

**Doc. Number :**

- ☐ Tentative Specification  
☐ Preliminary Specification  
☒ Approval Specification

MODEL NO.: G238HCJ  
SUFFIX: L02

|                                                                                    |           |
|------------------------------------------------------------------------------------|-----------|
| Customer: Common                                                                   |           |
| APPROVED BY                                                                        | SIGNATURE |
| Name / Title                                                                       |           |
| Note                                                                               |           |
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|              |            |             |
|--------------|------------|-------------|
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## REVISION HISTORY

| Version | Date      | Section | Description                              |
|---------|-----------|---------|------------------------------------------|
| 2.0     | 2021.4.9  | All     | Approval Specification was first issued. |
| 2.1     | 2022.5.31 | 13      | Add Converter Input Rush Current.        |
| 2.2     | 2023.6.9  | 9,10,15 | Modify Connector Part No.                |
| 2.3     | 2023.9.5  | 25      | Modify High Temperature Operation.       |
|         |           |         |                                          |
|         |           |         |                                          |
|         |           |         |                                          |
|         |           |         |                                          |

## 1. GENERAL DESCRIPTION

### 1.1 OVERVIEW

G238HCJ-L02 is a 23.8" TFT Liquid Crystal Display IAV module with WLED Backlight unit and 30 pins 2ch-LVDS interface. This module supports 1920 x 1080 Full HD mode and can display up to 16.7M colors.

### 1.2 GENERAL SPECIFICATIONS

| Item              | Specification                                         | Unit  | Note |
|-------------------|-------------------------------------------------------|-------|------|
| Screen Size       | 23.8" real diagonal                                   |       |      |
| Driver Element    | a-si TFT active matrix                                | -     | -    |
| Pixel Number      | 1920 x R.G.B. x 1080                                  | pixel | -    |
| Pixel Pitch       | 0.2745 (H) x 0.2745 (V)                               | mm    | -    |
| Pixel Arrangement | RGB vertical stripe                                   | -     | -    |
| Display Colors    | 16.7M                                                 | color | -    |
| Transmissive Mode | Normally black                                        | -     | -    |
| Surface Treatment | AG type, 3H hard coating, Haze 25                     | -     | -    |
| Luminance, White  | 450                                                   | Cd/m2 |      |
| Power Consumption | Total 23.49W(Max.)@cell 4.29W (Max.), BL 19.2W (Max.) |       | (1)  |

Note (1) The specified power consumption : Total= cell (reference 4.3.1)+BL (reference 4.3.3)

## 2. MECHANICAL SPECIFICATIONS

| Item        |                | Min.   | Typ.   | Max.   | Unit | Note |
|-------------|----------------|--------|--------|--------|------|------|
| Module Size | Horizontal (H) | 539.74 | 540.24 | 540.74 | mm   | (1)  |
|             | Vertical (V)   | 315.16 | 315.66 | 316.16 | mm   |      |
|             | Thickness (T)  | 13.05  | 13.55  | 13.85  | mm   |      |
| Bezel Area  | Horizontal     | 529.74 | 530.24 | 530.74 | mm   |      |
|             | Vertical       | 299.16 | 299.66 | 300.16 | mm   |      |
| Active Area | Horizontal     |        | 527.04 |        | mm   |      |
|             | Vertical       |        | 296.46 |        | mm   |      |
| Weight      |                | 2043   | 2270   | 2384   | g    |      |

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

Note (2) The depth is without connector.

## 3. ABSOLUTE MAXIMUM RATINGS

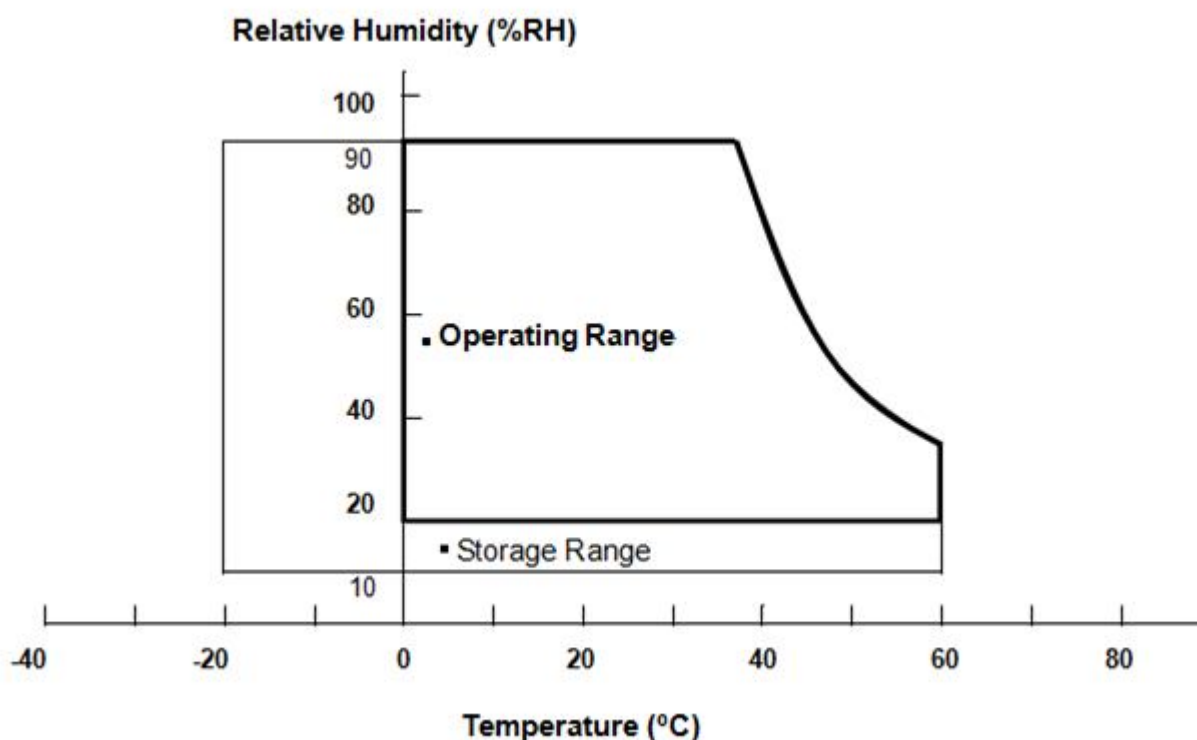
### 3.1 ABSOLUTE RATINGS OF ENVIRONMENT

| Item                          | Symbol | Value |      | Unit | Note     |
|-------------------------------|--------|-------|------|------|----------|
|                               |        | Min.  | Max. |      |          |
| Storage Temperature           | TST    | -20   | 60   | °C   | (1), (2) |
| Operating Ambient Temperature | TOP    | 0     | 60   | °C   |          |

Note (1)

- (a) 90 %RH Max.
- (b) Wet-bulb temperature should be 39 °C Max.
- (c) No condensation.

Note (2) Panel surface temperature should be 0°C min. and 65°C max under Vcc=5.0V, fr =60Hz, typical LED string current, 25°C ambient temperature, and no humidity control . Any condition of ambient operating temperature ,the surface of active area should be keeping not higher than 65°C



## 3.2 ELECTRICAL ABSOLUTE RATINGS

### 3.2.1 TFT LCD MODULE

| Item                 | Symbol          | Value |      | Unit | Note |
|----------------------|-----------------|-------|------|------|------|
|                      |                 | Min.  | Max. |      |      |
| Power Supply Voltage | VCCS            | -0.3  | 6.0  | V    | (1)  |
| Logic Input Voltage  | V <sub>IN</sub> | -0.3  | 3.6  | V    |      |

## 3.2.2 BACKLIGHT UNIT

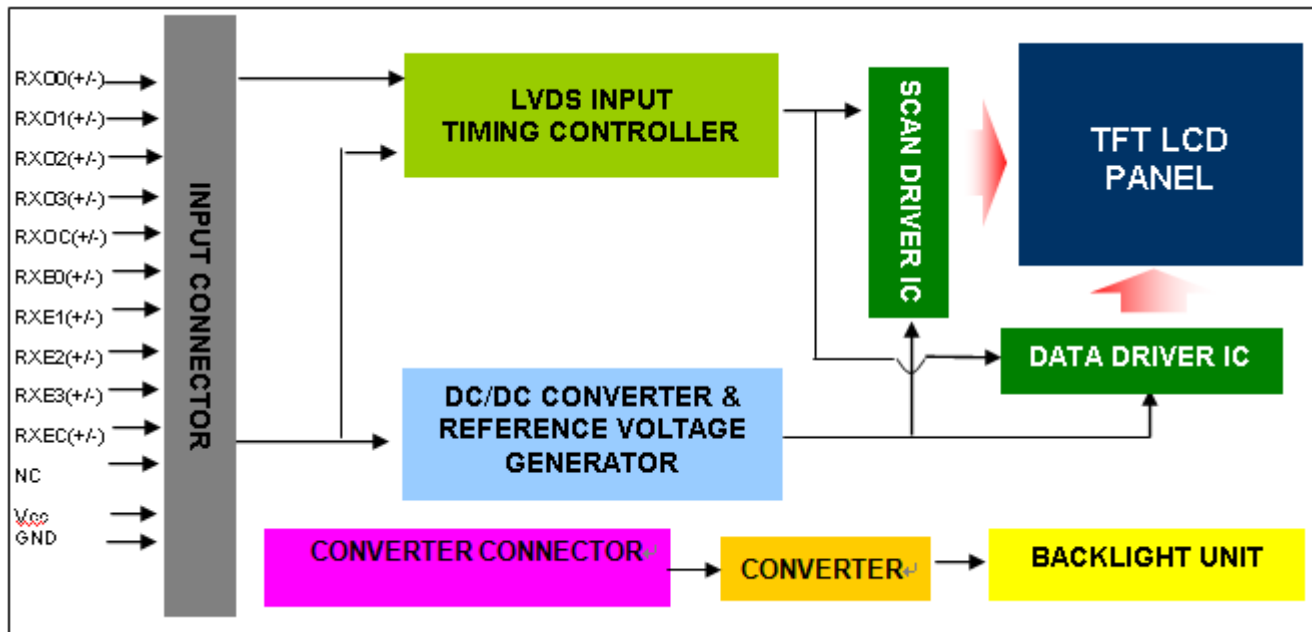
| Item              | Symbol  | Value |      | Unit | Note      |
|-------------------|---------|-------|------|------|-----------|
|                   |         | Min.  | Max. |      |           |
| Converter Voltage | $V_i$   | -0.3  | 18   | V    | (1) , (2) |
| Enable Voltage    | EN      | ---   | 5.5  | V    |           |
| Backlight Adjust  | Dimming | ---   | 5.5  | V    |           |

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 lamp (Refer to 4.3.3 for further information).

## 4. ELECTRICAL SPECIFICATIONS

### 4.1 FUNCTION BLOCK DIAGRAM



### 4.2. INTERFACE CONNECTIONS

#### PIN ASSIGNMENT

| Pin | Name  | Description                                              |
|-----|-------|----------------------------------------------------------|
| 1   | RXO0- | Negative LVDS differential data input. Channel O0 (odd)  |
| 2   | RXO0+ | Positive LVDS differential data input. Channel O0 (odd)  |
| 3   | RXO1- | Negative LVDS differential data input. Channel O1 (odd)  |
| 4   | RXO1+ | Positive LVDS differential data input. Channel O1 (odd)  |
| 5   | RXO2- | Negative LVDS differential data input. Channel O2 (odd)  |
| 6   | RXO2+ | Positive LVDS differential data input. Channel O2 (odd)  |
| 7   | GND   | Ground                                                   |
| 8   | RXOC- | Negative LVDS differential clock input. (odd)            |
| 9   | RXOC+ | Positive LVDS differential clock input. (odd)            |
| 10  | RXO3- | Negative LVDS differential data input. Channel O3(odd)   |
| 11  | RXO3+ | Positive LVDS differential data input. Channel O3 (odd)  |
| 12  | RXE0- | Negative LVDS differential data input. Channel E0 (even) |
| 13  | RXE0+ | Positive LVDS differential data input. Channel E0 (even) |
| 14  | GND   | Ground                                                   |
| 15  | RXE1- | Negative LVDS differential data input. Channel E1 (even) |
| 16  | RXE1+ | Positive LVDS differential data input. Channel E1 (even) |
| 17  | GND   | Ground                                                   |
| 18  | RXE2- | Negative LVDS differential data input. Channel E2 (even) |
| 19  | RXE2+ | Positive LVDS differential data input. Channel E2 (even) |
| 20  | RXEC- | Negative LVDS differential clock input. (even)           |
| 21  | RXEC+ | Positive LVDS differential clock input. (even)           |
| 22  | RXE3- | Negative LVDS differential data input. Channel E3 (even) |
| 23  | RXE3+ | Positive LVDS differential data input. Channel E3 (even) |
| 24  | GND   | Ground                                                   |

|    |     |                                           |
|----|-----|-------------------------------------------|
| 25 | NC  | For LCD internal use only, Do not connect |
| 26 | NC  | For LCD internal use only, Do not connect |
| 27 | NC  | For LCD internal use only, Do not connect |
| 28 | Vcc | +5.0V power supply                        |
| 29 | Vcc | +5.0V power supply                        |
| 30 | Vcc | +5.0V power supply                        |

Note (1) Connector Part No.:

FCN: WF13-422-3033 or P-TWO: 187098-30091.

Note (2) User's connector Part No:

Mating Wire Cable Connector Part No.: FI-X30H(JAE) or FI-X30HL(JAE)

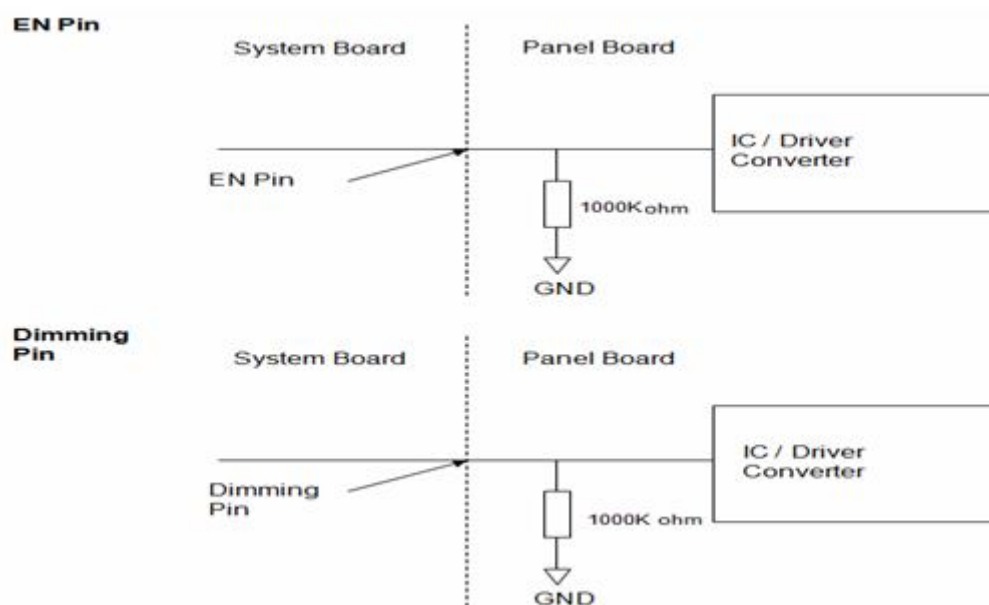
Mating FFC Cable Connector Part No.: 217007-013001 (P-TWO) or JF05X030-1 (JAE).

## BACKLIGHT UNIT(Converter connector pin)

| Pin | Symbol    | Description             | Remark                                                          |
|-----|-----------|-------------------------|-----------------------------------------------------------------|
| 1   | $V_i$     | Converter input voltage | 12V                                                             |
| 2   | $V_i$     | Converter input voltage | 12V                                                             |
| 3   | $V_i$     | Converter input voltage | 12V                                                             |
| 4   | $V_i$     | Converter input voltage | 12V                                                             |
| 5   | $V_{GND}$ | Converter ground        | Ground                                                          |
| 6   | $V_{GND}$ | Converter ground        | Ground                                                          |
| 7   | $V_{GND}$ | Converter ground        | Ground                                                          |
| 8   | $V_{GND}$ | Converter ground        | Ground                                                          |
| 9   | EN        | Enable pin              | 3.3V                                                            |
| 10  | Dimming   | Backlight Adjust        | PWM Dimming<br>(Hi: 3.3V <sub>DC</sub> , Lo: 0V <sub>DC</sub> ) |

Note (1)Connector Part No.: CI4310M1HR0-NH (Cvilux).

Note (2)User's connector Part No.: CI4310S0000 (Cvilux).



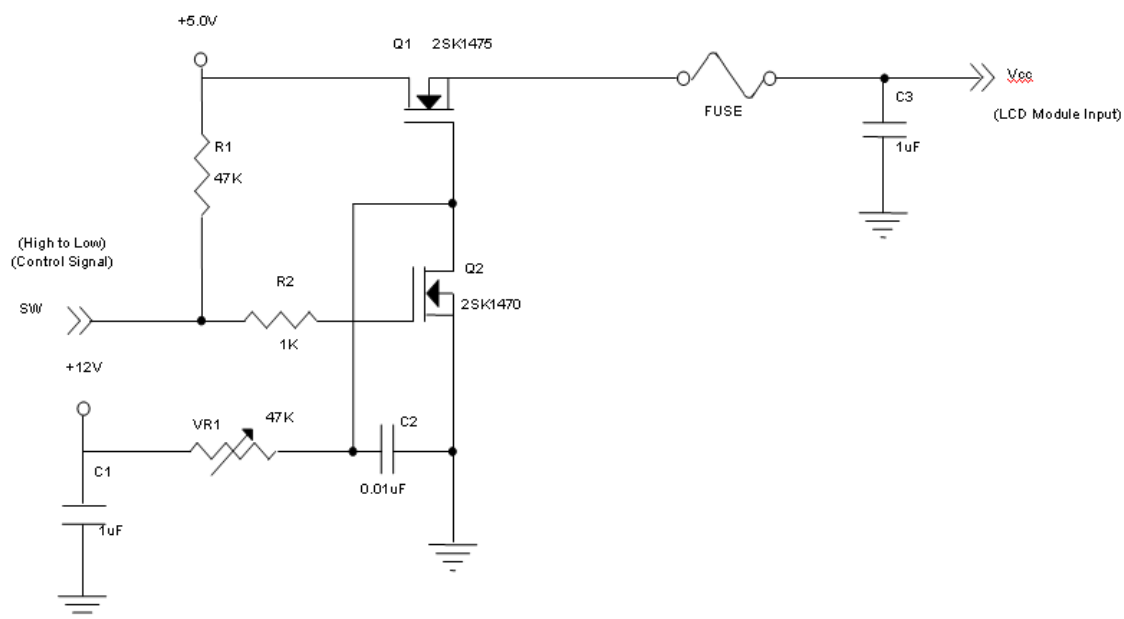
## 4.3 ELECTRICAL CHARACTERISTICS

### 4.3.1 LCD ELETRONICS SPECIFICATION

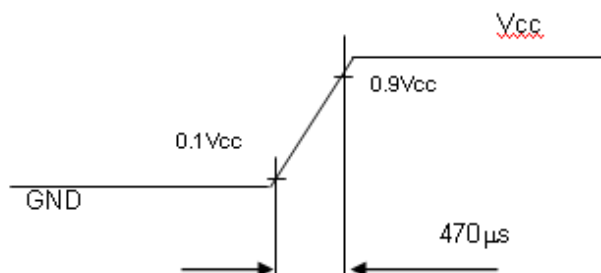
| Parameter                       | Symbol            | Value |       |       | Unit | Note |
|---------------------------------|-------------------|-------|-------|-------|------|------|
|                                 |                   | Min.  | Typ.  | Max.  |      |      |
| Power Supply Voltage            | V <sub>CC</sub>   | 4.5   | 5.0   | 5.5   | V    | -    |
| Ripple Voltage                  | V <sub>RP</sub>   | -     | -     | 300   | mV   | -    |
| Rush Current                    | I <sub>RUSH</sub> | -     | -     | 3     | A    | (2)  |
| Power Supply Current            | White             | -     | 0.362 | 0.449 | A    | (3)a |
|                                 | Black             | -     | 0.361 | 0.434 | A    | (3)b |
|                                 | Vertical Stripe   | -     | 0.703 | 0.836 | A    | (3)c |
| Power Consumption               | PLCD              | -     | 3.516 | 4.29  | Watt | (4)  |
| LVDS differential input voltage | V <sub>id</sub>   | 100   | -     | 600   | mV   |      |
| LVDS common input voltage       | V <sub>ic</sub>   | 1.0   | 1.2   | 1.4   | V    |      |
| LVDS Logic High Input Voltage   | V <sub>IH</sub>   | -     | -     | 0.1   | V    |      |
| LVDS Logic Low Input Voltage    | V <sub>IL</sub>   | -0.1  | -     |       | V    |      |

Note (1) The ambient temperature is  $T_a = 25 \pm 2^\circ\text{C}$ .

Note (2) Measurement Conditions:



**V<sub>CC</sub> rising time is 470μs**



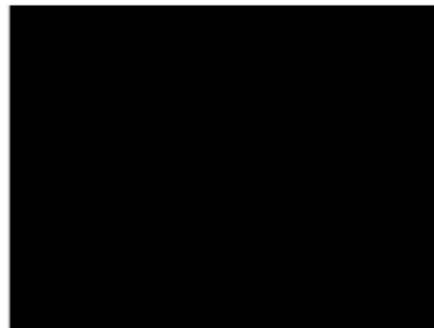
Note (3) The specified max power supply current is under the conditions at  $V_{CC} = 5.0\text{ V}$ ,  $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$ ,  $F_r = 60\text{ Hz}$ , whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern

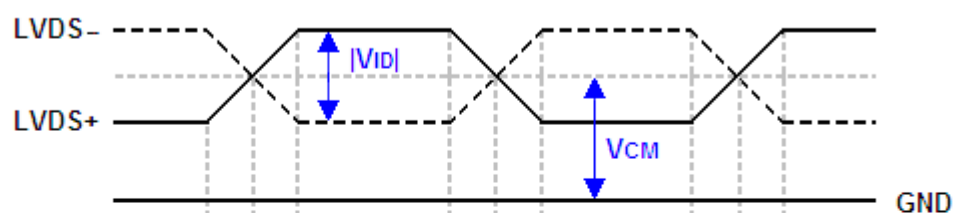


Active Area

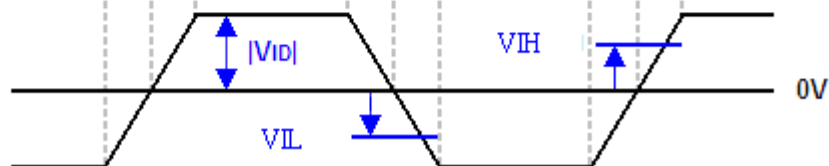
Note (4) The power consumption is specified at the pattern with the maximum current.

Note (5) VID waveform condition

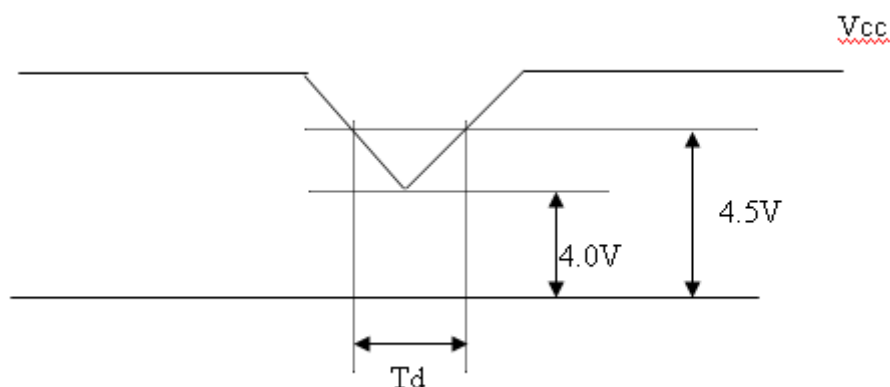
## Single-end Signals



## Differential Signal



## 4.3.2 Vcc POWER DIP CONDITION

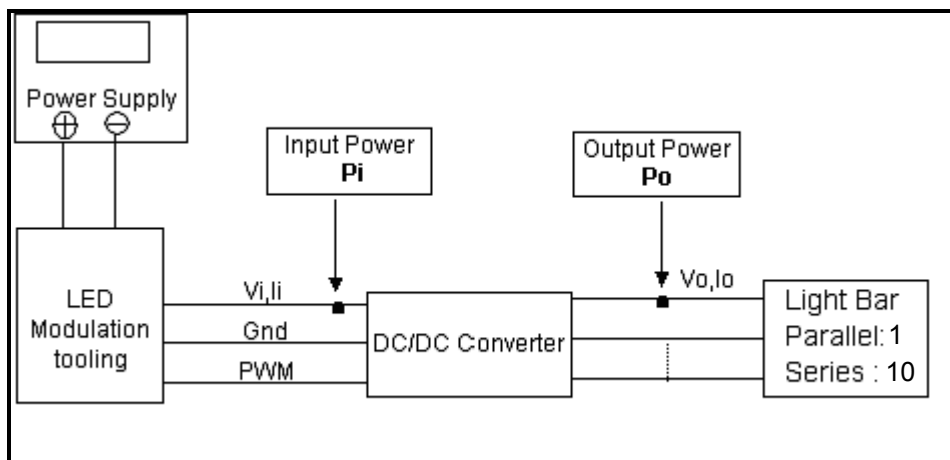


Dip condition:  $4.0 \leq V_{cc} \leq 4.5$ ,  $T_d \leq 20\text{ms}$

## 4.3.3 BACKLIGHT UNIT

| Parameter                      |                | Symbol             | Value  |      |      | Unit | Note                                   |
|--------------------------------|----------------|--------------------|--------|------|------|------|----------------------------------------|
|                                |                |                    | Min.   | Typ. | Max. |      |                                        |
| Converter Power Supply Voltage |                | LED_Vin            | 10.8   | 12.0 | 13.2 | V    |                                        |
| Converter Input Ripple Voltage |                | V <sub>IRP</sub>   | -      | -    | 1000 | mV   |                                        |
| Converter Power Supply Current |                | I <sub>i</sub>     |        | 1.3  | 1.6  | A    | @LED_Vin= 12V<br>Duty=100%             |
| Converter Input Rush Current   |                | I <sub>irsh</sub>  |        |      | 3    | A    | @LED_Vin rising =<br>20mS(Vi=12V)      |
| Input Power Consumption        |                | P <sub>i</sub>     | -      | 15.6 | 19.2 | W    | (1)                                    |
| EN Control Level               | Backlight on   | ENLED<br>(BLON)    | 2.0    | 3.3  | 5.0  | V    |                                        |
|                                | Backlight off  |                    | 0      | -    | 0.15 | V    |                                        |
| PWM Control Level              | PWM High Level | Dimming<br>(E_PWM) | 2.0    | --   | 5.0  | V    |                                        |
|                                | PWM Low Level  |                    | 0      | --   | 0.15 | V    |                                        |
| PWN Noise Range                |                | V <sub>Noise</sub> | -      | -    | 0.1  | V    |                                        |
| PWM Control Frequency          |                | f <sub>PWM</sub>   | 190    | 200  | 300  | Hz   | (3)                                    |
| PWM Dimming Control Duty Ratio |                | -                  | 1      | -    | 100  | %    | (3), @<br>190Hz<f <sub>PWM</sub> <1kHz |
|                                |                |                    | 20     | -    | 100  | %    | (3), @<br>1kHz≤f <sub>PWM</sub> <20kHz |
| LED Life Time                  |                | L <sub>LED</sub>   | 50,000 |      | -    | Hrs  | (2)                                    |

Note (1) LED current is measured by utilizing a high frequency current meter as shown below:



Note (2) The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at  $T_a = 25 \pm 2^\circ\text{C}$  and Duty 100% until the brightness becomes  $\leq 50\%$  of its original value. Operating LED at high temperature condition will reduce life time and lead to color shift.

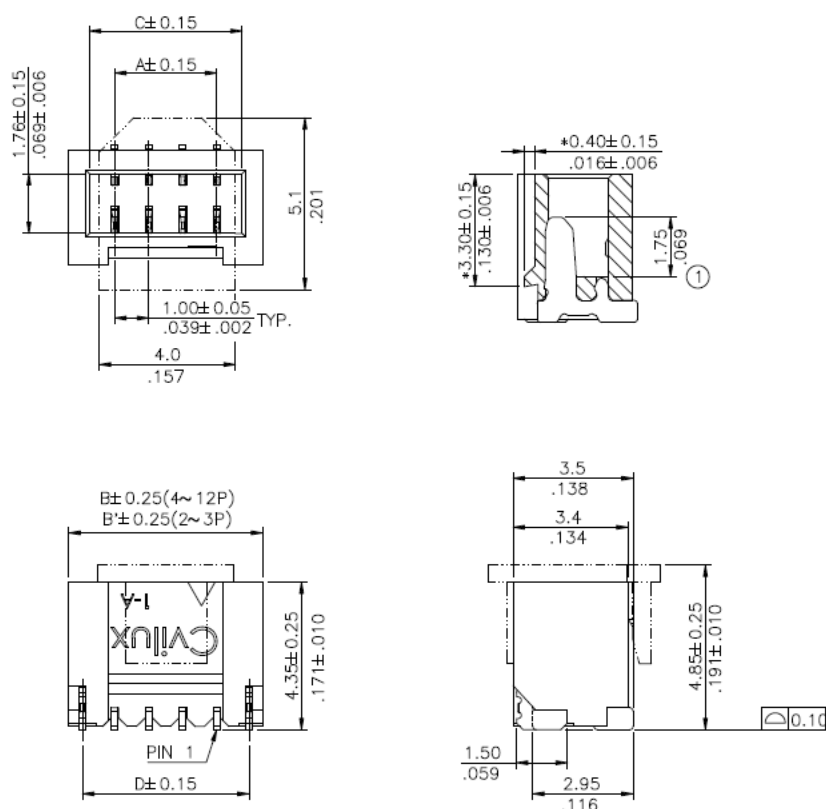
Note (3) At 190 ~1kHz PWM control frequency, duty ratio range is restricted from 5% to 100%.

1k ~ 20kHz PWM control frequency, duty ratio range is restricted from 20% to 100%.

If PWM control frequency is applied in the range from 1kHz to 20kHz, The “non-linear” phenomenon on the Backlight Unit may be found. So It’s a **suggestion** that PWM control frequency should be **less than 1KHz**.

## 4.3.4 POWER CONNECTOR PIN ASSIGNMENT

Connector: CI1406M1VL0-NH (CviLux) or Compatible



CN1

| Pin number | Description           |
|------------|-----------------------|
| 1          | Cathode of LED string |
| 2          | Cathode of LED string |
| 3          | VLED                  |
| 4          | VLED                  |
| 5          | Cathode of LED string |
| 6          | Cathode of LED string |

Note(1) Connector(wire type): CI1406M1VL0-NH (CviLux).

Note(2) User's mating connector part No.: FCN( WF1300106-B) and hook width must be less than 4.5mm.

## 4.4 LVDS INPUT SIGNAL SPECIFICATIONS

### 4.4.1 LVDS DATA MAPPING TABLE

|                 |             |     |     |     |     |     |     |     |
|-----------------|-------------|-----|-----|-----|-----|-----|-----|-----|
| LVDS Channel O0 | LVDS output | D7  | D6  | D4  | D3  | D2  | D1  | D0  |
|                 | Data order  | OG0 | OR5 | OR4 | OR3 | OR2 | OR1 | OR0 |
| LVDS Channel O1 | LVDS output | D18 | D15 | D14 | D13 | D12 | D9  | D8  |
|                 | Data order  | OB1 | OB0 | OG5 | OG4 | OG3 | OG2 | OG1 |
| LVDS Channel O2 | LVDS output | D26 | D25 | D24 | D22 | D21 | D20 | D19 |
|                 | Data order  | DE  | NA  | NA  | OB5 | OB4 | OB3 | OB2 |
| LVDS Channel O3 | LVDS output | D23 | D17 | D16 | D11 | D10 | D5  | D27 |
|                 | Data order  | NA  | OB7 | OB6 | OG7 | OG6 | OR7 | OR6 |
| LVDS Channel E0 | LVDS output | D7  | D6  | D4  | D3  | D2  | D1  | D0  |
|                 | Data order  | EG0 | ER5 | ER4 | ER3 | ER2 | ER1 | ER0 |
| LVDS Channel E1 | LVDS output | D18 | D15 | D14 | D13 | D12 | D9  | D8  |
|                 | Data order  | EB1 | EB0 | EG5 | EG4 | EG3 | EG2 | EG1 |
| LVDS Channel E2 | LVDS output | D26 | D25 | D24 | D22 | D21 | D20 | D19 |
|                 | Data order  | DE  | NA  | NA  | EB5 | EB4 | EB3 | EB2 |
| LVDS Channel E3 | LVDS output | D23 | D17 | D16 | D11 | D10 | D5  | D27 |
|                 | Data order  | NA  | EB7 | EB6 | EG7 | EG6 | ER7 | ER6 |

## 4.4.2 COLOR DATA INPUT ASSIGNMENT

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

| Color               |                 | Data Signal |    |    |    |    |    |    |    |       |    |    |    |    |    |    |    |      |    |    |    |    |    |    |    |
|---------------------|-----------------|-------------|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|------|----|----|----|----|----|----|----|
|                     |                 | Red         |    |    |    |    |    |    |    | Green |    |    |    |    |    |    |    | Blue |    |    |    |    |    |    |    |
|                     |                 | R7          | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7    | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7   | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors        | 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  |
|                     | Red             | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Green           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 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  | 1    | 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  | 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  | 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  | 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  |
| Gray Scale Of Red   | Red(0) / Dark   | 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  | 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  | 0  |
|                     | ⋮               | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  |
|                     | ⋮               | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  |
|                     | Red(253)        | 1           | 1  | 1  | 1  | 1  | 1  | 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  | 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  | 0  |
| Gray Scale Of Green | Green(0) / Dark | 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  | 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  | 0  |
|                     | ⋮               | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  |
|                     | ⋮               | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  |
|                     | Green(253)      | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 1    | 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  | 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  | 0  |
| Gray Scale Of Blue  | Blue(0) / Dark  | 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  | 0  | 1  |
|                     | Blue(2)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 1  | 0  |
|                     | ⋮               | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  |
|                     | ⋮               | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  |
|                     | Blue(253)       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  | 0  | 1  |
|                     | Blue(254)       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 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  | 1  |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

## 4.5 DISPLAY TIMING SPECIFICATIONS

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

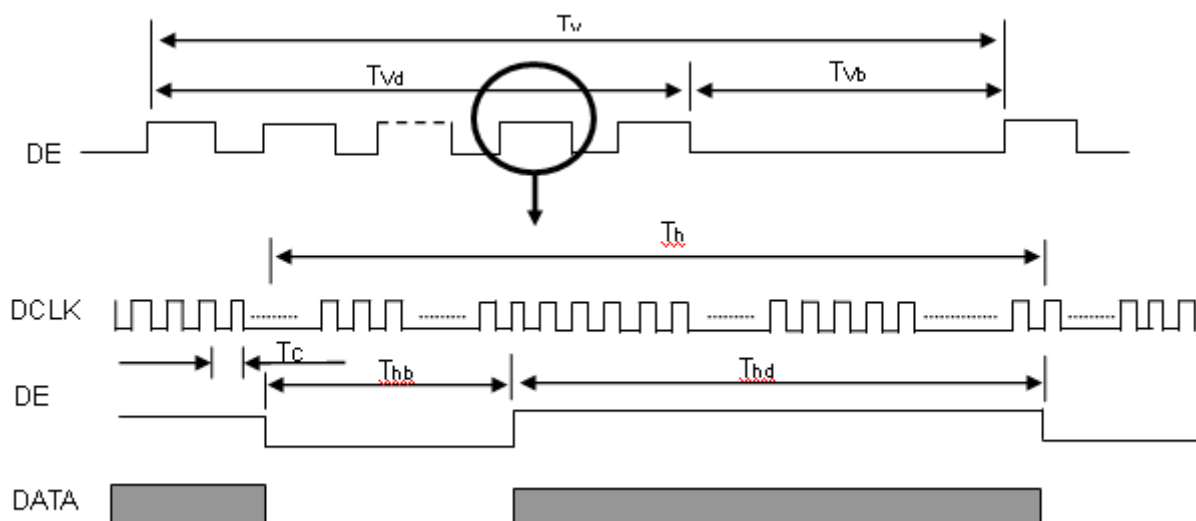
| Signal                  | Item                                 | Symbol                 | Min.                 | Typ.  | Max.                | Unit | Note       |
|-------------------------|--------------------------------------|------------------------|----------------------|-------|---------------------|------|------------|
| LVDS Clock              | Frequency                            | F <sub>c</sub>         | 56                   | 74.25 | (97.98)             | MHz  | -          |
|                         | Period                               | T <sub>c</sub>         | -                    | 13.47 | -                   | ns   | -          |
|                         | Input cycle to cycle jitter          | T <sub>rcl</sub>       | -0.02*T <sub>c</sub> | -     | 0.02*T <sub>c</sub> | ns   | (1)        |
|                         | Input Clock to data skew             | TLVCCS                 | -0.02*T <sub>c</sub> | -     | 0.02*T <sub>c</sub> | ps   | (2)        |
|                         | Spread spectrum modulation range     | F <sub>clkin_mod</sub> | 0.97*F <sub>c</sub>  | -     | 1.03*F <sub>c</sub> | MHz  | (3)        |
|                         | Spread spectrum modulation frequency | F <sub>SSM</sub>       | -                    | -     | 100                 | KHz  |            |
| Vertical Display Term   | Frame Rate                           | Fr                     | 49                   | 60    | 77                  | Hz   | Tv=Tvd+Tvb |
|                         | Total                                | Tv                     | 1100                 | 1125  | 1257                | Th   | -          |
|                         | Active Display                       | Tvd                    | 1080                 | 1080  | 1080                | Th   | -          |
|                         | Blank                                | Tvb                    | 20                   | 45    | 177                 | Th   | -          |
| Horizontal Display Term | Total                                | Th                     | 1050                 | 1100  | 1150                | Tc   | Th=Thd+Thb |
|                         | Active Display                       | Thd                    | 960                  | 960   | 960                 | Tc   | -          |
|                         | Blank                                | Thb                    | 90                   | 140   | 190                 | Tc   | -          |

Note: Because this module is operated by DE only mode, Hsync and Vsync input signals are ignored.

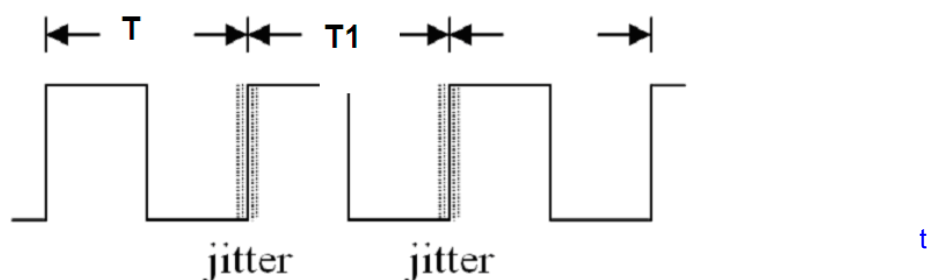
$$F_c = Fr \times Tv \times Th$$

Please make sure the range of pixel clock has follow the below equation and F<sub>c</sub>, Fr, Tv, Th not allowed to get beyond the min or max spec.

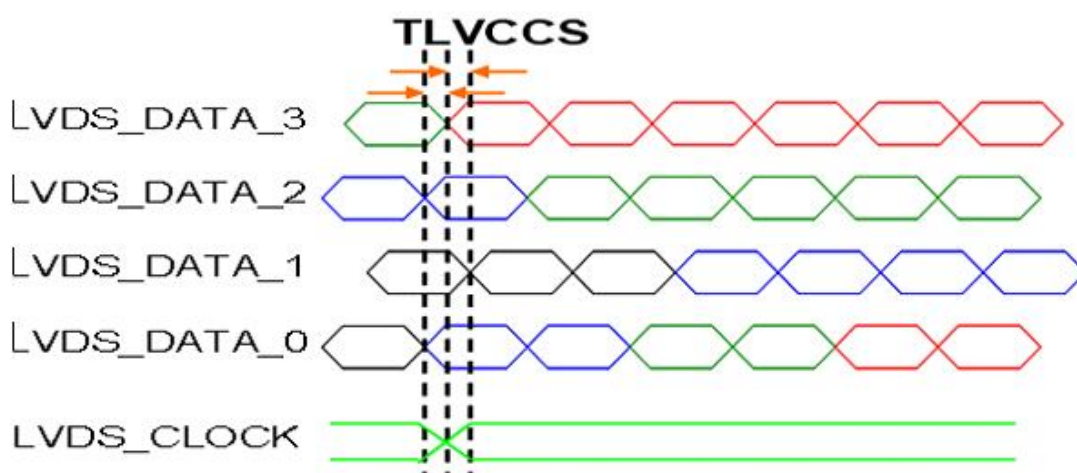
### INPUT SIGNAL TIMING DIAGRAM



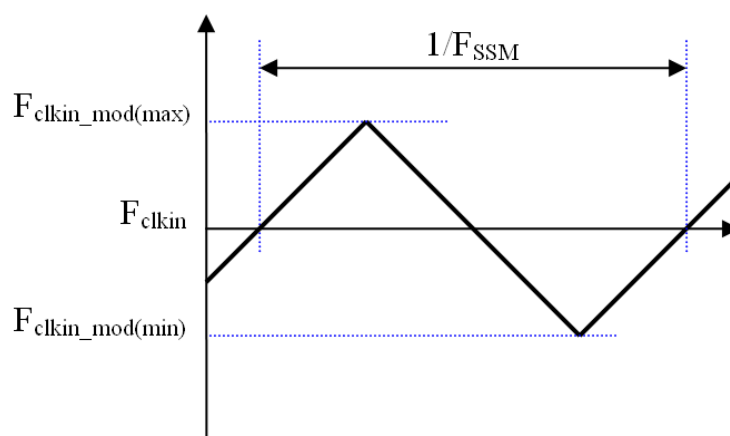
Note (1) The input clock cycle-to-cycle jitter is defined as below figures.  $Trcl = |T_1 - T|$



Note (2) Input Clock to data skew is defined as below figures.



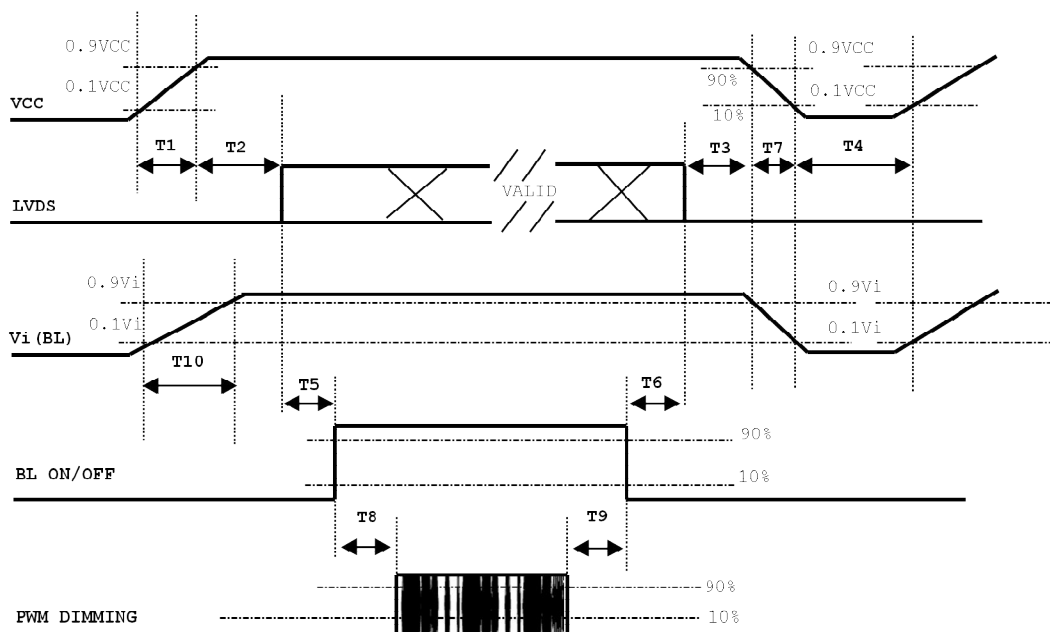
Note (3) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note(4) Note(4) The DCLK range at last line of V-blank should be set in 0 to Hdisplay/2

## 4.6 POWER ON/OFF SEQUENCE

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



**Power ON/OFF sequence**

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

| Parameter | Value |     |     | Units |
|-----------|-------|-----|-----|-------|
|           | Min   | Typ | Max |       |
| T1        | 0.5   | -   | 10  | ms    |
| T2        | 0     | -   | 50  | ms    |
| T3        | 0     | -   | 50  | ms    |
| T4        | 500   | -   | -   | ms    |
| T5        | 450   | -   | -   | ms    |
| T6        | 200   | -   | -   | ms    |
| T7        | 10    | -   | 100 | ms    |
| T8        | 10    | -   | -   | ms    |
| T9        | 10    | -   | -   | ms    |
| T10       | 20    |     | 50  | ms    |

## 5. OPTICAL CHARACTERISTICS

### 5.1 TEST CONDITIONS

| Item                | Symbol                                                        | Value | Unit |
|---------------------|---------------------------------------------------------------|-------|------|
| Ambient Temperature | Ta                                                            | 25±2  | °C   |
| Ambient Humidity    | Ha                                                            | 50±10 | %RH  |
| Supply Voltage      | V <sub>CC</sub>                                               | 5     | V    |
| Input Signal        | According to typical value in "3. ELECTRICAL CHARACTERISTICS" |       |      |
| PWM Duty Ratio      | D                                                             | 100   | %    |

### 5.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown here and all items are measured at the center point of screen unless otherwise noted. The following items should be measured under the test conditions described above and stable conditions shown in Note (5).

| Item                          |                                              | Symbol                            | Condition                                                   | Min.       | Typ.           | Max.       | Unit | Note     |
|-------------------------------|----------------------------------------------|-----------------------------------|-------------------------------------------------------------|------------|----------------|------------|------|----------|
| Color Chromaticity (CIE 1931) | Red                                          | R <sub>x</sub>                    | θ <sub>X</sub> =0°, θ <sub>Y</sub> =0°<br>Grayscale Maximum | Typ – 0.03 | 0.652          | Typ + 0.03 | -    | (1), (5) |
|                               |                                              | R <sub>y</sub>                    |                                                             |            | 0.337          |            |      |          |
|                               | Green                                        | G <sub>x</sub>                    |                                                             |            | 0.313          |            |      |          |
|                               |                                              | G <sub>y</sub>                    |                                                             |            | 0.626          |            |      |          |
|                               | Blue                                         | B <sub>x</sub>                    |                                                             |            | 0.151          |            |      |          |
|                               |                                              | B <sub>y</sub>                    |                                                             |            | 0.066          |            |      |          |
|                               | White                                        | W <sub>x</sub>                    |                                                             |            | 0.313          |            |      |          |
|                               |                                              | W <sub>y</sub>                    |                                                             |            | 0.329          |            |      |          |
|                               | Center Luminance of White (Center of Screen) |                                   |                                                             |            | L <sub>C</sub> |            |      |          |
| Contrast Ratio                |                                              | CR                                |                                                             | 700        | 1000           | -          | -    | (2), (5) |
| Response Time                 |                                              | T <sub>R</sub>                    | θ <sub>x</sub> =0°, θ <sub>y</sub> =0°                      | -          | 8              |            | ms   | (3)      |
|                               |                                              | T <sub>F</sub>                    |                                                             |            | 7              |            |      |          |
| White Variation               |                                              | δW                                | θ <sub>x</sub> =0°, θ <sub>y</sub> =0°                      | 75         |                |            | %    | (5), (6) |
| Viewing Angle                 | Horizontal                                   | θ <sub>x-</sub> + θ <sub>x+</sub> | CR ≥ 10                                                     | 170        | 178            | -          | Deg. | (1), (5) |
|                               | Vertical                                     | θ <sub>y-</sub> + θ <sub>y+</sub> |                                                             | 170        | 178            | -          |      |          |

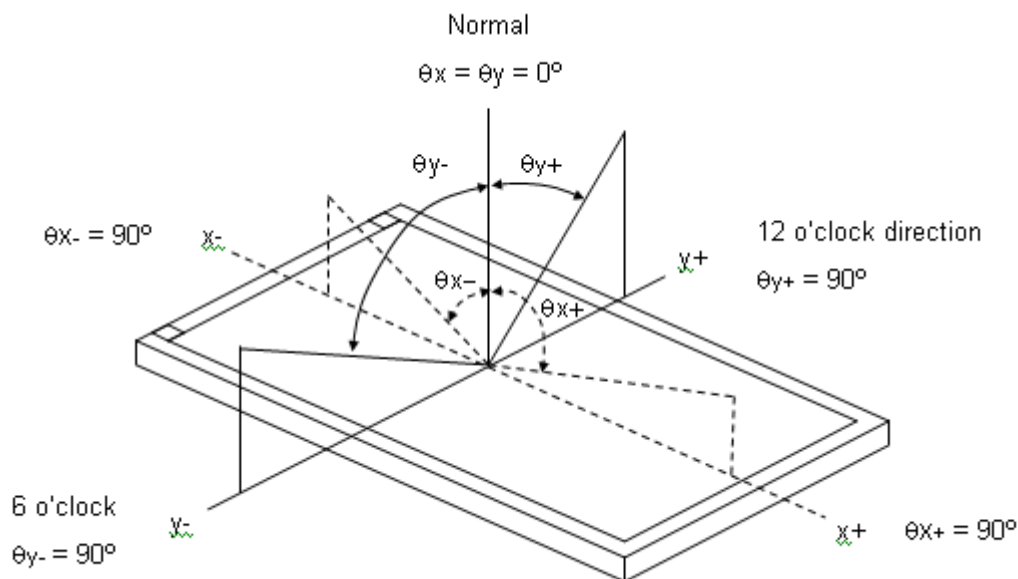
Definition :

Grayscale Maximum : Grayscale 255 (10 bits: grayscale 1023 ; 8 bits : grayscale 255 ; 6 bits: grayscale 63)

White : Luminance of Grayscale Maximum (All R,G,B)

Black : Luminance of grayscale 0 (All R,G,B)

Note (1) Definition of Viewing Angle ( $\theta_x$ ,  $\theta_y$ ):

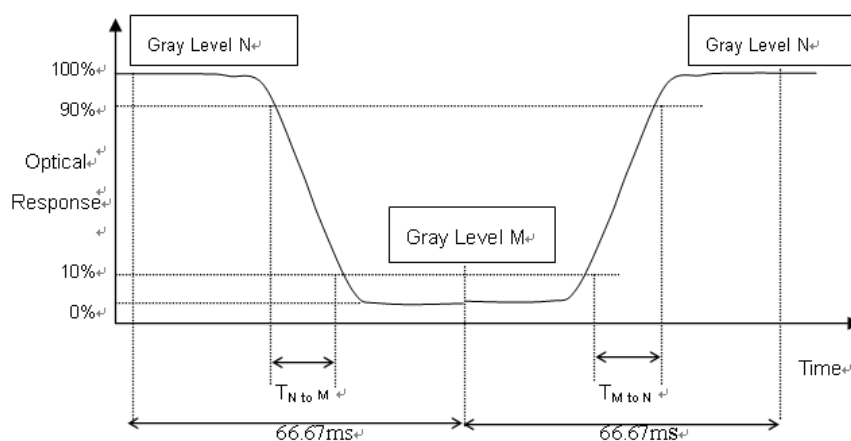


Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = White / Black

Note (3) Definition of Response Time ( $T_R$ ,  $T_F$ ):

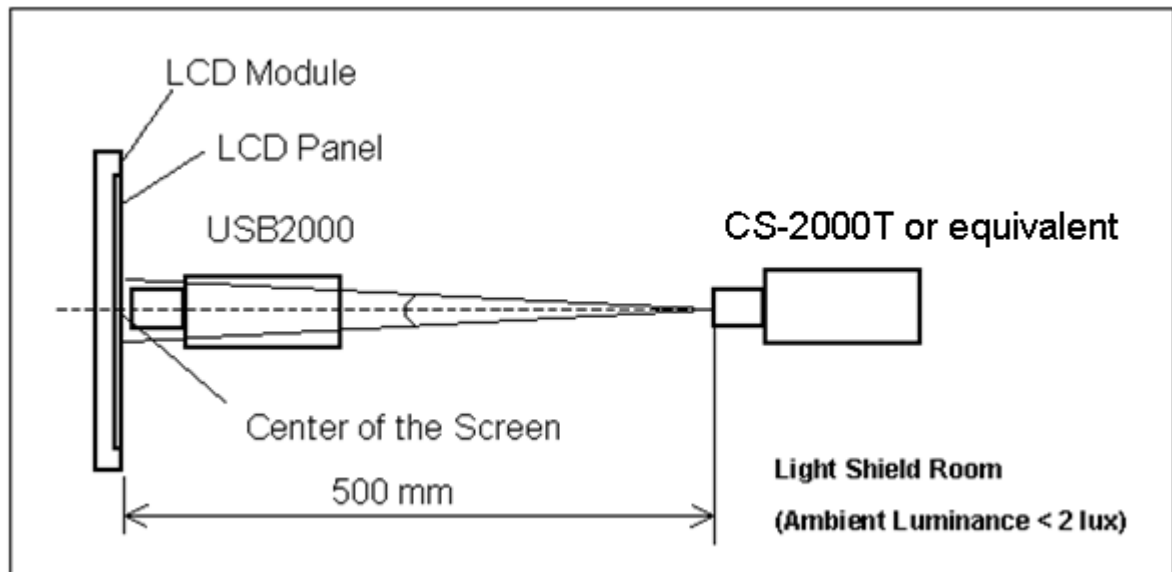


Note (4) Definition of Luminance of White ( $L_C$ ):

Measure the luminance of White 255 at center point

Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 40 minutes in a windless room.

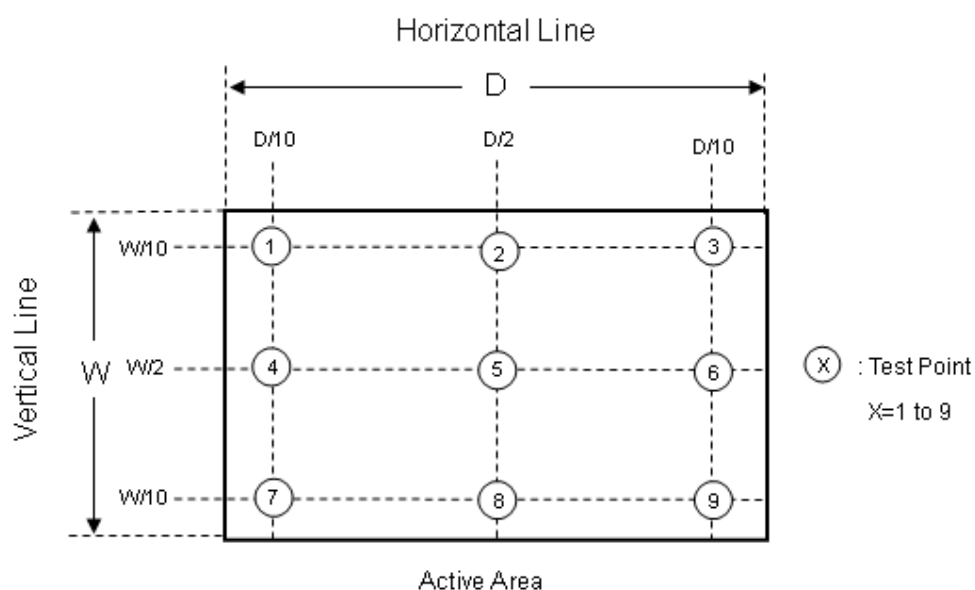


Note (6) Definition of White Variation ( $\delta W$ ):

Measure the luminance of White at 9 points.

Luminance of White :  $L(X)$  , where X is from 1 to 9.

$$\delta W = \frac{\text{Minimum [ } L(1) \text{ to } L(9) \text{ ]}}{\text{Maximum [ } L(1) \text{ to } L(9) \text{ ]}} \times 100\%$$



## 6. RELIABILITY TEST ITEM

| Items                             | Required Condition                                                                                                | Note         |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------|
| Temperature Humidity Bias (THB)   | Ta=50℃ , 80%RH, 240hours                                                                                          | (1)(2)(4)(5) |
| High Temperature Operation (HTO)  | Ta=60℃ , 240hours                                                                                                 |              |
| Low Temperature Operation (LTO)   | Ta= 0℃ , 240hours                                                                                                 |              |
| High Temperature Storage (HTS)    | Ta= 60℃ , 240hours                                                                                                |              |
| Low Temperature Storage (LTS)     | Ta= -20℃ , 240hours                                                                                               |              |
| Vibration Test<br>(Non-operation) | Acceleration: 1.5 G<br>Wave: sine<br>Frequency: 10 - 300 Hz<br>Sweep: 30 Minutes each Axis (X, Y, Z)              | (2) (3)      |
| Shock Test<br>(Non-operation)     | Acceleration: 50 G<br>Wave: Half-sine<br>Active Time: 11 ms<br>Direction : ± X, ± Y, ± Z.(one time for each Axis) |              |
| Thermal Shock Test (TST)          | (-20℃/30min , 60℃ / 30min , 100 cycles)                                                                           |              |

Note (1) There should be no condensation on the surface of panel during test ,

Note (2) Temperature of panel display surface area should be 65℃ Max.

Note (3) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

Note (4) In the standard conditions, there is no function failure issue occurred. All the cosmetic specification is judged before reliability test.

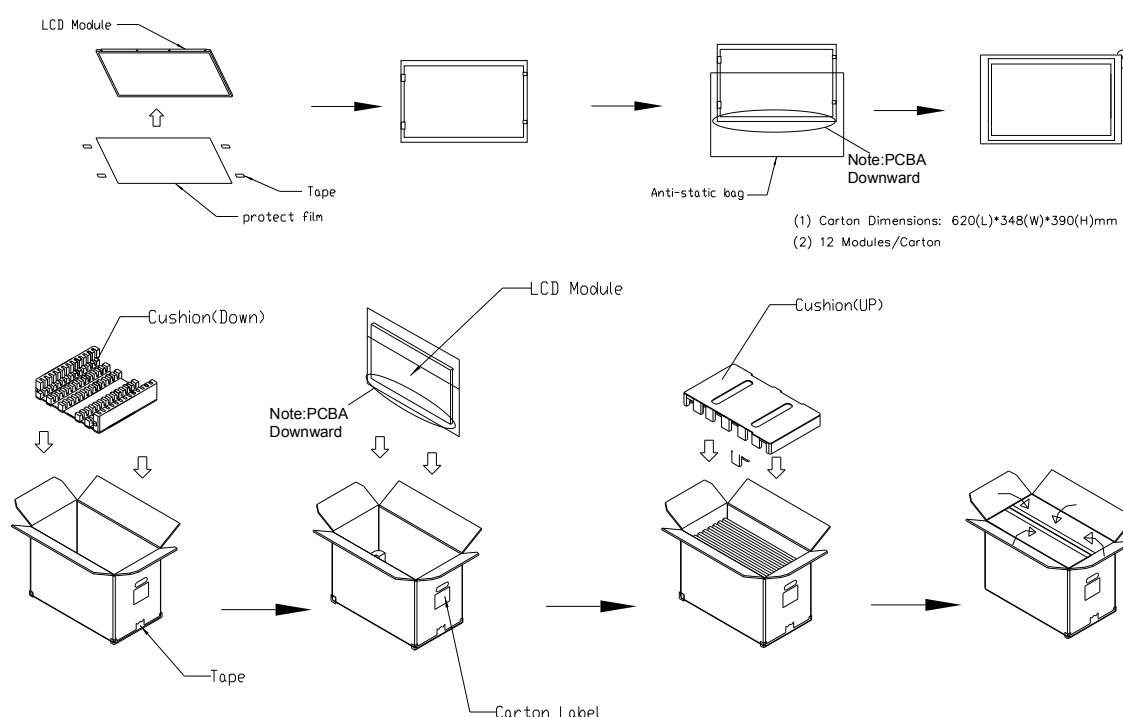
Note (5) Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.

## 7. PACKING

### 7.1 PACKING SPECIFICATIONS

- (1) 12 LCD modules / 1 Box
- (2) Box dimensions: 620(L) X 348(W) X 390(H) mm
- (3) Weight: approximately: 28.8kg

### 7.2 PACKING METHOD



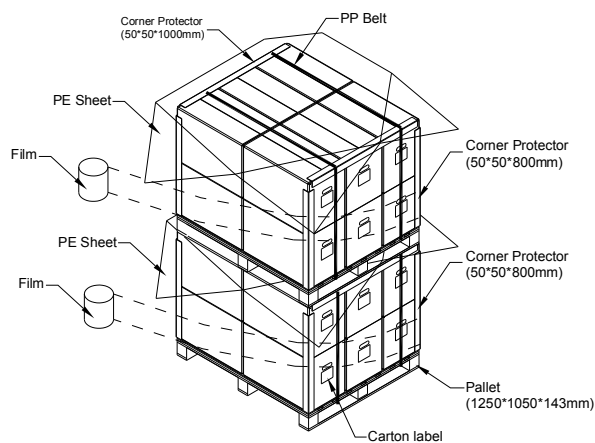
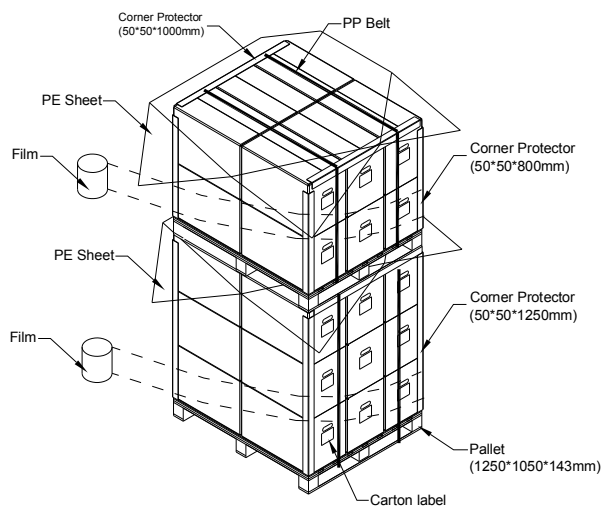
**Figure. 7-1 Packing method**

## 7.3 PALLET

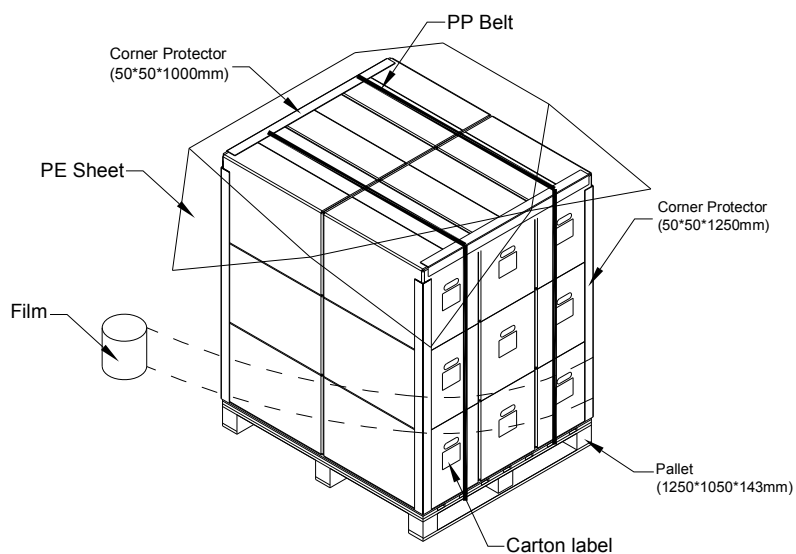
For ocean shipping

Sea / Land Transportation (40ft HQ Container)

Sea / Land Transportation (40ft Container)

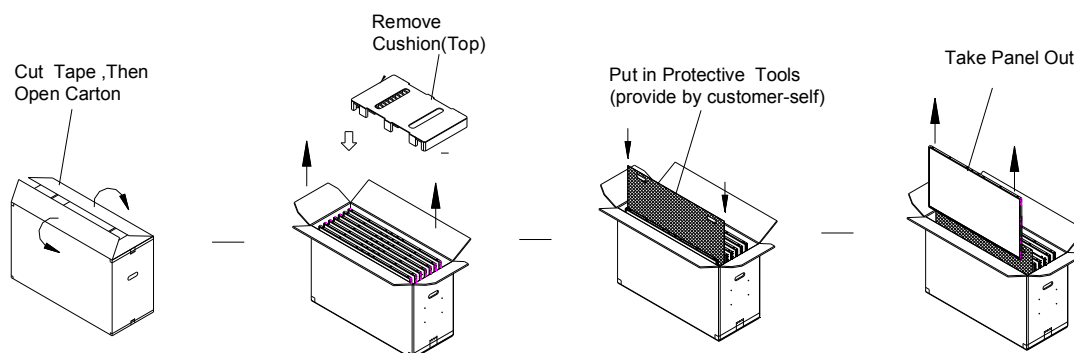


For air transport



**Figure. 7-2 Packing method**

## 7.4 UN-PACKING METHOD



**Figure. 7-3 UN-Packing method**

## 8. Innolux MODULE LABEL

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



(a) Model Name: G238HCJ-L02

(b) \* \* \* \* : Factory ID

(c) Innolux barcode definition:

Serial ID: XX-XX-X-XX-YMD-L-NNNN

| Code | Meaning              | Description                                                                                                                                                               |
|------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| XX   | Innolux internal use | -                                                                                                                                                                         |
| XX   | Revision             | Cover all the change                                                                                                                                                      |
| X    | Innolux internal use | -                                                                                                                                                                         |
| XX   | Innolux internal use | -                                                                                                                                                                         |
| YMD  | Year, month, day     | Year: 0~9, 2001=1, 2002=2, 2003=3...2010=0, 2011=1, 2012=2...<br>Month: 1~12=1, 2, 3, ~, 9, A, B, C<br>Day: 1~31=1, 2, 3, ~, 9, A, B, C, ~, W, X, Y, exclude I, O, and U. |
| X    | INX internal use     | Grade Code                                                                                                                                                                |
| NNNN | Serial number        | Manufacturing sequence of product                                                                                                                                         |

## 9. PRECAUTIONS

### 9.1 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 only 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 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 storage conditions.
- (10) When ambient temperature is lower than 10°C may reduce the display quality. For example, the response time will become slowly.

### 9.2 STORAGE PRECAUTIONS

- (1) When storing for a long time, the following precautions are necessary.
  - (a) Store them in a dark place. Do not expose the module to sunlight or fluorescent light.  
Keep the temperature between 5°C and 30°C at humidity 50+-10%RH.
  - (b) The polarizer surface should not come in contact with any other object.
  - (c) It is recommended that they be stored in the container in which they were shipped.
  - (d) Storage condition is guaranteed under packing conditions.
  - (e) The phase transition of Liquid Crystal in the condition of the low or high storage temperature will be recovered when the LCD module returns to the normal condition
- (2) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (3) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- (4) It may reduce the display quality if the ambient temperature is lower than 10 °C. For example, the response time will become slowly, and the starting voltage of lamp will be higher than the room temperature.

### 9.3 OPERATION PRECAUTIONS

- (1) Normal operating condition
  - (a) Display pattern: dynamic pattern (Real display)
    - (Note) Long-term static display can cause image sticking.
- (2) Operating usages to protect against image sticking due to long-term static display
  - (a) Suitable operating time: under 16 hours a day.
  - (b) Static information display recommended to use with moving image.
  - (c) Cycling display between 5 minutes' information(static) display and 10 seconds' moving image.
- (3) Abnormal condition just means conditions except normal condition.

### 9.4 SAFETY PRECAUTIONS

- (1) 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.
- (2) After the module's end of life, it is not harmful in case of normal operation and storage.

### 9.5 SAFETY STANDARDS

The LCD module should be certified with safety regulations as follows:

- (1) UL60950-1 or updated standard.
- (2) IEC60950-1 or updated standard.

### 9.6 OTHER

When fixed patterns are displayed for a long time, remnant image is likely to occur.

## Appendix. OUTLINE DRAWING

