

**Doc. Number:**

- Tentative Specification
- Preliminary Specification
- Approval Specification

# MODEL NO.: N156BGE

## SUFFIX: L31

|  |                  |
|--|------------------|
| <b>Customer: Common Model</b>  |                  |
| <b>APPROVED BY</b>   | <b>SIGNATURE</b> |
| <b>Name / Title</b> _____  | _____            |
| Note   |                  |
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|--|---|--|
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REVISION HISTORY

| Version | Date         | Page | Description                                      |
|---------|--------------|------|--|
| 3.0     | Oct. 16,2012 | All  | Approval Specification Ver.3.0 was first issued. |
|         |              |      |  |
|         |              |      |  |
|         |              |      |  |
|         |              |      |  |
|         |              |      |  |
|         |              |      |  |

## 1. GENERAL DESCRIPTION

### 1.1 OVERVIEW

N156BGE-L31 is a 15.6" (15.547" diagonal) TFT Liquid Crystal Display module with LED Backlight unit and 40 pins LVDS interface. This module supports 1366 x 768 HD mode and can display 262,144 colors. The optimum viewing angle is at 6 o'clock direction.

### 1.2 GENERAL SPECIFICATIONS

| Item              | Specification  | Unit  | Note   |
|-------------------|--|-------|--------|
| Screen Size       | 15.547" diagonal   |       |        |
| Driver Element    | a-si TFT active matrix                                       | -     | -      |
| Pixel Number      | 1366 x R.G.B. x 768  | pixel | -      |
| Pixel Pitch       | 0.252 (H) x 0.252 (V)  | mm    | -      |
| Pixel Arrangement | RGB vertical stripe  | -     | -      |
| Display Colors    | 262,144  | color | -      |
| Transmissive Mode | Normally white   | -     | -      |
| Surface Treatment | Hard coating (3H), Anti-Glare                                | -     | -      |
| Luminance, White  | 200  | Cd/m2 |        |
| Power Consumption | Total 3.308 W (Max.) @ cell 0.858 W (Max.), BL 2.45 W (Max.) |       | (1)(2) |

Note (1) The specified power consumption (with converter efficiency) is under the conditions at VCCS = 3.3 V, fv = 60 Hz, LED\_VCCS = Typ, fPWM = 200 Hz, Duty=100% and Ta = 25 ± 2 °C, whereas Mosaic pattern is displayed.

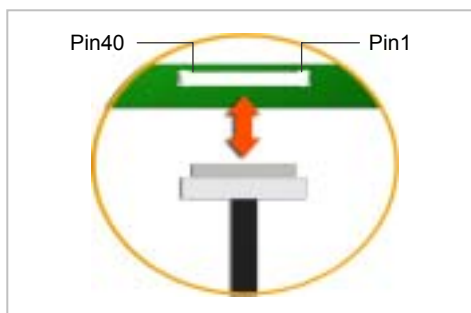
Note (2) Total power consumption=1.8W at BL=100nits.The specified power consumption (with converter efficiency) is under the conditions at VCCS = 3.3 V, fv = 60 Hz, LED\_VCCS = Typ, fPWM = 200 Hz, Duty=50% and Ta = 25 ± 2 °C, whereas Mosaic pattern is displayed.

## 2. MECHANICAL SPECIFICATIONS

| Item        | Min.                            | Typ.    | Max.    | Unit    | Note |     |
|-------------|---------------------------------|---------|---------|---------|------|-----|
| Module Size | Horizontal (H)                  | 359     | 359.5   | 360     | mm   | (1) |
|             | Vertical (V) w/o PCB and Hinge  | 206     | 206.5   | 207     | mm   |     |
|             | Vertical (V) with PCB w/o Hinge | 217     | 217.5   | 218     |      |     |
|             | Thickness (T)                   | -       | 3.5     | 3.8     | mm   |     |
| Bezel Area  | Horizontal                      | 347.06  | 347.36  | 347.66  | mm   |     |
|             | Vertical                        | 196.29  | 196.59  | 196.89  | mm   |     |
| Active Area | Horizontal                      | 343.932 | 344.232 | 344.532 | mm   |     |
|             | Vertical                        | 193.236 | 193.536 | 193.836 | mm   |     |
| Weight      | 395                             | 410     | 425     | g       |      |     |

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

### 2.1 CONNECTOR TYPE



Please refer Appendix Outline Drawing for detail design.

Connector Part No.: IPEX-20455-040E-12 or Tyco 5-2069716-3

User's connector Part No: IPEX-20453-040T-01 or Tyco#5-2069715-3

### 3. ABSOLUTE MAXIMUM RATINGS

#### 3.1 ABSOLUTE RATINGS OF ENVIRONMENT

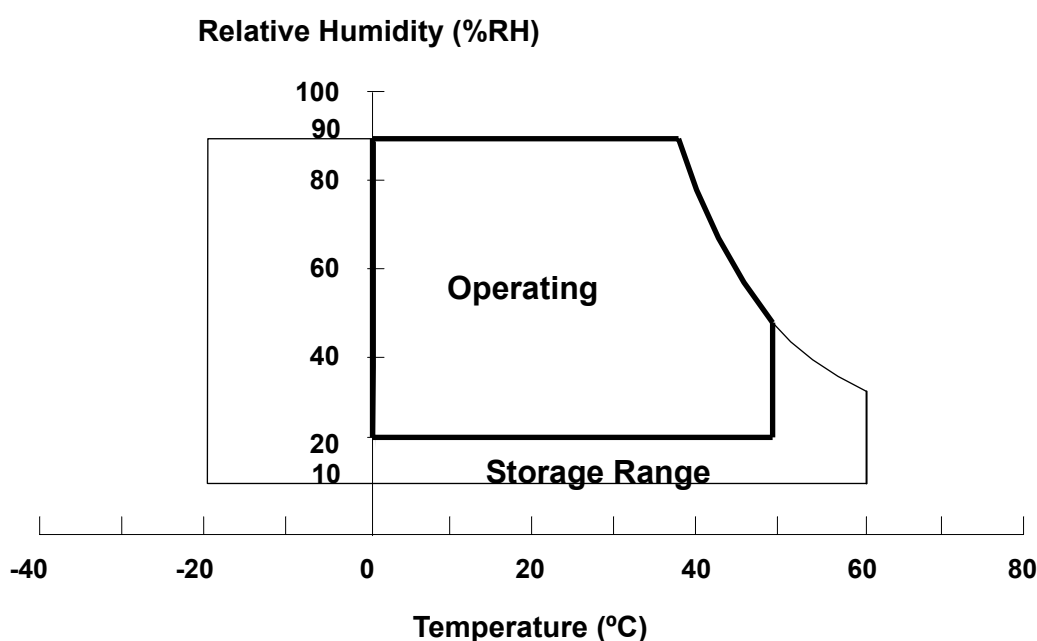
| Item                          | Symbol          | Value |      | Unit | Note     |
|-------------------------------|-----------------|-------|------|------|----------|
|                               |                 | Min.  | Max. |      |          |
| Storage Temperature           | T <sub>ST</sub> | -20   | +60  | °C   | (1)      |
| Operating Ambient Temperature | T <sub>OP</sub> | 0     | +50  | °C   | (1), (2) |

Note (1) (a) 90 %RH Max. (Ta ≤ 40 °C).

(b) Wet-bulb temperature should be 39 °C Max. (Ta > 40 °C).

(c) No condensation.

Note (2) The temperature of panel surface should be 0 °C min. and 60 °C max.



### 3.2 ELECTRICAL ABSOLUTE RATINGS

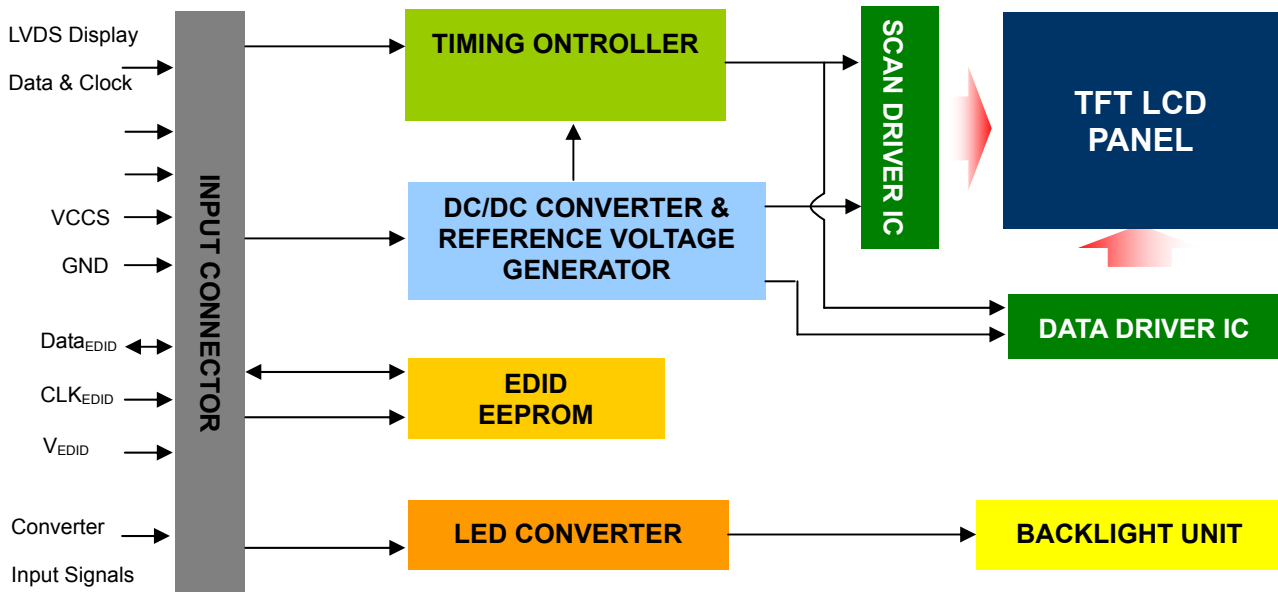
#### 3.2.1 TFT LCD MODULE

| Item                             | Symbol          | Value |          | Unit | Note |
|----------------------------------|-----------------|-------|----------|------|------|
|                                  |                 | Min.  | Max.     |      |      |
| Power Supply Voltage             | VCCS            | -0.3  | +4.0     | V    | (1)  |
| Logic Input Voltage              | V <sub>IN</sub> | -0.3  | VCCS+0.3 | V    |      |
| Converter Input Voltage          | LED_VCCS        | -0.3  | 25.0     | V    | (1)  |
| Converter Control Signal Voltage | LED_PWM,        | -0.3  | 3.6      | V    | (1)  |
| Converter Control Signal Voltage | LED_EN          | -0.3  | 3.6      | V    | (1)  |

Note (1) Stresses beyond those listed in above “ELECTRICAL ABSOLUTE RATINGS” may cause permanent damage to the device. Normal operation should be restricted to the conditions described in “ELECTRICAL CHARACTERISTICS”.

## 4. ELECTRICAL SPECIFICATIONS

### 4.1 FUNCTION BLOCK DIAGRAM



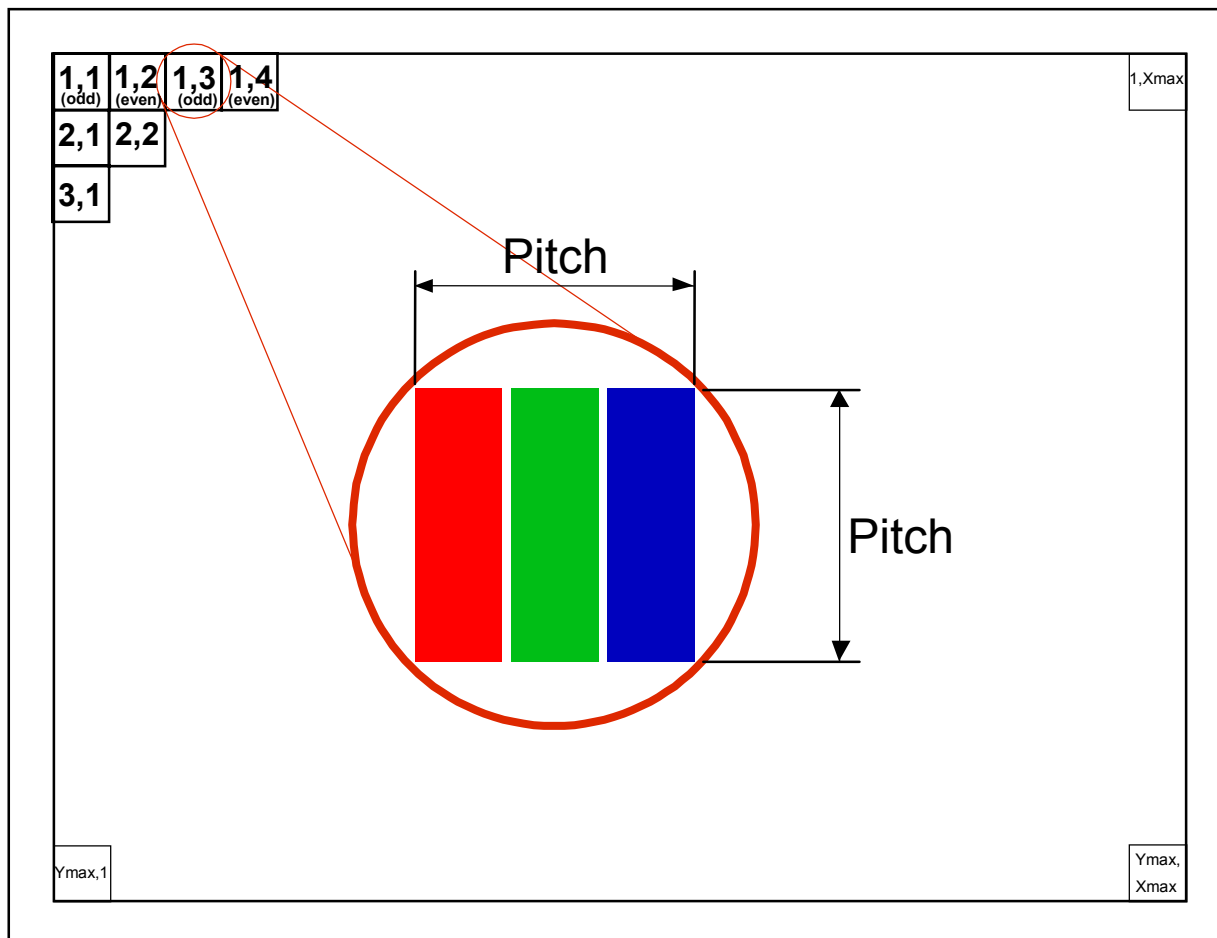
### 4.2. INTERFACE CONNECTIONS

#### PIN ASSIGNMENT

| Pin | Symbol   | Description                           | Remark          |
|-----|----------|---------------------------------------|-----------------|
| 1   | NC       | No Connection (Reserve)               |                 |
| 2   | VCCS     | Power Supply (3.3V typ.)              |                 |
| 3   | VCCS     | Power Supply (3.3V typ.)              |                 |
| 4   | VEDID    | DDC 3.3V power                        |                 |
| 5   | NC       | No Connection (Reserved for CMI test) |                 |
| 6   | CLKEDID  | DDC clock                             |                 |
| 7   | DATAEDID | DDC data                              |                 |
| 8   | Rxin0-   | LVDS differential data input          | R0-R5, G0       |
| 9   | Rxin0+   | LVDS differential data input          |                 |
| 10  | VSS      | Ground                                |                 |
| 11  | Rxin1-   | LVDS differential data input          | G1~G5, B0, B1   |
| 12  | Rxin1+   | LVDS differential data input          |                 |
| 13  | VSS      | Ground                                |                 |
| 14  | Rxin2-   | LVDS Differential Data Input          | B2-B5,HS,VS, DE |
| 15  | Rxin2+   | LVDS Differential Data Input          |                 |
| 16  | VSS      | Ground                                |                 |
| 17  | RxCLK-   | LVDS differential clock input         | LVDS CLK        |
| 18  | RxCLK+   | LVDS differential clock input         |                 |
| 19  | VSS      | Ground                                |                 |
| 20  | NC       | No Connection (Reserve)               |                 |
| 21  | NC       | No Connection (Reserve)               |                 |
| 22  | VSS      | Ground                                |                 |
| 23  | NC       | No Connection (Reserve)               |                 |

|    |          |  |  |
|----|----------|--|--|
| 24 | NC       | No Connection (Reserve)                |  |
| 25 | VSS      | Ground                                 |  |
| 26 | NC       | No Connection (Reserve)                |  |
| 27 | NC       | No Connection (Reserve)                |  |
| 28 | VSS      | Ground                                 |  |
| 29 | NC       | No Connection (Reserve)                |  |
| 30 | NC       | No Connection (Reserve)                |  |
| 31 | LED_GND  | LED Ground                             |  |
| 32 | LED_GND  | LED Ground                             |  |
| 33 | LED_GND  | LED Ground                             |  |
| 37 | NC       | No Connection (Reserve)                |  |
| 35 | LED_PWM  | PWM Control Signal of LED Converter    |  |
| 36 | LED_EN   | Enable Control Signal of LED Converter |  |
| 37 | NC       | No Connection (Reserve)                |  |
| 38 | LED_VCCS | LED Power Supply                       |  |
| 39 | LED_VCCS | LED Power Supply                       |  |
| 40 | LED_VCCS | LED Power Supply                       |  |

Note (1) The first pixel is odd as shown in the following figure.





### 4.3 ELECTRICAL CHARACTERISTICS

#### 4.3.1 LCD ELETRONICS SPECIFICATION

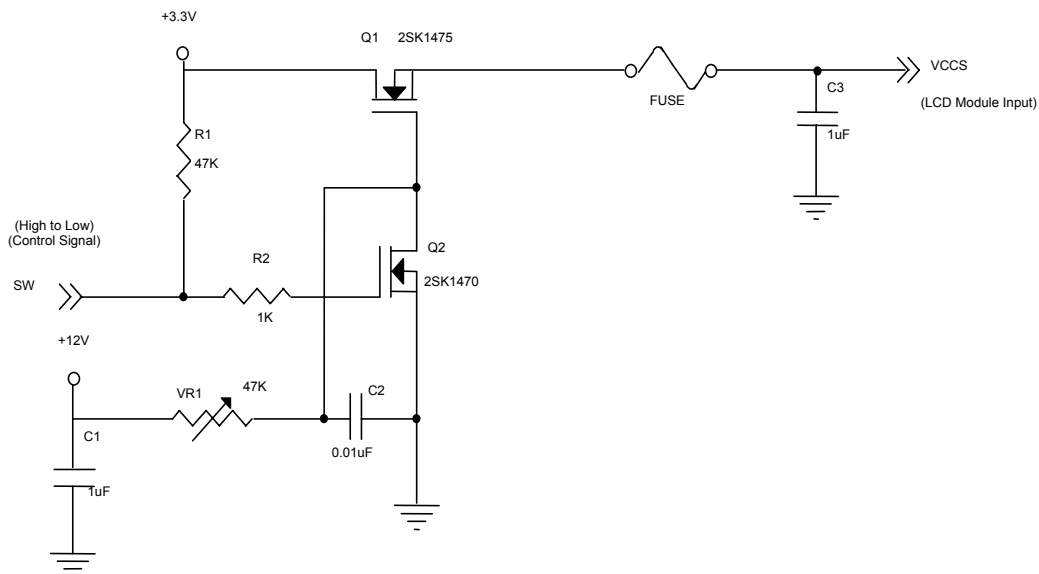
| Parameter            | Symbol            | Value |      |      | Unit | Note    |
|----------------------|-------------------|-------|------|------|------|---------|
|                      |                   | Min.  | Typ. | Max. |      |         |
| Power Supply Voltage | VCCS              | 3.0   | 3.3  | 3.6  | V    | (1)     |
| Ripple Voltage       | V <sub>RP</sub>   | -     | 50   | -    | mV   | (1)     |
| Inrush Current       | I <sub>RUSH</sub> | -     | -    | 1.5  | A    | (1),(2) |
| Power Supply Current | Mosaic            | -     | 230  | 260  | mA   | (3)a    |
|                      | Black             | -     | 280  | 310  | mA   | (3)b    |

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

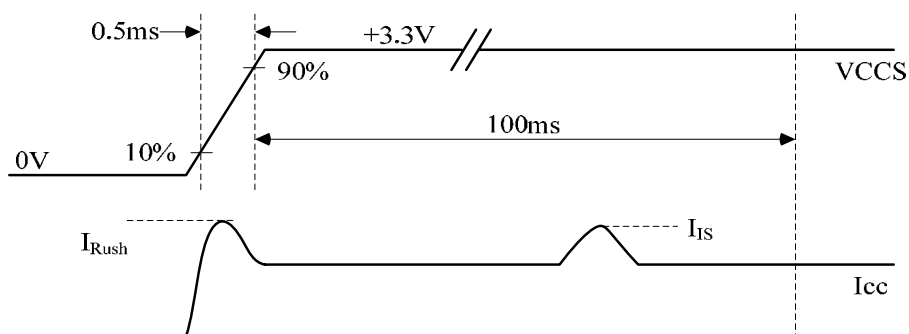
Note (2) I<sub>RUSH</sub>: the maximum current when VCCS is rising

I<sub>IS</sub>: the maximum current of the first 100ms after power-on

Measurement Conditions: Shown as the following figure. Test pattern: black.

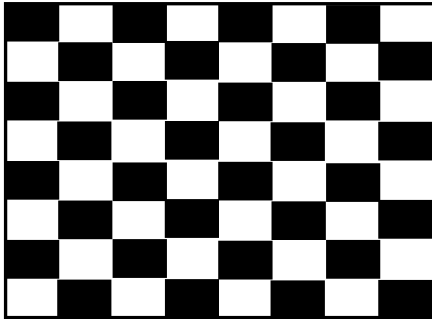


**VCCS rising time is 0.5ms**



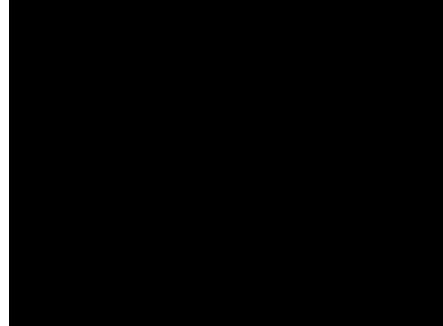
Note (3) The specified power supply current is under the conditions at  $V_{CCS} = 3.3\text{ V}$ ,  $T_a = 25 \pm 2\text{ }^\circ\text{C}$ , DC Current and  $f_v = 60\text{ Hz}$ , whereas a power dissipation check pattern below is displayed.

a. Mosaic Pattern



Active Area

b. Black Pattern



Active Area

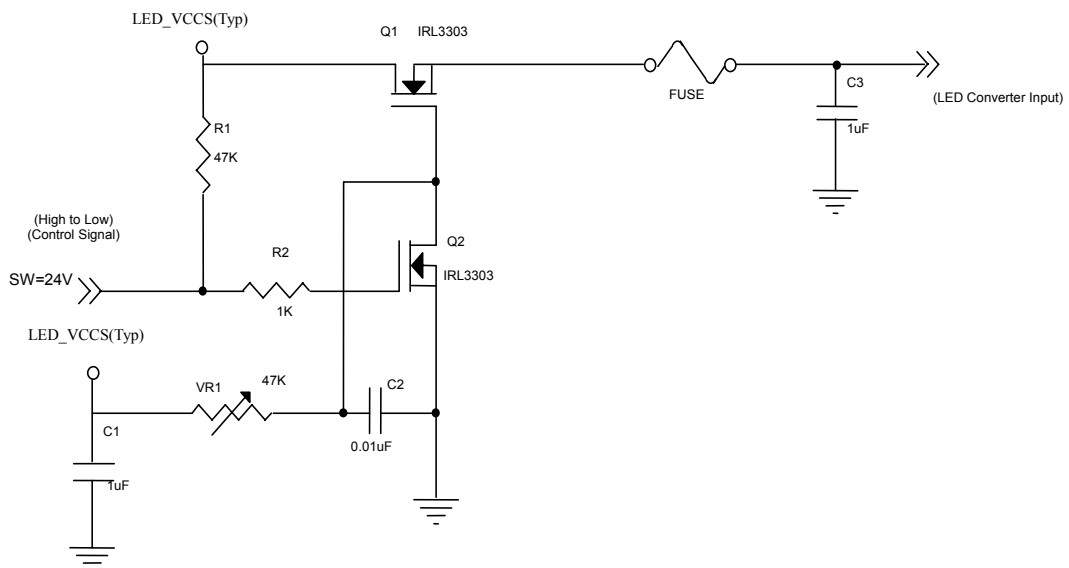
4.3.2 LED CONVERTER SPECIFICATION

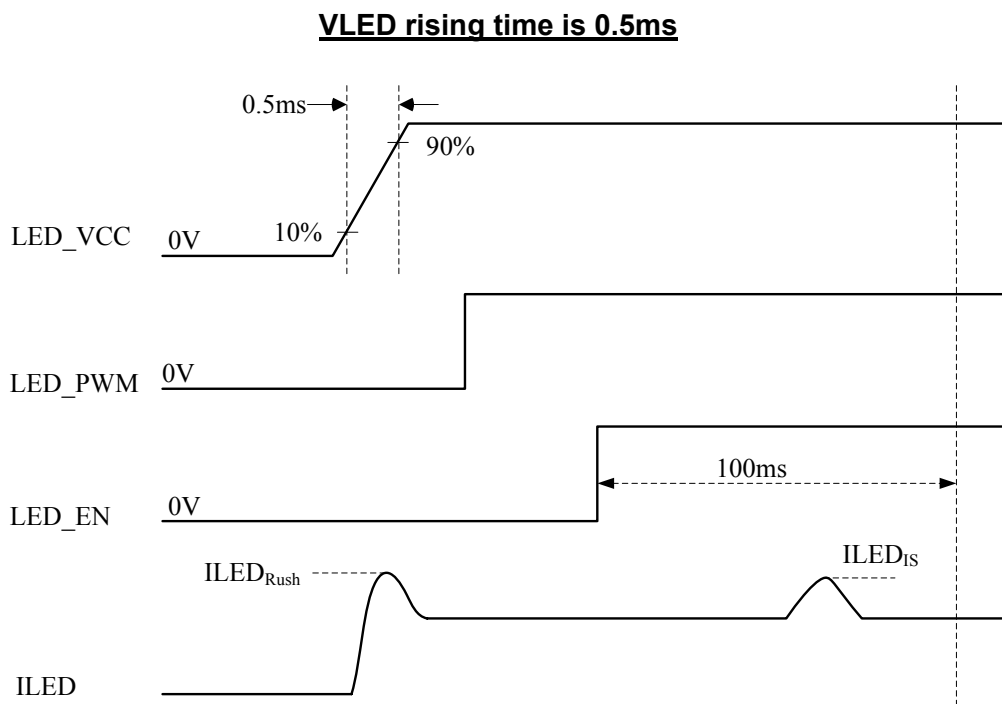
| Parameter                              |                | Symbol                | Value |      |      | Unit | Note |
|--|----------------|-----------------------|-------|------|------|------|------|
|  |                |                       | Min.  | Typ. | Max. |      |      |
| Converter Input power supply voltage   |                | LED_Vccs              | 6.0   | 12.0 | 21.0 | V    |      |
| Converter Inrush Current               |                | I <sub>LED_RUSH</sub> | -     | -    | 1.5  | A    | (1)  |
| EN Control Level                       | Backlight On   |                       | 2.4   | -    | 3.6  | V    |      |
|  | Backlight Off  |                       | 0     | -    | 0.5  | V    |      |
| PWM Control Level                      | PWM High Level |                       | 2.4   | -    | 3.6  | V    |      |
|  | PWM Low Level  |                       | 0     | -    | 0.5  | V    |      |
| PWM Control Duty Ratio                 |                |                       | 10    | -    | 100  | %    |      |
|  |                |                       | 5     | -    | 100  | %    | (2)  |
| PWM Control Permissible Ripple Voltage |                | V <sub>PWM_pp</sub>   | -     | -    | 100  | mV   |      |
| PWM Control Frequency                  |                | f <sub>PWM</sub>      | 190   | -    | 2K   | Hz   | (3)  |
| LED Power Current                      | LED_VCCS =Typ. | I <sub>LED</sub>      | -     | 197  | 204  | mA   | (4)  |

Note (1) I<sub>LED\_RUSH</sub>: the maximum current when LED\_VCCS is rising,

I<sub>LED<sub>IS</sub></sub>: the maximum current of the first 100ms after power-on,

Measurement Conditions: Shown as the following figure. LED\_VCCS = Typ, Ta = 25 ± 2 °C, f<sub>PWM</sub> = 200 Hz, Duty=100%.





Note (2) If the PWM control duty ratio is less than 10%, there is some possibility that acoustic noise or backlight flash can be found. And it is also difficult to control the brightness linearity.

Note (3) If PWM control frequency is applied in the range less than 1KHz, the “waterfall” phenomenon on the screen may be found. To avoid the issue, it’s a suggestion that PWM control frequency should follow the criterion as below.

PWM control frequency  $f_{PWM}$  should be in the range

$$(N + 0.33) * f \leq f_{PWM} \leq (N + 0.66) * f$$

$N$  : Integer ( $N \geq 3$ )

$f$  : Frame rate

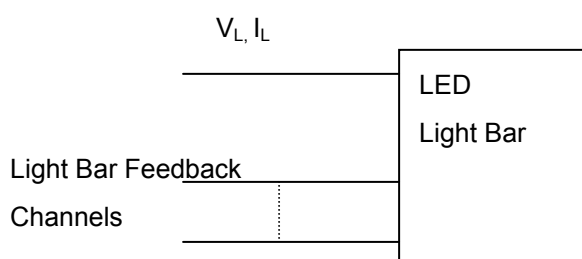
Note (4) The specified LED power supply current is under the conditions at “LED\_VCCS = Typ.”,  $T_a = 25 \pm 2^\circ\text{C}$ ,  $f_{PWM} = 200\text{ Hz}$ , Duty=100%.

4.3.3 BACKLIGHT UNIT

Ta = 25 ± 2 °C

| Parameter                          | Symbol          | Value |        |       | Unit | Note             |
|------------------------------------|-----------------|-------|--------|-------|------|------------------|
|                                    |                 | Min.  | Typ.   | Max.  |      |                  |
| LED Light Bar Power Supply Voltage | V <sub>L</sub>  | 27.5  | 30.8   | 33    | V    | (1)(2)(Duty100%) |
| LED Light Bar Power Supply Current | I <sub>L</sub>  | -     | 63     | -     | mA   | (3)              |
| Power Consumption                  | P <sub>L</sub>  | -     | 1.9404 | 2.079 | W    |                  |
| LED Life Time                      | L <sub>BL</sub> | 12000 | -      | -     | Hrs  | (4)              |

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



Note (2) For better LED light bar driving quality, it is recommended to utilize the adaptive boost converter with current balancing function to drive LED light-bar.

Note (3)  $P_L = I_L \times V_L$  (Without LED converter transfer efficiency)

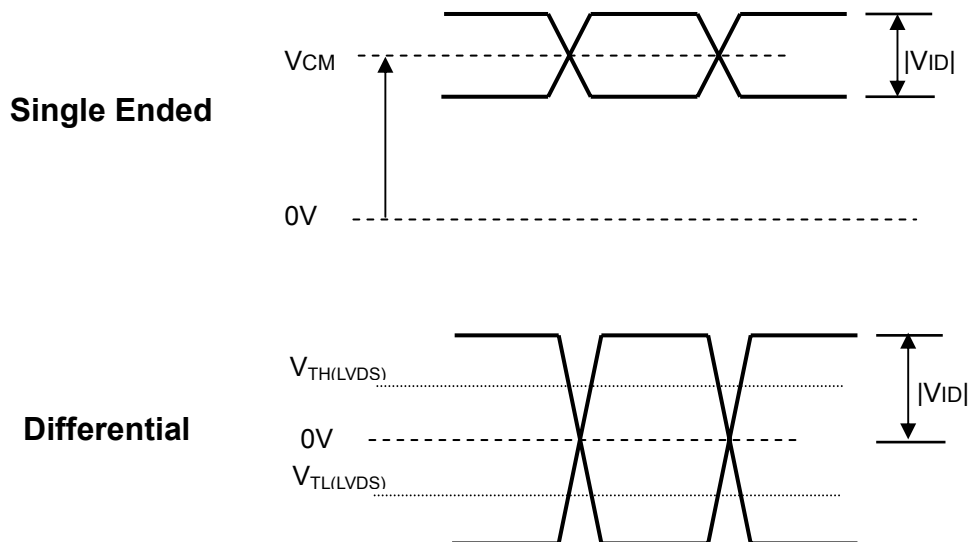
Note (4) The lifetime of LED is defined as the time when it continues to operate under the conditions at Ta = 25 ± 2 °C and I<sub>L</sub> = 21 mA(Per EA) until the brightness becomes ≤ 50% of its original value.

#### 4.4 LVDS INPUT SIGNAL TIMING SPECIFICATIONS

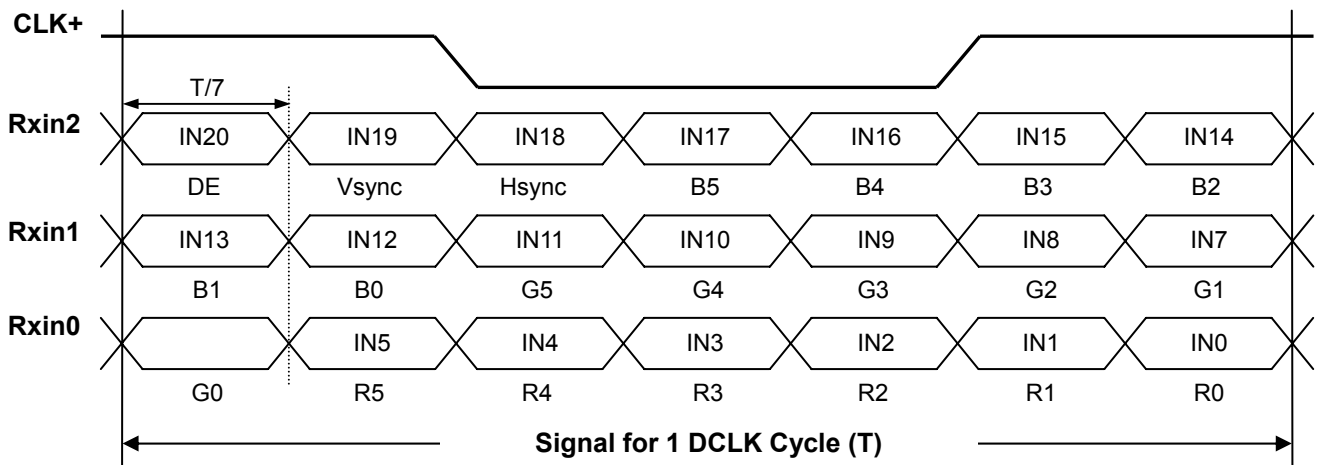
##### 4.4.1 LVDS DC SPECIFICATIONS

| Parameter                              | Symbol         | Value |      |       | Unit | Note                  |
|--|----------------|-------|------|-------|------|-----------------------|
|  |                | Min.  | Typ. | Max.  |      |                       |
| LVDS Differential Input High Threshold | $V_{TH(LVDS)}$ | -     | -    | +100  | mV   | (1),<br>$V_{CM}=1.2V$ |
| LVDS Differential Input Low Threshold  | $V_{TL(LVDS)}$ | -100  | -    | -     | mV   | (1),<br>$V_{CM}=1.2V$ |
| LVDS Common Mode Voltage               | $V_{CM}$       | 1.125 | -    | 1.375 | V    | (1)                   |
| LVDS Differential Input Voltage        | $ V_{ID} $     | 100   | -    | 600   | mV   | (1)                   |
| LVDS Terminating Resistor              | $R_T$          | -     | 100  | -     | Ohm  | -                     |

Note (1) The parameters of LVDS signals are defined as the following figures.



##### 4.4.2 LVDS DATA FORMAT



### 4.4.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-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 |    |    |    |    |    |
|                     |               | R5          | R4 | R3 | R2 | R1 | R0 | G5    | G4 | G3 | G2 | G1 | G0 | 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  |
|                     | Red           | 1           | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Green         | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Blue          | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  |
|                     | Cyan          | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  |
|                     | Magenta       | 1           | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  |
|                     | Yellow        | 1           | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 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  |
| Gray Scale Of Red   | Red(0)/Dark   | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Red(1)        | 0           | 0  | 0  | 0  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Red(2)        | 0           | 0  | 0  | 0  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  |    |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  |    |
|                     | Red(61)       | 1           | 1  | 1  | 1  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Red(62)       | 1           | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Red(63)       | 1           | 1  | 1  | 1  | 1  | 1  | 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  |    |
|                     | Green(1)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 1  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Green(2)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  |    |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  |    |
|                     | Green(61)     | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 0  | 1  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Green(62)     | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Green(63)     | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 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  |    |
|                     | Blue(1)       | 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  | 1  | 0  |    |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  |    |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  |    |
|                     | Blue(61)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 0  |    |
|                     | Blue(62)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 0  |    |
|                     | Blue(63)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  |    |

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

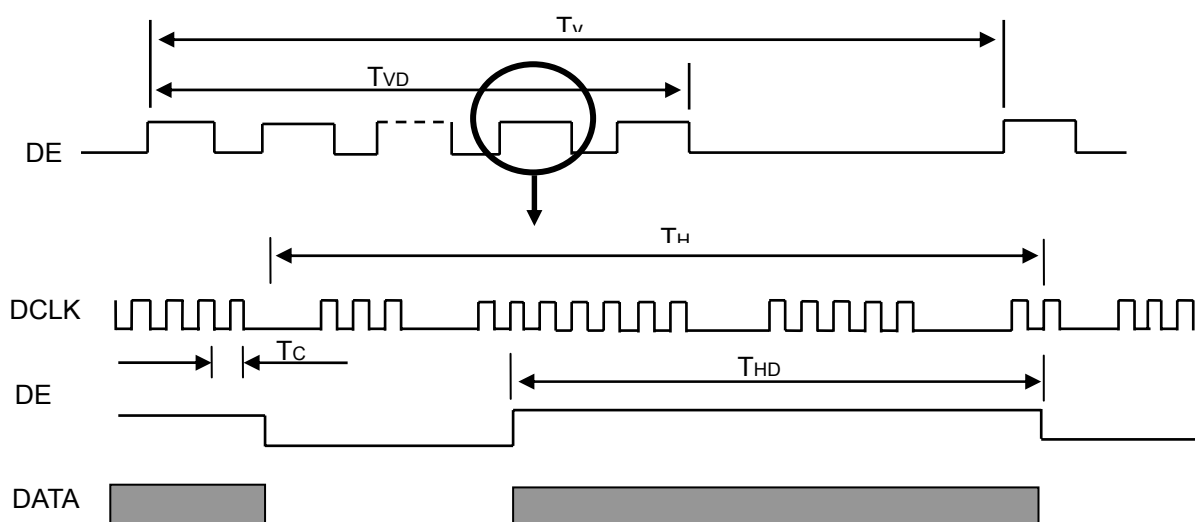
#### 4.5 DISPLAY TIMING SPECIFICATIONS

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

| Signal | Item                              | Symbol | Min.   | Typ.  | Max.   | Unit | Note |
|--------|-----------------------------------|--------|--------|-------|--------|------|------|
| DCLK   | Frequency                         | 1/Tc   | 71.68  | 75.45 | 79.22  | MHz  | -    |
| DE     | Vertical Total Time               | TV     | 774    | 806   | 1008   | TH   | -    |
|        | Vertical Active Display Period    | TVD    | 768    | 768   | 768    | TH   | -    |
|        | Vertical Active Blanking Period   | TVB    | TV-TVD | 38    | TV-TVD | TH   | -    |
|        | Horizontal Total Time             | TH     | 1466   | 1560  | 1950   | Tc   | -    |
|        | Horizontal Active Display Period  | THD    | 1366   | 1366  | 1366   | Tc   | -    |
|        | Horizontal Active Blanking Period | THB    | TH-THD | 194   | TH-THD | Tc   | -    |

Note (1) Because this module is operated by DE only mode, Hsync and Vsync are ignored.

**INPUT SIGNAL TIMING DIAGRAM**

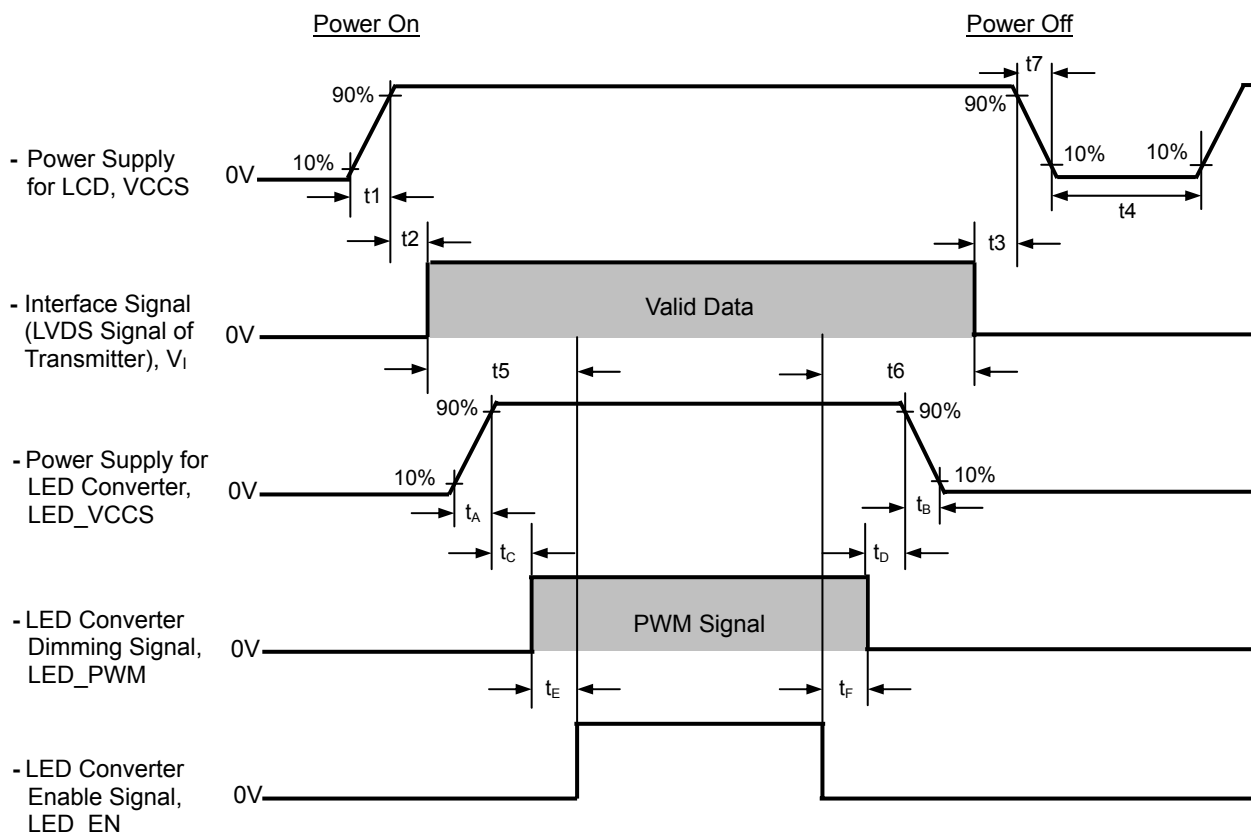




#### 4.6 POWER ON/OFF SEQUENCE

The power sequence specifications are shown as the following table and diagram.

| Symbol         | Value |      |      | Unit | Note |
|----------------|-------|------|------|------|------|
|                | Min.  | Typ. | Max. |      |      |
| t1             | 0.5   | -    | 10   | ms   |      |
| t2             | 0     | -    | 50   | ms   |      |
| t3             | 0     | -    | 50   | ms   |      |
| t4             | 500   | -    | -    | ms   |      |
| t5             | 200   | -    | -    | ms   |      |
| t6             | 200   | -    | -    | ms   |      |
| t7             | 0.5   | -    | 10   | ms   |      |
| t <sub>A</sub> | 0.5   | -    | 10   | ms   |      |
| t <sub>B</sub> | 0     | -    | 10   | ms   |      |
| t <sub>C</sub> | 1     | -    | -    | ms   |      |
| t <sub>D</sub> | 1     | -    | -    | ms   |      |
| t <sub>E</sub> | 1     | -    | -    | ms   |      |
| t <sub>F</sub> | 1     | -    | -    | ms   |      |



Note (1) Please don't plug or unplug the interface cable when system is turned on.

Note (2) Please avoid floating state of the interface signal during signal invalid period.

Note (3) It is recommended that the backlight power must be turned on after the power supply for LCD and the interface signal is valid.

## 5. OPTICAL CHARACTERISTICS

### 5.1 TEST CONDITIONS

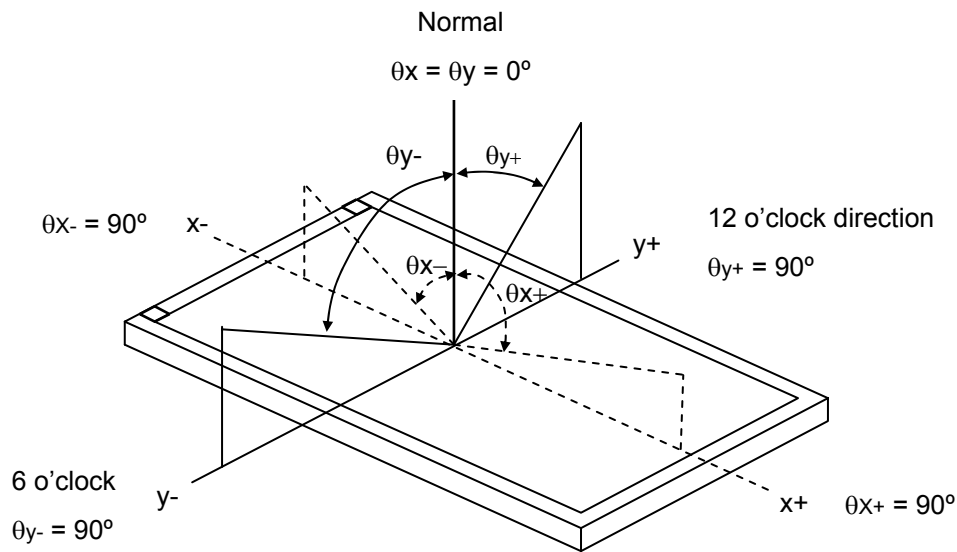
| Item                        | Symbol  | Value | Unit |
|-----------------------------|---|-------|------|
| Ambient Temperature         | Ta  | 25±2  | °C   |
| Ambient Humidity            | Ha  | 50±10 | %RH  |
| Supply Voltage              | V <sub>CC</sub>   | 3.3   | V    |
| Input Signal                | According to typical value in "3. ELECTRICAL CHARACTERISTICS" |       |      |
| LED Light Bar Input Current | I <sub>L</sub>  | 63    | mA   |

The measurement methods of optical characteristics are shown in Section 5.2. The following items should be measured under the test conditions described in Section 5.1 and stable environment shown in Note (5).

### 5.2 OPTICAL SPECIFICATIONS

| Item                        |            | Symbol           | Condition  | Min.   | Typ.          | Max.  | Unit          | Note              |                 |
|-----------------------------|------------|------------------|--|--|---------------|-------|---------------|-------------------|-----------------|
| Contrast Ratio              |            | CR               | $\theta_x=0^\circ, \theta_y=0^\circ$<br>Viewing Normal Angle | 350  | 500           | -     | -             | (2),<br>(5),(7)   |                 |
| Response Time               |            | T <sub>R</sub>   |  | -  | 3             | 8     | ms            | (3),(7)           |                 |
|                             |            | T <sub>F</sub>   |  | -  | 7             | 12    | ms            |                   |                 |
| Average Luminance of White  |            | L <sub>Ave</sub> |  |  | 170           | 200   | -             | cd/m <sup>2</sup> | (4),<br>(6),(7) |
| Color Chromaticity          | Red        | R <sub>x</sub>   |  | $\theta_x=0^\circ, \theta_y=0^\circ$<br>Viewing Normal Angle | Typ -<br>0.03 | 0.577 | Typ +<br>0.03 | -                 | (1),(7)         |
|                             |            | R <sub>y</sub>   |  |  |               | 0.364 |               | -                 |                 |
|                             | Green      | G <sub>x</sub>   |  |  |               | 0.348 |               | -                 |                 |
|                             |            | G <sub>y</sub>   |  |  |               | 0.563 |               | -                 |                 |
|                             | Blue       | B <sub>x</sub>   |  |  |               | 0.151 |               | -                 |                 |
|                             |            | B <sub>y</sub>   |  |  |               | 0.116 |               | -                 |                 |
|                             | White      | W <sub>x</sub>   | 0.313  |  |               | -     |               |                   |                 |
|                             |            | W <sub>y</sub>   | 0.329  |  |               | -     |               |                   |                 |
| Viewing Angle               | Horizontal | $\theta_{x+}$    | CR≥10  | 40   | 45            | -     | Deg.          | (1),(5),<br>(7)   |                 |
|                             |            | $\theta_{x-}$    |  | 40   | 45            |       |               |                   |                 |
|                             | Vertical   | $\theta_{y+}$    |  | 15   | 20            | -     |               |                   |                 |
|                             |            | $\theta_{y-}$    |  | 40   | 45            | -     |               |                   |                 |
| White Variation of 5 Points |            | $\delta W_{5p}$  | $\theta_x=0^\circ, \theta_y=0^\circ$                         | 80   | -             | -     | %             | (5),(6),<br>(7)   |                 |

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.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

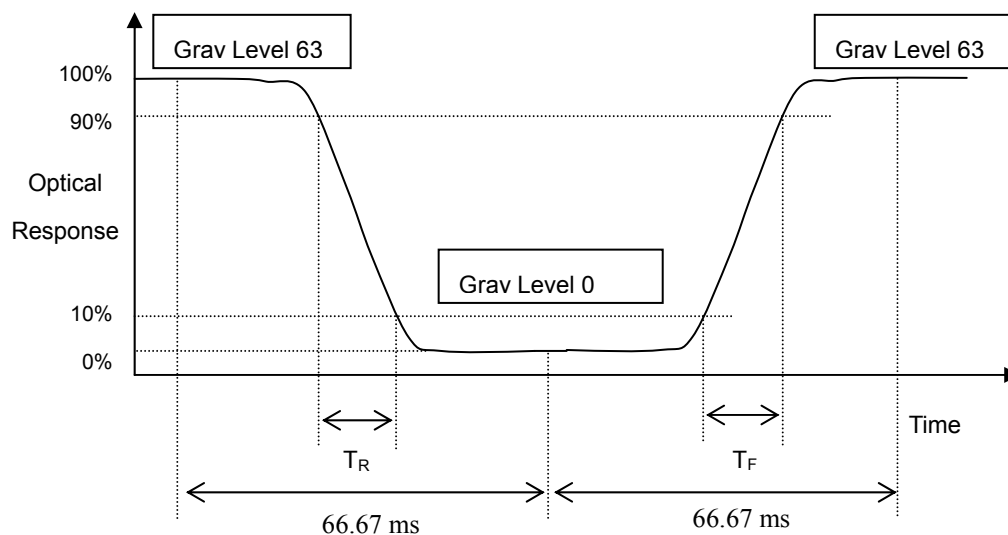
L<sub>63</sub>: Luminance of gray level 63

L<sub>0</sub>: Luminance of gray level 0

$$CR = CR(1)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

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



Note (4) Definition of Average Luminance of White ( $L_{AVE}$ ):

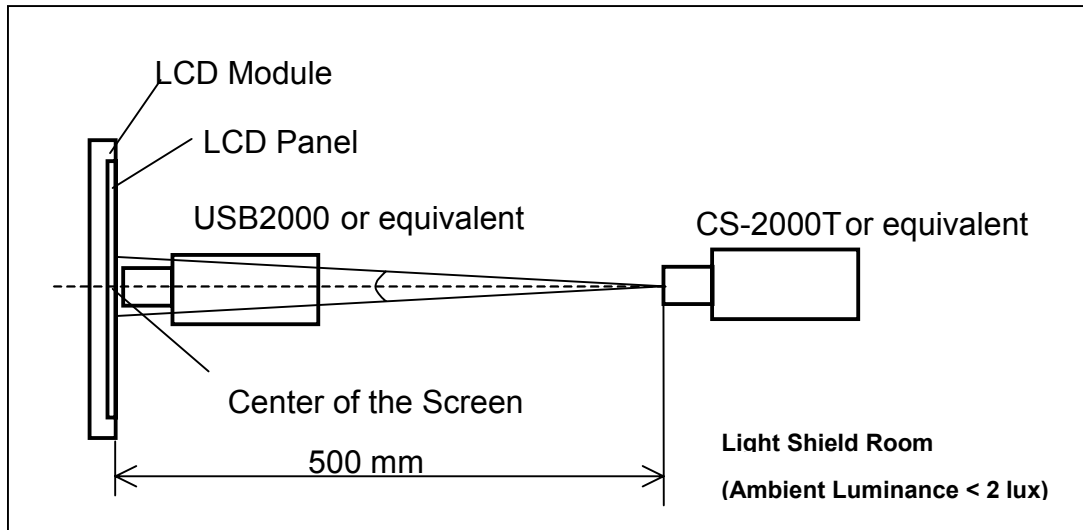
Measure the luminance of White at 5 points

$$L_{AVE} = [L(1) + L(2) + L(3) + L(4) + L(5)] / 5$$

L (x) is corresponding to the luminance of the point X at Figure in Note (6)

Note (5) Measurement Setup:

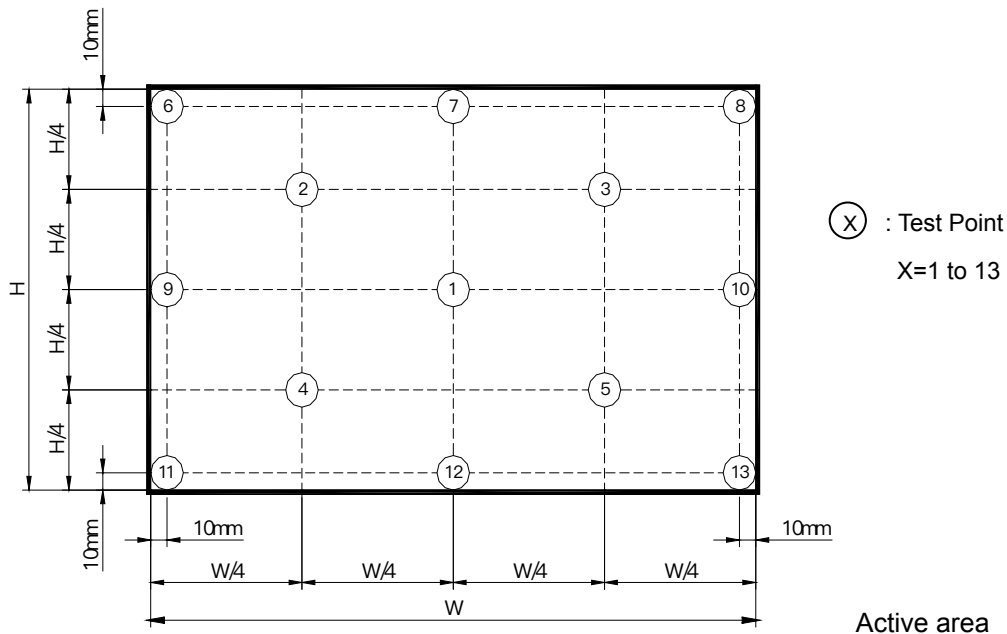
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



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

Measure the luminance of White at 5 points / 13 points

$$\delta W_{5p} = \{ \text{Minimum } [L(1) \sim L(5)] / \text{Maximum } [L(1) \sim L(5)] \} * 100\%$$



Note (7) The listed optical specifications refer to the initial value of manufacture, but the condition of the specifications after long-term operation will not be warranted.

## 6. RELIABILITY TEST ITEM

| Test Item                                       | Test Condition  | Note    |
|---|---|---------|
| High Temperature Storage Test                   | 60°C, 240 hours   | (1) (2) |
| Low Temperature Storage Test                    | -20°C, 240 hours  |         |
| Thermal Shock Storage Test                      | -20°C, 0.5hour←→60°C, 0.5hour; 100cycles, 1hour/cycle   |         |
| High Temperature Operation Test                 | 50°C, 240 hours   |         |
| Low Temperature Operation Test                  | 0°C, 240 hours  |         |
| High Temperature & High Humidity Operation Test | 50°C, 80% RH, 240 hours   |         |
| ESD Test (Operation)                            | 150pF, 330Ω , 1sec/cycle<br>Condition 1 : Contact Discharge, ±8KV<br>Condition 2 : Air Discharge, ±15KV | (1)     |
| Shock (Non-Operating)                           | 220G, 2ms, half sine wave, 1 time for each direction of ±X,±Y,±Z  | (1)(3)  |
| Vibration (Non-Operating)                       | 1.5G / 10-500 Hz, Sine wave, 30 min/cycle, 1cycle for each X, Y, Z                                      | (1)(3)  |

Note (1) criteria : Normal display image with no obvious non-uniformity and no line defect.

Note (2) Evaluation should be tested after storage at room temperature for more than two hour

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.

## 7. PACKING

### 7.1 MODULE LABEL

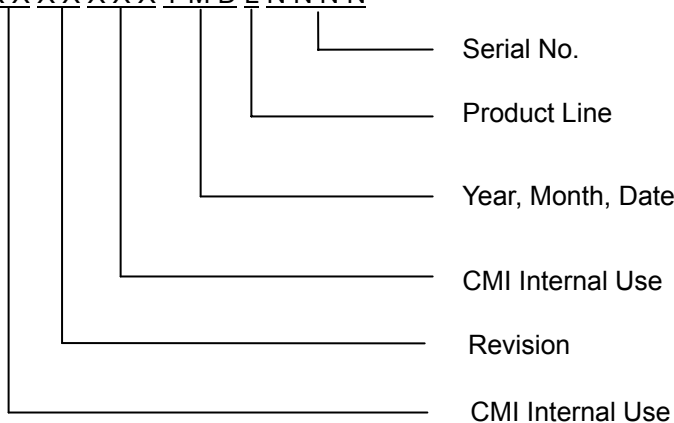
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



(a) Model Name: N156BGE - L31

(b) Revision: Rev. XX, for example: C1, C2 ...etc.

(c) Serial ID: XXXXXXYMDLNNNN



(d) Production Location: MADE IN XXXX. XXXX stands for production location.

(e) UL logo: "AAAA" especially stands for panel manufactured by CMI China satisfying UL requirement.  
"LEOO" and "COCKN" is the CMI's UL factory code for Ningbo factory..

7.2 CARTON

Box Dimensions : 500(L)\*370(W)\*270(H)  
Weight : Approx. 10.58Kg (20 module .per. 1box)

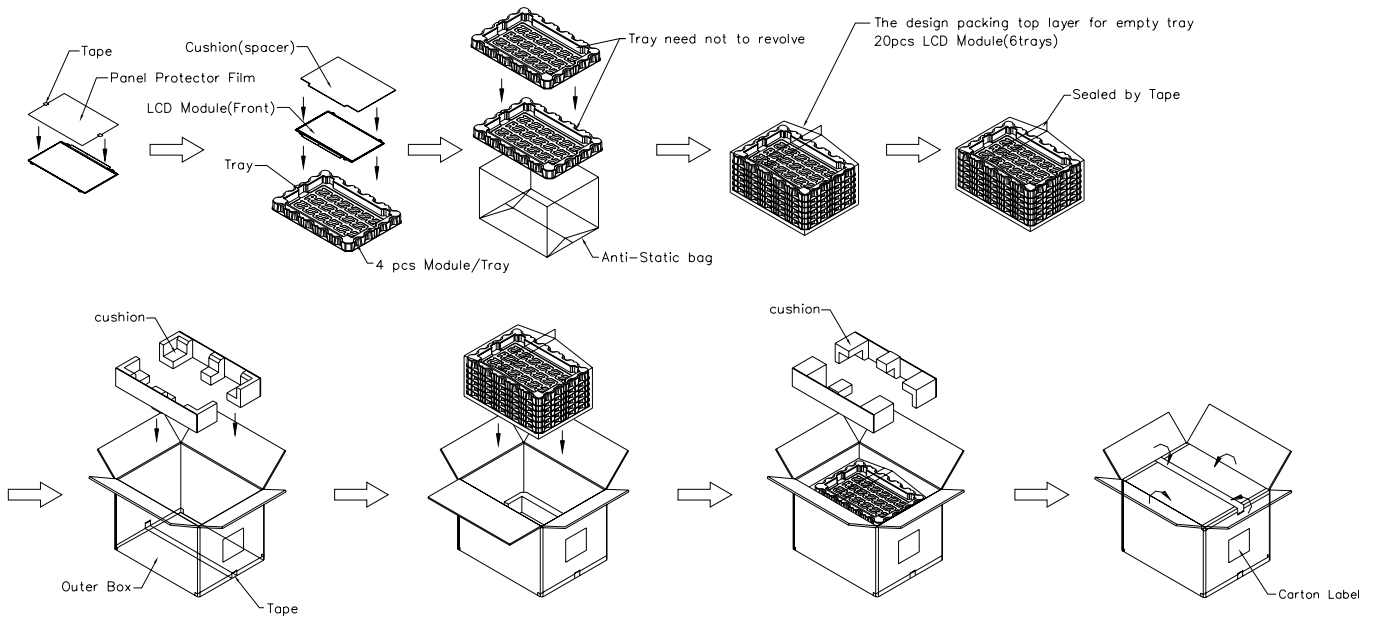


Figure. 7-2 Packing method

7.3 PALLET

Sea & Land Transportation

Air Transportation

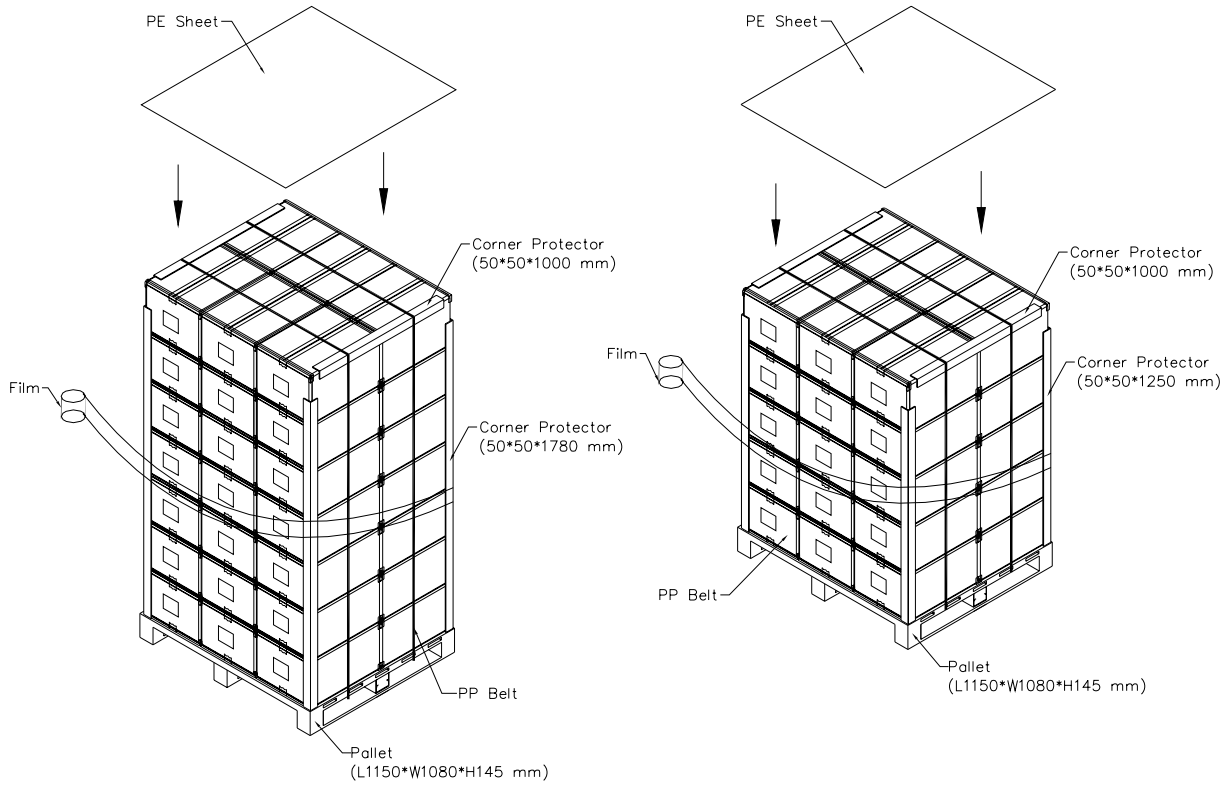


Figure. 7-3 Packing method



## 8. PRECAUTIONS

### 8.1 HANDLING PRECAUTIONS

- (1) The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.
- (2) While assembling or installing modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.
- (3) Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (4) Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily scratched.
- (5) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.
- (6) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static electricity, it may cause damage to the C-MOS Gate Array IC.
- (9) Do not disassemble the module.
- (10) Do not pull or fold the LED wire.
- (11) Pins of I/F connector should not be touched directly with bare hands.

### 8.2 STORAGE PRECAUTIONS

- (1) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (2) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- (3) 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 LED will be higher than the room temperature.

### 8.3 OPERATION PRECAUTIONS

- (1) Do not pull the I/F connector in or out while the module is operating.
- (2) Always follow the correct power on/off sequence when LCD module is connecting and operating. This can prevent the CMOS LSI chips from damage during latch-up.
- (3) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with converter. Do not disassemble the module or insert anything into the Backlight unit.

**Appendix. EDID DATA STRUCTURE**

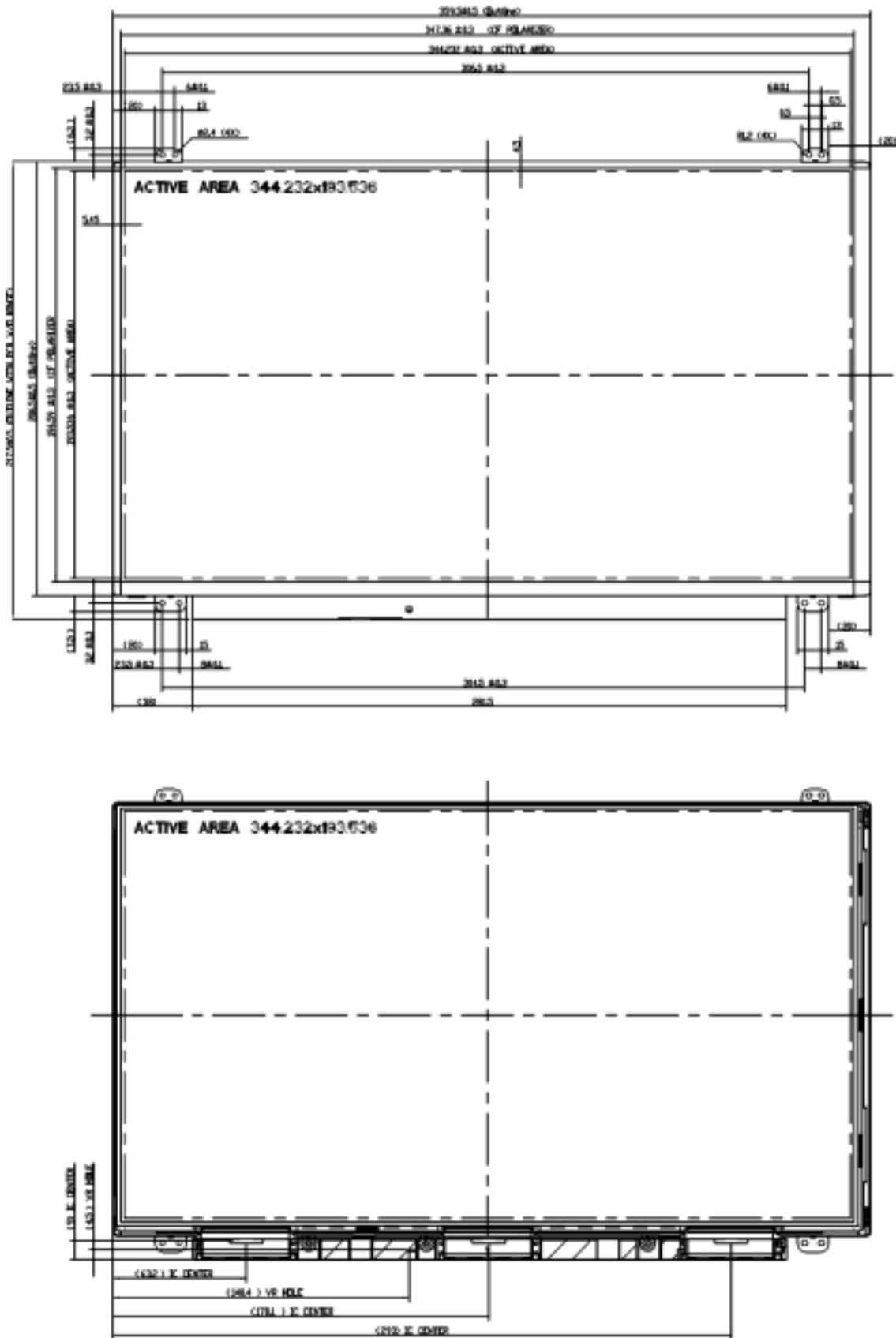
The EDID (Extended Display Identification Data) data formats are to support displays as defined in the VESA Plug & Display and FPD1 standards.

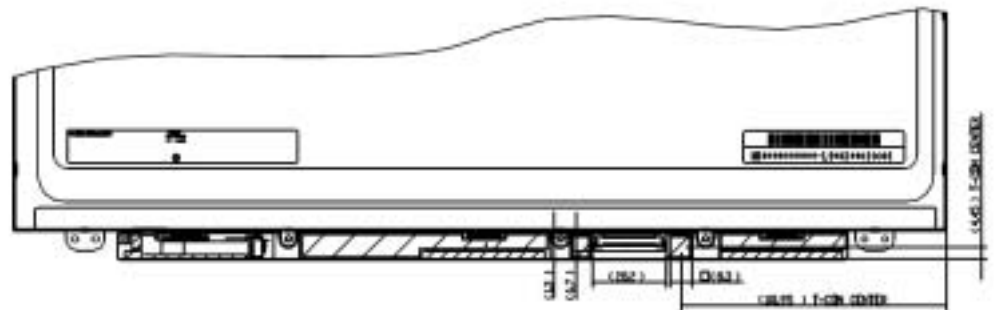
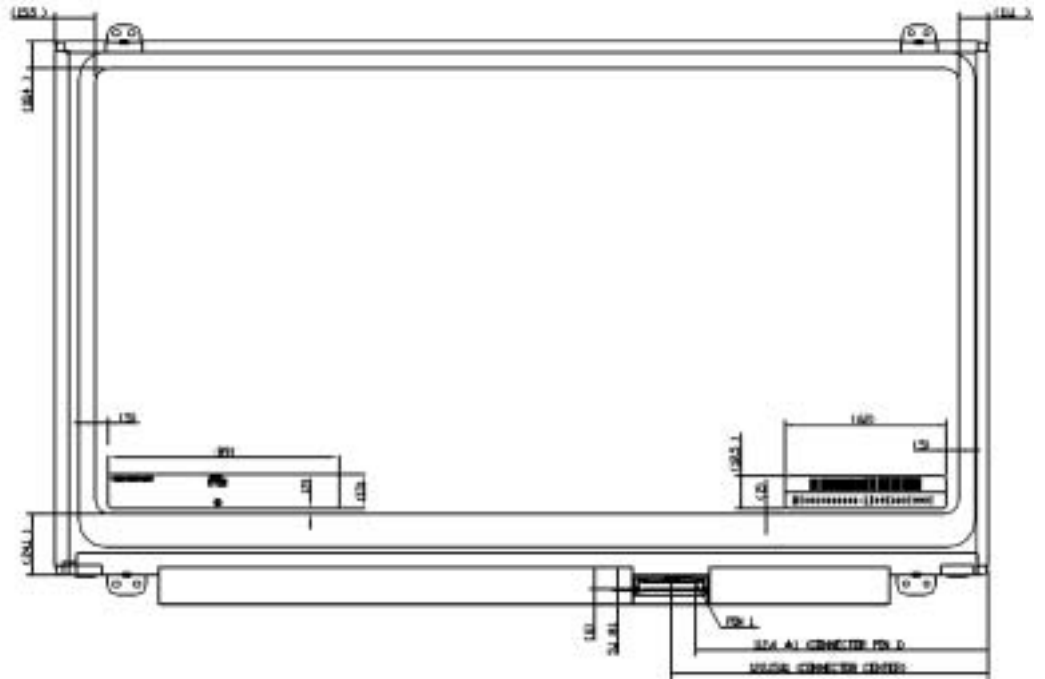
| Byte #<br>(decimal) | Byte #<br>(hex) | Field Name and Comments                      | Value<br>(hex) | Value<br>(binary) |
|---------------------|-----------------|--|----------------|-------------------|
| 0                   | 0               | Header                                       | 00             | 00000000          |
| 1                   | 1               | Header                                       | FF             | 11111111          |
| 2                   | 2               | Header                                       | FF             | 11111111          |
| 3                   | 3               | Header                                       | FF             | 11111111          |
| 4                   | 4               | Header                                       | FF             | 11111111          |
| 5                   | 5               | Header                                       | FF             | 11111111          |
| 6                   | 6               | Header                                       | FF             | 11111111          |
| 7                   | 7               | Header                                       | 00             | 00000000          |
| 8                   | 8               | EISA ID manufacturer name ("CMN")            | 0D             | 00001101          |
| 9                   | 9               | EISA ID manufacturer name (Compressed ASCII) | AE             | 10101110          |
| 10                  | 0A              | ID product code (N156BGE-L31)                | B8             | 10111000          |
| 11                  | 0B              | ID product code (hex LSB first; N156BGE-L31) | 15             | 00010101          |
| 12                  | 0C              | ID S/N (fixed "0")                           | 00             | 00000000          |
| 13                  | 0D              | ID S/N (fixed "0")                           | 00             | 00000000          |
| 14                  | 0E              | ID S/N (fixed "0")                           | 00             | 00000000          |
| 15                  | 0F              | ID S/N (fixed "0")                           | 00             | 00000000          |
| 16                  | 10              | Week of manufacture (fixed week code)        | 18             | 00011000          |
| 17                  | 11              | Year of manufacture (fixed year code)        | 16             | 00010110          |
| 18                  | 12              | EDID structure version # ("1")               | 01             | 00000001          |
| 19                  | 13              | EDID revision # ("3")                        | 03             | 00000011          |
| 20                  | 14              | Video I/P definition ("digital")             | 80             | 10000000          |
| 21                  | 15              | Max H image size ("34.42cm")                 | 22             | 00100010          |
| 22                  | 16              | Max V image size ("19.35cm")                 | 13             | 00010011          |
| 23                  | 17              | Display Gamma (Gamma = "2.2")                | 78             | 01111000          |
| 24                  | 18              | Feature support ("Active off, RGB Color")    | 0A             | 00001010          |
| 25                  | 19              | Rx1, Rx0, Ry1, Ry0, Gx1, Gx0, Gy1, Gy0       | D1             | 11010001          |
| 26                  | 1A              | Bx1, Bx0, By1, By0, Wx1, Wx0, Wy1, Wy0       | F5             | 11110101          |
| 27                  | 1B              | Rx=0.577                                     | 93             | 10010011          |
| 28                  | 1C              | Ry=0.364                                     | 5D             | 01011101          |
| 29                  | 1D              | Gx=0.348                                     | 59             | 01011001          |
| 30                  | 1E              | Gy=0.563                                     | 90             | 10010000          |
| 31                  | 1F              | Bx=0.151                                     | 26             | 00100110          |
| 32                  | 20              | By=0.116                                     | 1D             | 00011101          |
| 33                  | 21              | Wx=0.313                                     | 50             | 01010000          |
| 34                  | 22              | Wy=0.329                                     | 54             | 01010100          |
| 35                  | 23              | Established timings 1                        | 00             | 00000000          |
| 36                  | 24              | Established timings 2                        | 00             | 00000000          |
| 37                  | 25              | Manufacturer's reserved timings              | 00             | 00000000          |
| 38                  | 26              | Standard timing ID # 1                       | 01             | 00000001          |
| 39                  | 27              | Standard timing ID # 1                       | 01             | 00000001          |
| 40                  | 28              | Standard timing ID # 2                       | 01             | 00000001          |
| 41                  | 29              | Standard timing ID # 2                       | 01             | 00000001          |

|    |    |   |    |          |
|----|----|---|----|----------|
| 42 | 2A | Standard timing ID # 3  | 01 | 00000001 |
| 43 | 2B | Standard timing ID # 3  | 01 | 00000001 |
| 44 | 2C | Standard timing ID # 4  | 01 | 00000001 |
| 45 | 2D | Standard timing ID # 4  | 01 | 00000001 |
| 46 | 2E | Standard timing ID # 5  | 01 | 00000001 |
| 47 | 2F | Standard timing ID # 5  | 01 | 00000001 |
| 48 | 30 | Standard timing ID # 6  | 01 | 00000001 |
| 49 | 31 | Standard timing ID # 6  | 01 | 00000001 |
| 50 | 32 | Standard timing ID # 7  | 01 | 00000001 |
| 51 | 33 | Standard timing ID # 7  | 01 | 00000001 |
| 52 | 34 | Standard timing ID # 8  | 01 | 00000001 |
| 53 | 35 | Standard timing ID # 8  | 01 | 00000001 |
| 54 | 36 | Detailed timing description # 1 Pixel clock ("75.45MHz", According to VESA CVT Rev1.1)    | 79 | 01111001 |
| 55 | 37 | # 1 Pixel clock (hex LSB first)   | 1D | 00011101 |
| 56 | 38 | # 1 H active ("1366")   | 56 | 01010110 |
| 57 | 39 | # 1 H blank ("194")   | C2 | 11000010 |
| 58 | 3A | # 1 H active : H blank ("1366 :194")  | 50 | 01010000 |
| 59 | 3B | # 1 V active ("768")  | 00 | 00000000 |
| 60 | 3C | # 1 V blank ("38")  | 26 | 00100110 |
| 61 | 3D | # 1 V active : V blank ("768 :38")  | 30 | 00110000 |
| 62 | 3E | # 1 H sync offset ("31")  | 1F | 00011111 |
| 63 | 3F | # 1 H sync pulse width ("65")   | 41 | 01000001 |
| 64 | 40 | # 1 V sync offset : V sync pulse width ("4 : 12")   | 4C | 01001100 |
| 65 | 41 | # 1 H sync offset : H sync pulse width : V sync offset : V sync width ("31: 65 : 4 : 12") | 00 | 00000000 |
| 66 | 42 | # 1 H image size ("344 mm")   | 58 | 01011000 |
| 67 | 43 | # 1 V image size ("194 mm")   | C2 | 11000010 |
| 68 | 44 | # 1 H image size : V image size ("344 : 194")   | 10 | 00010000 |
| 69 | 45 | # 1 H boarder ("0")   | 00 | 00000000 |
| 70 | 46 | # 1 V boarder ("0")   | 00 | 00000000 |
| 71 | 47 | # 1 Non-interlaced, Normal, no stereo, Separate sync, H/V pol Negatives                   | 18 | 00011000 |
| 72 | 48 | Detailed timing description # 2   | A6 | 10100110 |
| 73 | 49 | # 2 Flag  | 00 | 00000000 |
| 74 | 4A | # 2 Reserved  | 00 | 00000000 |
| 75 | 4B | # 2 FE (hex) defines ASCII string (Model Name "N156BGE-L31", ASCII)                       | FE | 11111110 |
| 76 | 4C | # 2 Flag  | 00 | 00000000 |
| 77 | 4D | # 2 1st character of name ("N")   | 4E | 01001110 |
| 78 | 4E | # 2 2nd character of name ("1")   | 31 | 00110001 |
| 79 | 4F | # 2 3rd character of name ("5")   | 35 | 00110101 |
| 80 | 50 | # 2 4th character of name ("6")   | 36 | 00110110 |
| 81 | 51 | # 2 5th character of name ("B")   | 42 | 01000010 |
| 82 | 52 | # 2 6th character of name ("G")   | 47 | 01000111 |
| 83 | 53 | # 2 7th character of name ("E")   | 45 | 01000101 |
| 84 | 54 | # 2 8th character of name ("-")   | 2D | 00101101 |
| 85 | 55 | # 2 9th character of name ("L")   | 4C | 01001100 |

|     |    |   |    |          |
|-----|----|---|----|----------|
| 86  | 56 | # 2 9th character of name ("3")                                     | 33 | 00110011 |
| 87  | 57 | # 2 Ath character of name ("1")                                     | 31 | 00110001 |
| 88  | 58 | # 2 New line character indicates end of ASCII string                | 0A | 00001010 |
| 89  | 59 | # 2 Padding with "Blank" character                                  | 20 | 00100000 |
| 90  | 5A | Detailed timing description # 3                                     | 00 | 00000000 |
| 91  | 5B | # 3 Flag  | 00 | 00000000 |
| 92  | 5C | # 3 Reserved  | 00 | 00000000 |
| 93  | 5D | # 3 FE (hex) defines ASCII string (Vendor "CMO", ASCII)             | FE | 11111110 |
| 94  | 5E | # 3 Flag  | 00 | 00000000 |
| 95  | 5F | # 3 1st character of string ("C")                                   | 43 | 01000011 |
| 96  | 60 | # 3 2nd character of string ("M")                                   | 4D | 01001101 |
| 97  | 61 | # 3 3rd character of string ("N")                                   | 4E | 01001110 |
| 98  | 62 | # 3 New line character indicates end of ASCII string                | 0A | 00001010 |
| 99  | 63 | # 3 Padding with "Blank" character                                  | 20 | 00100000 |
| 100 | 64 | # 3 Padding with "Blank" character                                  | 20 | 00100000 |
| 101 | 65 | # 3 Padding with "Blank" character                                  | 20 | 00100000 |
| 102 | 66 | # 3 Padding with "Blank" character                                  | 20 | 00100000 |
| 103 | 67 | # 3 Padding with "Blank" character                                  | 20 | 00100000 |
| 104 | 68 | # 3 Padding with "Blank" character                                  | 20 | 00100000 |
| 105 | 69 | # 3 Padding with "Blank" character                                  | 20 | 00100000 |
| 106 | 6A | # 3 Padding with "Blank" character                                  | 20 | 00100000 |
| 107 | 6B | # 3 Padding with "Blank" character                                  | 20 | 00100000 |
| 108 | 6C | Detailed timing description # 4                                     | 00 | 00000000 |
| 109 | 6D | # 4 Flag  | 00 | 00000000 |
| 110 | 6E | # 4 Reserved  | 00 | 00000000 |
| 111 | 6F | # 4 FE (hex) defines ASCII string (Model Name "N156BGE-L31", ASCII) | FE | 11111110 |
| 112 | 70 | # 4 Flag  | 00 | 00000000 |
| 113 | 71 | # 4 1st character of name ("N")                                     | 4E | 01001110 |
| 114 | 72 | # 4 2nd character of name ("1")                                     | 31 | 00110001 |
| 115 | 73 | # 4 3rd character of name ("5")                                     | 35 | 00110101 |
| 116 | 74 | # 4 4th character of name ("6")                                     | 36 | 00110110 |
| 117 | 75 | # 4 5th character of name ("B")                                     | 42 | 01000010 |
| 118 | 76 | # 4 6th character of name ("G")                                     | 47 | 01000111 |
| 119 | 77 | # 4 7th character of name ("E")                                     | 45 | 01000101 |
| 120 | 78 | # 4 8th character of name ("-")                                     | 2D | 00101101 |
| 121 | 79 | # 4 9th character of name ("L")                                     | 4C | 01001100 |
| 122 | 7A | # 4 9th character of name ("3")                                     | 33 | 00110011 |
| 123 | 7B | # 4 Ath character of name ("1")                                     | 31 | 00110001 |
| 124 | 7C | # 4 New line character indicates end of ASCII string                | 0A | 00001010 |
| 125 | 7D | # 4 Padding with "Blank" character                                  | 20 | 00100000 |
| 126 | 7E | Extension flag  | 00 | 00000000 |
| 127 | 7F | Checksum  | 17 | 00010111 |

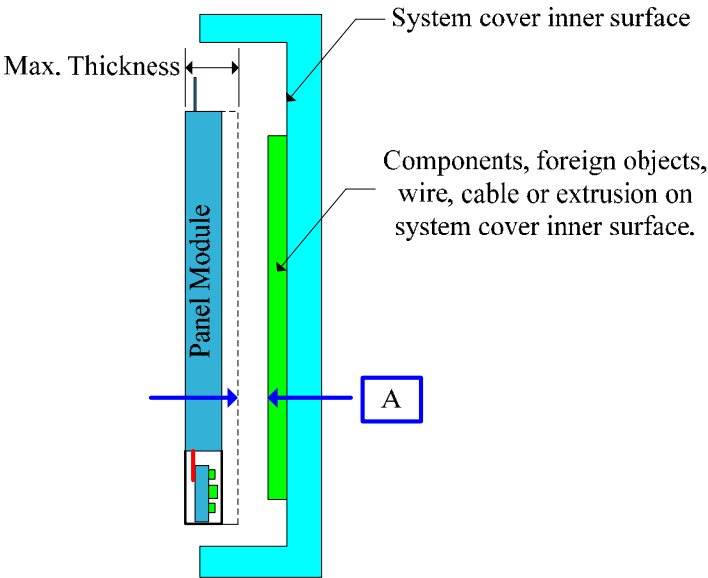
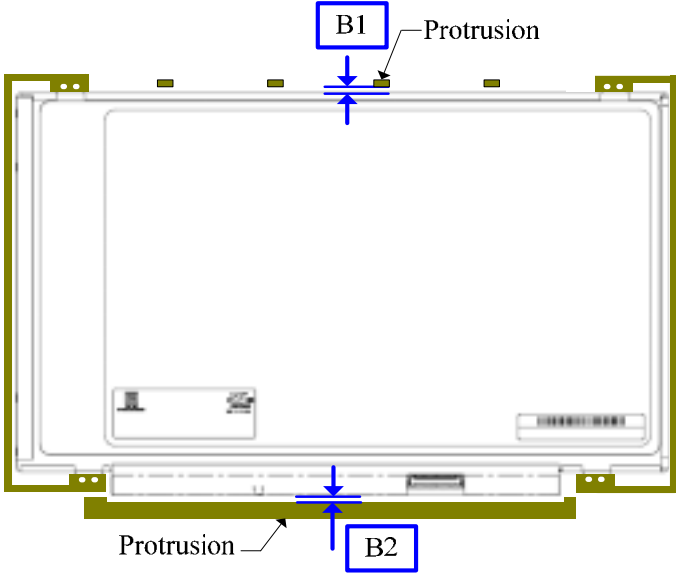
Appendix. OUTLINE DRAWING

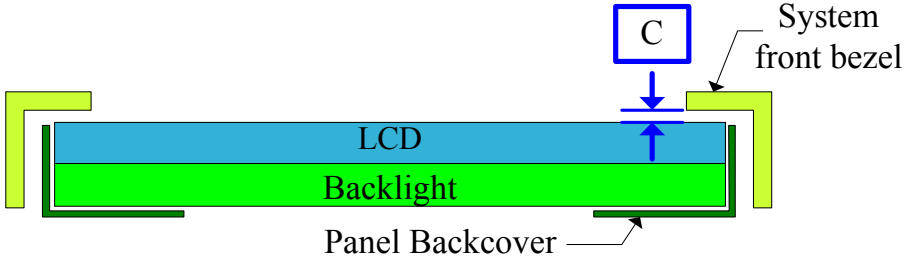
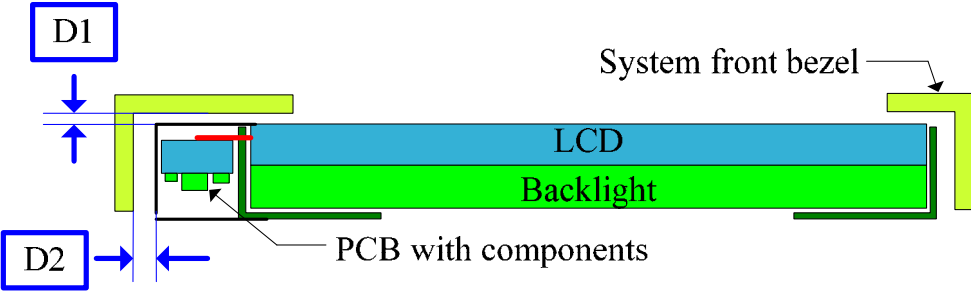
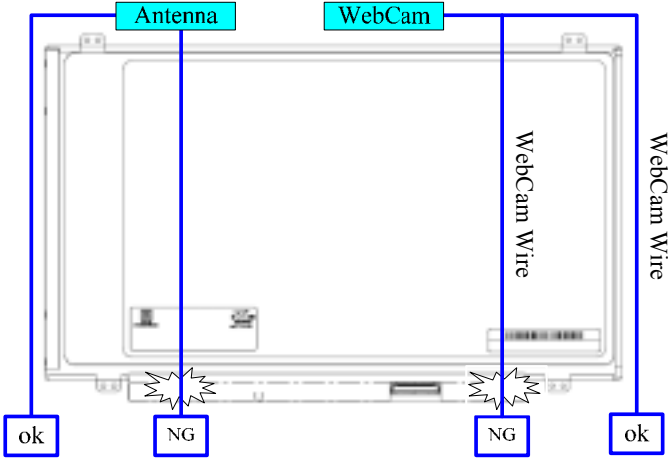




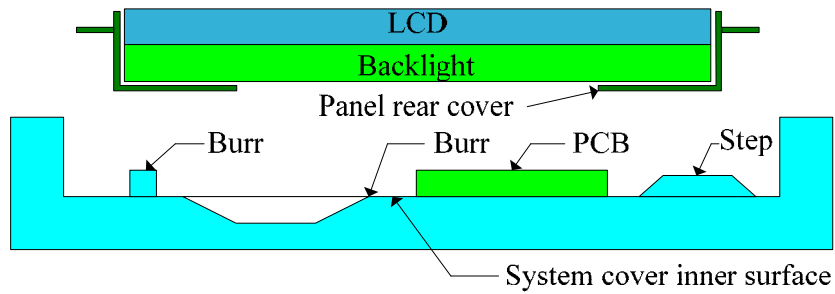
NOTES:  
 1. OUTLINE TOLERANCE ± 0.05mm.  
 2. SLVES ± 3-PER 28450-349E-32 OR EQUIVALENT.  
 3. FLATNESS ± 0.05mm MAX.  
 4. IN ORDER TO AVOID ABNORMAL DISPLAY/BEELING AND WHITE SPOT,  
 NO OVERLAPPING IS SUGGESTED AT CABLES, ANTENNAS, CAMERA, WLAN,  
 WAN OR OTHER FOREIGN OBJECTS OVER CDG IC, FPC, TCON AND VR LOCATIONS.

Appendix. SYSTEM COVER DESIGN NOTICE

|                   |   |
|-------------------|---|
| <p>1.</p>         | <p><b>Design gap A between panel &amp; any components on system cover</b></p>  <p>Max. Thickness</p> <p>Panel Module</p> <p>System cover inner surface</p> <p>Components, foreign objects, wire, cable or extrusion on system cover inner surface.</p> <p>A</p> |
| <p>Definition</p> | <p>a). Sufficient gap between panel &amp; system is a must for preventing from backpack or pogo test fail.</p> <p>b). Zero gap from panel's maximum thickness boundary to any components, foreign objects, wire, cable or extrusion on system cover inner surface is forbidden.</p>   |
| <p>2</p>          | <p><b>Design gap B1 &amp; B2 between panel &amp; protrusions</b></p>  <p>B1</p> <p>Protrusion</p> <p>Protrusion</p> <p>B2</p>   |
| <p>Definition</p> | <p>2.0mm min. gap is recommended between panel &amp; protrusions for preventing from shock related failures.</p>  |
| <p>3</p>          | <p><b>Design gap C between system front bezel &amp; panel surface.</b></p>  |

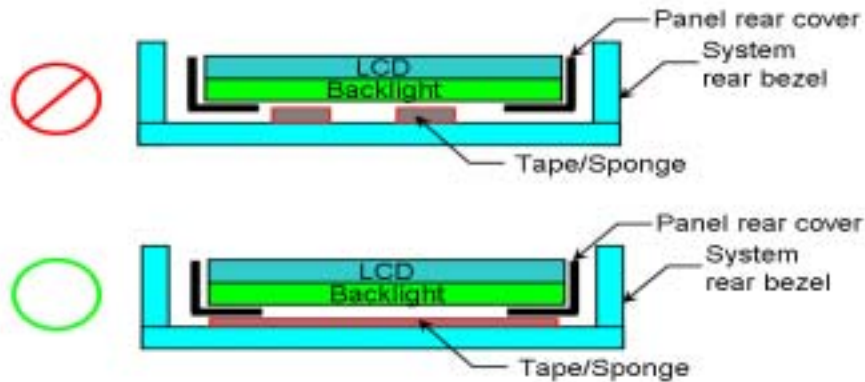
|            |  |
|------------|--|
|            |  <p>System front bezel</p> <p>LCD</p> <p>Backlight</p> <p>Panel Backcover</p> <p>C</p>   |
| Definition | <p>a). Sufficient gap between system front bezel &amp; panel surface is a must for preventing from pooling or glass broken.</p> <p>b). Zero gap or interference is forbidden.</p>  |
| 4          | <b>Design gap D1 &amp; D2 between system front bezel &amp; PCB Assembly.</b>   |
|            |  <p>System front bezel</p> <p>LCD</p> <p>Backlight</p> <p>PCB with components</p> <p>D1</p> <p>D2</p>   |
| Definition | <p>a). Sufficient gap between system front bezel &amp; PCB assembly is a must for preventing from abnormal display after backpack test, hinge test, twist test or pogo test.</p> <p>b). Zero gap or interference is forbidden.</p>   |
| 5          | <b>Interference examination of antenna cable and WebCam wire</b>   |
|            |  <p>Antenna</p> <p>WebCam</p> <p>WebCam Wire</p> <p>WebCam Wire</p> <p>ok</p> <p>NG</p> <p>NG</p> <p>ok</p>  |
| Definition | <p>a). Antenna cable or WebCam wire overlap with panel outline is forbidden for preventing from abnormal display &amp; white spot after backpack test, hinge test, twist test or pogo test.</p> <p>b). Antenna cable or WebCam wire bypass panel outline is recommended.</p> |
| 6          | <b>System inner surface examination</b>  |





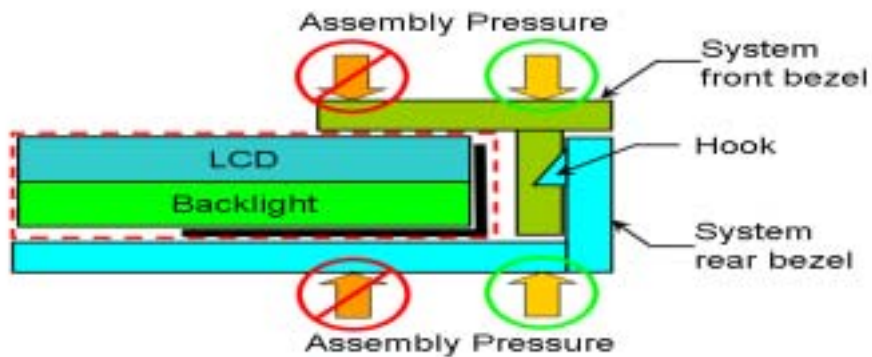
Definition a). Burr at logo edge, step, protrusion or PCB board will easily cause white spot or glass broken.  
b). Keeping flat surface underneath backlight is recommended.

7 Tape/sponge design on system inner surface



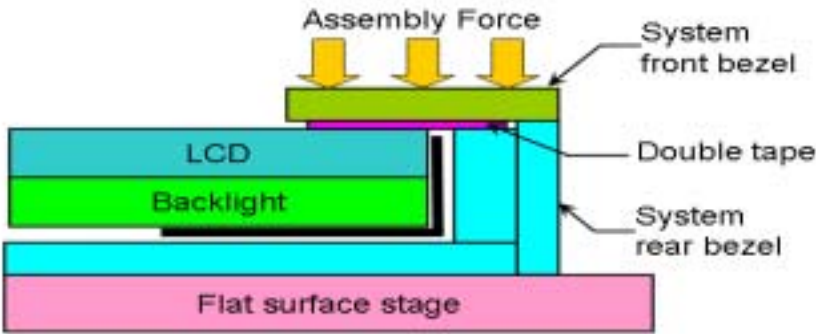
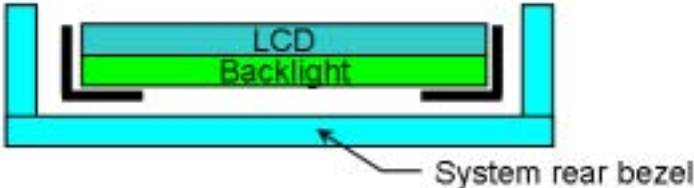
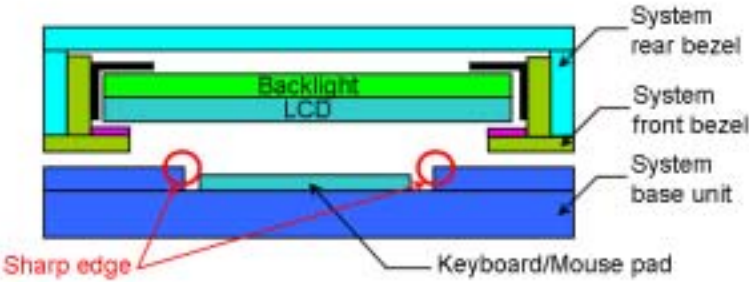
Definition a) To prevent abnormal display & white spot after scuffing test, hinge test, pogo test, backpack test, it is not recommended to add tape/sponge in separate location. Since each tape/sponge may act as pressure concentration location.  
b) We suggest to design a tape/sponge that well covered under panel rear cover.

8 Assembly SOP examination



Definition To prevent panel crack during system front bezel assembly process with hook design, it is prohibited to press panel or any location that related directly to the panel.

9 Material used for system rear bezel

|                   |   |
|-------------------|---|
|                   |   |
| <p>Definition</p> | <p>To prevent panel crack during system front bezel assembly process without hook design, it is only allowed to give slight pressure with large contact area. This can help to distribute the stress to prevent point concentration, also it is suggest to put the system on a flat surface stage during the assembly.</p>              |
| <p>10</p>         | <p>Material used for system rear bezel</p>  |
|                   |    |
| <p>Definition</p> | <p>a) To prevent abnormal display &amp; white spot after scuffing test, hinge test, pogo test, backpack test, as the poor rigidity result from deformation of system rear cover during the test.</p> <p>b) We suggest to use aluminum-magnesium alloy as the rear frame material with thickness min 1.5mm, instead of using PC/ABS.</p> |
| <p>11</p>         | <p>System base unit design near keyboard and mouse pad</p>  |
|                   |   |
| <p>Definition</p> | <p>To prevent abnormal display &amp; white spot after scuffing test, hinge test, pogo test, backpack test, no sharp edge design is allowed in any area that may damage the panel during the test. We suggest to remove all sharp edges, or to reduce the thickness difference of keyboard/mouse pad from the nearby surface.</p>        |