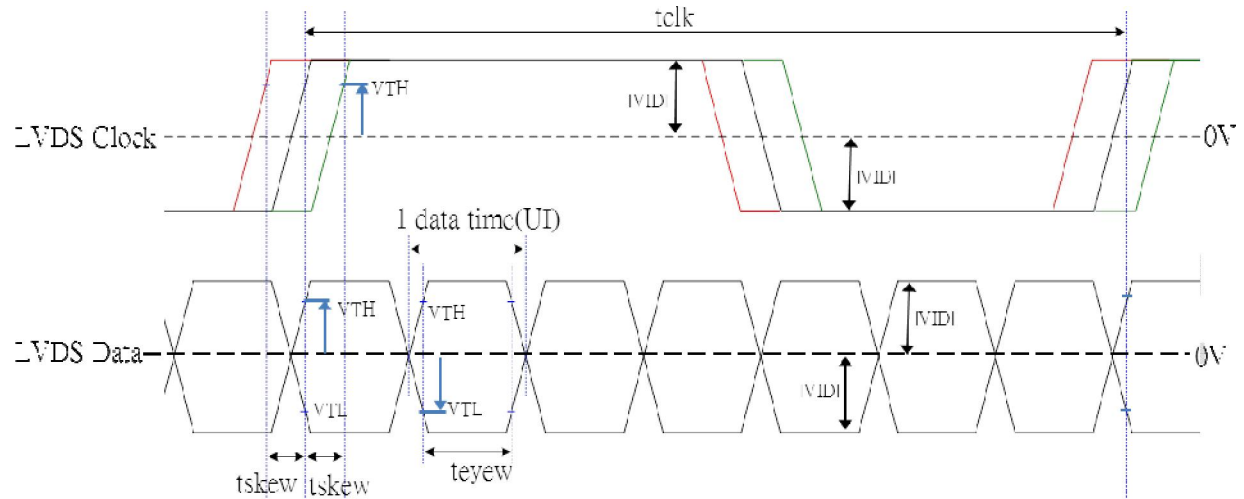
Black Pattern

2).LVDS DC electrical characteristics :

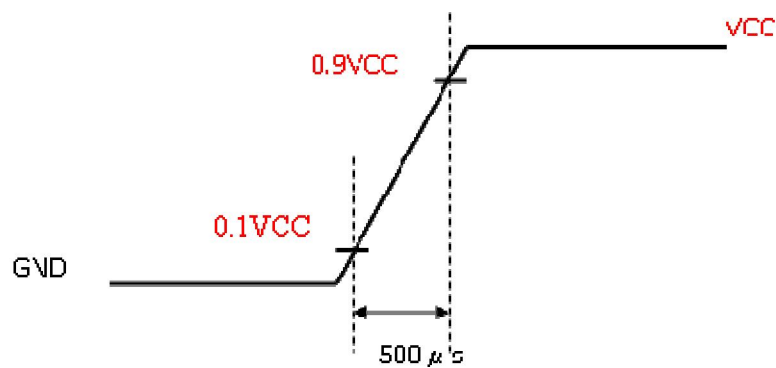
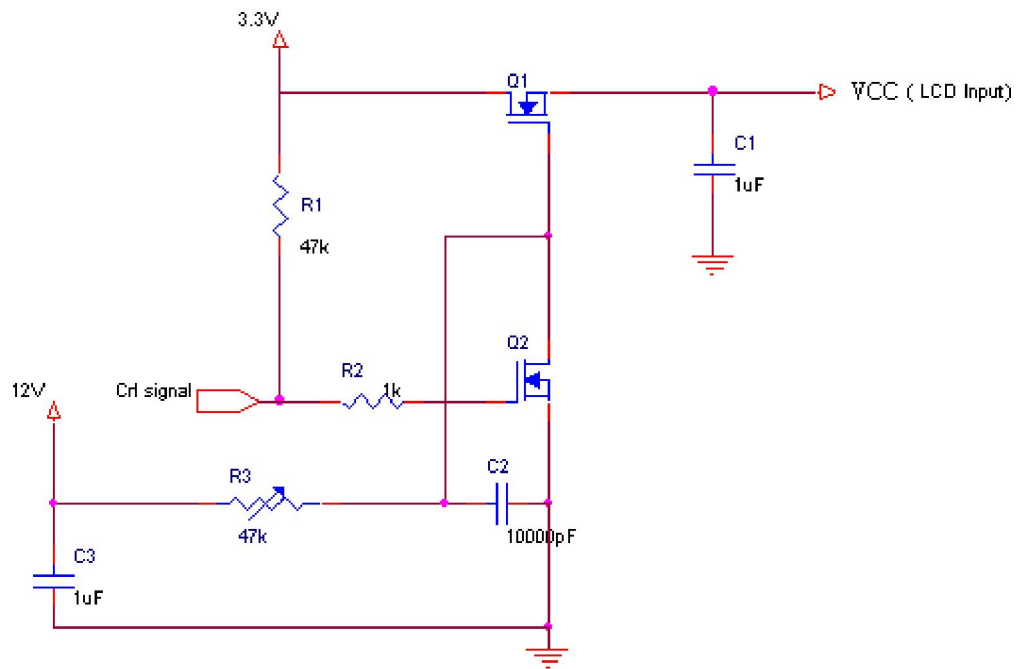


### 3) LVDS AC electrical characteristics :

The following condition is base on operation frequency at MAX MHz



### 4).Irush Measurement Condition



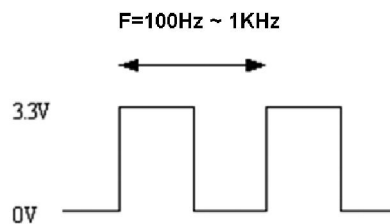
### 3.2. Converter Specification for Backlight

Ta = 25°C

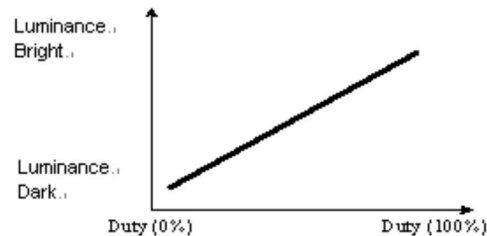
| Item                             | Symbol     | Min. | Typ.  | Max.  | Unit | Note            |
|----------------------------------|------------|------|-------|-------|------|-----------------|
| LED Driver Input Voltage         | VLED       | 10.8 | 12.0  | 13.2  | V    |                 |
| LED Driver Input Current         | IVLED      | --   | (TBD) | (TBD) | mA   | *1)             |
| LED Driver Inrush Current        | VLED_Irush |      |       | 2     | A    | *3)             |
| Internal Dimming Control Voltage | High       | 2.4  | --    | 5.5   | V    | Dimming Control |
|                                  | Low        | 0    | --    | 0.8   |      |                 |
| External PWM Frequency           | LED_PWM    | 100  | 200   | 1K    | Hz   | *2)             |
| Duty Ratio                       |            | 5    | --    | 100   | %    |                 |
| ON/OFF Control Voltage           | ON         | 2.4  |       | 5.5   | V    | ON/OFF Control  |
|                                  | OFF        | 0    |       | 0.8   |      |                 |
| Power Consumption (Backlight )   | BLW        | --   | (TBD) | (TBD) | W    |                 |
| LIFE TIME(Backlight )            |            | --   | 70000 | --    | hr   | *4)             |

\*1) Maximum LED Driver Input Current at 10.8V Input Voltage/PWM Duty 100%.

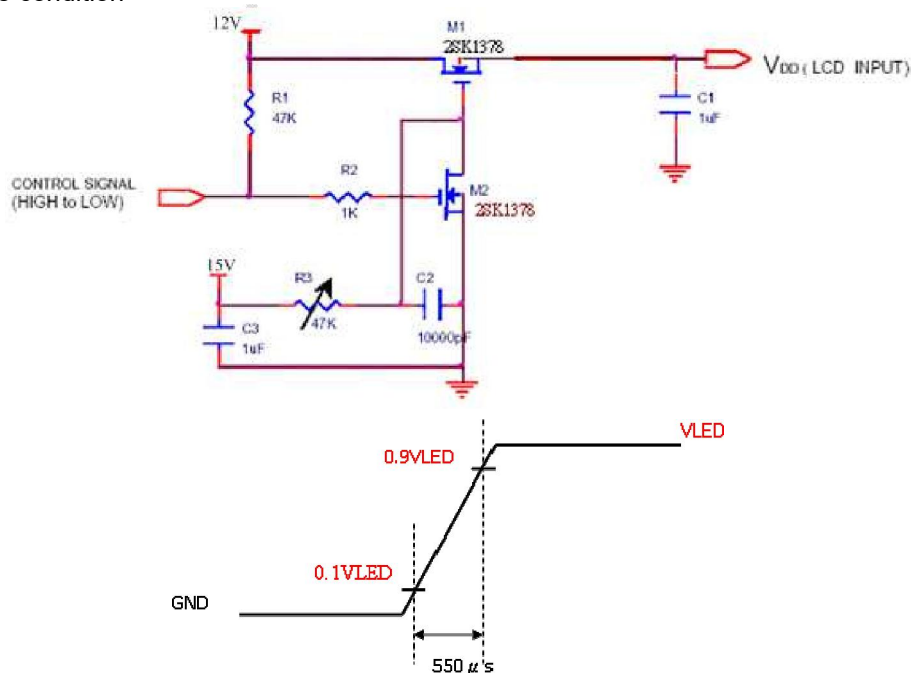
\*2) The ADJ adjust signal level is 0~3.3V , operation frequency:100Hz~1KHz .



The ADJ can adjust LED BL brightness , where Duty and Luminance are in direct ratio.



\*3) Irush measure condition

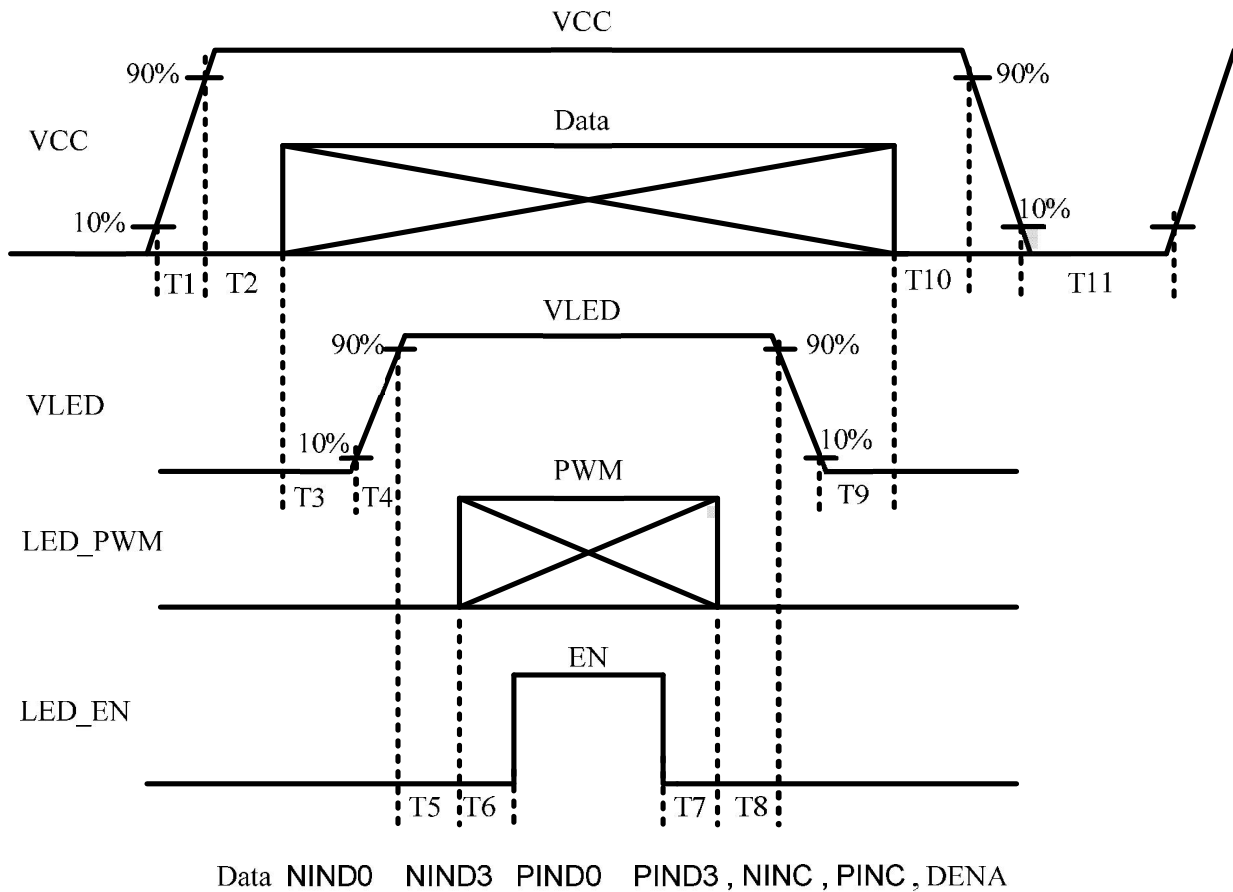


\*4). Definition of the LED life time: Luminance (L) under 50% of the initial value. LED life time is restricted under normal condition, ambient temperature=25°C and LED operation forward current=110mA.

### 3.3. Power and Signal sequence

#### Power Sequence :

|                                            |                         |                          |
|--------------------------------------------|-------------------------|--------------------------|
| $0.50\text{ ms} \leq T1 \leq 10\text{ ms}$ | $200\text{ ms} \leq T3$ | $10\text{ ms} \leq T8$   |
| $0.01\text{ ms} < T2 \leq 50\text{ ms}$    | $10\text{ ms} \leq T5$  | $200\text{ ms} \leq T9$  |
| $0.50\text{ ms} \leq T4 \leq 10\text{ ms}$ | $10\text{ ms} \leq T6$  | $500\text{ ms} \leq T11$ |
| $0.01\text{ ms} < T10 \leq 50\text{ ms}$   | $0\text{ ms} \leq T7$   |                          |



## 4. INTERFACE CONNECTION

### 4.1 CN1 (Data Signal and Power Supply)

Outlet connector: MSB240420HD (STM)

Plug connector: P240420 (STM) or equivalent

| PIN # | SYMBOL | FUNCTION                                            |
|-------|--------|-----------------------------------------------------|
| 1     | VCC    | +3.3V Power Supply                                  |
| 2     | VCC    | +3.3V Power Supply                                  |
| 3     | GND    | GND                                                 |
| 4     | GND    | GND                                                 |
| 5     | RXIN0- | Negative LVDS Differential Data Input               |
| 6     | RXIN0+ | Positive LVDS Differential Data Input               |
| 7     | GND    | GND                                                 |
| 8     | RXIN1- | Negative LVDS Differential Data Input               |
| 9     | RXIN1+ | Positive LVDS Differential Data Input               |
| 10    | GND    | GND                                                 |
| 11    | RXIN2- | Negative LVDS Differential Data Input               |
| 12    | RXIN2+ | Positive LVDS Differential Data Input               |
| 13    | GND    | GND                                                 |
| 14    | RXCLK  | Negative LVDS Differential Clock Input              |
| 15    | RXCLK  | Positive LVDS Differential Clock Input              |
| 16    | GND    | GND                                                 |
| 17    | RXIN3- | Negative LVDS Differential Data Input               |
| 18    | RXIN3+ | Positive LVDS Differential Data Input               |
| 19    | NC     | Not Connected, please keep it floating              |
| 20    | SEL    | Input Mode Select :6-bits(3.3V) / VESA 8-bits(GND ) |

1) Please keep the NC Pin and don't connect it to GND or other signals.

2) GND Pin must connect to the ground, don't let it be a vacant pin.

3) High: 6bit ; Low: 8 bit (VESA)

### 4.2 CN2 (Backlight)

Outlet connector: 3808K-F05N-03L (ENTERY)

Plug connector: H208K-D05N-22B (ENTERY) or equivalent

| PIN # | SYMBOL  | FUNCTION                                        |
|-------|---------|-------------------------------------------------|
| 1     | VLED    | +12V Power Supply                               |
| 2     | GND     | GND                                             |
| 3     | LED_EN  | Input ON-OFF (High: ON, Low or Open: OFF) *1)   |
| 4     | LED_PWM | Light Dimming Control : PWM Input for Dimming ° |
| 5     | NC      | Not Connected, please keep it floating *2)      |

\*1) High=2.4 to 5V, Low=0 to 0.8V or Open.

\*2) Please keep the NC Pin and don't connect it to GND or other signals.

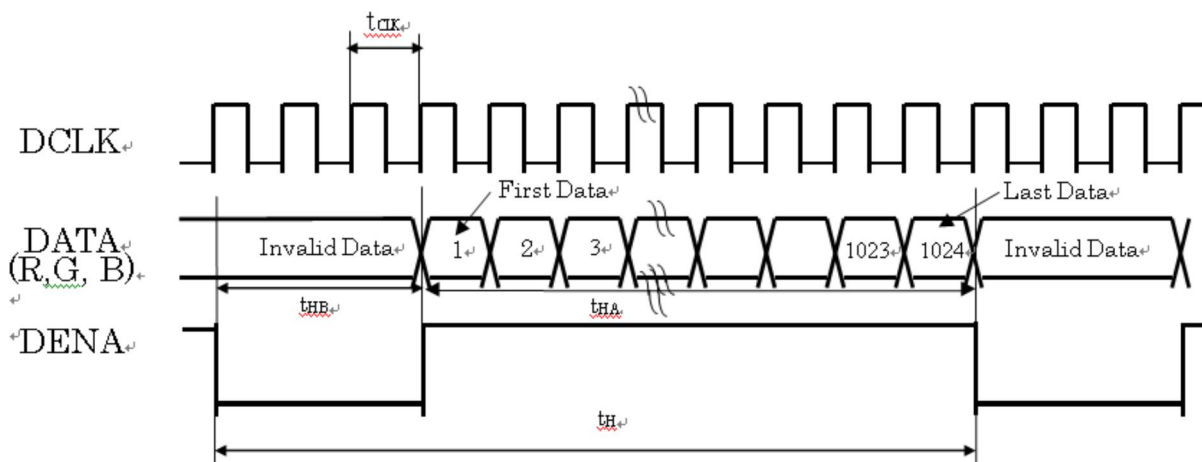
## 5. INPUT SIGNAL

### 5.1 Timing Specification

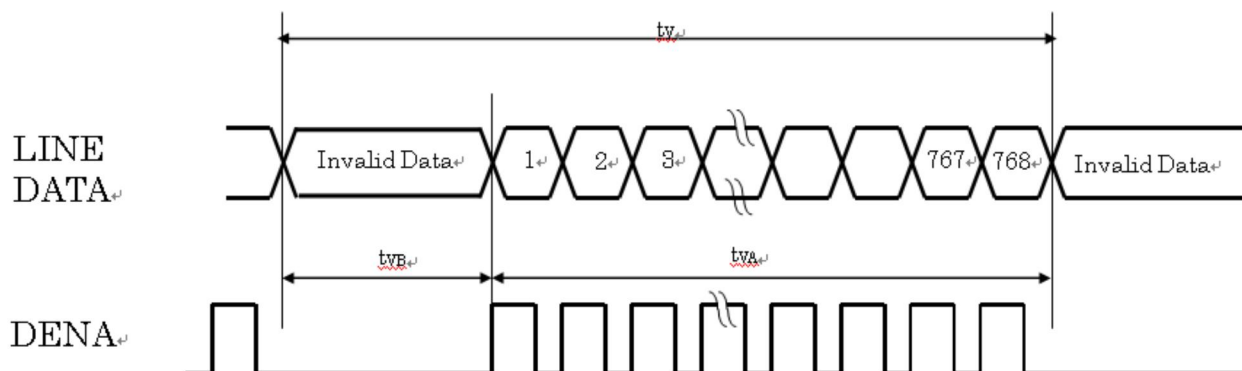
| ITEM          |      |            |                           | SYMBOL           | MIN.           | TYP. | MAX.  | UNIT             |    |
|---------------|------|------------|---------------------------|------------------|----------------|------|-------|------------------|----|
| LCD<br>Timing | DCLK |            | Frequency                 | f <sub>CLK</sub> | 52.14          | 65   | 71.1  | MHz              |    |
|               |      |            | Cycle                     | t <sub>CLK</sub> | 14.1           | 15.4 | 19.18 | ns               |    |
|               | DENA | Horizontal | Horizontal total time     | t <sub>H</sub>   | 1200           | 1344 | 1348  | t <sub>CLK</sub> |    |
|               |      |            | Horiaontal effective time | t <sub>HA</sub>  | 1024           |      |       | t <sub>CLK</sub> |    |
|               |      |            | Horizontal blank time     | t <sub>HB</sub>  | 176            | 320  | 324   | t <sub>CLK</sub> |    |
|               |      | Vertical   | Vertical total time       | t <sub>V</sub>   | 790            | 806  | 810   | t <sub>H</sub>   |    |
|               |      |            | Vertical effective time   | t <sub>VA</sub>  | 768            |      |       | t <sub>H</sub>   |    |
|               |      |            | Vertical blank time       | t <sub>VB</sub>  | 22             | 38   | 42    | t <sub>H</sub>   |    |
|               |      | Frame rate |                           |                  | F <sub>V</sub> | 55   | 60    | 65               | Hz |

### 5.2 Timing Sequence (Timing chart)

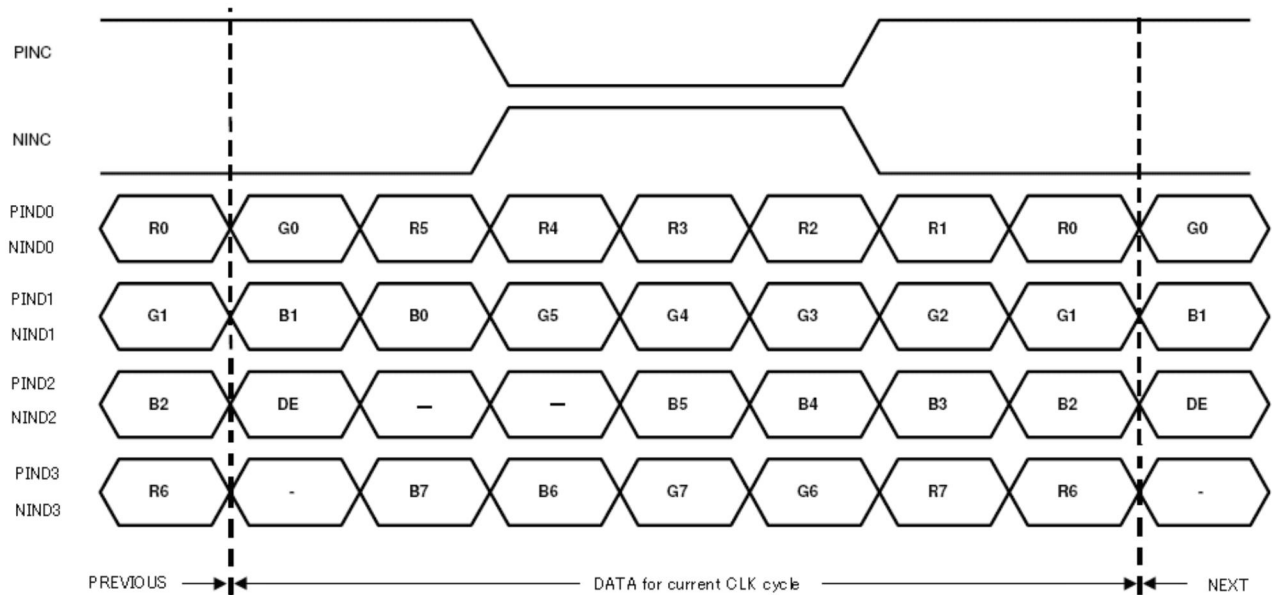
#### 5.2.1 Horizontal Timing Sequence



#### 5.2.2 Vertical Timing Sequence



### 5.2.3 LVDS Input Data(VESA) mapping



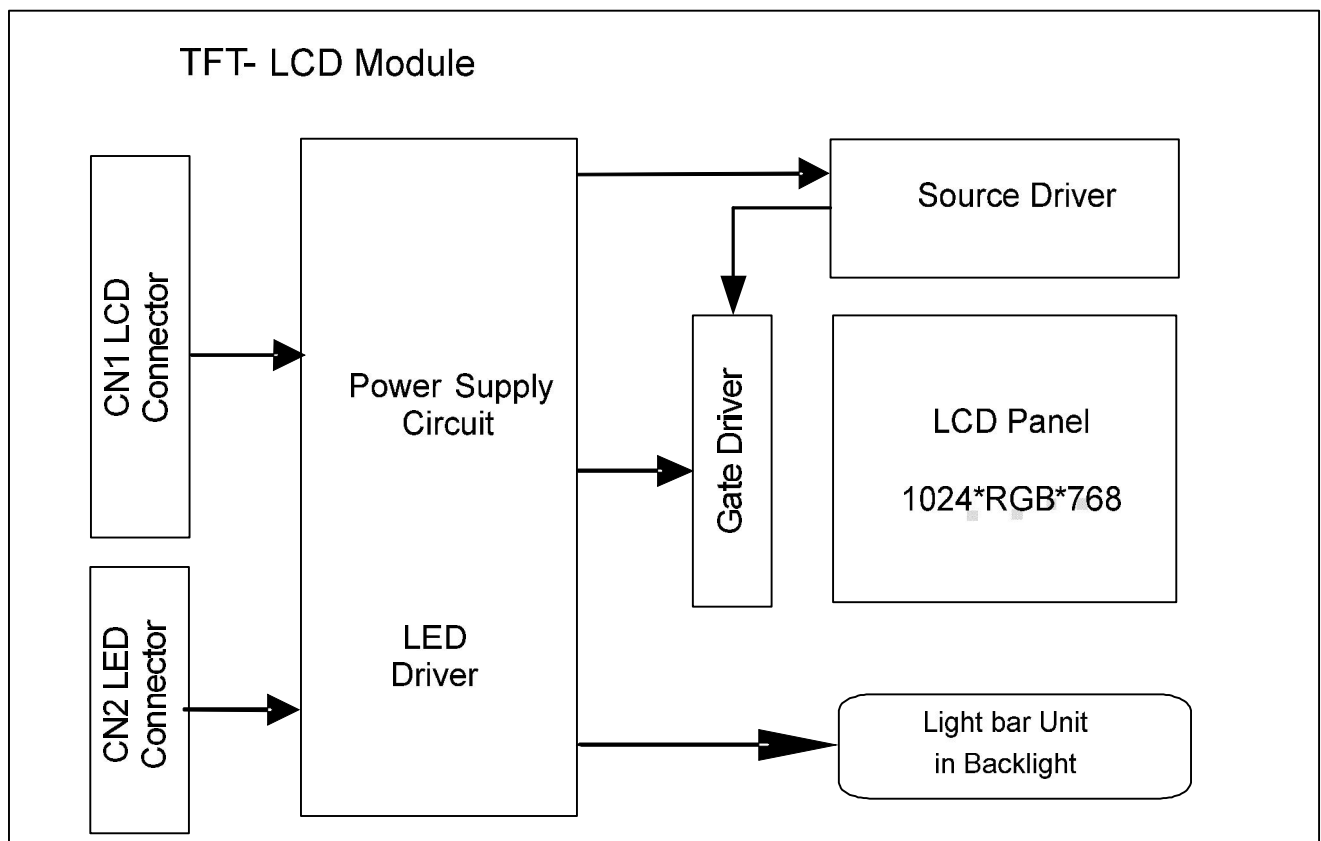
### 5.2.4 Color Data Reference

| COLOR       | INPUT DATA | R DATA    |    |    |    |    |    |    |           | G DATA    |    |    |    |    |    |    |           | B DATA    |    |    |    |    |    |    |           |
|-------------|------------|-----------|----|----|----|----|----|----|-----------|-----------|----|----|----|----|----|----|-----------|-----------|----|----|----|----|----|----|-----------|
|             |            | R7<br>MSB | R6 | R5 | R4 | R3 | R2 | R1 | R0<br>LSB | G7<br>MSB | G6 | G5 | G4 | G3 | G2 | G1 | G0<br>LSB | B7<br>MSB | B6 | B5 | B4 | B3 | B2 | B1 | B0<br>LSB |
| BASIC COLOR | BLACK      | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             | RED(255)   | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             | GREEN(255) | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             | BLUE(255)  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 1         | 1  | 1  | 1  | 1  | 1  | 1  |           |
|             | CYAN       | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 1         | 1  | 1  | 1  | 1  | 1  | 1  |           |
|             | MAGENTA    | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 1         | 1  | 1  | 1  | 1  | 1  | 1  |           |
|             | YELLOW     | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             | WHITE      | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 1         | 1  | 1  | 1  | 1  | 1  | 1  |           |
| RED         | RED(0)     | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             | RED(1)     | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 1         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             | RED(2)     | 0         | 0  | 0  | 0  | 0  | 0  | 1  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             |            |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |
|             |            |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |
|             | RED(254)   | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             | RED(255)   | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
| GREEN       | GREEN(0)   | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             | GREEN(1)   | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 1         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             | GREEN(2)   | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 1  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             |            |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |
|             |            |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |
|             | GREEN(254) | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             | GREEN(255) | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
| BLUE        | BLUE(0)    | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  |           |
|             | BLUE(1)    | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 1  |           |
|             | BLUE(2)    | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 1  | 0  | 0  |           |
|             |            |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |
|             |            |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |           |    |    |    |    |    |    |           |
|             | BLUE(254)  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 1         | 1  | 1  | 1  | 1  | 1  | 0  |           |
|             | BLUE(255)  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 1         | 1  | 1  | 1  | 1  | 1  | 1  |           |

[Note]

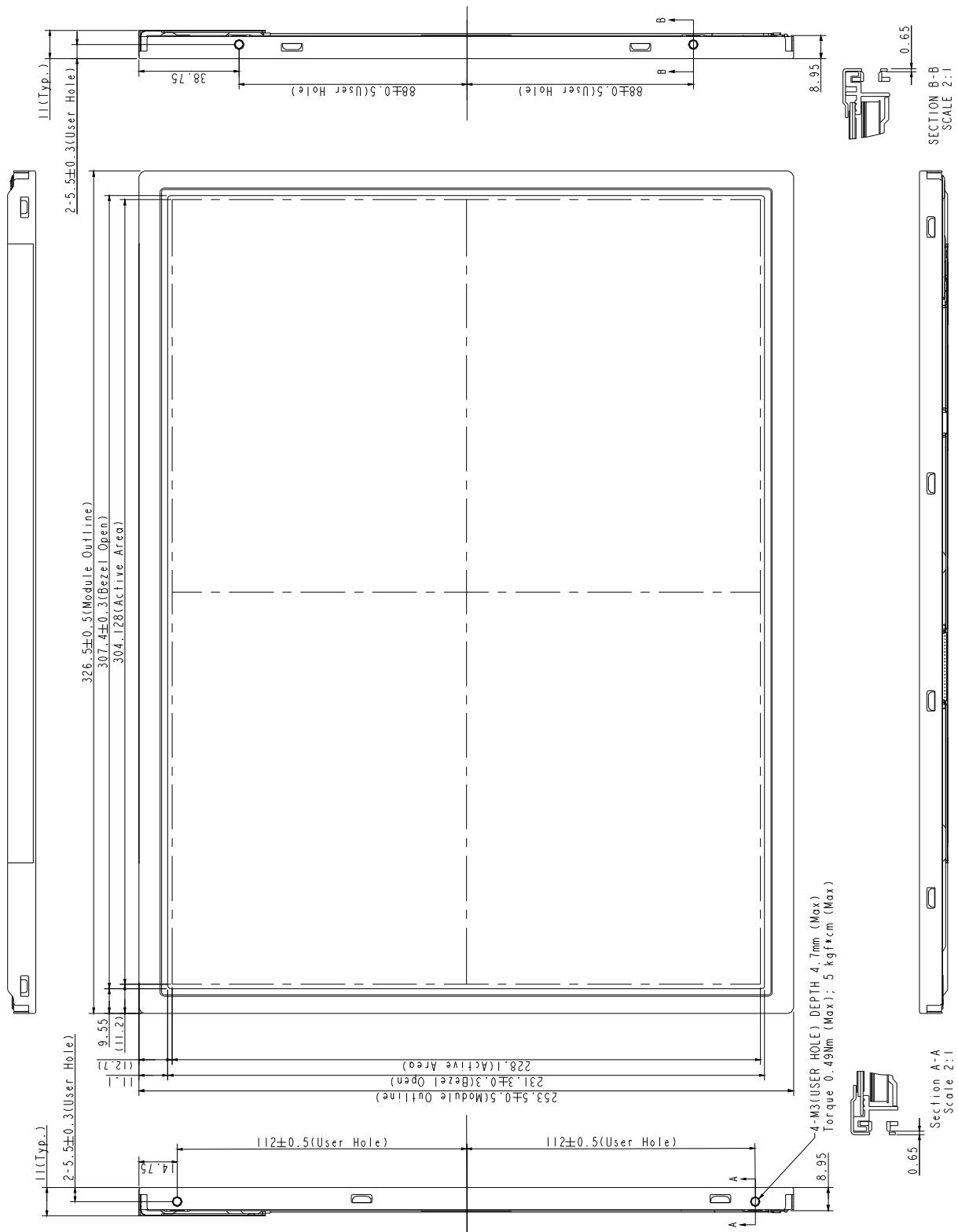
- Definition of gray scale:  
Color (n): n indicates gray scale level; higher n means brighter level.
- Data: 1-High, 0-Low.
- This assignment is applied to both odd and even data.

## 6. BLOCK DIAGRAM



## 7. MECHANICAL DIMENSION

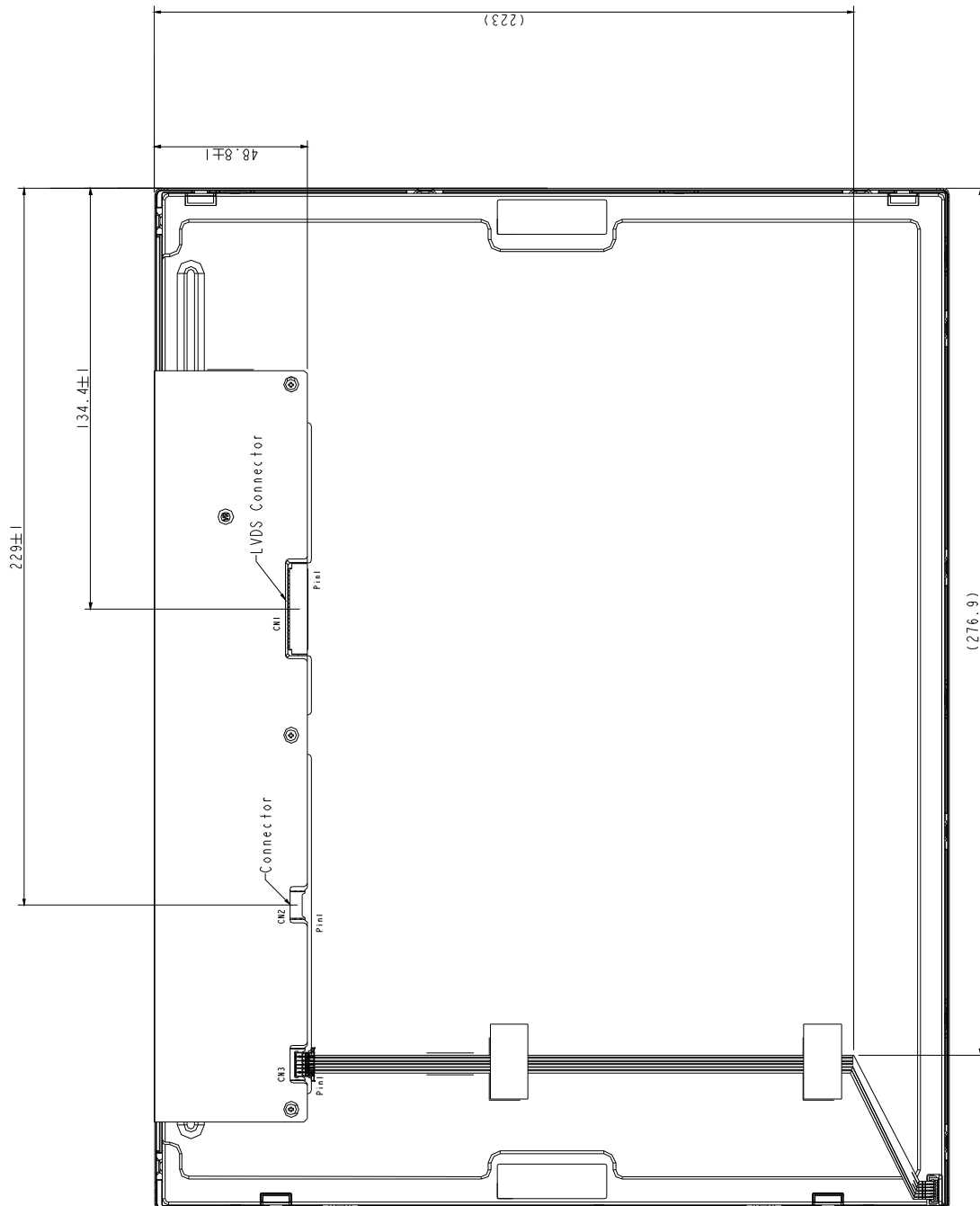
### 7.1 Front Side

(Tolerance is  $\pm 0.5\text{mm}$  unless noted) Unit: mm


## 7.2 Rear Side

(Tolerance is  $\pm 0.5\text{mm}$  unless noted)

Unit: mm



CN1: Connector MSB240420HD 20Pin (STM)  
CN2: Connector 3808K-F05N-03L (ENTER)

Note: The label direction of product label, & BL bar code is that the bottom is forward to right, and the top is forward to left.

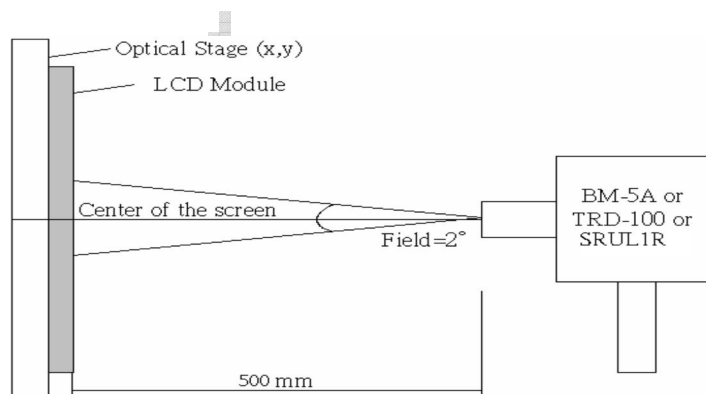
## 8. OPTICAL CHARACTERISTICS

 $T_a=25^{\circ}\text{C}$  ,  $V_{CC}=3.3\text{V}$ 

| ITEM              |            | SYMBOL     | CONDITION                   | min            | typ            | max            | UNIT              | REMARK     |
|-------------------|------------|------------|-----------------------------|----------------|----------------|----------------|-------------------|------------|
| Contrast Ratio    |            | CR         | $\theta = \psi = 0^{\circ}$ | 500            | 700            | --             | --                | Note 1 & 2 |
| Luminance(CEN)    |            | L          | $\theta = \psi = 0^{\circ}$ | 360            | 450            | --             | cd/m <sup>2</sup> | Note 1 & 3 |
| 9P Uniformity     |            | $\Delta L$ | $\theta = \psi = 0^{\circ}$ | 75             | 80             | --             | %                 | Note 1 & 3 |
| Response Time     |            | $T_r+T_f$  | $\theta = \psi = 0^{\circ}$ |                | 8              | 15             | ms                | Note 5     |
|                   |            |            | $\theta = \psi = 0^{\circ}$ |                |                |                |                   |            |
| Crosstalk         |            | CT         | $\theta = \psi = 0^{\circ}$ | 0              | --             | 1              | %                 | Note 6     |
| Viewing Angle     | Horizontal | $\psi$     | $CR \geq 10$                | 140            | 160            | --             | Deg.              | Note 4     |
|                   | Vertical   | $\theta$   |                             | 120            | 140            | --             | Deg.              |            |
| Color Coordinates | White      | X<br>Y     | $\theta = \psi = 0^{\circ}$ | 0.273<br>0.289 | 0.313<br>0.329 | 0.353<br>0.369 |                   | Note 1     |
|                   | Red        | X<br>Y     |                             | 0.595<br>0.305 | 0.634<br>0.345 | 0.675<br>0.385 |                   |            |
|                   | Green      | X<br>Y     |                             | 0.305<br>0.555 | 0.345<br>0.595 | 0.385<br>0.635 |                   |            |
|                   | Blue       | X<br>Y     |                             | 0.110<br>0.033 | 0.150<br>0.073 | 0.190<br>0.113 |                   |            |
| Gamut             |            | CG         | $\theta = \psi = 0^{\circ}$ | 58             | 63             |                | --                |            |
| Gamma             |            | $\gamma$   | VESA                        | 2.0            | 2.2            | 2.4            | --                | Note 7     |

### 【Note1】 Setup of Measurement Equipment

The LCD module should be turn-on to a stable luminance level to be reached. The measurement should be executed after lighting Backlight for 20 minutes and in a dark room.



### 【Note2】 Definition of Contrast Ratio :

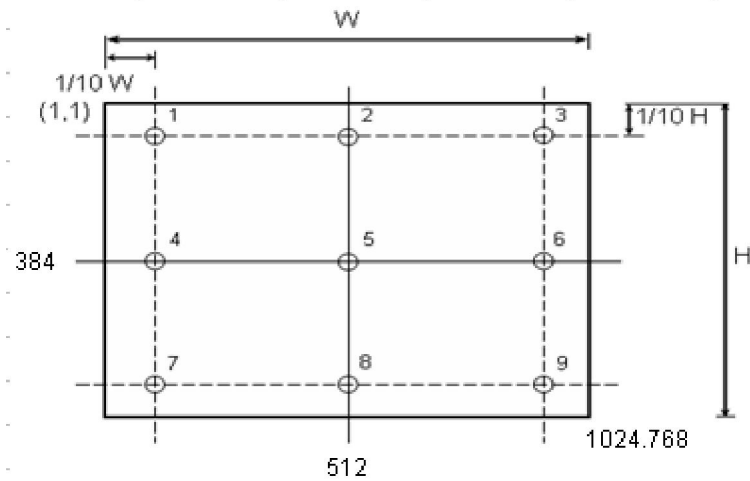
$CR = \text{White Luminance (ON)} / \text{Black Luminance (OFF)}$

【Note3】 Definition of Luminance and Luminance uniformity:

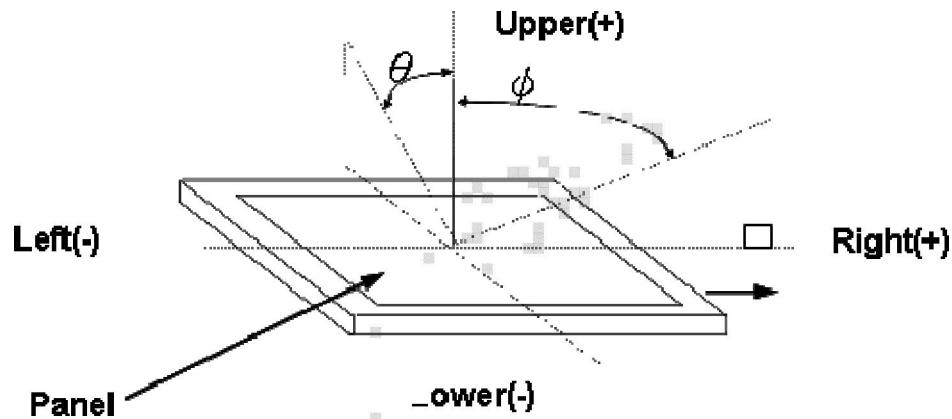
Center Luminance, &Color coordinate: measuring the luminance of the point no. 5

Average Luminance: measuring average luminance of points no.1-no.9

Uniformity:  $\Delta L = [L(\text{Min})/L(\text{Max})] \times 100\%$

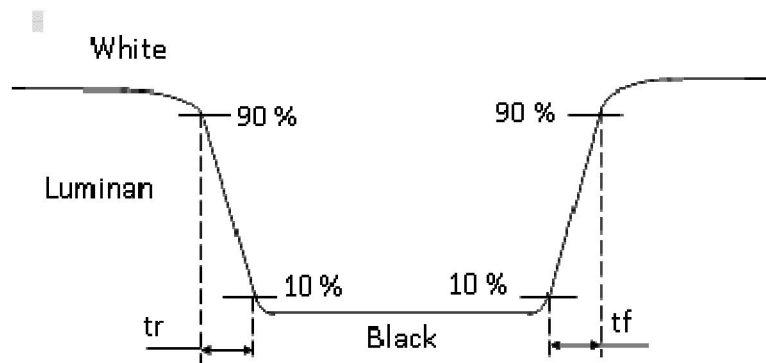


【Note4】 Definition of view angle( $\theta$ ,  $\phi$ ):



【Note 5】 The time to go from “white” to “black” time :

and from “white” to “black” of response amplitudes.

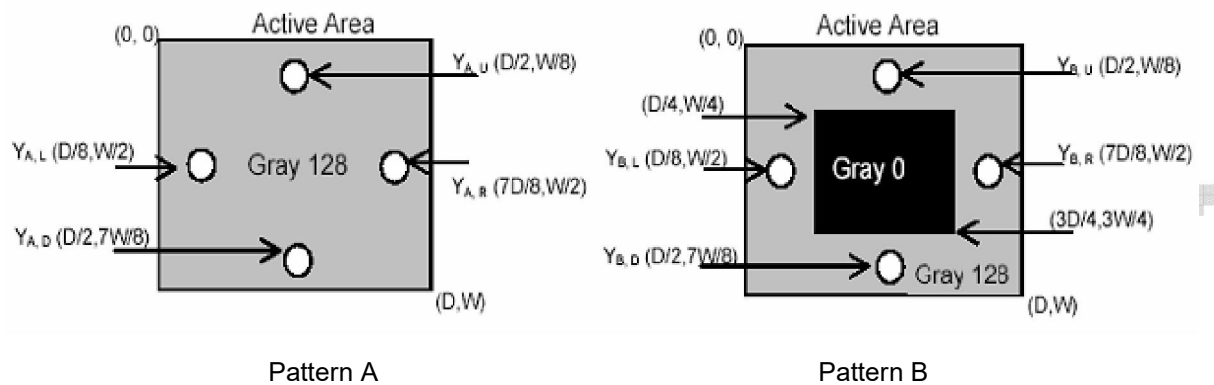


【Note 6】 Definition of crosstalk:

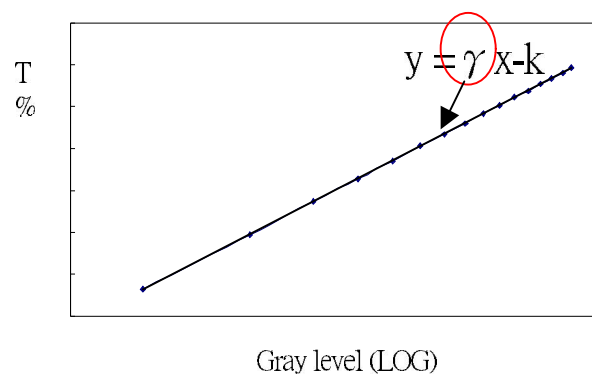
$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

$Y_A$ : The luminance of measured position at pattern A

$Y_B$ : The luminance of measured position at pattern B with Gray level 0



【Note 7】 Definition of Gamma ( $\gamma$ ), follow VESA standard sampling every 16 gray level (0,16,32,.....224,240,255)



## 9. RELIABILITY TEST CONDITIONS

### (1) Temperature and Humidity

| TEST ITEMS                                  | CONDITIONS                                    | NOTE |
|---------------------------------------------|-----------------------------------------------|------|
| High Temperature<br>High Humidity Operation | 60°C; 90%RH; 240hrs<br>(No condensation)      |      |
| High Temperature Operation                  | 80°C; 240hrs                                  |      |
| High Temperature Storage                    | 80°C; 240hrs                                  |      |
| Low Temperature Operation                   | -30°C; 240hrs                                 |      |
| Low Temperature Storage                     | -30°C; 240hrs                                 |      |
| Thermal Shock (No operation)                | Between -30°C(1hr) ~ 80°C(1hr);<br>100 Cycles |      |
| Image Sticking                              | 25°C, 4hr                                     | 1)   |

### (2) Shock & Vibration

| ITEMS                        | CONDITIONS                                                                                                                                                                                                   |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SHOCK<br>(NON-OPERATION)     | Shock level:(150G)<br>Waveform: half sinusoidal wave, 2ms<br>Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs                        |
| VIBRATION<br>(NON-OPERATION) | Vibration level: (1.0G) zero to peak<br>Waveform: sinusoidal<br>Frequency range: 10 to 300 Hz<br>Duration: one sweep from 10 to 300Hz in each of three mutually perpendicular axis(each x,y,z axis: 30 min,) |

### (3) ESD

| POSITION  | CONDITION( MDL turn off)                                                                                                                                                           |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Connector | 1. 200 pF , 0 $\Omega$ , $\pm 200$ V<br>2. contact mode for each pin                                                                                                               |
| Module    | 1. 150 pF , 330 $\Omega$ , $\pm 15$ K V (Air mode) , $\pm 8$ K V (Contact mode)<br>2. Air mode, test 25 times for each test point<br>3. Contact mode, 25 times for each test point |

### (4) Judgment standard

The judgment of the above test should be made as follow:

Pass: Normal display image with no obvious non-uniformity and no line defect. Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.

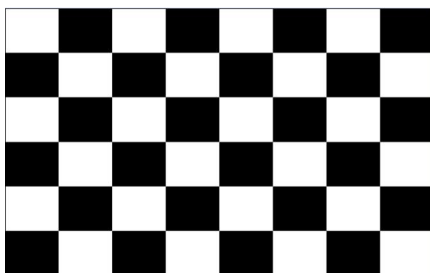
#### NOTE

##### 1) Image Sticking :

Condition of Image Sticking test : 25 °C  $\pm$  2 °C

Operation with test pattern sustained for 4hrs, then change to gray pattern immediately.

After 5 mins, the mura must be disappeared completely .



(a) Test Pattern(Chess Board Pattern)



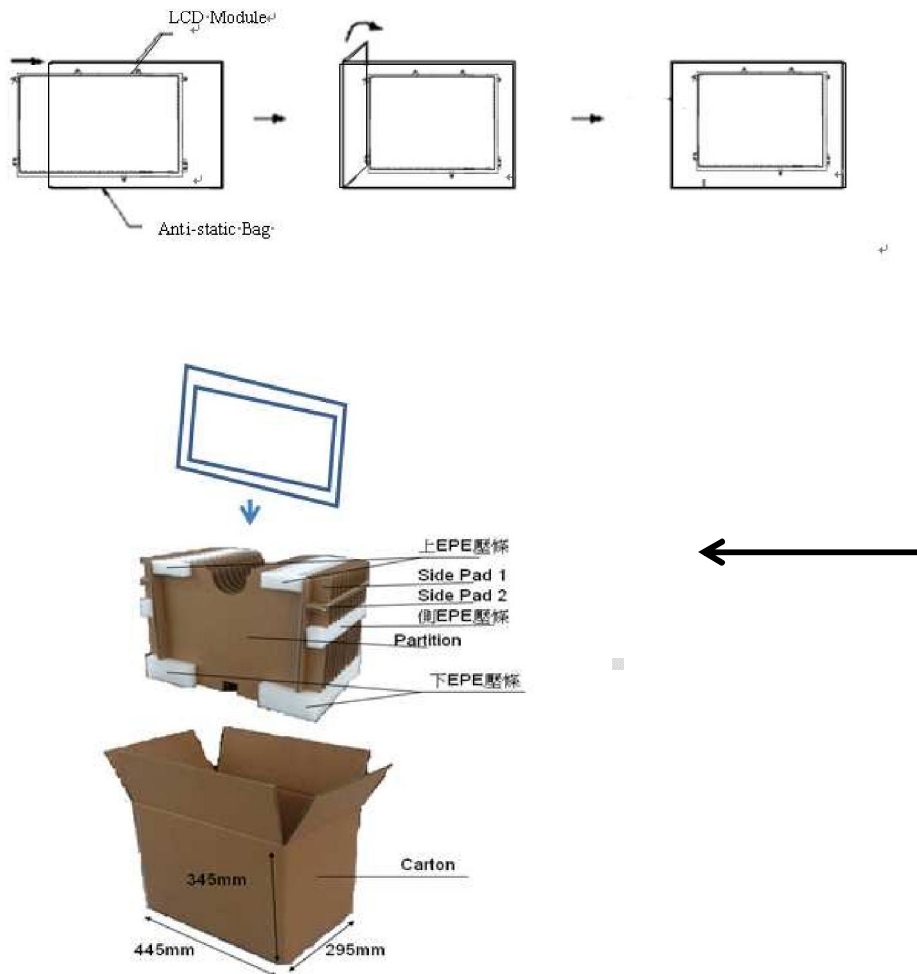
(b) judgment Pattern(128 Gray Pattern)

## 10. PACKING INFORMATION

### 1. Packing order:

(1) Box Dimension: 445mm(L) X 295mm(W) X 345mm(H)

(2) Package Quantity in one Box : 10 pcs

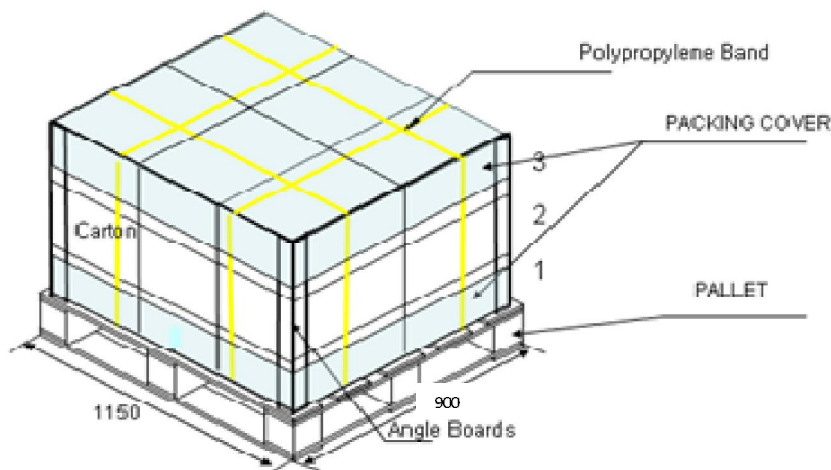


### 2. Pallet Packing

(1) 18 box (max.) / 1 pallet

(2) Pallet: 1150(L) X 900(W) X 133(H) mm

(3) Angle boards: L 1125 X 50 X 5 mm



## 11.WARRANTY

- (1) The period is within 12 months since the date of shipping out under normal using and storage conditions.
- (2) The warranty will be avoided in case of defect induced by customer.