# SPECIFICATION
# FOR
# APPROVAL

( ) **Preliminary Specification**
( ◆ ) **Final Specification**

| Title | 15.4” WXGA TFT LCD |
|---|---|

| Customer | DELL |
|---|---|
| MODEL | |

| SUPPLIER | LG.Philips LCD Co., Ltd. |
|---|---|
| *MODEL | LP154WP1 |
| Suffix | TLD1 |

*When you obtain standard approval,
please use the above model name without suffix

| APPROVED BY | SIGNATURE |
|---|---|
| / | |
| / | |
| / | |

Please return 1 copy for your confirmation with your signature and comments.

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# RECORD OF REVISIONS

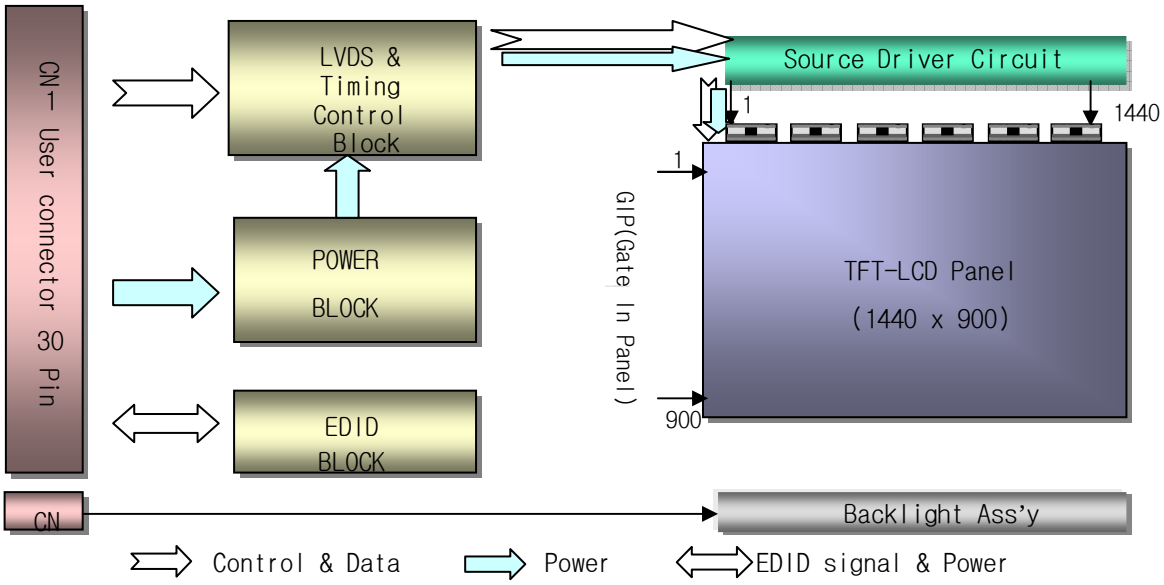
| Revision No | Revision Date | Page | Description | EDID ver |
|---|---|---|---|---|
| 0.0 | Sep. 10. 2007 | - | First Draft (Preliminary Specification) | 0.0 |
| 1.0 | Oct. 31. 2007 | - | Final CAS | 0.0 |

## 1. General Description

The LP154WP1 is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp (CCFL) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. This TFT-LCD has 15.4 inches diagonally measured active display area with WXGA resolution(900 vertical by 1440 horizontal pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 6-bit gray scale signal for each dot, thus, presenting a palette of more than 262,144 colors.

The LP154WP1 has been designed to apply the interface method that enables low power, high speed, low EMI.

The LP154WP1 is intended to support applications where thin thickness, low power are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LP154WP1 characteristics provide an excellent flat display for office automation products such as Notebook PC.




## General Features

| | |
|---|---|
| Active Screen Size | 15.4 inches diagonal |
| Outline Dimension | 344.0 (H) × 222.0 (V) × 6.4(D, max) mm |
| Pixel Pitch | 0.2301 mm × 0.2301 mm |
| Pixel Format | 1440 horiz. by 900 vert. Pixels RGB strip arrangement |
| Color Depth | 6-bit, 262,144 colors |
| Luminance, White | 250 cd/m$^2$(Typ.) , 5 point |
| Power Consumption | Total 5.77 Watt(Typ.) @ LCM circuit 1.35 Watt(Typ.), B/L input 4.42 Watt(Typ.) |
| Weight | 515g (Max.) w/o inverter & bracket |
| Display Operating Mode | Transmissive mode, normally white |
| Surface Treatment | Hard coating(3H) Glare treatment of the front polarizer |
| RoHS Comply | Yes |

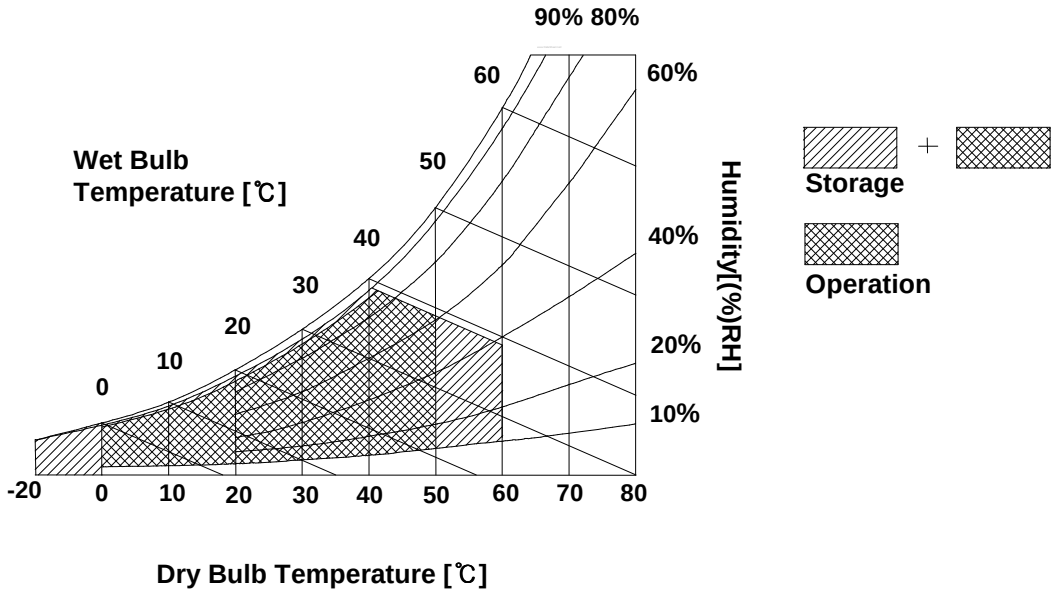
## 2. Absolute Maximum Ratings

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

**Table 1. ABSOLUTE MAXIMUM RATINGS**

| Parameter | Symbol | Values | | Units | Notes |
|---|---|---|---|---|---|
| | | Min | Max | | |
| Power Input Voltage | VCC | -0.3 | 4.0 | Vdc | at 25 ± 5°C |
| Operating Temperature | TOP | 0 | 50 | °C | 1 |
| Storage Temperature | HST | -20 | 60 | °C | 1 |
| Operating Ambient Humidity | HOP | 10 | 90 | %RH | 1 |
| Storage Humidity | HST | 10 | 90 | %RH | 1 |

Note : 1. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39°C Max, and no condensation of water.



# 3. Electrical Specifications

## 3-1. Electrical Characteristics

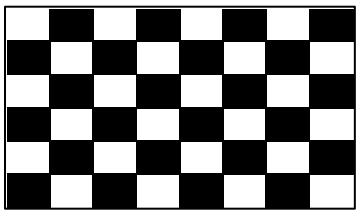
The LP154WP1 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input which powers the CCFL, is typically generated by an inverter. The inverter is an external unit to the LCD.

**Table 2. ELECTRICAL CHARACTERISTICS**

| Parameter | Symbol | Values | | | Unit | Notes |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| MODULE : | | | | | | |
| Power Supply Input Voltage | VCC | 3.0 | 3.3 | 3.6 | $V_{DC}$ | |
| Power Supply Input Current | $I_{CC}$ | | 405 | 465 | mA | 1 |
| Power Consumption | Pc | - | 1.35 | 1.67 | Watt | 1 |
| Differential Impedance | Zm | 90 | 100 | 110 | Ohm | 2 |
| LAMP : | | | | | | |
| Operating Voltage | $V_{BL}$ | 665 (7.0mA) | 680 (6.5mA) | 895 (2.0mA) | $V_{RMS}$ | |
| Operating Current | $I_{BL}$ | 2.0 | 6.5 | 7.0 | $mA_{RMS}$ | 3 |
| Power Consumption | $P_{BL}$ | - | 4.42 | 4.73 | | |
| Operating Frequency | $f_{BL}$ | 45 | 60 | 80 | kHz | |
| Discharge Stabilization Time | Ts | - | - | 3 | Min | 4 |
| Life Time | | 15,000 | - | - | Hrs | 5 |
| Established Starting Voltage<br>at 25℃<br>at 0 ℃ | Vs | | | <br>1170<br>1400 | <br>$V_{RMS}$<br>$V_{RMS}$ | |

Note)

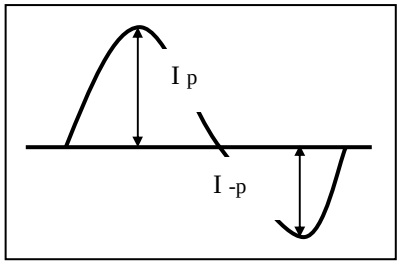
1. The specified current and power consumption are under the Vcc = 3.3V , 25℃, fv = 60Hz condition whereas Mosaic pattern is displayed and fv is the frame frequency.



2. This impedance value is needed to proper display and measured form LVDS Tx to the mating connector.
3. The typical operating current is for the typical surface luminance ($L_{WH}$) in optical characteristics.
4. Define the brightness of the lamp after being lighted for 5 minutes as 100%, Ts is the time required for the brightness of the center of the lamp to be not less than 95%.
5. The life time is determined as the time at which brightness of lamp is 50% compare to that of initial value at the typical lamp current.

Note)

6. The output of the inverter must have symmetrical(negative and positive) voltage waveform and symmetrical current waveform.(Asymmetrical ratio is less than 10%) Please do not use the inverter which has asymmetrical voltage and asymmetrical current and spike wave.
   Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.
7. It is defined the brightness of the lamp after being lighted for 5 minutes as 100%.
   $T_S$ is the time required for the brightness of the center of the lamp to be not less than 95%.
8. The lamp power consumption shown above does not include loss of external inverter.
   The applied lamp current is a typical one.
9. Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp, are following.
   It shall help increase the lamp lifetime and reduce leakage current.
   a. The asymmetry rate of the inverter waveform should be less than 10%.
   b. The distortion rate of the waveform should be within $\sqrt{2} \pm 10\%$.
   * Inverter output waveform had better be more similar to ideal sine wave.




* Asymmetry rate:

$| I_p - I_{-p} | / I_{rms} * 100\%$

* Distortion rate

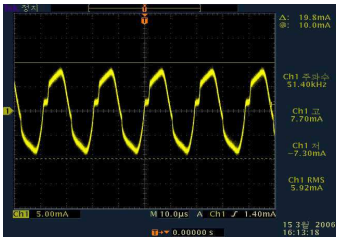
$I_p$ (or $I_{-p}$) / $I_{rms}$

10. Inverter open voltage must be more than lamp voltage for more than 1 second for start-up. Otherwise, the lamps may not be turned on.
    ※ Do not attach a conducting tape to lamp connecting wire.
    If the lamp wire attach to a conducting tape, TFT-LCD Module has a low luminance and the inverter has abnormal action. Because leakage current is occurred between lamp wire and conducting tape.

Ex of current wave)

**Normal current wave - Standard**

**Abnormal current wave - Bad**



**Abnormal current wave - Bad**

**Abnormal current wave - Bad**

## 3-2. Interface Connections

This LCD employs two interface connections, a 30 pin connector is used for the module electronics interface and the other connector is used for the integral backlight system.
The electronics interface connector is a model FI-XB30SRL-HF11 manufactured by JAE.

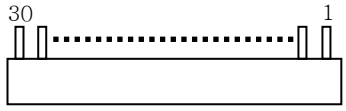
**Table 3. MODULE CONNECTOR PIN CONFIGURATION (CN1)**

| Pin | Symbol | Description | Notes |
|---|---|---|---|
| 1 | GND | Ground | |
| 2 | VCC | Power Supply, 3.3V Typ. | |
| 3 | VCC | Power Supply, 3.3V Typ. | |
| 4 | V EEDID | DDC 3.3V power | |
| 5 | BIST | Panel BIST control | |
| 6 | Clk EEDID | DDC Clock | |
| 7 | DATA EEDID | DDC Data | |
| 8 | Odd_$R_{IN}$ 0- | Negative LVDS differential data input | |
| 9 | Odd_$R_{IN}$ 0+ | Positive LVDS differential data input | |
| 10 | GND | Ground | |
| 11 | Odd_$R_{IN}$ 1- | Negative LVDS differential data input | |
| 12 | Odd_$R_{IN}$ 1+ | Positive LVDS differential data input | |
| 13 | GND | Ground | |
| 14 | Odd_$R_{IN}$ 2- | Negative LVDS differential data input | |
| 15 | Odd_$R_{IN}$ 2+ | Positive LVDS differential data input | |
| 16 | GND | Ground | |
| 17 | Odd_CLKIN- | Negative LVDS differential clock input | |
| 18 | Odd_CLKIN+ | Positive LVDS differential clock input | |
| 19 | GND | Ground | |
| 20 | Even_$R_{IN}$ 0- | Negative LVDS differential data input | |
| 21 | Even_$R_{IN}$ 0+ | Positive LVDS differential data input | |
| 22 | GND | Ground | |
| 23 | Even_$R_{IN}$ 1- | Negative LVDS differential data input | |
| 24 | Even_$R_{IN}$ 1+ | Positive LVDS differential data input | |
| 25 | GND | Ground | |
| 26 | Even_$R_{IN}$ 2- | Negative LVDS differential data input | |
| 27 | Even_$R_{IN}$ 2+ | Positive LVDS differential data input | |
| 28 | GND | Ground | |
| 29 | Even_CLKIN- | Negative LVDS differential clock input | |
| 30 | Even_CLKIN+ | Positive LVDS differential clock input | |

1, Interface chips
1.1 LCD : DTML012(LCD Controller) including LVDS Receiver

1.2 System : THC63LVD823A or equivalent
* Pin to Pin compatible with THINE LVDS

2. Connector
2.1 LCD : FI-XB30SRL-HF11, JAE or MDF76LARW-30S-1H, Hirose equivalent. Locking design
2.2 Mating : FI-X30M or equivalent.
2.3 Connector pin arrangement




[LCD Module Rear View]

The backlight interface connector is a model BHSR-02VS-1, manufactured by JST or Compatible.
The mating connector part number is AMP1674817-2 or equivalent.

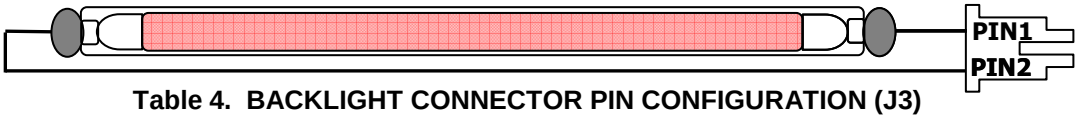


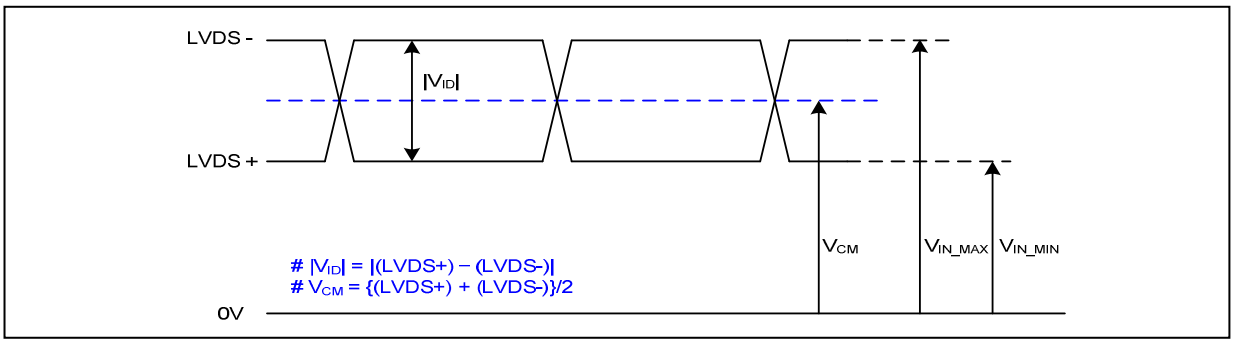

**Table 4. BACKLIGHT CONNECTOR PIN CONFIGURATION (J3)**

| Pin | Symbol | Description | Notes |
|---|---|---|---|
| 1 | HV | Power supply for lamp (High voltage side) | 1 |
| 2 | LV | Power supply for lamp (Low voltage side) | 1 |

Notes : 1. The high voltage side terminal is colored Pink and the low voltage side terminal is Black.

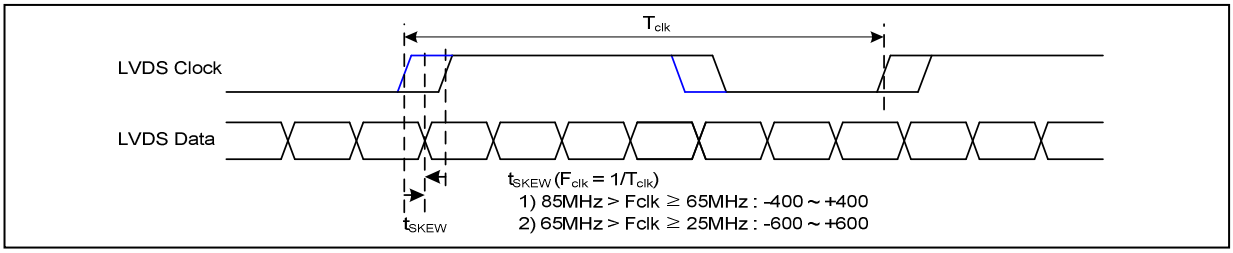
## 3-3. LVDS Signal Timing Specifications

### 3-3-1. DC Specification

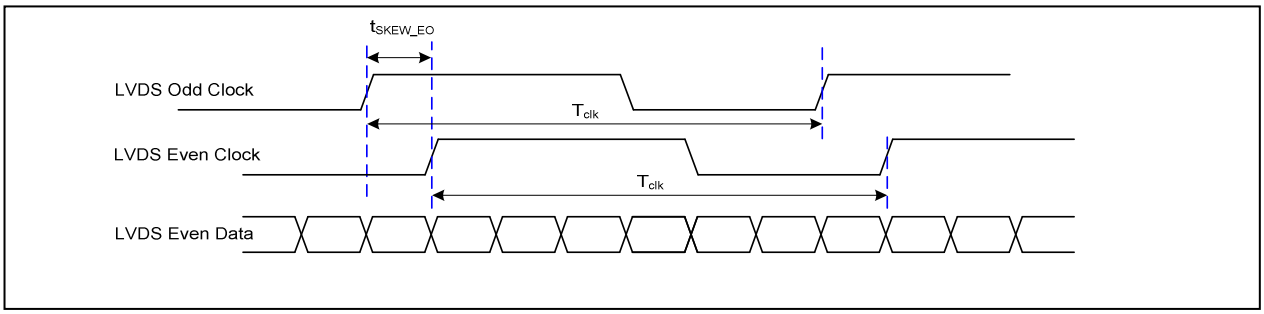



| Description | Symbol | Min | Max | Unit | Notes |
|---|---|---|---|---|---|
| LVDS Differential Voltage | $\|V_{ID}\|$ | 100 | 600 | mV | - |
| LVDS Common mode Voltage | $V_{CM}$ | 0.6 | 1.8 | V | - |
| LVDS Input Voltage Range | $V_{IN}$ | 0.3 | 2.1 | V | - |

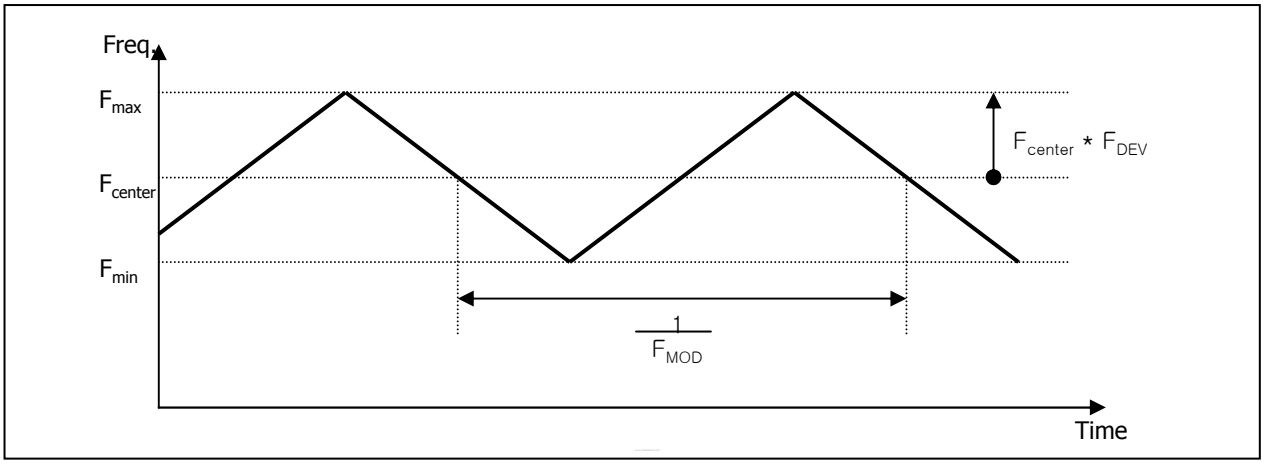
### 3-3-2. AC Specification




| Description | Symbol | Min | Max | Unit | Notes |
|---|---|---|---|---|---|
| LVDS Clock to Data Skew Margin | $t_{SKEW}$ | - 400 | + 400 | ps | 85MHz > Fclk ≥ 65MHz |
| | $t_{SKEW}$ | - 600 | + 600 | ps | 65MHz > Fclk ≥ 25MHz |
| LVDS Clock to Clock Skew Margin (Even to Odd) | $t_{SKEW\_EO}$ | - 1/7 | + 1/7 | $T_{clk}$ | - |
| Maximum deviation of input clock frequency during SSC | $F_{DEV}$ | - | ± 3 | % | - |
| Maximum modulation frequency of input clock during SSC | $F_{MOD}$ | - | 200 | KHz | - |



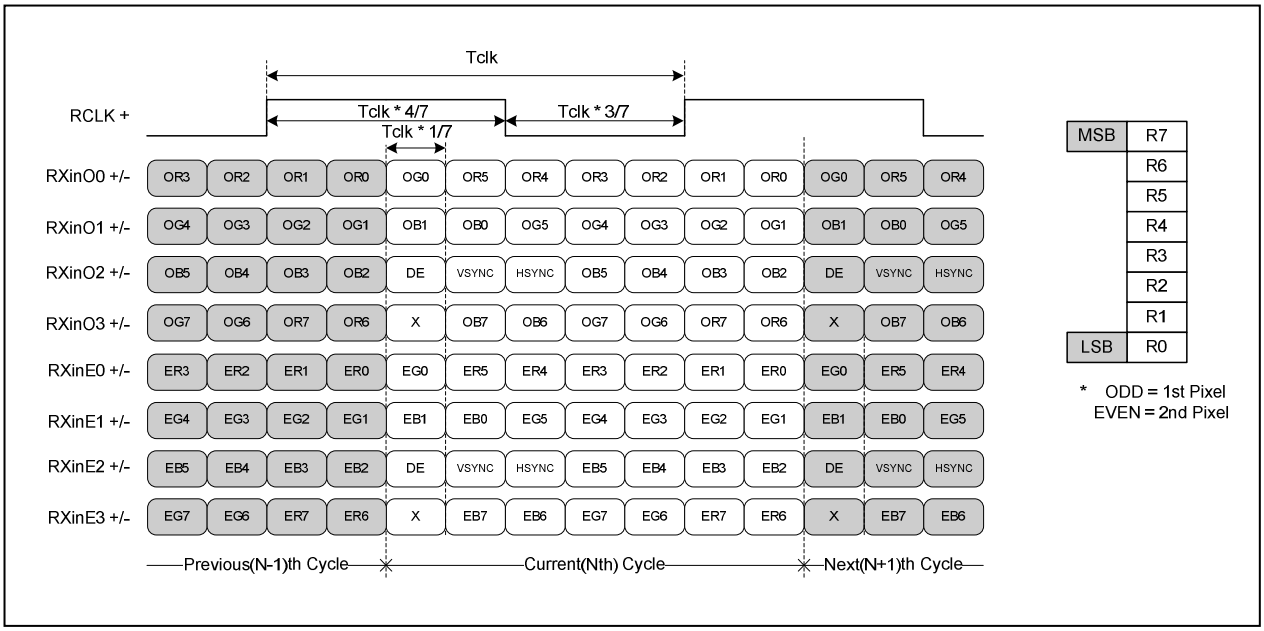

< Clock skew margin between channel >




< Spread Spectrum >

### 3-3-3. Data Format

1) LVDS 2 Port




< LVDS Data Format >

## 3-4. Signal Timing Specifications

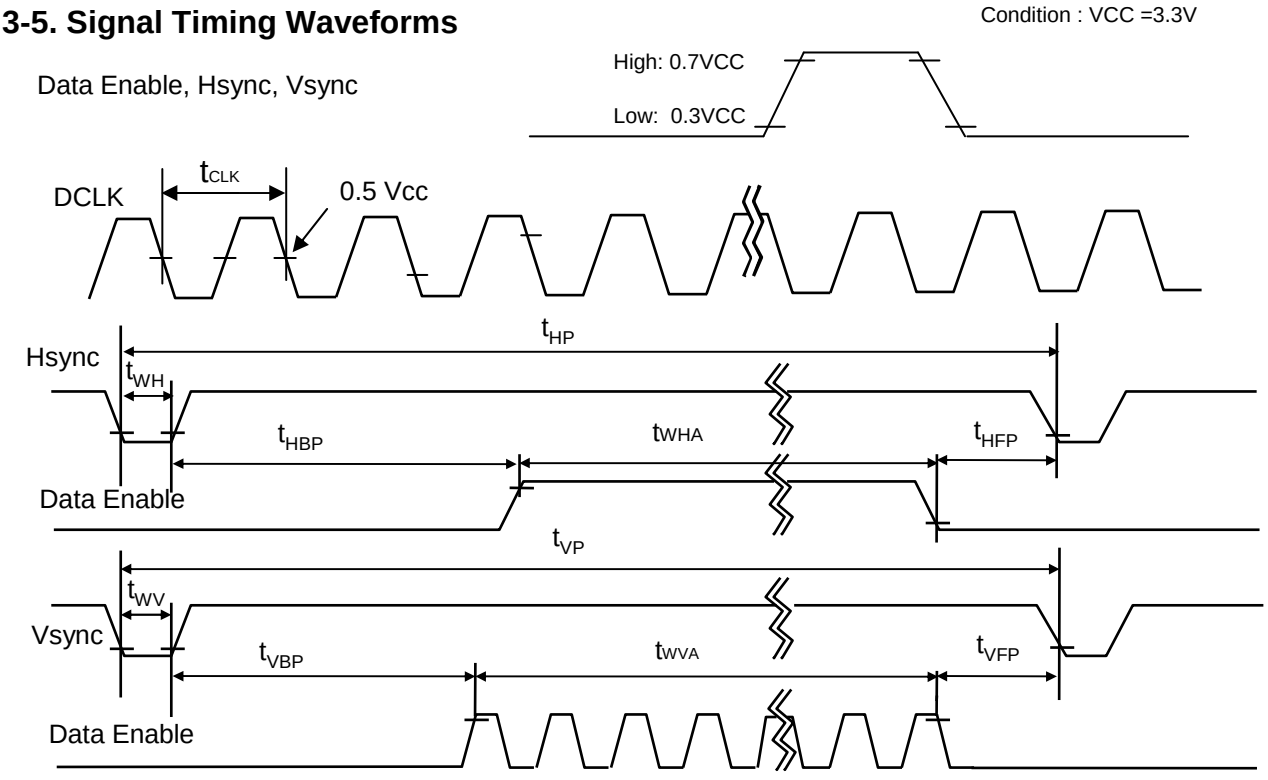
This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications and specifications of LVDS Tx/Rx for its proper operation.

**Table 6. TIMING TABLE**

| ITEM | Symbol | | Min | Typ | Max | Unit | Note |
|---|---|---|---|---|---|---|---|
| DCLK | Frequency | $f_{CLK}$ | - | 43.35 | - | MHz | |
| Hsync | Period | Thp | - | 776 | 1080 | tCLK | |
| | Width | $t_{WH}$ | 12 | 16 | - | | |
| | Width-Active | $t_{WHA}$ | 720 | 720 | 720 | | |
| Vsync | Period | $t_{VP}$ | - | 931 | - | tHP | |
| | Width | $t_{WV}$ | 2 | 6 | - | | |
| | Width-Active | $t_{WVA}$ | 900 | 900 | 900 | | |
| Data Enable | Horizontal back porch | $t_{HBP}$ | 16 | 24 | - | tCLK | |
| | Horizontal front porch | $t_{HFP}$ | 8 | 16 | - | | |
| | Vertical back porch | $t_{VBP}$ | 7 | 20 | - | tHP | |
| | Vertical front porch | $t_{VFP}$ | 2 | 5 | - | | |

## 3-5. Signal Timing Waveforms

Condition : VCC =3.3V



## 3-6. Color Input Data Reference

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 a reference for color versus data input.

**Table 7. COLOR DATA REFERENCE**

| Color | | Input Color Data | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | RED | | | | | | GREEN | | | | | | BLUE | | | | | |
| | | MSB | | | | | LSB | MSB | | | | | LSB | MSB | | | | | LSB |
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | 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 |
| RED | RED (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED (01) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 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 | 0 |
| | RED (63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| GREEN | GREEN (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN (01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ... | | | ... | | | | | | ... | | | | | | ... | | | |
| | GREEN (62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 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 | 0 |
| BLUE | BLUE (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | BLUE (01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | ... | | | ... | | | | | | ... | | | | | | ... | | | |
| | BLUE (62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | BLUE (63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

## 3-7. Power Sequence

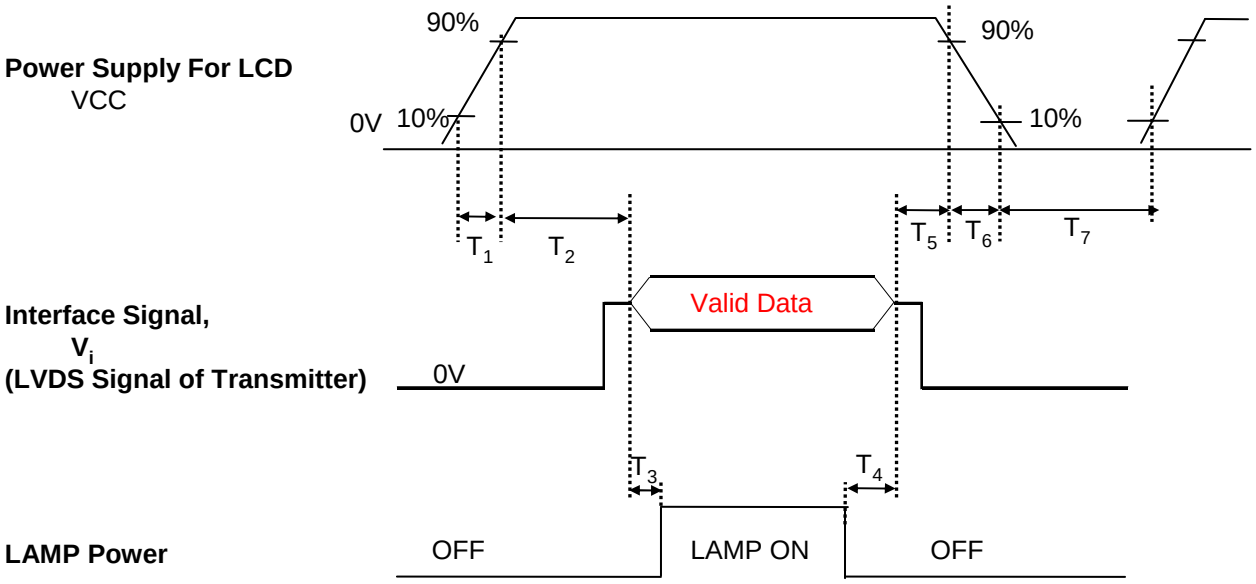



**Table 8. POWER SEQUENCE TABLE**

| Parameter | Value | | | Units |
|---|---|---|---|---|
| | Min. | Typ. | Max. | |
| $T_1$ | 0 | - | 10 | (ms) |
| $T_2$ | 0 | - | 50 | (ms) |
| $T_3$ | 200 | - | - | (ms) |
| $T_4$ | 200 | - | - | (ms) |
| $T_5$ | 0 | - | 50 | (ms) |
| $T_6$ | 0 | - | 10 | (ms) |
| $T_7$ | 400 | - | - | (ms) |

Note)
1. Valid Data is Data to meet “3-3. LVDS Signal Timing Specifications”
2. Please avoid floating state of interface signal at invalid period.
3. When the interface signal is invalid, be sure to pull down the power supply for LCD VCC to 0V.
4. Lamp power must be turn on after power supply for LCD and interface signal are valid.

## 4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and Θ equal to 0°.
FIG. 1 presents additional information concerning the measurement equipment and method.

**FIG. 1 Optical Characteristic Measurement Equipment and Method**

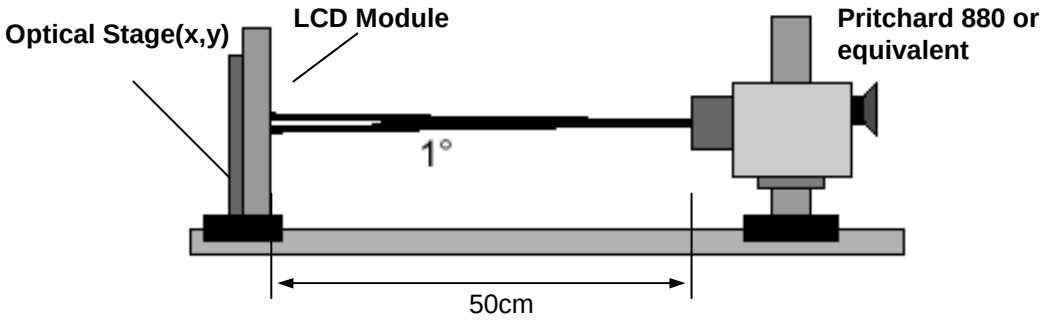



**Table 9. OPTICAL CHARACTERISTICS**

Ta=25°C, VCC=3.3V, $f_V$=60Hz, $f_{CLK}$= 86.7MHz, $F_{BL}$ = 60KHz , $I_{BL}$= 6.5mA

| Parameter | Symbol | Values | | | Units | Notes |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| Contrast Ratio | CR | 400 | 600 | | | 1 |
| Surface Luminance, white | $L_{WH}$ | 210 | 250 | | cd/m$^2$ | 2 |
| Luminance Variation | $\delta_{WHITE}$ | | | 2.0 | | 3 |
| Response Time | $Tr_R$+ $Tr_D$ | | 16 | 25 | ms | 4 |
| Color Coordinates | | | | | | |
| RED | RX | 0.571 | 0.601 | 0.631 | | |
| | RY | 0.320 | 0.350 | 0.380 | | |
| GREEN | GX | 0.296 | 0.326 | 0.356 | | |
| | GY | 0.526 | 0.556 | 0.586 | | |
| BLUE | BX | 0.129 | 0.159 | 0.189 | | |
| | BY | 0.119 | 0.149 | 0.179 | | |
| WHITE | WX | 0.283 | 0.313 | 0.343 | | |
| | WY | 0.299 | 0.329 | 0.359 | | |
| Viewing Angle | | | | | | 5 |
| x axis, right(Φ=0°) | Θr | | 80 | | degree | |
| x axis, left (Φ=180°) | Θl | | 80 | | degree | |
| y axis, up (Φ=90°) | Θu | | 60 | | degree | |
| y axis, down (Φ=270°) | Θd | | 60 | | degree | |
| Gray Scale | | | | | | 6 |

Note)

1. Contrast Ratio(CR) is defined mathematically as

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

2. Surface luminance is the average of 5 point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 1.

$$L_{WH} = \text{Average}(L_1, L_2, \ldots L_5)$$

3. The variation in surface luminance , The panel total variation ($\delta_{WHITE}$) is determined by measuring $L_N$ at each test position 1 through 13 and then defined as followed numerical formula. For more information see FIG 2.

$$\delta_{WHITE} = \frac{\text{Maximum}(L_1, L_2, \ldots L_{13})}{\text{Minimum}(L_1, L_2, \ldots L_{13})}$$

4. Response time is the time required for the display to transition from white to black (rise time, $Tr_R$) and from black to white(Decay Time, $Tr_D$). For additional information see FIG 3.

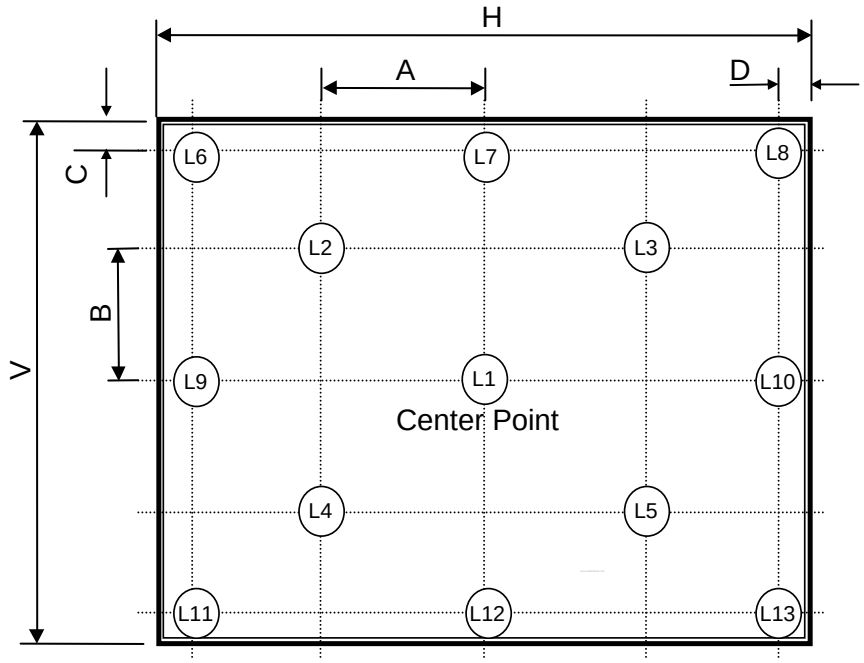
5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.

6. Gray scale specification * $f_V$ = 60Hz

| Gray Level | Luminance [%] (Typ) |
|---|---|
| L0 | 0.12 |
| L7 | 0.47 |
| L15 | 3.24 |
| L23 | 9.70 |
| L31 | 21.0 |
| L39 | 35.9 |
| L47 | 55.5 |
| L55 | 79.1 |
| L63 | 100 |

**FIG. 2 Luminance**

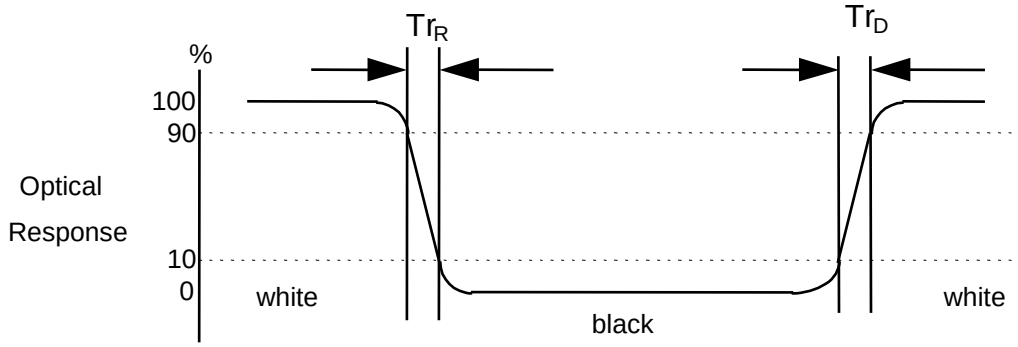
<measuring point for surface luminance & measuring point for luminance variation>




H,V : ACTIVE AREA
A : H/4 mm
B : V/4 mm
C : 10 mm
D : 10 mm
POINTS : 13 POINTS

**FIG. 3 Response Time**

The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white”.



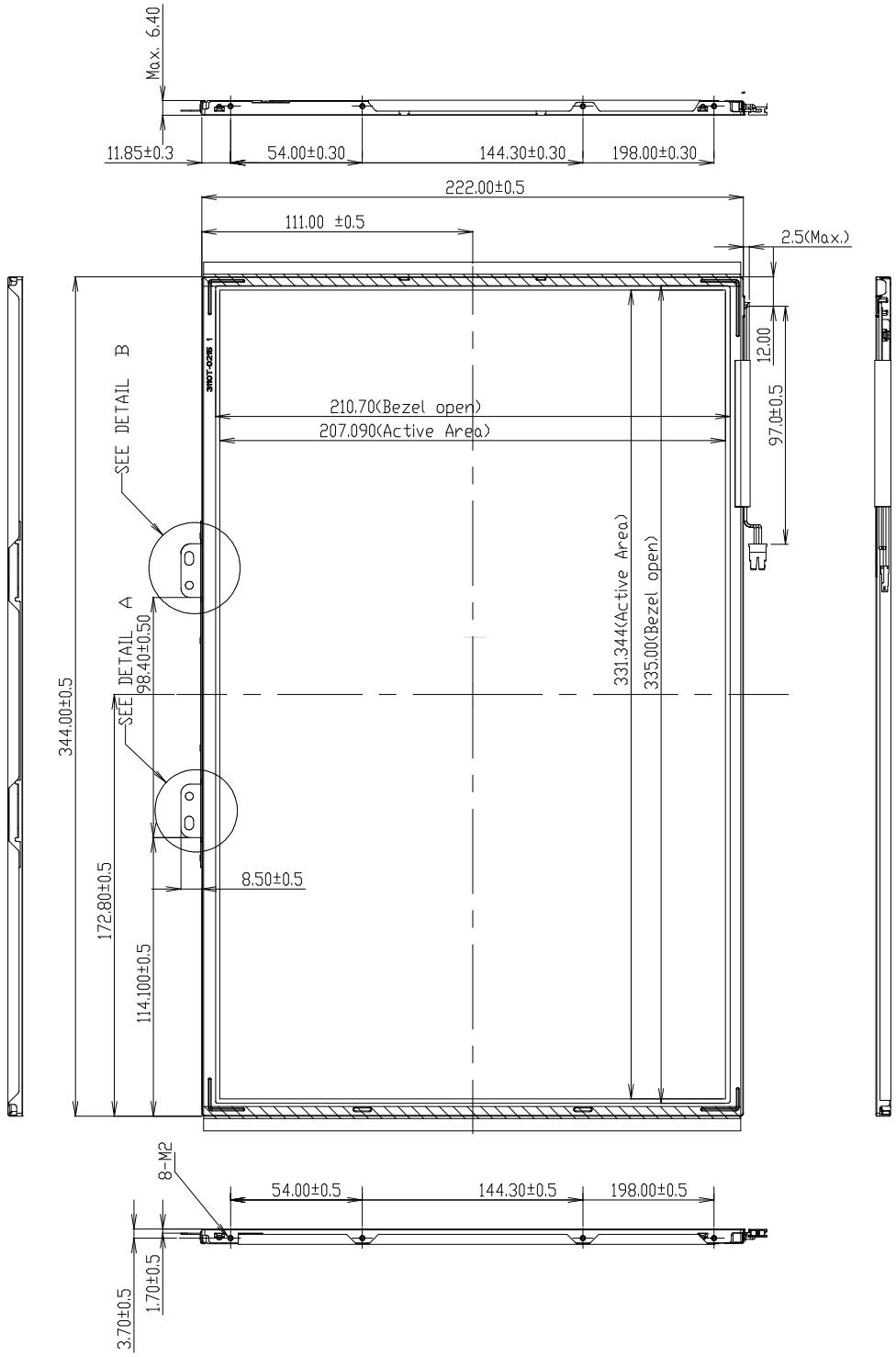
## 5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LP154WP1.
In addition the figures in the next page are detailed mechanical drawing of the LCD.

| | | |
|---|---|---|
| Outline Dimension | Horizontal | 344.0 ± 0.5mm |
| | Vertical | 222.0 ± 0.5mm |
| | Thickness | 6.1 ± 0.3mm |
| Bezel Area | Horizontal | 335.0 ± 0.5mm |
| | Vertical | 210.7 ± 0.5mm |
| Active Display Area | Horizontal | 331.344 mm |
| | Vertical | 207.090 mm |
| Weight | 515g (Max.) | |
| Surface Treatment | Hard coating(3H)<br>Glare treatment of the front polarizer | |

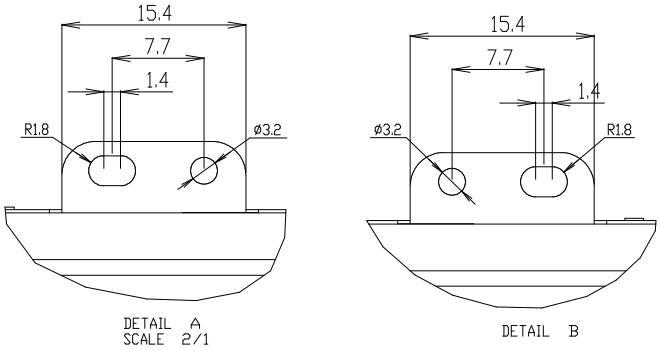
<FRONT VIEW>

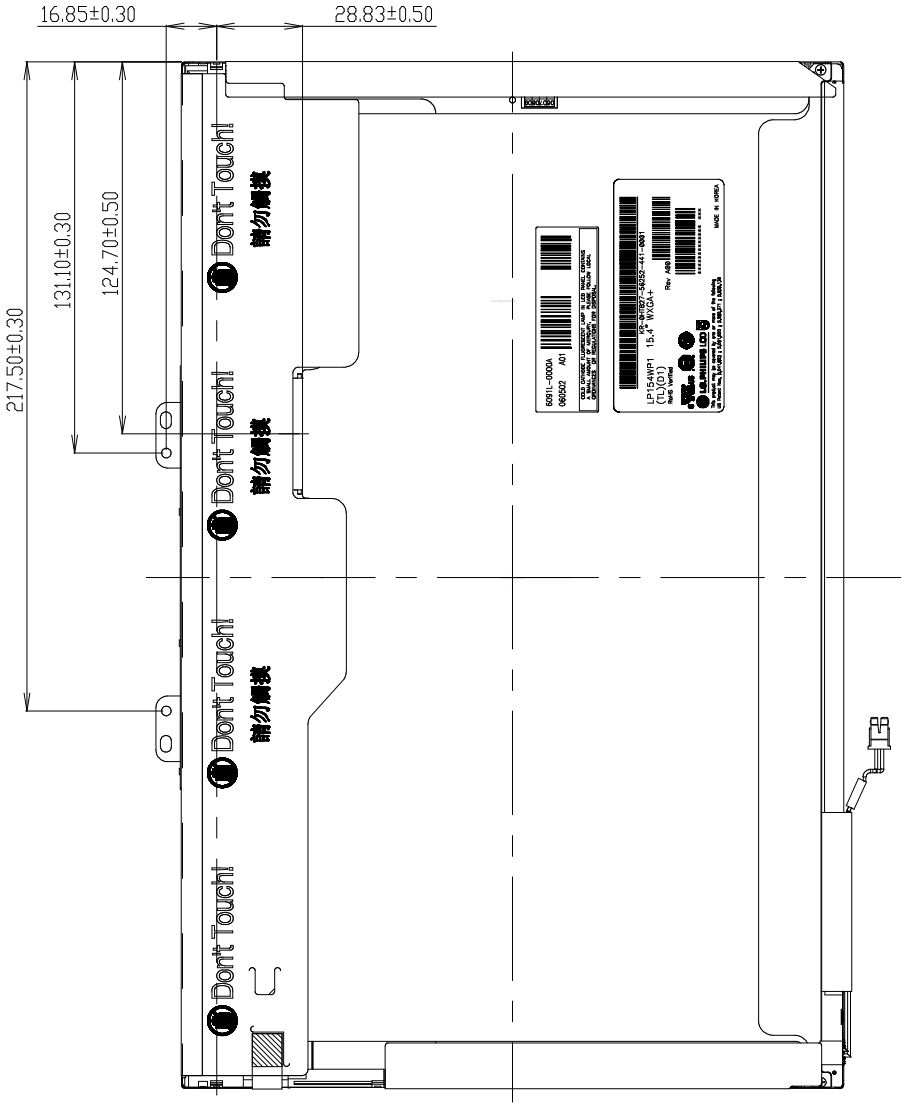
Note) Unit:[mm], General tolerance: ± 0.5mm



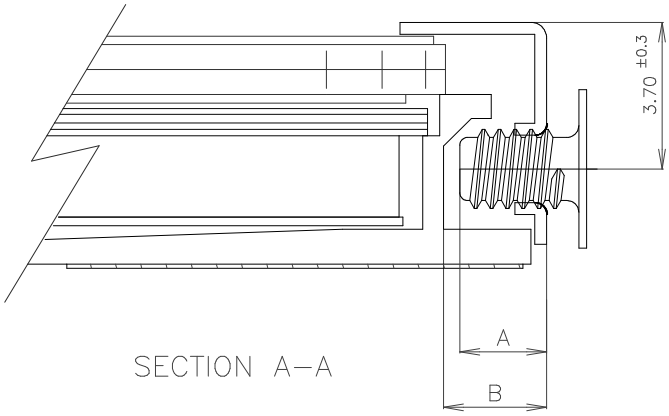
<REAR VIEW>

Note) Unit:[mm], General tolerance: ± 0.5mm



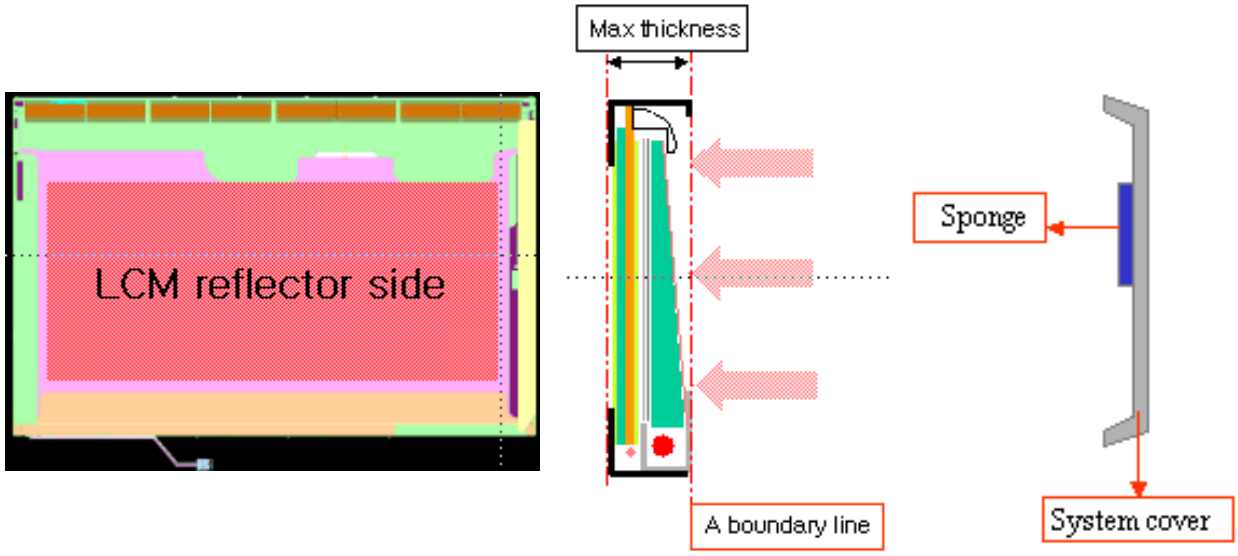
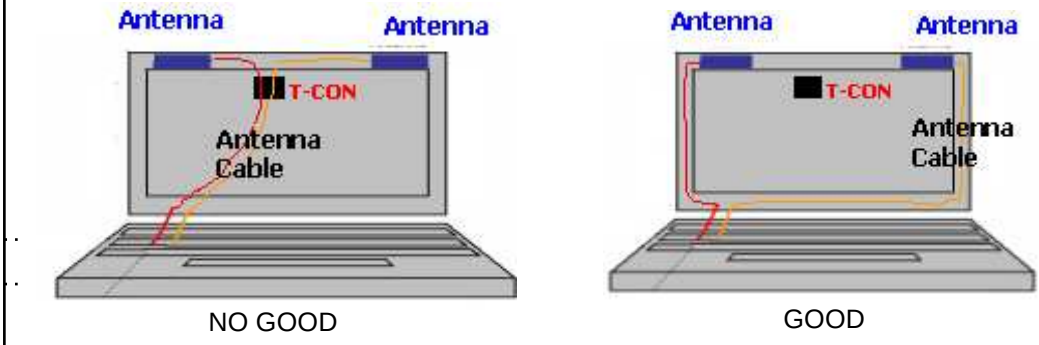
[ DETAIL DESCRIPTION OF SIDE MOUNTING SCREW ]



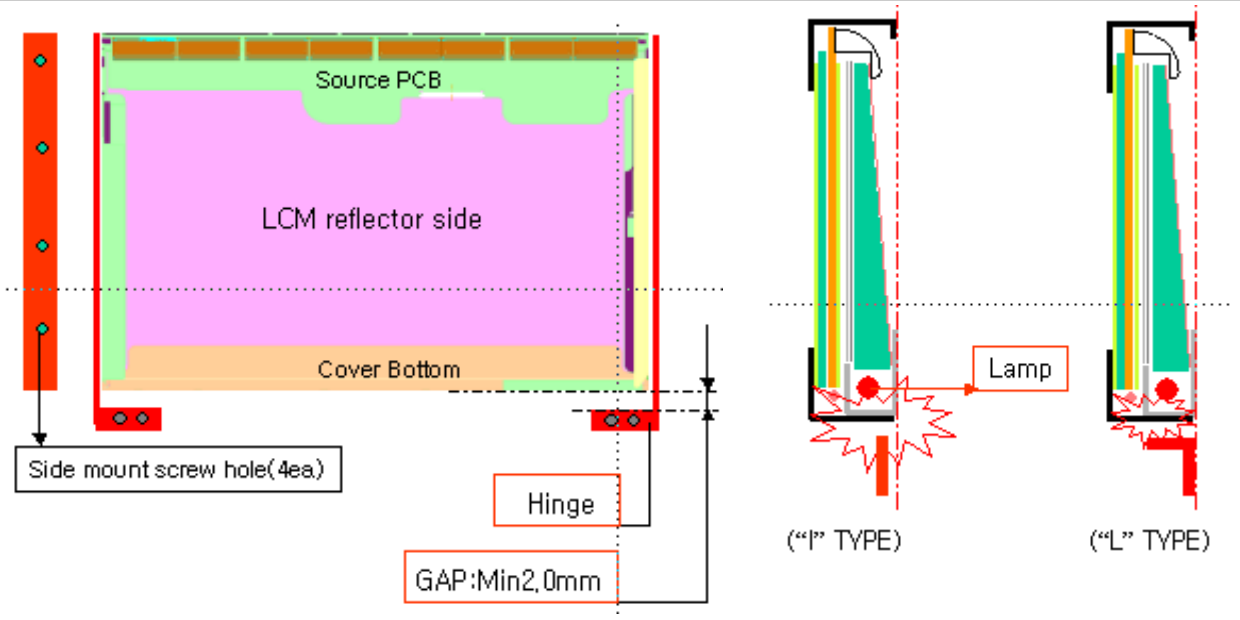
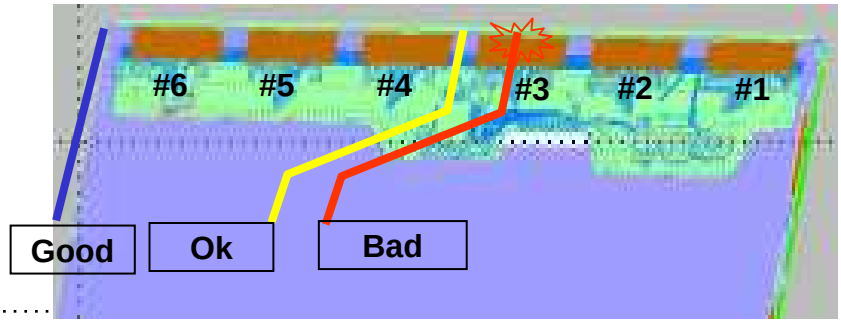

* Mounting Screw Length (A)
  = 2.0(Min) / 2.5(Max)
* Mounting Screw Hole Depth (B)
  = 2.5(Min)
* Mounting hole location : 3.7(typ.)
* Torque : 2.5 kgf.cm(Max)
  (Measurement gauge : torque meter)

Notes : 1. Screw plated through the method of non-electrolytic nickel plating is preferred to reduce possibility that results in vertical and/or horizontal line defect due to the conductive particles from screw surface.

## LPL Proposal for system cover design.(Appendix)

| | | |
|---|---|---|
| 1 | Gap check for securing the enough gap between LCM and System cover. | |
| |  | |
| Define | 1.Rear side of LCM is sensitive against external stress,and previous check about interference is highly needed.<br>2.In case there is something from system cover comes into the boundary above,mechanical interference may cause the FOS defects.<br>(Eg:Ripple,White spot..) | |
| 2 | Check if antenna cable is sufficiently apart from T-CON of LCD Module. | |
| Define |  | |
| | 1.If system antenna is overlapped with T-CON,it might be cause the noise. | |

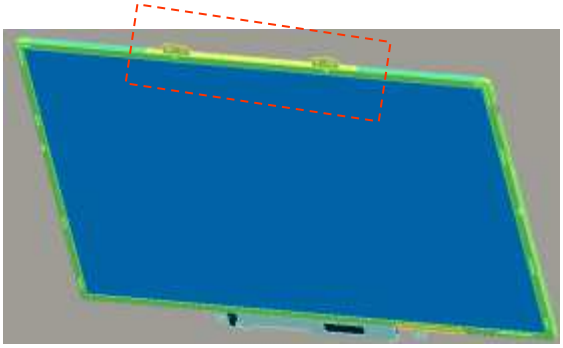
**LPL Proposal for system cover design.**

| | | |
|---|---|---|
| 3 | Gap check for securing the enough gap between LCM and System hinge. | |
| |  | |
| Define | 1.At least 2.0mm of gap needs to be secured to prevent the shock related defects.<br>2."L" type of hinge is recommended than "I" type under shock test. | |
| 4 | Checking the path of the System wire. | |
| |  | |
| Define | 1.COF area needs to be handled with care.<br>2.GOOD ➔Wire path design to system side.<br>OK➔ Wire path is located between COFs.<br>BAD➔Wire path overlapped with COF area. | |

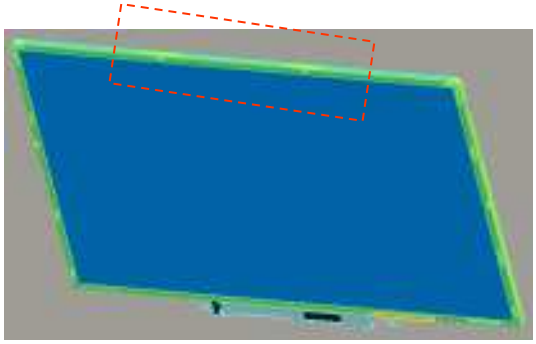
**LPL Proposal for system cover design.**

| | | |
|---|---|---|
| 5 | Using a bracket on the top of LCM is not recommended. | |

bracket

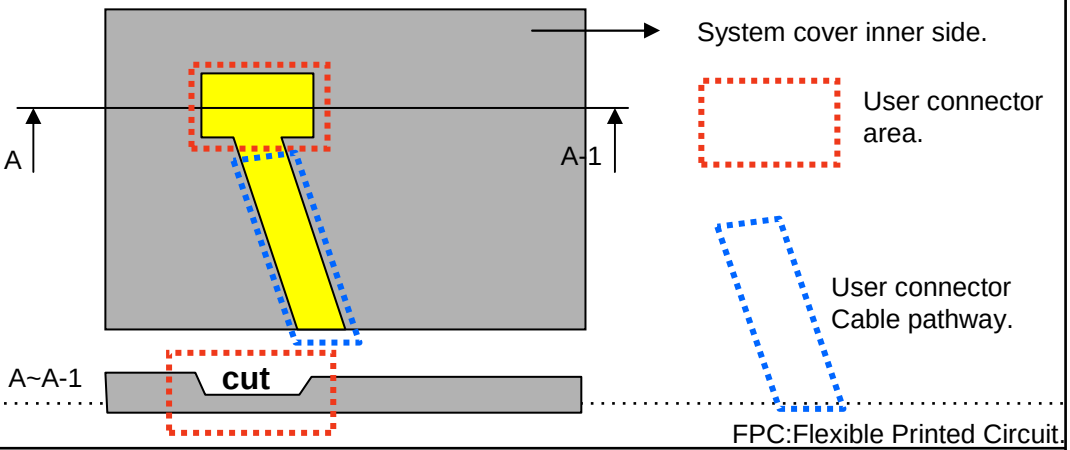


With bracket



Without bracket

| | |
|---|---|
| Define | 1.Condition without bracket is good for mechanical noise,and can minimize the light leakage from deformation of bracket.<br>2.The results shows that there is no difference between the condition with or without bracket. |
| 6 | Securing additional gap on CNT area.. |




| | |
|---|---|
| Define | 1.CNT area is specially sensitive against external stress,and additional gap by cutting on system cover will be helpful on removing the Ripple.<br>2.Using a thinner CNT will be better. (eg: FPC type) |

## 6. Reliability

Environment test condition

| No. | Test Item | Conditions |
|---|---|---|
| 1 | High temperature storage test | Ta= 60°C, 240h |
| 2 | Low temperature storage test | Ta= -20°C, 240h |
| 3 | High temperature operation test | Ta= 50°C, 50%RH, 240h |
| 4 | Low temperature operation test | Ta= 0°C, 240h |
| 5 | Vibration test (non-operating) | Sine wave, 10 ~ 500 ~ 10Hz, 1.5G, 0.37oct/min<br>3 axis, 1hour/axis |
| 6 | Shock test (non-operating) | Half sine wave, 180G, 2ms<br>one shock of each six faces(I.e. run 180G 6ms<br>for all six faces) |
| 7 | Altitude operating<br>storage / shipment | 0 ~ 10,000 feet (3,048m) 24Hr<br>0 ~ 40,000 feet (12,192m) 24Hr |

{ Result Evaluation Criteria }
There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

# 7. International Standards

## 7-1. Safety

a) UL 60950-1:2003, First Edition, Underwriters Laboratories, Inc.,
Standard for Safety of Information Technology Equipment.
b) CAN/CSA C22.2, No. 60950-1-03 1st Ed. April 1, 2003, Canadian Standards Association,
Standard for Safety of Information Technology Equipment.
c) EN 60950-1:2001, First Edition,
European Committee for Electrotechnical Standardization(CENELEC)
European Standard for Safety of Information Technology Equipment.

## 7-2. EMC

a) ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHZ to 40GHz. “American National Standards Institute(ANSI), 1992
b) C.I.S.P.R “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.“ International Special Committee on Radio Interference.
c) EN 55022 “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.“ European Committee for Electrotechnical Standardization.(CENELEC), 1998
( Including A1: 2000 )

# 8. Packing

## 8-1. Designation of Lot Mark

a) Lot Mark

| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

A,B,C : SIZE(INCH)
D : YEAR
E : MONTH
F ~ M : SERIAL NO.

Note

1. YEAR

| Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mark | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |

2. MONTH

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mark | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |

b) Location of Lot Mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

## 8-2. Packing Form

a) Package quantity in one box : 20 pcs

b) Box Size : 395mm × 390mm × 309mm

# 9. PRECAUTIONS

Please pay attention to the followings when you use this TFT LCD module.

## 9-1. MOUNTING PRECAUTIONS

(1) You must mount a module using holes arranged in four corners or four sides.
(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.
(4) You should adopt radiation structure to satisfy the temperature specification.
(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental to the polarizer.)
(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(9) Do not open the case because inside circuits do not have sufficient strength.

## 9-2. OPERATING PRECAUTIONS

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
V=± 200mV(Over and under shoot voltage)

(2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
(3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)
And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.

## 9-3. ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

## 9-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

## 9-5. STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

## 9-6. HANDLING PRECAUTIONS FOR PROTECTION FILM

(1) When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
(2) The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt to remain on the polarizer.
Please carefully peel off the protection film without rubbing it against the polarizer.
(3) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
(4) You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

# APPENDIX A. Enhanced Extended Display Identification Data (EEDID™) 1/3

| Byte# (decimal) | Byte# (HEX) | Field Name and Comments | Value (HEX) | | Value (binary) | | |
|---|---|---|---|---|---|---|---|
| 0 | 00 | Header | 0 | 0 | 0000 | 0000 | Header |
| 1 | 01 | Header | F | F | 1111 | 1111 | |
| 2 | 02 | Header | F | F | 1111 | 1111 | |
| 3 | 03 | Header | F | F | 1111 | 1111 | |
| 4 | 04 | Header | F | F | 1111 | 1111 | |
| 5 | 05 | Header | F | F | 1111 | 1111 | |
| 6 | 06 | Header | F | F | 1111 | 1111 | |
| 7 | 07 | Header | 0 | 0 | 0000 | 0000 | |
| 8 | 08 | EISA manufacturer code(3 Character ID) = LPL | 3 | 2 | 0011 | 0010 | Vender/ Product ID |
| 9 | 09 | EISA manufacture code (Compressed ASCII) | 0 | C | 0000 | 1100 | |
| 10 | 0A | Panel Supplier Reserved – Product code | 0 | 0 | 0000 | 0000 | |
| 11 | 0B | Panel Supplier Reserved – Product code | D | F | 1101 | 1111 | |
| 12 | 0C | LCD Module Serial No. = 0 (If not used) | 0 | 0 | 0000 | 0000 | |
| 13 | 0D | LCD Module Serial No. = 0 (If not used) | 0 | 0 | 0000 | 0000 | |
| 14 | 0E | LCD Module Serial No. = 0 (If not used) | 0 | 0 | 0000 | 0000 | |
| 15 | 0F | LCD Module Serial No. = 0 (If not used) | 0 | 0 | 0000 | 0000 | |
| 16 | 10 | Week of Manufacture = 00 | 0 | 0 | 0000 | 0000 | |
| 17 | 11 | Year of Manufacture = 2007 | 1 | 1 | 0001 | 0001 | |
| 18 | 12 | EDID Structure version # = 1 | 0 | 1 | 0000 | 0001 | EDID Version/ Revision |
| 19 | 13 | EDID Revision # = 3 | 0 | 3 | 0000 | 0011 | |
| 20 | 14 | Video Input Definition = Digital I/P,non TMDS CRGB | 8 | 0 | 1000 | 0000 | Display Parameter |
| 21 | 15 | Max H image size(㎝) = 33.12㎝(33) | 2 | 1 | 0010 | 0001 | |
| 22 | 16 | Max V image size(㎝) = 20.70㎝(21) | 1 | 5 | 0001 | 0101 | |
| 23 | 17 | Display gamma =2.2 | 7 | 8 | 0111 | 1000 | |
| 24 | 18 | Feature support(DPMS) = Active off, RGB Color | 0 | A | 0000 | 1010 | |
| 25 | 19 | Red/Green low Bits | E | 9 | 1110 | 1001 | Color Characteristic |
| 26 | 1A | Blue/White Low Bits | D | 5 | 1101 | 0101 | |
| 27 | 1B | Red X = 0.601 | 9 | 9 | 1001 | 1001 | |
| 28 | 1C | Red Y = 0.350 | 5 | 9 | 0101 | 1001 | |
| 29 | 1D | Green X = 0.326 | 5 | 3 | 0101 | 0011 | |
| 30 | 1E | Green Y = 0.556 | 8 | E | 1000 | 1110 | |
| 31 | 1F | Blue X = 0.159 | 2 | 8 | 0010 | 1000 | |
| 32 | 20 | Blue Y = 0.149 | 2 | 6 | 0010 | 0110 | |
| 33 | 21 | White X = 0.313 | 5 | 0 | 0101 | 0000 | |
| 34 | 22 | White Y = 0.329 | 5 | 4 | 0101 | 0100 | |
| 35 | 23 | Established timings 1 (00h if not used) | 0 | 0 | 0000 | 0000 | Established Timings |
| 36 | 24 | Established timings 2 (00h if not used) | 0 | 0 | 0000 | 0000 | |
| 37 | 25 | Manufacturer's timings (00h if not used) | 0 | 0 | 0000 | 0000 | |
| 38 | 26 | Standard Timing Identification 1 was not used | 0 | 1 | 0000 | 0001 | Standard Timing ID |
| 39 | 27 | Standard Timing Identification 1 was not used | 0 | 1 | 0000 | 0001 | |
| 40 | 28 | Standard Timing Identification 2 was not used | 0 | 1 | 0000 | 0001 | |
| 41 | 29 | Standard Timing Identification 2 was not used | 0 | 1 | 0000 | 0001 | |
| 42 | 2A | Standard Timing Identification 3 was not used | 0 | 1 | 0000 | 0001 | |
| 43 | 2B | Standard Timing Identification 3 was not used | 0 | 1 | 0000 | 0001 | |
| 44 | 2C | Standard Timing Identification 4 was not used | 0 | 1 | 0000 | 0001 | |
| 45 | 2D | Standard Timing Identification 4 was not used | 0 | 1 | 0000 | 0001 | |
| 46 | 2E | Standard Timing Identification 5 was not used | 0 | 1 | 0000 | 0001 | |
| 47 | 2F | Standard Timing Identification 5 was not used | 0 | 1 | 0000 | 0001 | |
| 48 | 30 | Standard Timing Identification 6 was not used | 0 | 1 | 0000 | 0001 | |
| 49 | 31 | Standard Timing Identification 6 was not used | 0 | 1 | 0000 | 0001 | |
| 50 | 32 | Standard Timing Identification 7 was not used | 0 | 1 | 0000 | 0001 | |
| 51 | 33 | Standard Timing Identification 7 was not used | 0 | 1 | 0000 | 0001 | |
| 52 | 34 | Standard Timing Identification 8 was not used | 0 | 1 | 0000 | 0001 | |
| 53 | 35 | Standard Timing Identification 8 was not used | 0 | 1 | 0000 | 0001 | |

## APPENDIX A. Enhanced Extended Display Identification Data (EEDID™) 2/3

| Byte# (decimal) | Byte# (HEX) | Field Name and Comments | Value (HEX) | | Value (binary) | | |
|---|---|---|---|---|---|---|---|
| 54 | 36 | Pixel Clock/10,000 (LSB) | D | E | 1101 | 1110 | Detailed Timing Description #1 |
| 55 | 37 | Pixel Clock/10,000 (MSB) / 1440 x 900 @ 60㎐ pixel clock = 86.7 | 2 | 1 | 0010 | 0001 | |
| 56 | 38 | Horizontal Active = 1440 pixels | A | 0 | 1010 | 0000 | |
| 57 | 39 | Horizontal Blanking = 112 pixels | 7 | 0 | 0111 | 0000 | |
| 58 | 3A | Horizontal Active : Horizontal Blanking = 1440 : 112 | 5 | 0 | 0101 | 0000 | |
| 59 | 3B | Vertical Avtive = 900 lines | 8 | 4 | 1000 | 0100 | |
| 60 | 3C | Vertical Blanking = 31 lines | 1 | F | 0001 | 1111 | |
| 61 | 3D | Vertical Active : Vertical Blanking = 900 : 31 | 3 | 0 | 0011 | 0000 | |
| 62 | 3E | Horizontal Sync. Offset = 32 pixels | 2 | 0 | 0010 | 0000 | |
| 63 | 3F | Horizontal Sync Pulse Width = 32 pixels | 2 | 0 | 0010 | 0000 | |
| 64 | 40 | Vertical Sync Offset = 5 lines : Sync Width = 6 lines | 5 | 6 | 0101 | 0110 | |
| 65 | 41 | Horizontal Vertical Sync Offset/Width upper 2bits = 0 | 0 | 0 | 0000 | 0000 | |
| 66 | 42 | Horizontal Image Size = 33.12mm | 4 | B | 0100 | 1011 | |
| 67 | 43 | Vertical Image Size = 20.70mm | C | F | 1100 | 1111 | |
| 68 | 44 | Horizontal & Vertical Image Size | 1 | 0 | 0001 | 0000 | |
| 69 | 45 | Horizontal Border = 0 | 0 | 0 | 0000 | 0000 | |
| 70 | 46 | Vertical Border = 0 | 0 | 0 | 0000 | 0000 | |
| 71 | 47 | Non-interlaced,Normal display,no stereo,Digital separate sync,H/V pol negatives | 1 | 8 | 0001 | 1000 | |
| 72 | 48 | Pixel Clock/10,000 (LSB) | D | E | 1101 | 1110 | Detailed Timing Description #2 |
| 73 | 49 | Pixel Clock/10,000 (MSB) / 1440 x 900 @ 60㎐ pixel clock = 86.7 | 2 | 1 | 0010 | 0001 | |
| 74 | 4A | Horizontal Active = 1440 pixels | A | 0 | 1010 | 0000 | |
| 75 | 4B | Horizontal Blanking = 112 pixels | 7 | 0 | 0111 | 0000 | |
| 76 | 4C | Horizontal Active : Horizontal Blanking = 1440 : 112 | 5 | 0 | 0101 | 0000 | |
| 77 | 4D | Vertical Avtive = 900 lines | 8 | 4 | 1000 | 0100 | |
| 78 | 4E | Vertical Blanking = 31 lines | 1 | F | 0001 | 1111 | |
| 79 | 4F | Vertical Active : Vertical Blanking = 900 : 31 | 3 | 0 | 0011 | 0000 | |
| 80 | 50 | Horizontal Sync. Offset = 32 pixels | 2 | 0 | 0010 | 0000 | |
| 81 | 51 | Horizontal Sync Pulse Width = 32 pixels | 2 | 0 | 0010 | 0000 | |
| 82 | 52 | Vertical Sync Offset = 5 lines : Sync Width = 6 lines | 5 | 6 | 0101 | 0110 | |
| 83 | 53 | Horizontal Vertical Sync Offset/Width upper 2bits = 0 | 0 | 0 | 0000 | 0000 | |
| 84 | 54 | Horizontal Image Size = 33.12mm | 4 | B | 0100 | 1011 | |
| 85 | 55 | Vertical Image Size = 20.70mm | C | F | 1100 | 1111 | |
| 86 | 56 | Horizontal & Vertical Image Size | 1 | 0 | 0001 | 0000 | |
| 87 | 57 | Horizontal Border = 0 | 0 | 0 | 0000 | 0000 | |
| 88 | 58 | Vertical Border = 0 | 0 | 0 | 0000 | 0000 | |
| 89 | 59 | Module "A" Revision = 00 | 0 | 0 | 0000 | 0000 | |
| 90 | 5A | Flag | 0 | 0 | 0000 | 0000 | Detailed Timing Description #3 |
| 91 | 5B | Flag | 0 | 0 | 0000 | 0000 | |
| 92 | 5C | Flag | 0 | 0 | 0000 | 0000 | |
| 93 | 5D | Dummy Descriptor | F | E | 1111 | 1110 | |
| 94 | 5E | Flag | 0 | 0 | 0000 | 0000 | |
| 95 | 5F | Dell P/N 1st Character = H | **4** | **8** | 0100 | 1000 | |
| 96 | 60 | Dell P/N 2nd Character = T | **5** | **4** | 0101 | 0100 | |
| 97 | 61 | Dell P/N 3nd Character = 8 | **3** | **8** | 0011 | 1000 | |
| 98 | 62 | Dell P/N 4th Character = 2 | **3** | **2** | 0011 | 0010 | |
| 99 | 63 | Dell P/N 5th Character = 7 | **3** | **7** | 0011 | 0111 | |
| 100 | 64 | LCD Supplier EEDID Revision # = 0.0 | 0 | 0 | 0000 | 0000 | |
| 101 | 65 | Manufacturer P/N = 1 | 3 | 1 | 0011 | 0001 | |
| 102 | 66 | Manufacturer P/N = 5 | 3 | 5 | 0011 | 0101 | |
| 103 | 67 | Manufacturer P/N = 4 | 3 | 4 | 0011 | 0100 | |
| 104 | 68 | Manufacturer P/N = W | 5 | 7 | 0101 | 0111 | |
| 105 | 69 | Manufacturer P/N = P | 5 | 0 | 0101 | 0000 | |
| 106 | 6A | Manufacturer P/N = 1 | 3 | 1 | 0011 | 0001 | |
| 107 | 6B | P/N(If <13 char, then terminate with ASCII code 0Ah, set remaini | 0 | A | 0000 | 1010 | |

## APPENDIX A. Enhanced Extended Display Identification Data (EEDID™) 3/3

| Byte# (decimal) | Byte# (HEX) | Field Name and Comments | Value (HEX) | | Value (binary) | | |
|---|---|---|---|---|---|---|---|
| 108 | 6C | Flag | 0 | 0 | 0000 | 0000 | Detailed Timing Description #4 |
| 109 | 6D | Flag | 0 | 0 | 0000 | 0000 | |
| 110 | 6E | Flag | 0 | 0 | 0000 | 0000 | |
| 111 | 6F | Data Type Tag : ASCII String | F | E | 1111 | 1110 | |
| 112 | 70 | Flag | 0 | 0 | 0000 | 0000 | |
| 113 | 71 | SMBUS Value = 10 nits | 2 | 3 | 0010 | 0011 | |
| 114 | 72 | SMBUS Value = 17 nits | 3 | 3 | 0011 | 0011 | |
| 115 | 73 | SMBUS Value = 24 nits | 3 | D | 0011 | 1101 | |
| 116 | 74 | SMBUS Value = 30 nits | 4 | 8 | 0100 | 1000 | |
| 117 | 75 | SMBUS Value = 60 nits | 6 | 5 | 0110 | 0101 | |
| 118 | 76 | SMBUS Value = 110 nits | 8 | 4 | 1000 | 0100 | |
| 119 | 77 | SMBUS Value = 180 nits | A | A | 1010 | 1010 | |
| 120 | 78 | SMBUS Value = Max (Typically = FFh) | F | F | 1111 | 1111 | |
| 121 | 79 | Number of LVDS receiver chips = 1 or 2 | 0 | 2 | 0000 | 0010 | |
| 122 | 7A | BIST Enable: Yes = '01' No = '00' | 0 | 1 | 0000 | 0001 | |
| 123 | 7B | 13 char, then terminate with ASCII code 0Ah, set remaining char= | 0 | A | 0000 | 1010 | |
| 124 | 7C | (If<13 char, then terminate with ASCII code 0Ah) | 2 | 0 | 0010 | 0000 | |
| 125 | 7D | (If<13 char, then terminate with ASCII code 0Ah) | 2 | 0 | 0010 | 0000 | |
| 126 | 7E | Extension flag = 00 | 0 | 0 | 0000 | 0000 | Extension Flag |
| 127 | 7F | Checksum | **9** | **E** | 1001 | 1110 | **Checksum** |