| CUSTOMER APPROVE |
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| |

# SPECIFICATION

# FOR

# TFT-LCD MODULE

# LED55E

**Edition : Preliminary spec 1.0**

**Date of issue : 2017-03-21**

**Product No. : LC550EQY-SJA3_V1.0_160222**

| APPROVED | CHECKED | PREPARED |
| --- | --- | --- |
| | | |

# Revision History

| Date | Rev. | Page | Old Description | New Description | Remark |
|---|---|---|---|---|---|
| 2016-12-15 | 1.0 | All | The specification was first issued | | |

# CONTENTS

## 1.Scope

This specifications is applicable to 55E" diagonal module :"LED55E"designed for TFT LCD TV.

### 1.1 Features

--Super Wide viewing angle
--Super High contrast ratio
--Super Fast response time
--High color saturation
--DE(Data Enable ) only mode
--LVDS Interface
--RoHS compliance

### 1.2 Application

TFT LCD TV
Multi-Media Display

### 1.3 General Specifications

| Item | Specifications | Unit | Note |
|---|---|---|---|
| Driving Method | a-Si TFT active matrix | | Note 1 |
| Active Screen Size | 1387.8 | mm | |
| Bezel opening area | 1225.2 (W) x 696.7(H) x 1.3(D) Typ | mm | |
| Number of Pixels | 3840×2160 | pixel | |
| Pixel Pitch | 0.315(H) x 0.315(V) | mm | |
| Pixel Arrangement | RGB Vertical Stripe | | |
| Transmissive Mode | Normally Black | | |
| Surface Treatment | Anti-Glare coating Hardness (3H) | | Haze=1% |
| Display Colors | 16.7M | color | |

### 1.4 Mechanical Specification

| Item | | Min | Typ | Max | Unit | Note |
|---|---|---|---|---|---|---|
| Weight | | -0.5 | TBD | 0.5 | Kg | - |
| Module Size | Horizontal(H) | (TYP)-0.5 | 1238 | (TYP)+0.5 | mm | 1 |
| | Vertical (V) | | 716.9 | | mm | |
| | Depth(D) | | 26.0 | | mm | |

Note 1: Please refer to the"outline dimension" for more information of back and front outline dimensions.

# 2. Absolute Maximum Ratings

## 2.1 Abosolute Ratings of Environment

The followings are maximum values which, if exceeded, may cause damage to the unit.

| Item | Symbol | Value | | Unit |
|---|---|---|---|---|
| | | Min. | Max. | |
| Power Supply Voltage | $V_{CC}$ | -0.3 | 13.8 | V |
| Input Signal Voltage | $V_{IN}$ | -0.3 | 3.6 | V |

**2.2 Environment Requirement(Based on CSOT's BLU)**

(1) Temperature and relative humidity range are shown as below.

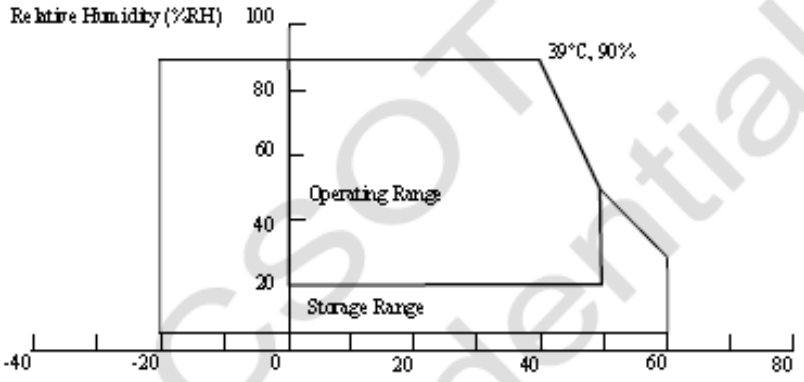



Fig. 2.1 Operating and storage environment

(a) 90%RH maximum ($T_A \leq$ 39 °C).

(b) Wet-bulb temperature should be 39°C maximum ($T_A >$ 39 °C).

(c) No condensation.

(2) The storage temperature is between - 20 °C to 60 °C, and the operating ambient temperature is between 0 °C to 50 °C The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 65°C with LCD module in a temperature controlled chamber alone. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 65°C. The range of operating temperature may degrade in case of improper thermal management in the end product design.

(3) The rating of environment is based on LCD module. Leave LCD cell alone, this environment condition can't be guaranteed. Except LCD cell, the customer has to consider the ability of other parts of LCD module and LCD module process.

**2.3 Absolute Ratings of Environment (Open Cell)**

When storing open cell as spares for a long time, please follow the precaution instructions:

(1) Do not store the module in high temperature and high humidity for a long time. It is highly recommended to store the module with temperature from 20°C to 30°C in normal humidity (50 ± 10%RH) with shipping package.

(2) The open cell should be keep within one month shelf life.

## 2.2 Electrical Absolute Ratings

### 2.2.1 TFT LCD MODULE

| Item | Symbol | Min | Max | Unit | Note 1 |
|---|---|---|---|---|---|
| Power Supply Module | VCC | 10.8 | 13.2 | V | Note 1 |

Note 1: Permanent damage to the device may occur if maximum values are exceeded. Functional operation should be restricted to the conditions described under normal operating conditions.

### 2.2.2 Backlight Unit

| Item | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min | Max | | |
| Single LightBar Voltage | VL | — | 125.4 | V | Note 1,2 |
| Single LightBar Current | IL | — | 960 | mA | |

Note 1:Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under normal operating conditions.

Note 2: Specified values are for input of LED lightbar at Ta=25±2 ℃ (Refer to 3.2 for further Information).

## 3. Electrical Specifications

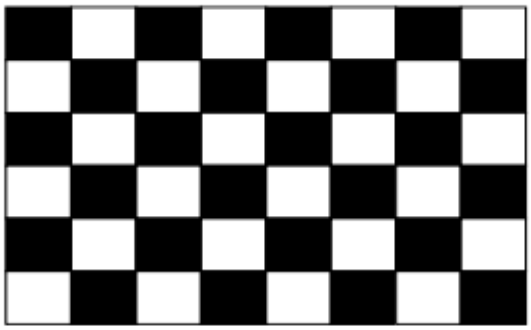
### 3-1. Electrical Characteristics

Table 2. ELECTRICAL CHARACTERISTICS

| Parameter | | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Circuit : | | | | | | | |
| Power Input Voltage | | $V_{LCD}$ | 10.8 | 12.0 | 13.2 | $V_{DC}$ | |
| Power Input Current | | $I_{LCD}$ | - | 1380 | 1795 | mA | 1 |
| | | | - | 1850 | 2405 | mA | 2 |
| T-CON Option Selection Voltage | Input High Voltage | $V_{IH}$ | 2.7 | - | 3.6 | $V_{DC}$ | |
| | Input Low Voltage | $V_{IL}$ | 0 | - | 0.7 | $V_{DC}$ | |
| Power Consumption | | $P_{LCD}$ | - | 16.6 | 21.5 | Watt | 1 |
| Rush current | | $I_{RUSH}$ | - | - | 10 | A | 3 |

Note
1. The specified current and power consumption are under the $V_{LCD}$=12.0V, Ta=25 ± 2°C, $f_V$=60Hz condition, and mosaic pattern(8 x 6) is displayed and $f_V$ is the frame frequency.
2. The current is specified at the maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power input is 0.5ms (min.).
4. Ripple voltage level is recommended under ±5% of typical voltage

White : 1023 Gray
Black : 0 Gray



**Mosaic Pattern(8 x 6)**

**3.2 Backlight system**

| ITEM | SYMBOL | MIN | TYP | MAX | UNIT | Remark |
|---|---|---|---|---|---|---|
| LightBar Voltage | $V_L$ | 114 | 117.8 | 125.4 | V | Note 1 |
| LightBar Current | $I_L$ | — | 960 | 1056 | mA | |
| Power Consumption | $P_{BL}$ | — | 113 | — | W | LightBar |
| LED Life Time | $L_{BL}$ | 30000 | — | — | | |

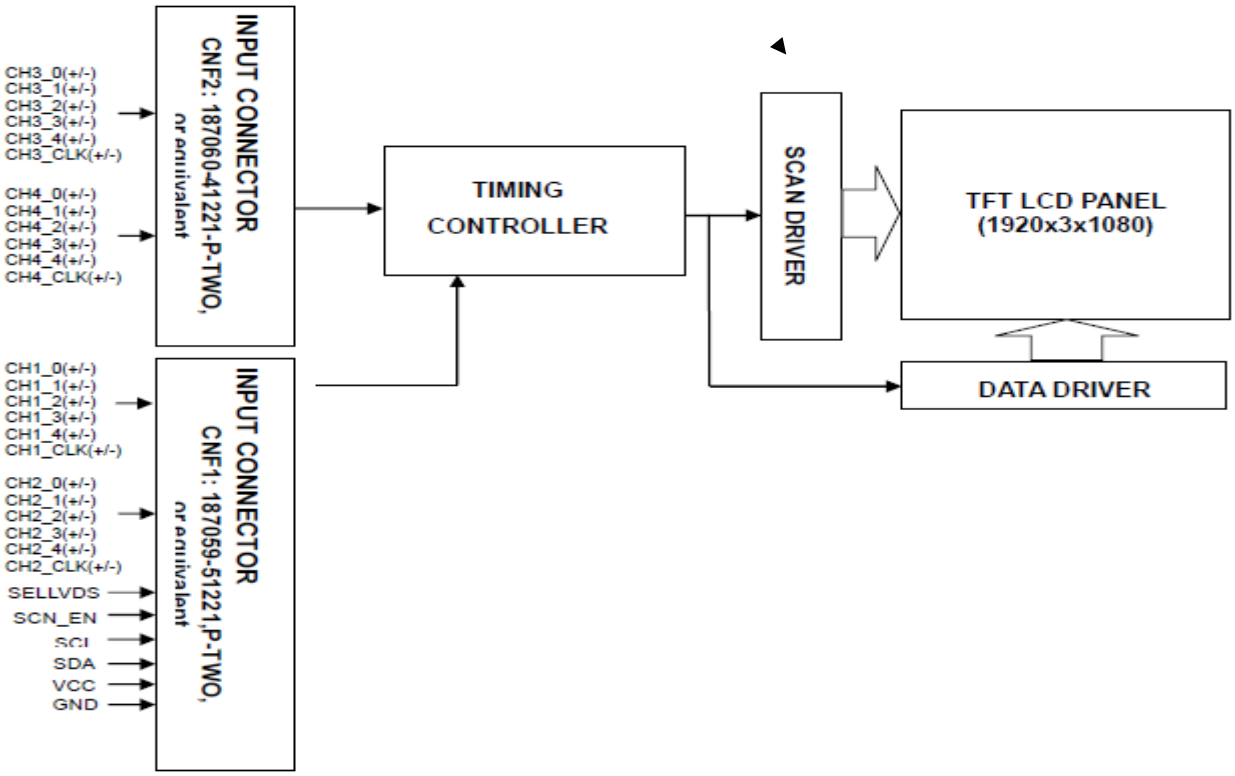
Note 1 The LED LightBar connector part No: PHR-6 (JST) or equivalent, as shown next page.

Note 2: $P_{BL} = I_L \times V_L$, The LED LightBar circuit is 19 Series,8 Parallel.

Note 3: The lifetime of LED is defined as the time when LED packages continue to operate under the conditions at Ta = 25 ±2 ℃ and I= (960)mA (per chip) until the brightness becomes ≦ 50% of its original value.

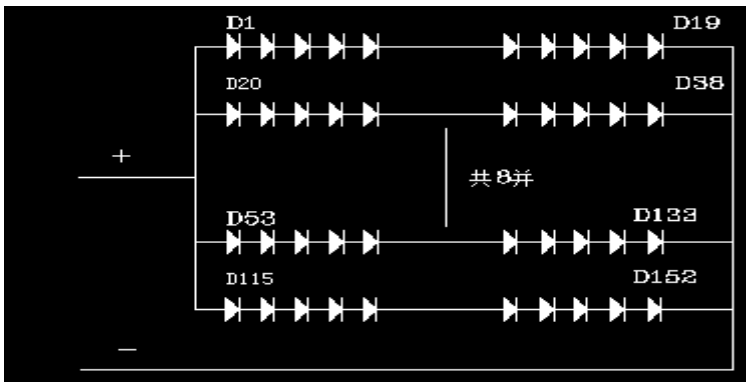
## 4. Block Diagram

### 4.1 TFT LCD Module



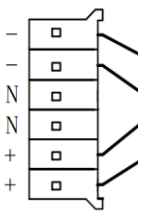

### 4.2 Backlight Unit

The LED LightBar Series and Parallel circuit, interface type as shown below:




19 Series, 8 Parallel

### 4.3 Backlight wire



## 5.Input Termianl Pin Assignment

### 5.1 TFT LCD OPEN CELL

CNF1 Connector Pin Assignment: (187059-51221,P-Two )

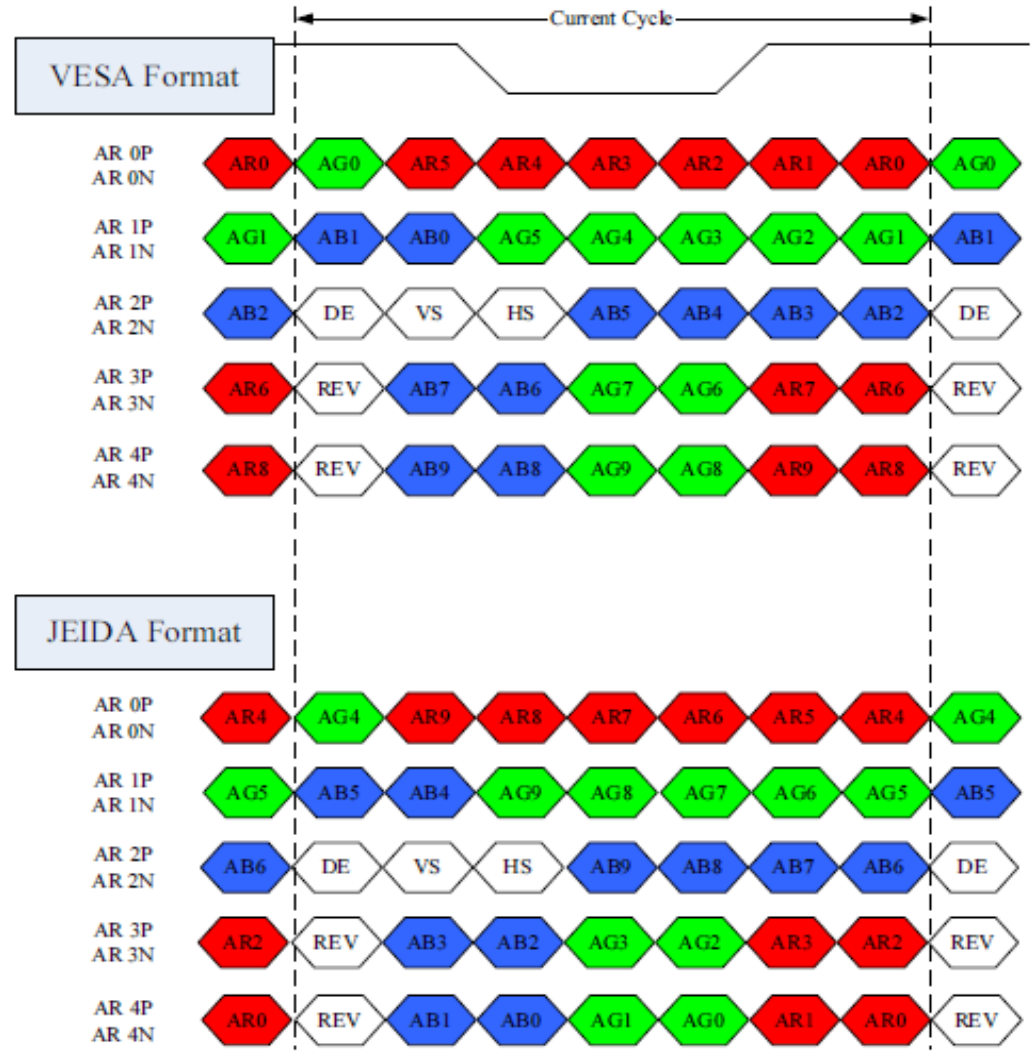
| No | Symbol | Description | No | Symbol | Description |
|---|---|---|---|---|---|
| 1 | VLCD | Power Supply +12.0V | 27 | GND | Ground |
| 2 | VLCD | Power Supply +12.0V | 28 | Rx0n | V-by-One HS Data Lane 0 |
| 3 | VLCD | Power Supply +12.0V | 29 | Rx0p | V-by-One HS Data Lane 0 |
| 4 | VLCD | Power Supply +12.0V | 30 | GND | Ground |
| 5 | VLCD | Power Supply +12.0V | 31 | Rx1n | V-by-One HS Data Lane 1 |
| 6 | VLCD | Power Supply +12.0V | 32 | Rx1p | V-by-One HS Data Lane 1 |
| 7 | VLCD | Power Supply +12.0V | 33 | GND | Ground |
| 8 | VLCD | Power Supply +12.0V | 34 | Rx2n | V-by-One HS Data Lane 2 |
| 9 | NC | NO CONNECTION | 35 | Rx2p | V-by-One HS Data Lane 2 |
| 10 | GND | Ground | 36 | GND | Ground |
| 11 | GND | Ground | 37 | Rx3n | V-by-One HS Data Lane 3 |
| 12 | GND | Ground | 38 | Rx3p | V-by-One HS Data Lane 3 |
| 13 | GND | Ground | 39 | GND | Ground |
| 14 | SPI_EN | SPI_WP Enable | 40 | Rx4n | V-by-One HS Data Lane 4 |
| 15 | NC | NO CONNECTION | 41 | Rx4p | V-by-One HS Data Lane 4 |
| 16 | SPI_DI | SPI Data In for Flash | 42 | GND | Ground |
| 17 | SPI_DO | SPI Data Out for Flash | 43 | Rx5n | V-by-One HS Data Lane 5 |
| 18 | SDA | SDA for I2C | 44 | Rx5p | V-by-One HS Data Lane 5 |
| 19 | SCL | SCL for I2C | 45 | GND | Ground |
| 20 | nWP | WP(Write Protection) | 46 | Rx6n | V-by-One HS Data Lane 6 |
| 21 | SPI_CLK | SPI_CLK for Flash | 47 | Rx6p | V-by-One HS Data Lane 6 |
| 22 | SPI_CS | SPI_CS for Flash | 48 | GND | Ground |
| 23 | Aging Mode | "H" or NC : AGP or Flicker PTN<br>"L" : NSB (No signal Black) | 49 | Rx7n | V-by-One HS Data Lane 7 |
| 24 | GND | Ground | 50 | Rx7p | V-by-One HS Data Lane 7 |
| 25 | HTPDN | Hot plug detect | 51 | GND | Ground |
| 26 | LOCKN | Lock detect | · | · | · |

Note
1. All GND (ground) pins should be connected together to the LCD module's metal frame.
2. All Input levels of V-by-One signals are based on the V-by-One-HS Standard Version 1.4
3. Specific pin No. #23 is used for "No signal detection" of system signal interface.
   It should be GND for NSB (No Signal Black) while the system interface signal is not.
   If this pin is "H", LCD Module displays AGP (Auto Generation Pattern).
4. Specific Pin No. #20 & #23 is used for "Vcom Adjustment", (Please see the Appendix V-2

## 5.2 LVDS Interface

JEIDA Format : SELLVDS = L
VESA Format : SELLVDS = H or Open

JEIDA Format : SELLVDS = L
VESA Format : SELLVDS = H or Open




AR0~AR9: First Pixel R Data (9; MSB, 0; LSB)
AG0~AG9: First Pixel G Data (9; MSB, 0; LSB)
AB0~AB9: First Pixel B Data (9; MSB, 0; LSB)
DE : Data enable signal
DCLK : Data clock signal
RSV: Reserved

### 5.3 Colors Data Input Assignment

The brightness of each primary color (red,green,blue) is based on the 8-bits gray scale data input for the color.The higher the binary input, the brighter the color.The table below provide the assignment of color versus data input.

| | Colors & Gray Scale | Gray Scale | Data signal | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | R0 | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | G0 | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | B0 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 |
| | | | LSB | | | | | | | | | MSB | LSB | | | | | | | | | MSB | LSB | | | | | | | | | MSB |
| 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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Green | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cyan | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red | – | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Magenta | – | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | – | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 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 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale of Red | Black | GS0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | GS1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | GS2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | ⇩ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | Brighter | GS1021 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇩ | GS1022 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | GS1023 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale of Green | Black | GS0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | GS1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | GS2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | ⇩ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | Brighter | GS1021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇩ | GS1022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | GS1023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale of Blue | Black | GS0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | GS1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | GS2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | ⇩ | ↓ | | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | |
| | Brighter | GS1021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | ⇩ | GS1022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Blue | GS1023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

# 6. INTERFACE TIMNG

## 6.1 Input Signal Timing Specifications

The input signal timing specifications are shown as the following table and timing diagram.

| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Frequency | Data Clock | $F_{clkin}$ (=1/TC) | 73 | 74.25 | 75.8 | MHz | (1) |
| Vby1 | Spread spectrum modulation range | Fclkin _mod | -0.5% | - | 0.5% | % | (4) |
| | Spread spectrum modulation frequency | FSSM | - | - | 30 | KHz | |

## 6.2 Timing spec for Frame Rate = 100Hz

| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Frame rate | Mode | $F_{rs}$ | | 60 | | Hz | (8),(9) |
| Vertical Section | Total | Tv | | 2250 | | Line | Tv=Tvd+ Tvb |
| | Display | Tvd | | 2160 | | Line | — |
| | Blank | Tvb | | 90 | | Line | — |
| Horizontal Section | Total | Th | | 4400 | | Pixel | Th=Thd+Thb |
| | Display | Thd | | 3840 | | Pixel | — |
| | Blank | Thb | | 560 | | Pixel | — |
| Clock | Frequency | | | 594 | | MHz | — |
| Vertical Freq. | Frequency | | | 60 | | Hz | — |
| Horizontal Freq. | Frequency | | | 135 | | KHz | — |

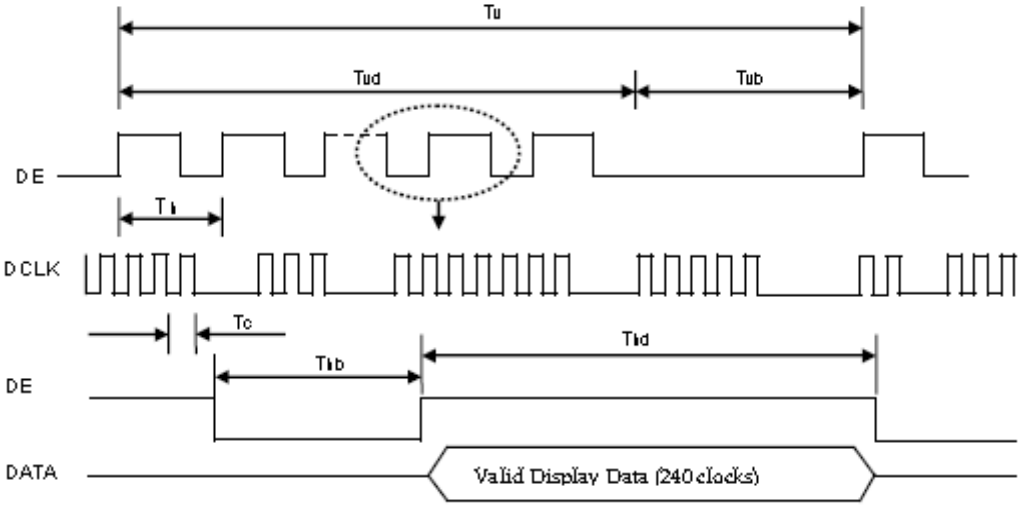
## 6.3 Timing spec for Frame Rate = 120Hz

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Frame rate | 2D mode | | Frs | 114 | 120 | 126 | Hz | |
| | 3D mode | | Frs | (228) | 240 | (252) | Hz | (6) |
| Vertical Active Display Term (4 Lan,960X2160 Active Area) | 2D Mode | Total | Tv | 2200 | 2250 | 2790 | Th | Tv=Tvd+Tvb |
| | | Display | Tvd | 2160 | 2160 | 2160 | Th | — |
| | | Blank | Tvb | 40 | 90 | 630 | Th | — |
| | 3D Mode | Total | Tv | (1116) | 1125 | (1200) | Th | (6),(7) |
| | | Display | Tvd | 1080 | 1080 | 1080 | Th | |
| | | Blank | Tvb | (36) | 45 | (120) | Th | |
| Horizontal Active Display Term (4 Lan,960X2160 Active Area) | 2D Mode | Total | Th | 270 | 285 | 300 | Tc | Th=Thd+Thb |
| | | Display | Thd | 240 | 240 | 240 | Tc | — |
| | | Blank | Thb | 30 | 45 | 60 | Tc | — |
| | 3D Mode | Total | Th | (270) | 285 | (300) | Tc | Th=Thd+Thb |
| | | Display | Thd | 240 | 240 | 240 | Tc | — |
| | | Blank | Thb | (30) | 45 | (60) | Tc | — |

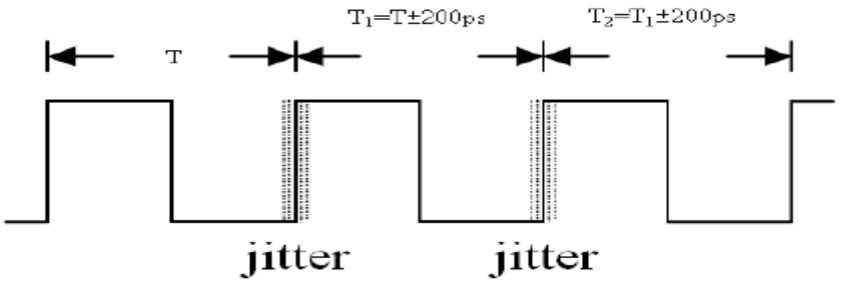
(Note (1) Since the module is operated in DE only mode, Hsync and Vsync input signals should be set to low logic level. Otherwise, this module would operate abnormally.

Note (2) Please make sure the range of pixel clock has follow the below equation:

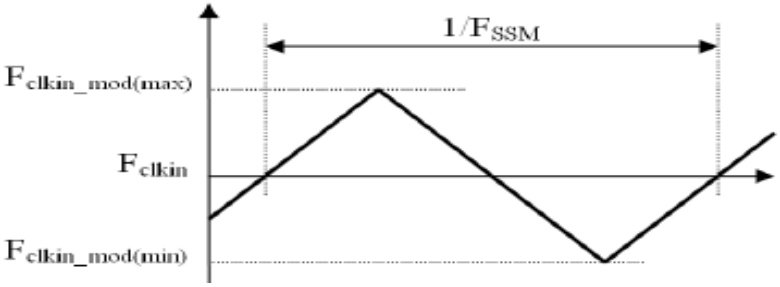
Fclkin(max) ≧ Fr6 ╳ Tv ╳ Th  Fr5 ╳ Tv ╳ Th ≧ Fclkin(min)




Note (3) The input clock cycle-to-cycle jitter is defined as below figures. Trcl = I T1 – TI

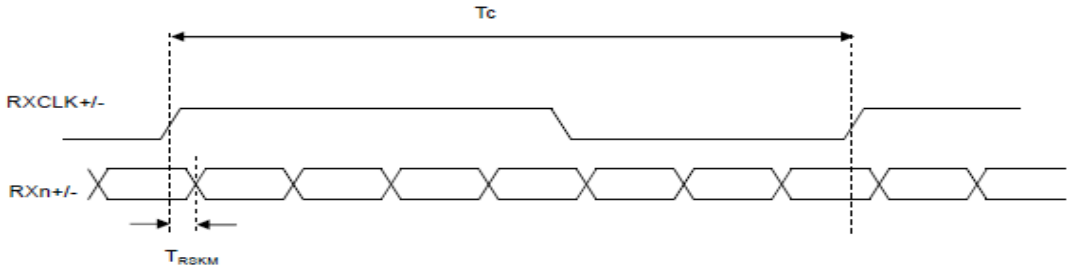



Note (4) The SSCG (Spread spectrum clock generator) is defined as below figures.



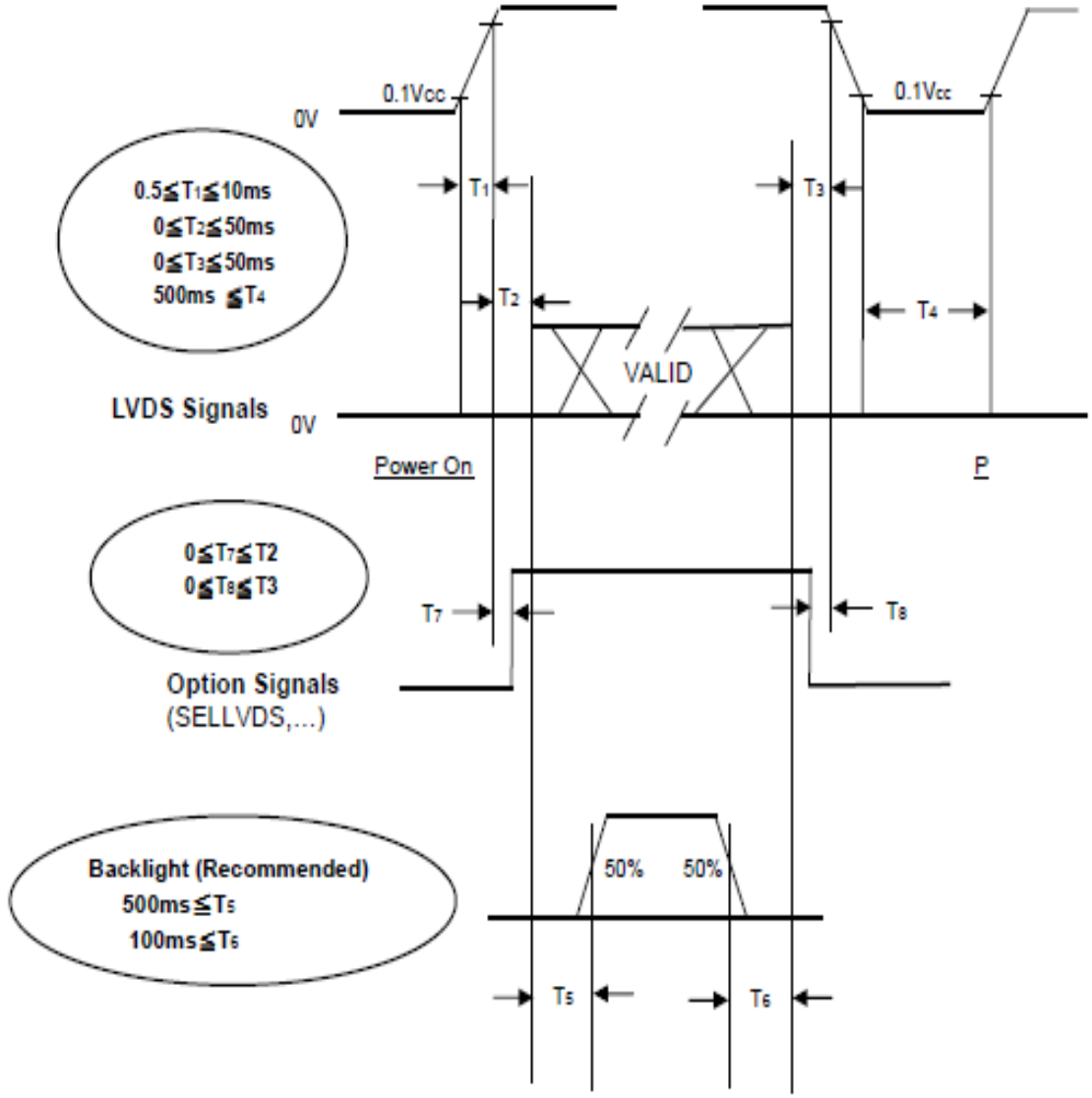

Note (5) LVDS receiver skew margin is defined and shown as below.

**LVDS RECEIVER INTERFACE TIMING DIAGRAM**



## 6.2 Power On/Off Sequence

To prevent a latch-up or DC operation of LCD module ,the power on/off sequence should follow be as the diagram below.




Power ON/OFF Sequence

Note (1) The supply voltage of the external system for the module input should follow the definition of Vcc.

Note (2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

Note (3) In case of Vcc is in off level, please keep the level of input signals on the low or high impedance. If T2<0,that maybe cause electrical overstress failure.

Note (4) T4 should be measured after the module has been fully discharged between power off and on period.

Note (5) Interface signal shall not be kept at high impedance when the power is on.

## 7 Optical Characteristics

### 7.1 Test Condition

| Item | Symbol | Value | Unit |
|---|---|---|---|
| Ambient Temperature | Ta | 25 ±2 | ℃ |
| Ambient Humidity | Ha | 50 ±10 | %RH |
| Supply Voltage | Vcc | 12 | V |
| Input Signal | According to typical value in "3. Electrical characteristics | | |
| LED LightBar Current | $I_L$ | 3 | mA |

### 7.2 Optical Characteristics

The relative measurement methods of optical characteristics are shown in the 7.2. The following items should be measured under the test condition in 7.1 and the stable environment shown in the in 7.1.

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio | | CR | θx=0,θy=0, viewing normal angle | 800 | 1100 | — | — | — |
| Response Time | | Gray to gray average | | — | 8 | 12 | ms | Note 3 |
| Transmittance | | | T | — | 5.34 | — | % | |
| Brightness uniformity | | BU | | — | 1.33 | 1.42 | — | Note 2 |
| Center Luminance of White | | Lc | | 300 | 350 | — | cd/m2 | — |
| The color chromaticity | Red | Rx | | -0.03 | 0.636 | +0.03 | — | Note 0 |
| | | Ry | | | 0.334 | | — | |
| | Green | Gx | | | 0.293 | | — | |
| | | Gy | | | 0.633 | | — | |
| | Blue | Bx | | | 0.153 | | — | |
| | | By | | | 0.064 | | — | |
| | White | Wx | | | 0.268 | | — | |
| | | Wy | | | 0.306 | | — | |
| Viewing Angle | Horizontal | θx+ | CR≧10 | | 89 | — | Deg | Note 1、2 |
| | | θx- | | | 89 | — | | |
| | Vertical | θy+ | | | 89 | — | | |
| | | θy- | | | 89 | — | | |

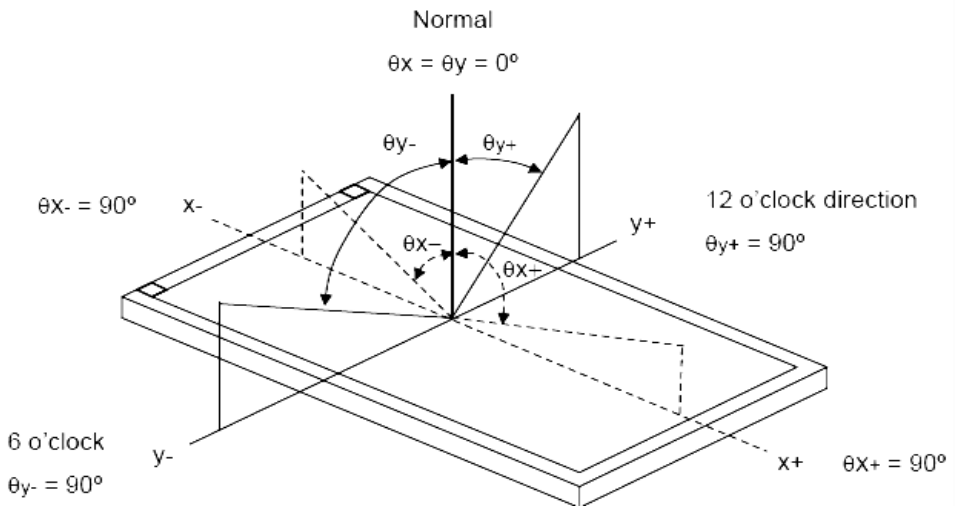
Note 0: Light source is the standard light source ”C” which is defined by CIE and driving voltage are based on suitable gamma voltages. The calculating method is as following:

1. Measure Module’s and BLU’s spectrum at center point. White and R,G,B are with signal input. BLU (for V500HK3-L01) is supplied by CMI.
2. Calculate cell’s spectrum.
3. Calculate cell’s chromaticity by using the spectrum of standard light source “C”.

Note 1: Light source is the BLU which supplied by CMI and driving voltage are based on suitable gamma voltages.

Note 2: Definition of Viewing Angle ( x, y):

Viewing angles are measured by Autronic Conoscope Cono-80




Note 3: Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

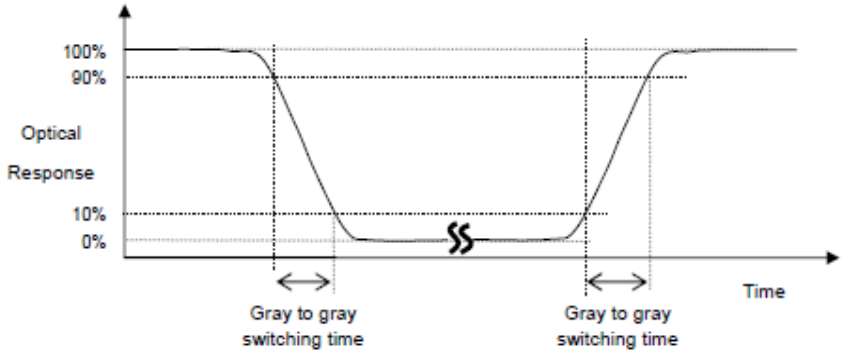
$$\text{Contrast Ratio (CR)} = \frac{\text{Surface Luminance of L255}}{\text{Surface Luminance of L0}}$$

L255: Luminance of gray level 255

L 0: Luminance of gray level 0

CR = CR (5), where CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (5).

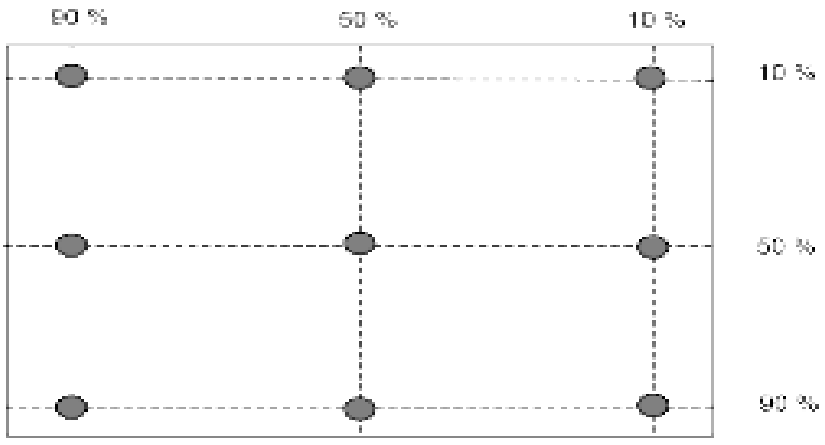
Note 4: Definition of Gray-to-Gray Switching Time:



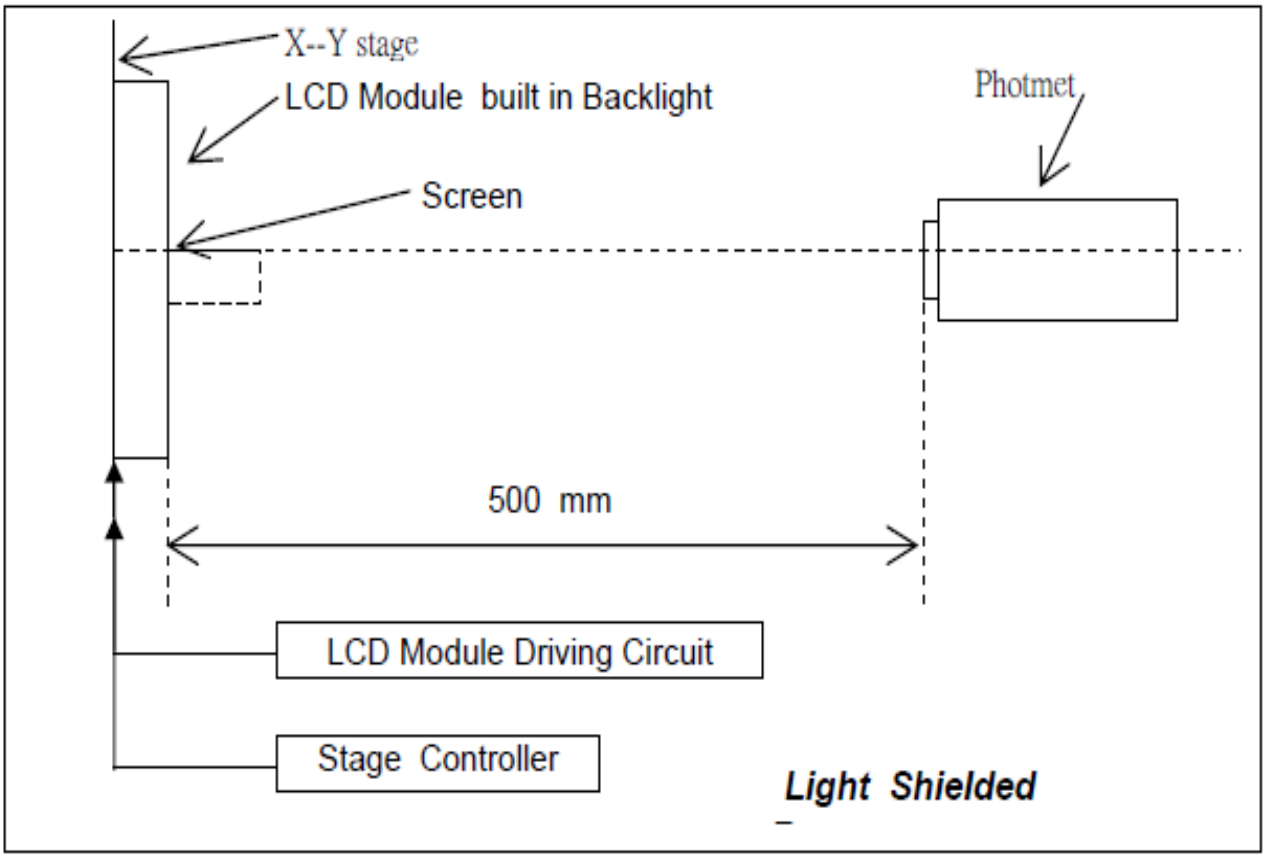

The driving signal means the signal of gray level 0, 124, 252, 380, 508, 636, 764, 892 and 1023.

Gray to gray average time means the average switching time of gray level 0, 124, 252, 380, 508, 636, 764, 892 and 1023 to each other.

Note 5: Definition of White Variation :



Note6: The measure method




Note(1): The measurement point is the center of the active area except for the measurement of Luminance Uniformity

Note (2): Photometer :BM-7 TOPCON (Aperture 2deg.)

### 7.3 Flicker Adjustment

(1) Adjustment pattern :

Sub pixel on/off Pattern was shown as below. If customer need below pattern, please directly contact with Account FAE. (bright sub-pixel：G128 ; dark sub-pixel：G0)


Fig 9.6Flicker pattern

(2) Adjustment method: (Digital V-com / Gamma)

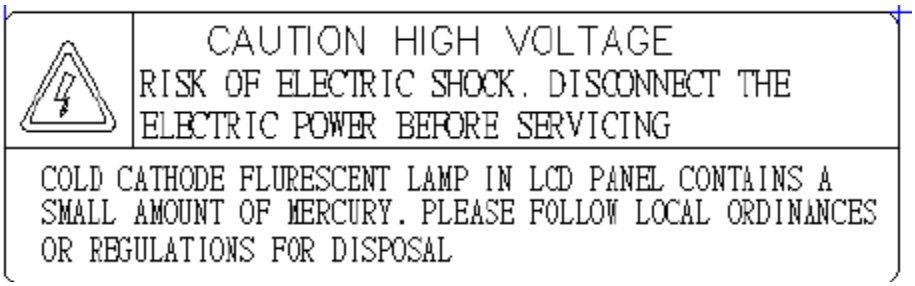
Programmable memory IC is used for Digital V-com (Gamma) adjustment in this model. CMI provide Auto V-com (Auto Gamma) tools to adjust Digital V-com (Gamma). The detail connection and setting instruction, please directly contact with Account FAE or refer CMI Auto V-com (Auto Gamma) adjustment OI.

Below items is suggested to be ready before Digital V-com (Gamma) adjustment in customer LCM line.

## 8. Labels

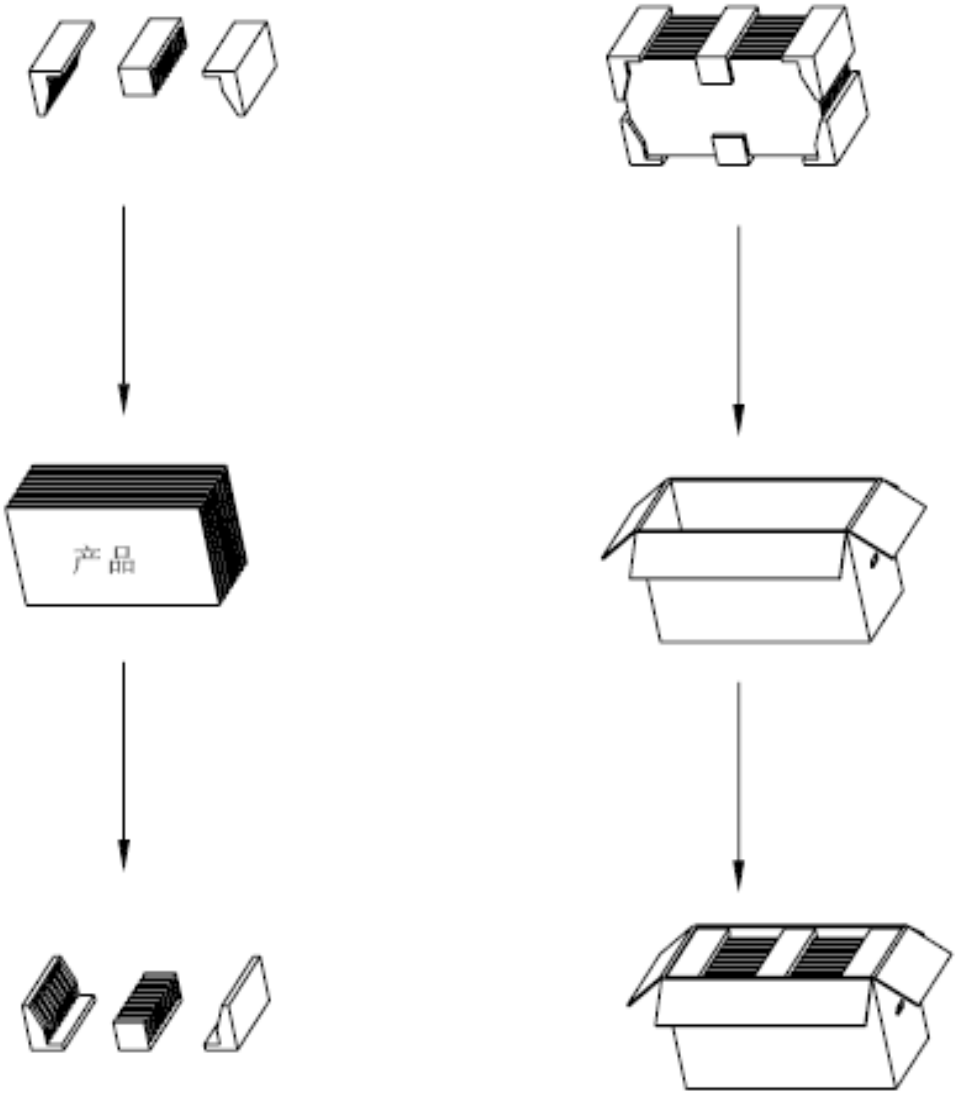
### 8.1 Panel Label:

### 8.2 Caution Label:

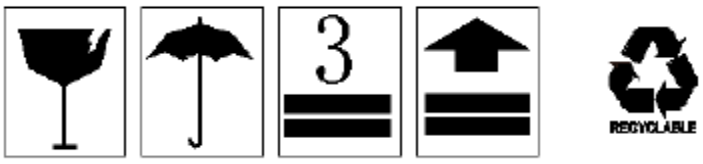


## 9. Packaging

### 9.1 Carton(internal package)




### 9.2 Pakaging Mark



# 10. PRECAUTION

## 10.1 ASSEMBLY AND HANDLING PRECAUTIONS

1 Do not apply rough force such as bending or twisting to the module during assembly.
2 To assemble or install module into user's system can be in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
3 It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will will be damaged.
4 Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
5 Do not pull the I/F connector in or out while the module is operating .
6 Do not disassemble the module.
7 Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
8 It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
9 High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storaged conditions.
10 When ambient temperature is lower than 10 ℃ may reduce the display quality.

## 10.2 SAFETY PRECAUTIONS

1 The LED LightBar voltage of Backlight is can't exceed out Volts Spec, otherwise it may cause electrical shock.. Do not disassemble the module or insert anything into the Backlight unit.
2 If the liquid crystal material leaks from the panel,it should be kept away from the eyes or mouth, in case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
3 After the modlule's end of life, it is not harmful in case of normal operation and storage.

## 11.Outline dimension