# SPECIFICATION

# For

# APPROVAL

**(      ) Preliminary Specification**

**(  •  ) Final Specification**

| Title | 13.3" XGA TFT LCD |
|-------|-------------------|

| BUYER NAME | APPLE |
|------------|-------|
| MODEL NAME | |

| SUPPLIER | LG Semicon. Co. Ltd. |
|----------|----------------------|
| MODEL NAME | LP133X4 |

| SIGNATURE | DATE |
|-----------|------|
| _____/_____ | _____ |
| _____/_____ | _____ |
| _____/_____ | _____ |

**Please return 1 copy for our confirmation**

**with your signature and comments.**

| APPROVED BY | DATE |
|-------------|------|
| _____/G.Manager | _____ |
| REVIEWED BY | |
| _____/S.Engineer | _____ |
| PREPARED BY | |
| _____/ Engineer | _____ |

**Product Engineering Dept.**

**LCD Division    LG Semicon. Co. Ltd.**

# CONTENTS

# Record of Revision

| DATE AND VERSION | DESCRIPTION |
|---|---|
|  |  |

## 1. General Description

The LG Semicon Co. Ltd. model LP133X4 LCD is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Tube(CCFT) back light 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 a 13.3 inch diagonally measured active display area with XGA resolution(768 vertical by 1024 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.

LP133X4 has been designed to apply the interface method that enables low power, high speed and low EMI. Flat Link must be used as a LVDS(Low Voltage Differential Signaling) chip.

The LP133X4 LCD 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 LP133X4 characteristics provide an excellent flat panel display for office automation products such as Notebook PC.
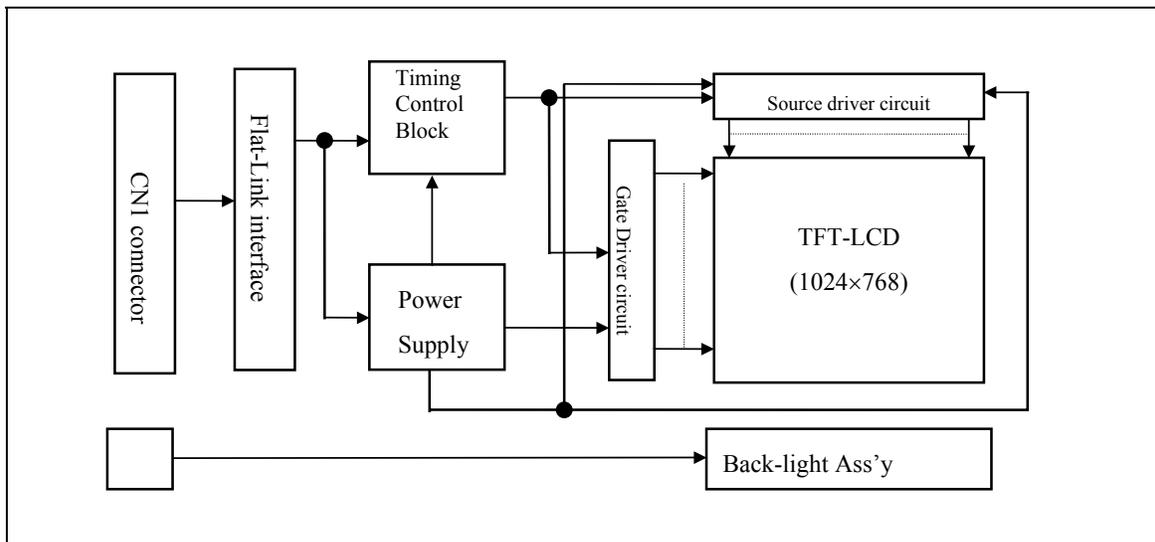


General Display Characteristics

S The following are general feature of the model LP133X4 LCD;
Active display area           13.3 inches(33.78cm) diagonal

Outsize dimensions            284(H) × 215(V) × 6.9(W) mm(typ.)

Pixel pitch                  0.264 mm × 0.264 mm
Pixel format                 1024 horiz. By 768 vert. pixels
                             RGB stripe arrangement
Color depth                  6-bit,   262,144 colors
Display operating mode        transmissive mode, normally white
urface treatments            hard coating(3H),
                             anti-glare treatment of the front polarizer

## 2. 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 | $V_{DD}$ | -0.3 | +3.6 | Vdc | at 25℃ |
| Operating Temperature | $T_{OP}$ | 0 | +50 | ℃ | Flat-Link Tx |
| Storage Temperature | $T_{ST}$ | -20 | +60 | ℃ | 1 |

Note:   1.   The Relative Humidity must not exceed 95% non-condensing at temperatures of 40℃  or less.

At temperatures greater than 40℃, the wet bulb temperature must not exceed 39℃.

**Table 2   ELECTRICAL CHARACTERISTICS**

| Parameter | Symbol | Values | | | Units | Notes |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| MODULE: | | | | | | |
| Power Supply Input Voltage | $V_{DD}$ | 3.0 | 3.3 | 3.6 | Vdc | |
| Power Supply Input Current | $I_{DD}$ | 0.270 | 0.300 | 0.330 | A | 1 |
| Ripple/Noise | - | - | 50 | - | mV | |
| Logic Input Level, High | $V_{IH}$ | 2.0 | - | $V_{DD}$ +0.3 | Vdc | 2 |
| Logic Input Level, Low | $V_{IL}$ | - 0.3 | - | 0.8 | Vdc | 2 |
| Power   Consumption | $P_c$ | 0.9 | 1.0 | 1.1 | Watts | 1 |
| | | | | | | |
| BACK LIGHT | | | | | | |
| Back light Input voltage | $V_{BL}$ | 535 | 615 | 730 | $V_{RMS}$ | |
| Back-light Current | $I_{BL}$ | 2.5 | 5.0 | 7.0 | $mA_{RMS}$ | |
| Lamp Start-up Voltage | | - | - | 1100 | $V_{RMS}$ | 25±2℃ |
| Operating Frequency | $F_{BL}$ | 45 | 55 | 75 | KHz | |
| Power   Consumption | $P_{BL}$ | 1.83 | 3.08 | 3.75 | Watts | 3 |

Notes: 1.   The current draw and power consumption specified is for 3.3 Vdc at 25℃  and fv at 60Hz.(at Black pattern displayed)

2.    Logic levels are specified for 3.3Vdc at Flat-Link chips, transmitter & receiver. The values specified apply to all logic inputs to Flat-Link; data enable, clock, data signals, etc.

3.   The back-light current consumption shown above does not include loss of external inverter.

Product Specification

## 4. Optical Specifications

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

**Table 3   OPTICAL CHARACTERISTICS**

| Parameter | Symbol | Values Min. | Values Typ. | Values Max. | Units | Notes |
|---|---|---|---|---|---|---|
| Contrast Ratio | CR | 100 | 150 | - | | 2 |
| Surface Brightness, white | $SB_{WH}$ | - | 120 | - | $cd/m^2$ | 3 |
| Brightness Variation | $SB_V$ | - | 1.25 | 1.45 | | 4 |
| Response Time | Tr | | | | msec | 5 |
| Rise Time | $Tr_R$ | - | 30 | 50 | | |
| Decay Time | $Tr_D$ | - | 30 | 50 | | |
| CIE Color Coordinates | | | | | | 1 |
| Red | $x_R$ | 0.537 | 0.567 | 0.597 | | |
|  | $y_R$ | 0.322 | 0.352 | 0.382 | | |
| Green | $x_G$ | 0.266 | 0.296 | 0.326 | | |
|  | $y_G$ | 0.530 | 0.560 | 0.590 | | |
| Blue | $x_B$ | 0.124 | 0.154 | 0.184 | | |
|  | $y_B$ | 0.113 | 0.143 | 0.173 | | |
| White | $x_W$ | 0.273 | 0.303 | 0.333 | | |
|  | $y_W$ | 0.313 | 0.343 | 0.373 | | |
| Viewing Angle | | | | | degree ° | 6 |
| x axis, right (Φ =0º) | θ x | +40 | - | - | | |
| x axis, left(Φ =180º) | θ x | -40 | - | - | | |
| y axis, up(Φ =90º) | θ y | +10 | - | - | | |
| y axis, down (Φ =270º) | θ y | -30 | - | - | dB | 7 |
| Flicker | | | | | | |

Notes   1.   Color Coordinates is measured by PR1908B(S-2755), SL-20A Lens.
2.   Contrast Ratio (CR) is defined mathematically as :

  (Surface Brightness with all white pixels) ÷ (Surface Brightness with all black pixels)

3.   Surface brightness is the average of 5 measurement across the LCD surface 50cm from the surface with all pixels displaying white. For more information see Appendix A - 1.
4.   The variation in surface brightness, $SB_V$ is determined by measuring $B_{ON}$ at each test position 0 through 9, and then dividing the maximum $B_{ON}$ of 9 points luminance by minimum $B_{ON}$ of 9 points luminance. For more information see Appendix A - 1.

  $SB_V$  =  Maximum $(B_{ON0}, B_{ON1}, ....B_{ON9})$ ÷ Minimum $(B_{ON0}, B_{ON1}, ....B_{ON9})$

5.   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 Appendix A - 2.
6.   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 Appendix A - 3
7.   When the lcd is refreshed at 60Hz rate with the back-light on, there are no noticeable flicker at green dot level 31 when the screen is viewed with naked eye.

## 5. Environment

5.1 Altitude      : operating 0 - 10,000 feet (3048m)
                     storage/shipment 0 - 40,000 feet (12192m)
5.2 Corrosive gas : use at indoor & outdoor in a big city.
5.3 Environment test condition

**Table 4   Environment Test Condition**

| No. | Test ITEM | | Conditions |
|---|---|---|---|
| 1 | High temperature storage test | | $Ta = 60℃$   240h |
| 2 | Low temperature storage test | | $Ta = -20℃$  240h |
| 3 | High temperature & high humidity operation test | | $Ta = 40℃$   95%RH   240h (no condensation) |
| 4 | High temperature operation test | | $Ta = 50℃$   240h |
| 5 | Low temperature operation test | | $Ta = 0℃$   240h |
| 6 | Vibration test (non-operating) | Sine wave | 10~500~10Hz, 1.5G, 0.5oct/min, 3 axis, 1 hour/axis |
| | | Random | 6 Hz,   0.001 $G^2$/Hz,   1/3 hour,   0.49<br>12~18 Hz,   0.01 $G^2$/Hz,   1/3 hour,   0.49<br>42~80 Hz,   0.001 $G^2$/Hz,   1/3 hour,   0.49<br>200 Hz,   0.0001 $G^2$/Hz,   1/3 hour,   0.49<br>6 Hz,   0.001 $G^2$/Hz,   1/3 hour,   2.13<br>18~200 Hz,   0.02 $G^2$/Hz,   1/3 hour,   2.13<br>200 Hz,   0.001 $G^2$/Hz,   1/3 hour,   2.13 |
| 7 | Shock test (non-operating) | Half sine wave, | 180G, 2ms, one shock of each six faces. |
| | | Square wave | 100G, 6ms, one shock of each six faces. |

{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.

**LG Semicon. Co. Ltd.**

## 6. Interface Connections

Interface chip must be used Flat-Link, part No. THC63LVDM63A(Transmitter), THC63LVDF64A(Receiver) made by THine Microsystems,Inc.

This LCD employs two interface connections, a 20 pin connector is used for the module electronics and two connectors is used for the integral back-light system.

The electronics interface connector is a model FI-SEB20P manufactured by JAE. The pin configuration for the connector is shown in the table below.

### Table 5    MODULE CONNECTOR PIN CONFIGURATION (LVDS)

| Pin | Symbol | Description | Notes |
|-----|--------|-------------|-------|
| 1 | VCC | Power (3.3V) | 1. Interface chips |
| 2 | VCC | Power (3.3V) |   1.1 LCD    : THC63LVDF64A 48TSSOP |
| 3 | VCC | Power (3.3V) |   1.2 System : THC63LVDM63A 48TSSOP |
| 4 | VCC | Power (3.3V) |   * Pin to Pin compatible with TI LVDS |
| 5 | GND | Ground | |
| 6 | GND | Ground | 2. Connector |
| 7 | GND | Ground |   2.1 LCD    : FI-SEB20P-HF13 |
| 8 | GND | Ground |   2.2 System : FI-WEB21P-HF |
| 9 | A0M | Difference Signal |   2.3 Connector pin arrangement |
| 10 | A0P | Difference Signal | |
| 11 | GND | Ground | |
| 12 | A1M | Difference Signal | 20Pin User Con. |
| 13 | A1P | Difference Signal | |
| 14 | GND | Ground | |
| 15 | A2M | Difference Signal | 1 |
| 16 | A2P | Difference Signal | |
| 17 | GND | Ground | |
| 18 | CLKM | Difference Signal | |
| 19 | CLKP | Difference Signal | |
| 20 | GND | Ground | LCM Bottom view |
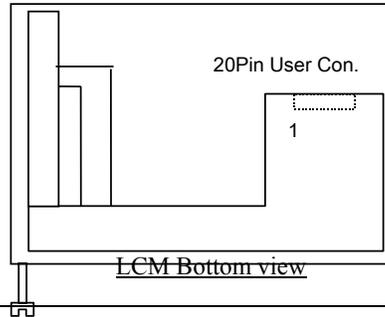
The back-light interface connector is a model BHSR-02VS-1, manufactured by JST.    The mating connector part number is SM02B-BHSS-1 or equivalent.    The pin configuration for the connector is shown in the table below.

### Table 6    BACK-LIGHT CONNECTOR PIN CONFIGURATION

| Pin | Symbol | Description | Notes |
|-----|--------|-------------|-------|
| 1 | HV | Lamp power input | 1 |
| 2 | LV | Ground | 2 |

Notes:    1. The input power terminal is colored pink. Ground pin color is black.
        2. The back-light ground should be common with Vss.

## 7. Signal Timing Specification(Between Flat-Link and Timing Controller

This is the signal timing required at the input of the ASIC inside module.  All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

**Table 7 Timing Table**

| | ITEM | SYMBOL | MIN. | TYP. | MAX. | UNIT | NOTE |
|---|---|---|---|---|---|---|---|
| DCLK | Period | $t_{CLK}$ | 14.3 | 15.4 | 16.7 | | 65MHz (typ.) |
| | Width-Low | $t_{WCL}$ | 5 | - | - | | |
| | Width-High | $t_{WCH}$ | 5 | - | - | ns | |
| | Rise Time | $t_{rCLK}$ | - | - | - | | |
| | Fall Time | $t_{fCLK}$ | - | - | - | | |
| | Duty | D | 0.45 | 0.5 | 0.55 | - | $D=t_{CLKL}/t_{CLK}$ |
| Hsync | Set up Time | $t_{SH}$ | 5 | - | - | ns | for DCLK |
| | Hold Time | $t_{HH}$ | 5 | - | - | | |
| | Period | $t_{HP}$ | 1206 | 1344 | 1364 | $t_{CLK}$ | |
| | Width-Active | $t_{WH}$ | 8 | 136 | 240 | | |
| | Rise/Fall Time | $t_{Hr}, t_{Hf}$ | - | - | 10 | ns | |
| Vsync | Set up Time | $t_{SV}$ | 0 | - | - | $t_{CLK}$ | for Hsync |
| | Hold Time | $t_{HV}$ | 2 | - | - | | |
| | Period | $t_{VP}$ | 780 | 806 | 830 | $t_{HP}$ | |
| | Width-Active | $t_{WV}$ | 1 | - | 24 | | |
| | Frame Rate | $V_{FR}$ | 55 | 60 | 70 | Hz | |
| | Rise/Fall Time | $t_{Vr}, t_{Vf}$ | - | - | 30 | ns | |
| DTMG | Set up Time | $t_{SI}$ | 5 | - | - | ns | for DCLK |
| | Hold Time | $t_{HI}$ | 5 | - | - | | |
| | Rise/Fall Time | $t_{Ir}, t_{If}$ | - | - | 10 | ns | |
| | Horizontal Back Porch | $t_{HBP}$ | 10 | - | - | $t_{CLK}$ | |
| | Horizontal Front Porch | $t_{HFP}$ | 10 | - | - | | |
| | Vertical Back Porch | $t_{VBP}$ | 2 | - | - | $t_{HP}$ | |
| | Vertical Front Porch | $t_{VFP}$ | 1 | - | - | | |
| DATA | Set up Time | $t_{SD}$ | 5 | - | - | ns | for DCLK |
| | Hold Time | $t_{HD}$ | 5 | - | - | | |
| | Rise/Fall Time | $t_{Dr}, t_{Df}$ | - | - | 5 | ns | |

**LG Semicon. Co. Ltd.**

## 8. Signal Timing Wave form
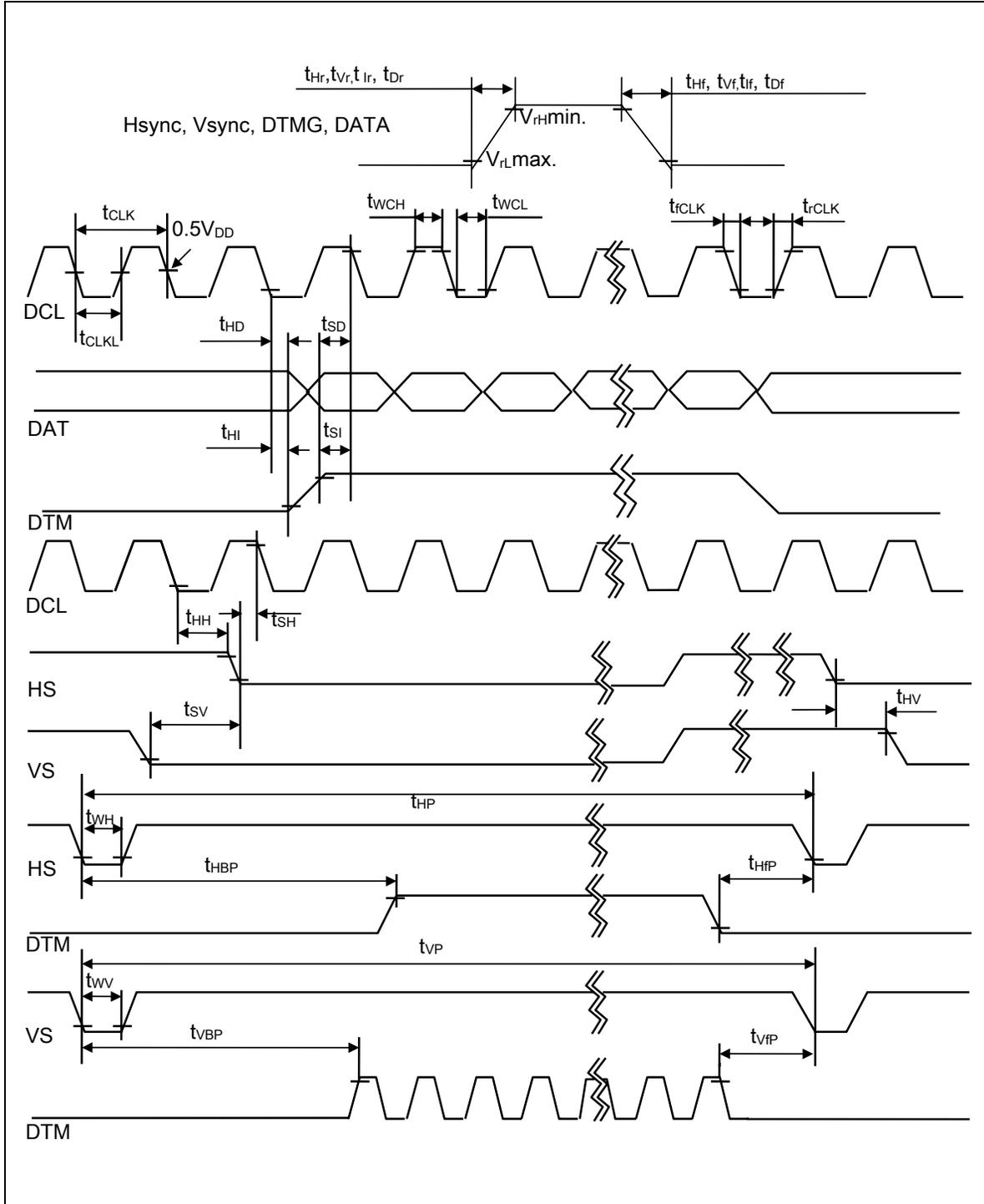
## 9. Color Input Data Reference

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 8 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 Colors | Black | 0 | 0 | 0 | 0 | 0 | 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(63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(63) | 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) Dark | 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(02) | 0 | 0 | 0 | 0 | 1 | 0 | 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 | 0 |
| | Red(62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(63) Bright | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green | Green(00)Dark | 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(02) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 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 | 0 |
| | Green(62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(63)Bright | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue | Blue(00) Dark | 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(02) | 0 | 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 | 1 |
| | Blue(62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(63) Bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

## 10. Power On/Off Sequence
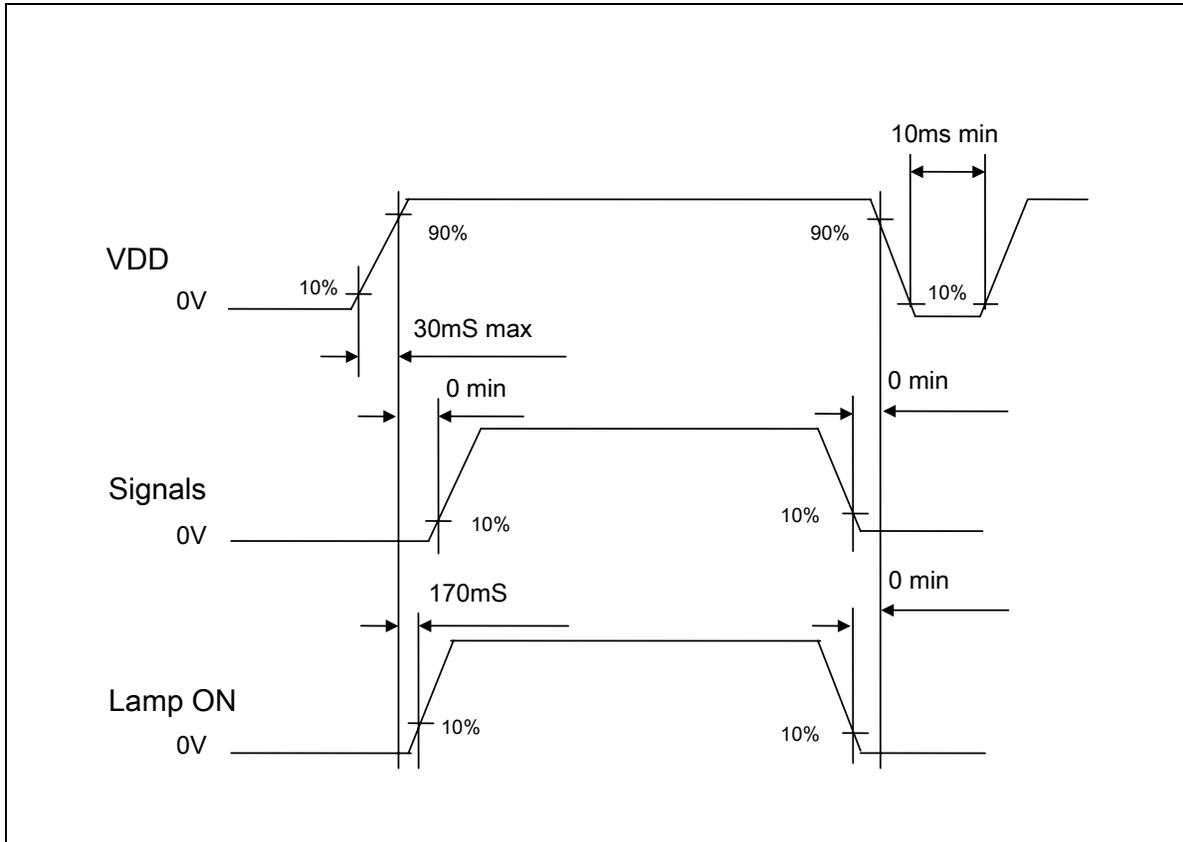


Notes : 1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for LCD $V_{DD}$ to 0V.

**Product Specification**

## 11. Mechanical Characteristics

The chart below provides general mechanical characteristics for the model LP133X4 LCD.   In addition, the figure below is a detailed mechanical drawing of the LCD. Note that dimension are given for reference purposes only.

Outside dimensions :

|  |  |
|---|---|
| Width | 284mm(TYP.) |
| Height | 215mm(TYP.) |
| Thickness | 6.9mm(TYP.) |

Active Display area    :

|  |  |
|---|---|
| Width | 270.33mm |
| Height | 202.75mm |

Weight (approximate) :          540±10 g (TYP.)

< LCM FRONT SIDE >

<LCM BACK SIDE>
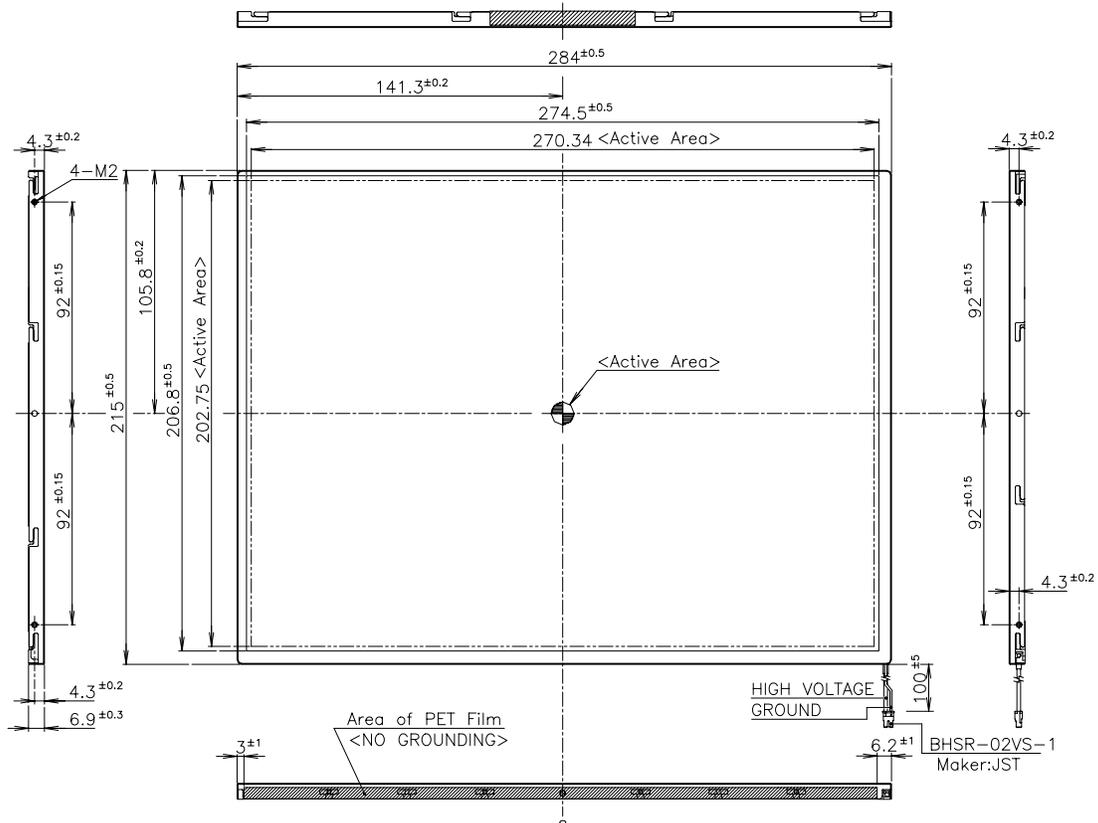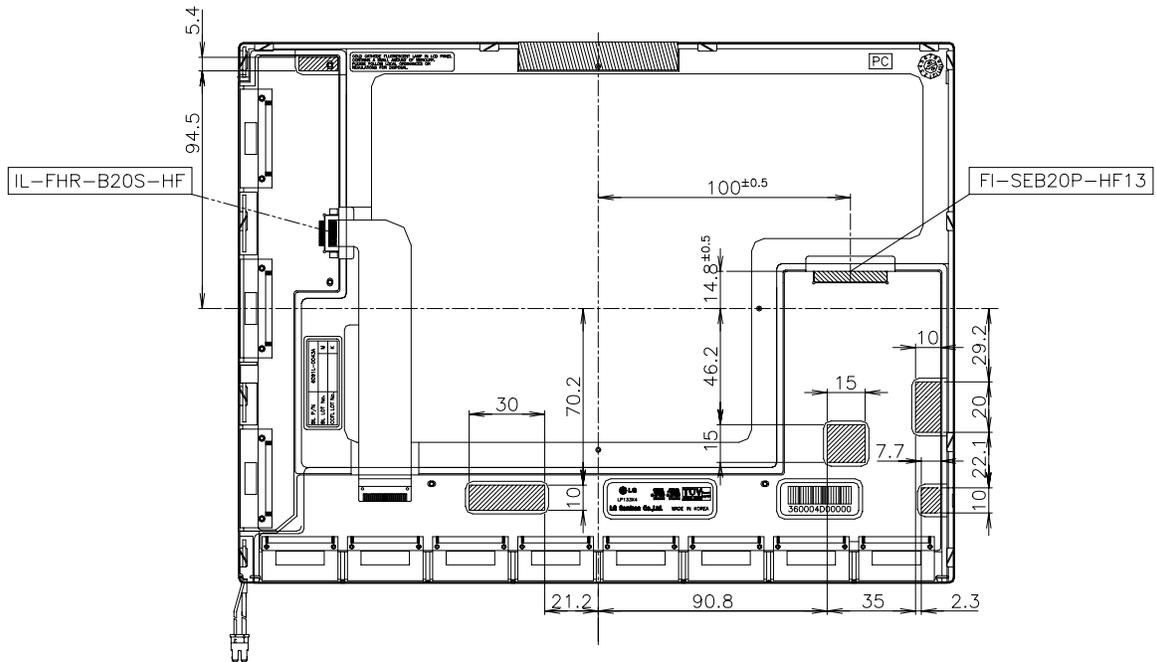
## 12. COSMETICS

This cosmetic inspection is related to the acceptance quality levels of any defects in the LCD module which we produce.

For more information about the following , contact LG Semicon Co., Ltd. any time.

### 12.1 Cosmetic Inspection Conditions

12.1.1 Inspective viewing angle
- This inspection should be executed according to the following figure.
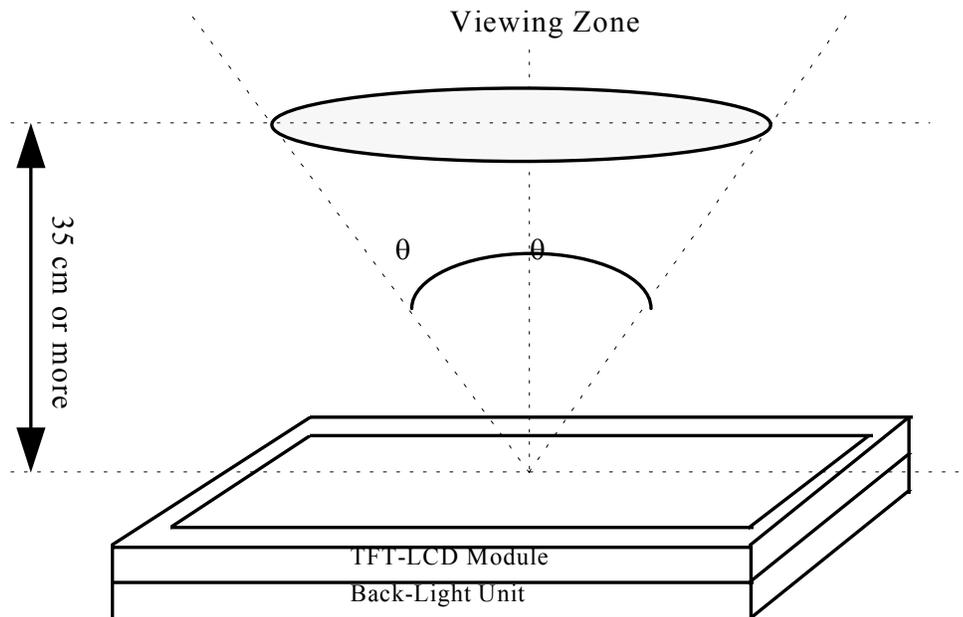


- Viewing angle should be in the range of :

$q < 45^o$    when non-operating inspection

$q < 20^o$    when operating inspection ( Horizontal direction )

$q < 10^o$    when operating inspection ( Vertical direction )

12.1.2 Environment Conditions

- Ambient temperature    :    $25 \pm 5\ ^oC$
- Ambient Humidity    :    $65 \pm 5$ % RH
- Ambient Lumination    :    Using single 20 watts fluorescent lamp ( about 500 lux )

## 13. Reliability

13.1 Mean Time Between Failure
:   The LCD Panel and interface board assembly (excluding the CCFTs) shell have a mean time between failures of 30,000 hours with a confidence level 90%.

3.2 CCFL Life(Continuous)
:   The assured CCFL Life will be longer than 10,000 hours at the general test condition.
(The operating life of the lamp is defined as having ended when the illumination of light has reached 50% of the initial value)

13.3 ON/OFF Cycle
:   The display module will be capable of being operated over 24,000 ON/OFF cycles (B/L, Vdd ON/OFF)

## 14. Safety

14.1 Sharp edge : There will be no sharp edges or corners on the display assembly that could cause injury.

14.2 materials

14.2.1 Toxicity : There is no carcinogenic materials used anywhere in the display module.

14.2.2 Flammability : All components including electrical components of the module should meet the flammability grade Min.UL94-V1.
The printed circuit board is made from material rated UL94-V1 or better.
The actual UL flammability rating is printed on the printed circuit board.

14.2.3 capacitors : If any polarized capacitors are used in the display assembly, provisions will be made to keep them from being inserted backwards.

14.2.4 Hazardous Voltages : Any points exceeding 42.2volts meets the requirement of the limited current circuit.
The current through a 2 Kohm resistance is less than 0.7 x f(Khz)mA.

## 15. Packaging

: The packaging of the LCD meets 75 cm drop test.

## 16. Smoke free design

:   No smoke or strange smell shall not be observed by the operator as a result of any single failure.

## 17.Performance

:   All electromagnetic compatibility apply when the display module is attached to the host system.

## 18.PRECAUTIONS

Please pay attention to the followings when you use this TFT/LCD module with Back-light unit.

### 18.1 MOUNTING PRECAUTIONS

(1)  You must mount a module using holes arranged in four corners.
(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 with a transparent protective plate in order to protect the polarizer LC cell. Transparent protective plate should have sufficient strength in order to 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 polalizer 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 df 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 soaked with petrolium benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluen 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 suffcent strength.

### 18.2 OPERATING PRECAUTIONS

(1)  The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
     $VDD = \pm 200mV$, $V1 = \pm 200mV$ (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)  A module has high frequency circuit.   If you need to shield the electromagnetic noise, please do in yours.
(7)  When a Back-light unit is operating, it sounds.   If you need to shield the noise, please do in yours.

### 18.3 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 I/F pin directly.

### 18.4 PRECAUTION FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

## 18.5 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℃ and 35℃ 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.

## 18.6 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.

## A-1 Brightness

<measuring point for brightness vibration>          <measuring point for surface brightness >

```
     256      512      768                                    512

      1        2        3  ......192

      4        5        6  ......384                           ..........384

      7        8        9  ......576
```
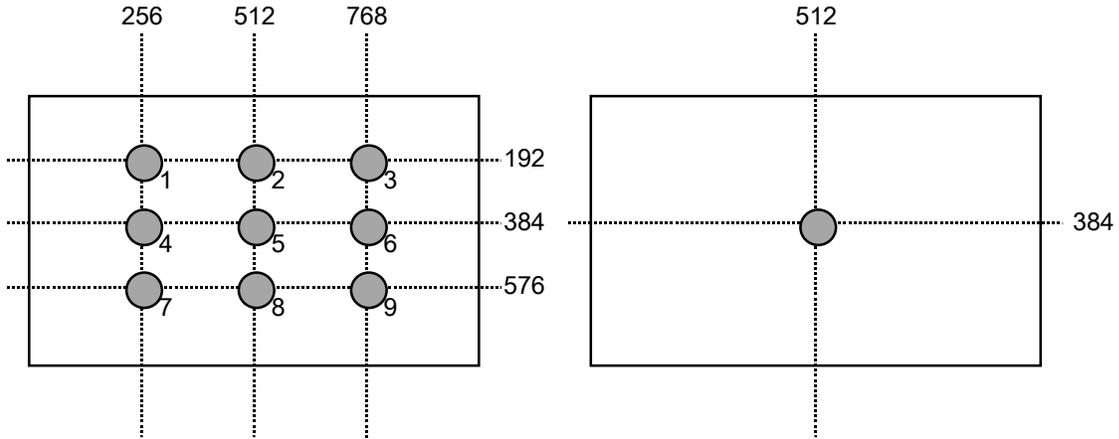
## A-2 RESPONSE TIME

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

## A-3 Viewing angle

<Definition of viewing angle range>