

**Product Specification**

# SPECIFICATION FOR APPROVAL

( ♦ ) Preliminary Specification

( ) Final Specification

|       |                    |
|-------|--------------------|
| Title | 10.4" SVGA TFT LCD |
|-------|--------------------|

|       |  |
|-------|--|
| BUYER |  |
| MODEL |  |

|          |                          |
|----------|--------------------------|
| SUPPLIER | LG.Philips LCD Co., Ltd. |
| Model    | LP104S5                  |
| SUFFIX   | A2VT                     |

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

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

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

| APPROVED BY                                                 | DATE |
|-------------------------------------------------------------|------|
| S. H. Kang / G.Manager                                      |      |
| REVIEWED BY<br>J. H. Lee / Manager<br>H.S. Yoon / Manager   |      |
| PREPARED BY<br>S.Y. Lee / Engineer<br>J.H. Hwang / Engineer |      |

Product Engineering Dept.  
LG.Philips LCD Co., Ltd.

**Product Specification**
**CONTENTS**

| NO. | ITEM                         | Page |
|-----|------------------------------|------|
| -   | COVER                        | 1    |
| -   | CONTENTS                     | 2    |
| -   | RECORD OF REVISIONS          | 3    |
| 1   | GENERAL DESCRIPTION          | 4    |
| 2   | ABSOLUTE MAXIMUM RATINGS     | 5    |
| 3   | ELECTRICAL SPECIFICATIONS    |      |
| 3-1 | ELECTRICAL CHARACTERISTICS   | 6    |
| 3-2 | INTERFACE CONNECTIONS        | 7    |
| 3-3 | SIGNAL TIMING SPECIFICATIONS | 9    |
| 3-4 | SIGNAL TIMING WAVEFORMS      | 10   |
| 3-5 | COLOR INPUT DATA REFERENCE   | 11   |
| 3-6 | POWER SEQUENCE               | 12   |
| 4   | OPTICAL SPECIFICATIONS       | 13   |
| 5   | MECHANICAL CHARACTERISTICS   | 16   |
| 6   | RELIABILITY                  | 20   |
| 7   | INTERNATIONAL STANDARDS      |      |
| 7-1 | SAFETY                       | 21   |
| 7-2 | EMC                          | 21   |
| 8   | PACKING                      |      |
| 8-1 | DESIGNATION OF LOT MARK      | 22   |
| 8-2 | PACKING FORM                 | 22   |
| 9   | PRECAUTIONS                  | 23   |

**Product Specification****RECORDS OF REVISIONS**

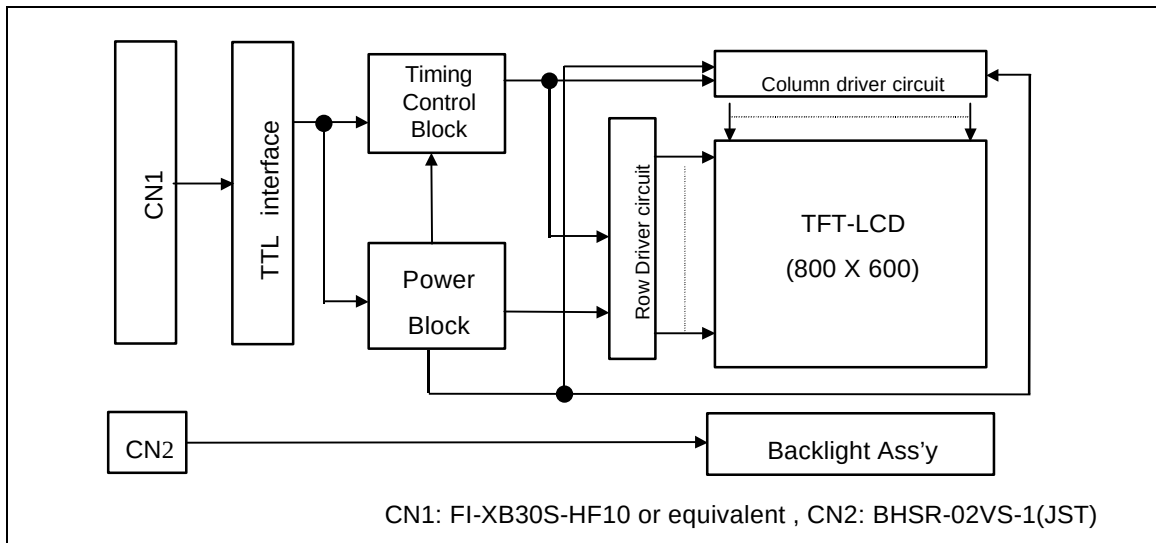
| Version No | Date         | Page | DESCRIPTION |
|------------|--------------|------|-------------|
| 0.0        | Oct 06, 2000 | -    | First draft |

**Product Specification**

## 1. General Description

The LP104S5-A2VT 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 a 10.4 inches diagonally measured active display area with SVGA resolution(600 vertical by 800 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 LP104S5-A2VT is intended to support applications where thin thickness is critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LP104S5-A2VT characteristics provide an excellent flat panel display for office automation products such as Notebook PC.



## General Features

|                        |                                        |
|------------------------|----------------------------------------|
| Active screen size     | 10.4 inches(264.16mm) diagonal         |
| Outline dimensions     | 224.5(H) X 172.0(V) X 5.7(D) mm (Typ.) |
| Pixel pitch            | 0.264 mm X 0.264 mm                    |
| Pixel format           | 800 horiz. by 600 vert. pixels         |
|                        | RGB stripe arrangement                 |
| Color depth            | 6-bit, 262,144 colors                  |
| Luminance,White        | 170 cd/m <sup>2</sup> (Typ.)           |
| Power Consumption      | Total 3.9 Watt(Typ.)                   |
| Weight                 | 310g (Typ.)                            |
| Display operating mode | Transmissive mode, normally white      |
| Surface treatments     | Hard coating (3H),                     |

Anti-glare treatment on the front  
and the bottom polarizer  
Vernissakatu 8A  
01300 Vantaa, Finland  
<http://www.alpha.fi>



Tel.: +358-9-34 64 34 1  
Fax: +358-9-34 64 34 2

**Product Specification**
**2. Absolute Maximum Ratings**

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

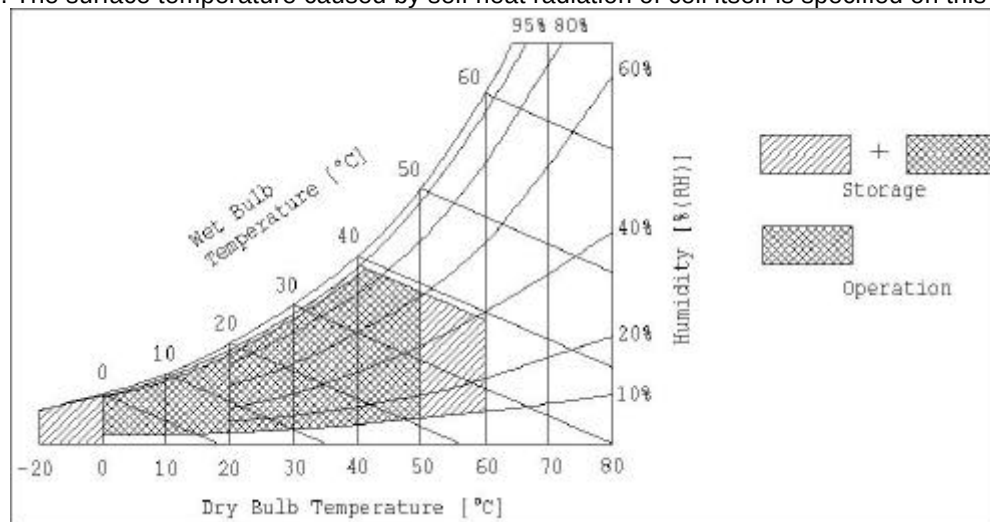
**Table 1 ABSOLUTE MAXIMUM RATINGS**

| Parameter                  | symbol          | Values |      | Units | Notes       |
|----------------------------|-----------------|--------|------|-------|-------------|
|                            |                 | Min.   | Max. |       |             |
| Power Input Voltage        | V <sub>CC</sub> | -0.3   | 4.0  | Vdc   | at 25 ± 5°C |
| Operating Temperature      | T <sub>OP</sub> | 0      | 50   | °C    | 1           |
| Operating Tempe. for Panel | -               | 0      | 60   | °C    | 2           |
| Storage Temperature        | T <sub>ST</sub> | -20    | 60   | °C    | 1           |
| Operating Ambient Humidity | H <sub>OP</sub> | 10     | 90   | %RH   | 1           |
| Storage Humidity           | H <sub>ST</sub> | 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.

2. The surface temperature caused by self heat radiation of cell itself is specified on this item.



**Product Specification**

### 3. Electrical Specifications

#### 3-1. Electrical Characteristics

The LP104S5-A2VT 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   |          |          | Units            | Notes |
|---------------------------------------------|-------------------|----------|----------|----------|------------------|-------|
|                                             |                   | Min.     | Typ.     | Max.     |                  |       |
| <b>Module</b>                               |                   |          |          |          |                  |       |
| Power Supply Input Voltage                  | V <sub>CC</sub>   | 3.0      | 3.3      | 3.6      | Vdc              |       |
| Power Supply Input Current                  | I <sub>CC</sub>   | -        | 290      | 360      | A                | 1     |
| Power Consumption                           | P <sub>c</sub>    | -        | 0.96     | 1.2      | W                | 1     |
| Rush Current                                | I <sub>RUSH</sub> | -        | 1.0      | 1.5      | A                | 3     |
| <b>Lamp</b>                                 |                   |          |          |          |                  |       |
| Operating Voltage                           | V <sub>BL</sub>   | 475(7mA) | 500(6mA) | 640(3mA) | V <sub>RMS</sub> | 4     |
| Operating Current                           | I <sub>BL</sub>   | 3.0      | 6.0      | 7        | mA               |       |
| Established Starting Voltage at 25°C<br>0°C |                   | -        | -        | 845      | V <sub>RMS</sub> | 5     |
|                                             |                   | -        | -        | 1015     | V <sub>RMS</sub> | 5     |
| Discharge Stabilization Time                | T <sub>s</sub>    |          |          | 3        | min              | 7     |
| Operating Frequency                         | f <sub>BL</sub>   | 45       | 60       | 80       | kHz              | 6     |
| Power Consumption                           | P <sub>BL</sub>   | -        | 3.0      | 3.3      | Watts            | 8     |
| Life Time                                   |                   | 20,000   |          | -        | Hours            | 9     |

Notes: **The design of the inverter must have specifications for the lamp in LCD Assembly.**

The performance of the Lamp in LCM, for example life time or brightness, is extremely influenced by the

characteristics of the DC-AC Inverter. So all the parameters of an inverter should be carefully designed

so as not to produce too much leakage current from high-voltage output of the inverter.

When you design or order the inverter, please make sure unwanted lighting caused by the mismatch of

the lamp and the inverter (no lighting, flicker, etc) never occurs. When you confirm it, the LCD Assembly should be operated in the same condition as installed in your instrument.

1. The specified current and power consumption are under the  $V_{CC} = 3.3V$ ,  $25^\circ C$ ,  $f_v = 60Hz$  condition

whereas mosaic pattern is displayed.

2. The duration of rush current is about 20ms.

3. The variance of the voltage is  $\pm 10\%$ .

4. The voltage above  $V_s$  should be applied to the lamps for more than 1 second for start-up.

Otherwise, the lamps may not be turned on.

5. The output of the inverter must have symmetrical (negative and positive) voltage waveform and symmetrical current waveform. (Unsymmetrical ratio is less than 10%)

Please do not use the inverter which has unsymmetrical voltage and unsymmetrical current and

spike wave. Lamp frequency may produce interference with horizontal synchronous frequency

and

as a result this may cause beat on the display.

Therefore lamp frequency shall be as away as possible from the horizontal synchronous frequency

and from its harmonics in order to prevent interference.

6. Let's define 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%.

**Product Specification**

7. The lamp power consumption shown above does not include loss of external inverter.
8. The life time is determined as the time at which brightness of lamp is 50% compared to that of initial  
value at the typical lamp current on condition of continuous operating at  $25 \pm 2^{\circ}\text{C}$ .

## Product Specification

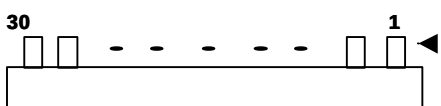
### 3-2. Interface Connections

This LCD employs interface connection, a 30 pin connector is used for the module electronics and a two pin connector is used for the backlight system.

The electronic interface connector is a FI-XB30S-HF10, manufactured by JAE.

The pin configuration for the connector is shown in the table below.

**Table 3 MODULE CONNECTOR PIN CONFIGURATION (LVDS)**

| Pin | Symbol | Description     | Notes                                                                                                                                                 |
|-----|--------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Vcc    | Power (3.3V)    | 1. Connector<br>1.1 LCD: <b>FI-XB30S-HF10</b> or equivalent<br>1.2 Mating: FI-30M (FPC Type)<br>FI-X30H (Cable Type)<br>1.3 Connector pin arrangement |
| 2   | Vcc    | Power (3.3V)    |                                                                                                                                                       |
| 3   | GND    | Ground          |                                                                                                                                                       |
| 4   | DTMG   | Data Enable     |                                                                                                                                                       |
| 5   | VSYNC  | Vertical sync   |                                                                                                                                                       |
| 6   | HSYNC  | Horizontal sync |                                                                                                                                                       |
| 7   | GND    | Ground          |                                                                                                                                                       |
| 8   | DCLK   | Data Clock      |                                                                                                                                                       |
| 9   | GND    | Ground          |                                                                                                                                                       |
| 10  | R5     | Red data (MSB)  |                                                                                                                                                       |
| 11  | R4     | Red data        |  <p style="text-align: center;">[ LCD Module Rear View ]</p>        |
| 12  | R3     | Red data        |                                                                                                                                                       |
| 13  | R2     | Red data        |                                                                                                                                                       |
| 14  | R1     | Red data        |                                                                                                                                                       |
| 15  | R0     | Red data (LSB)  |                                                                                                                                                       |
| 16  | GND    | Ground          |                                                                                                                                                       |
| 17  | G5     | Green data(MSB) |                                                                                                                                                       |
| 18  | G4     | Green data      |                                                                                                                                                       |
| 19  | G3     | Green data      |                                                                                                                                                       |
| 20  | G2     | Green data      |                                                                                                                                                       |
| 21  | G1     | Green data      |                                                                                                                                                       |
| 22  | G0     | Green data(LSB) |                                                                                                                                                       |
| 23  | GND    | Ground          |                                                                                                                                                       |
| 24  | B5     | Blue data (MSB) |                                                                                                                                                       |
| 25  | B4     | Blue data       |                                                                                                                                                       |
| 26  | B3     | Blue data       |                                                                                                                                                       |
| 27  | B2     | Blue data       |                                                                                                                                                       |
| 28  | B1     | Blue data       |                                                                                                                                                       |
| 29  | B0     | Blue data (LSB) |                                                                                                                                                       |
| 30  | GND    | Ground          |                                                                                                                                                       |

The backlight 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 4 BACKLIGHT CONNECTOR PIN CONFIGURATION**

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

Notes: 1. The high voltage side terminal is colored pink. The low voltage side terminal is black

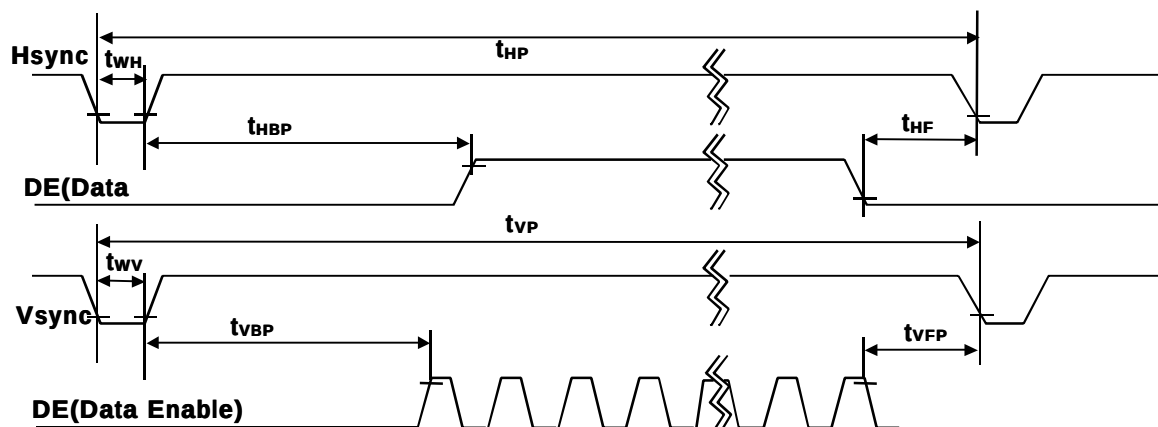
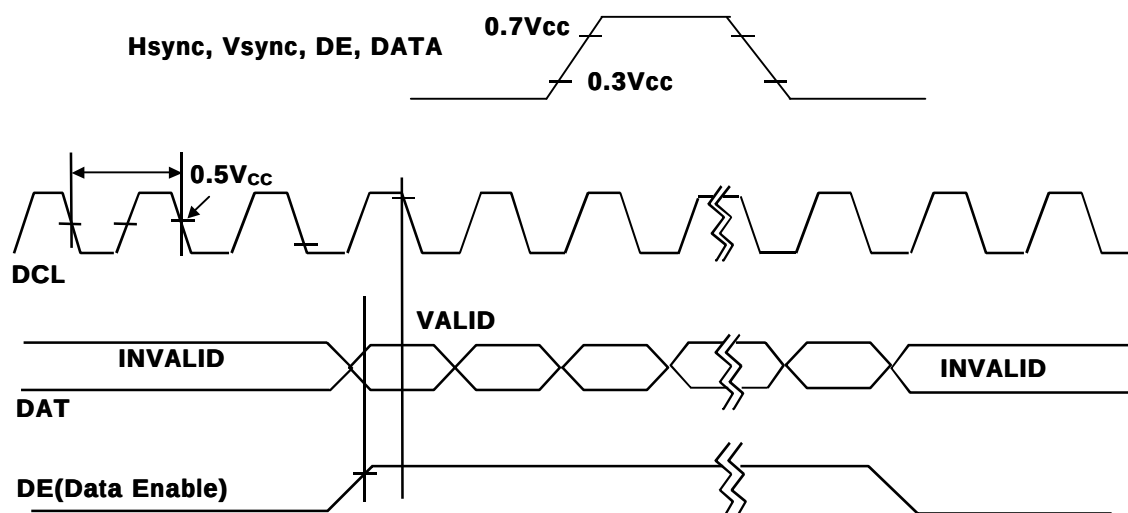


**Product Specification**
**3-3. Signal Timing Specifications**

All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

**Table 6 Timing Table**

| ITEM                   |               | SYMBOL    | MIN. | TYP. | MAX. | UNIT      | NOTE         |
|------------------------|---------------|-----------|------|------|------|-----------|--------------|
| Dclk                   | Period        | $t_{CLK}$ | 25   | 26   | 27   | ns        | TYP. 38.5MHz |
| Hsync                  | Period        | $t_{HP}$  | 990  | 1024 | 1100 | $t_{CLK}$ |              |
|                        | Width-Active  | $t_{WH}$  | 12   | -    | 120  |           |              |
| Vsync                  | Period        | $t_{VP}$  | 604  | 625  | 730  | $t_{HP}$  |              |
|                        | Frequency     | $f_V$     | -    | 60   | -    | Hz        |              |
|                        | Width-Active  | $t_{WV}$  | 1    | -    | 24   | $t_{HP}$  |              |
| DE<br>(Data<br>Enable) | H-Back Porch  | $t_{HBP}$ | 30   | -    | -    | $t_{CLK}$ |              |
|                        | H-Front Porch | $t_{HFP}$ | 30   | -    | -    |           |              |
|                        | V-Back Porch  | $t_{VBP}$ | 0    | -    | -    | $t_{HP}$  |              |
|                        | V-Front Porch | $t_{VFP}$ | 3    | -    | -    |           |              |

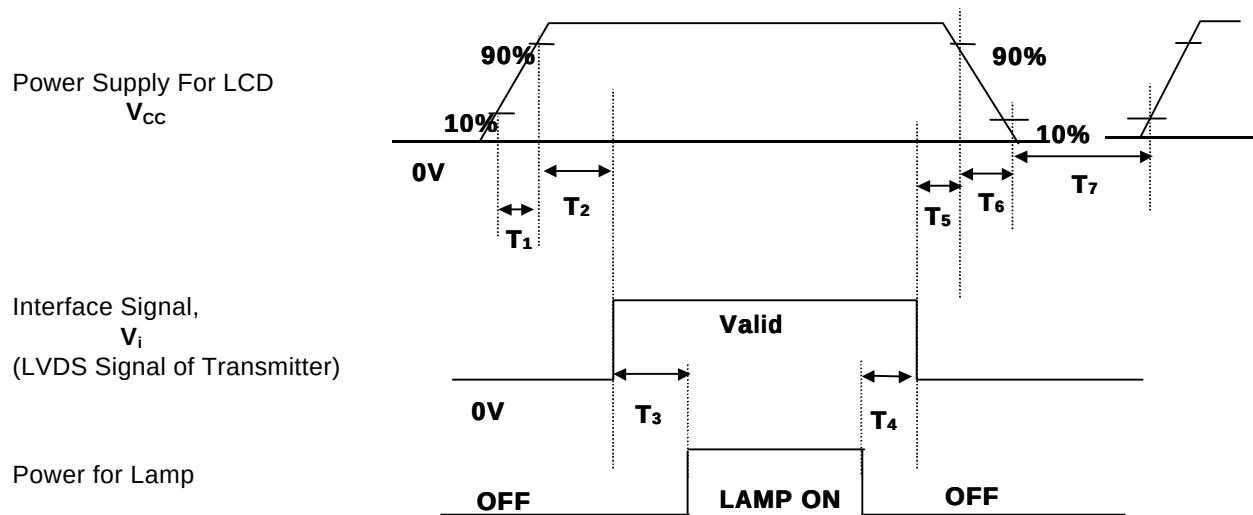
**Product Specification**
**3-4. Signal Timing Waveforms**


**Product Specification**
**3-5. 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 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  |

**Product Specification**
**3-6. Power Sequence**


| Parameter      | Values |      |      | Units |
|----------------|--------|------|------|-------|
|                | Min.   | Typ. | Max. |       |
| T <sub>1</sub> | -      | -    | 10   | ms    |
| T <sub>2</sub> | 0      | -    | 50   |       |
| T <sub>3</sub> | 200    | -    | -    |       |
| T <sub>4</sub> | 200    | -    | -    |       |
| T <sub>5</sub> | 0      | -    | 50   |       |
| T <sub>6</sub> | -      | -    | 10   |       |
| T <sub>7</sub> | 400    | -    | -    |       |

- 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  $V_{CC}$  to 0V.
  3. Lamp power must be turn on after power supply for LCD and interface signal are valid.

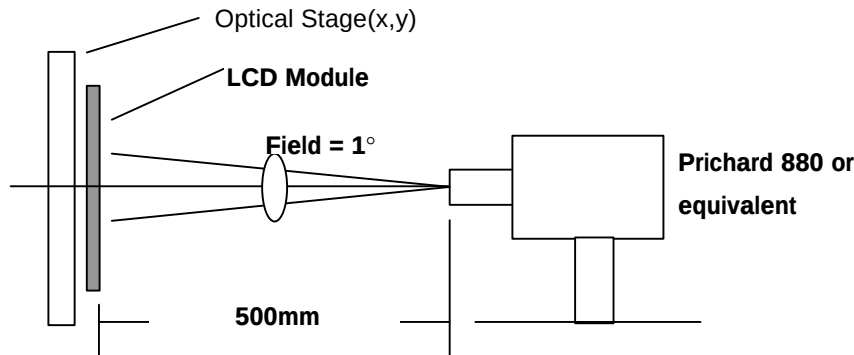
**Product Specification**

#### 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°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of  $\Phi$  and  $\theta$  equal to 0°C.

FIG 1. presents additional information concerning the measurement equipment and method.

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



**Table 8 OPTICAL CHARACTERISTICS** ( Ta=25°C, Vcc=3.3V, f<sub>v</sub> =60Hz, Dclk=38.5MHz, I<sub>BL</sub>= 6 mA)

| Parameter                         | Symbol          | Values |       |       | Units             | Notes |
|-----------------------------------|-----------------|--------|-------|-------|-------------------|-------|
|                                   |                 | Min.   | Typ.  | Max.  |                   |       |
| Contrast Ratio                    | CR              | -      | 200   | -     | cd/m <sup>2</sup> | 1     |
| Surface Luminance, white          | L <sub>WH</sub> | 150    | 170   | -     |                   | 2     |
| Luminance Variation               | $\delta$ WHITE  | -      | 1.35  | 1.45  |                   | 3     |
| Response Time                     | T <sub>r</sub>  | -      | 30    | 50    | ms                | 4     |
| Rise Time                         | T <sub>rR</sub> | -      | 30    | 50    |                   |       |
| Decay Time                        | T <sub>rD</sub> | -      | 30    | 50    |                   |       |
| CIE Color Coordinates             |                 |        |       |       |                   |       |
| Red                               | X <sub>R</sub>  |        | TBD   |       |                   |       |
|                                   | y <sub>R</sub>  |        | TBD   |       |                   |       |
| Green                             | X <sub>G</sub>  |        | TBD   |       |                   |       |
|                                   | y <sub>G</sub>  |        | TBD   |       |                   |       |
| Blue                              | X <sub>B</sub>  |        | TBD   |       |                   |       |
|                                   | y <sub>B</sub>  |        | TBD   |       |                   |       |
| White                             | X <sub>W</sub>  | 0.283  | 0.313 | 0.343 |                   |       |
|                                   | y <sub>W</sub>  | 0.299  | 0.329 | 0.359 |                   |       |
| Viewing Angle                     |                 |        |       |       |                   |       |
| x axis, right ( $\Phi=0^\circ$ )  | $\theta_r$      | 40     | -     | -     | degree            | 5     |
| x axis, left( $\Phi=180^\circ$ )  | $\theta_l$      | 40     | -     | -     |                   |       |
| y axis, up( $\Phi=90^\circ$ )     | $\theta_u$      | 10     | -     | -     |                   |       |
| y axis, down ( $\Phi=270^\circ$ ) | $\theta_d$      | 30     | -     | -     |                   |       |
| Gray Scale                        |                 | -      | -     | -     |                   | 6     |

Notes:

- Contrast Ratio (CR) is defined mathematically as :  

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$
- Surface luminance is the center point across the LCD surface 50cm from the surface with all

**Product Specification**

pixels displaying white. For more information see FIG 1.

3. The variation in surface luminance,  $\delta$  WHITE is determined by measuring  $L_{ON}$  at each test position 1 through 5, and then dividing the maximum  $L_{ON}$  of 5 points luminance by minimum  $L_{ON}$  of 5 points luminance. For more information see FIG 2.

$$\delta \text{ WHITE} = \frac{\text{Maximum } (L_{ON1}, L_{ON2}, \dots, L_{ON5})}{\text{Minimum } (L_{ON1}, L_{ON2}, \dots, L_{ON5})}$$

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.

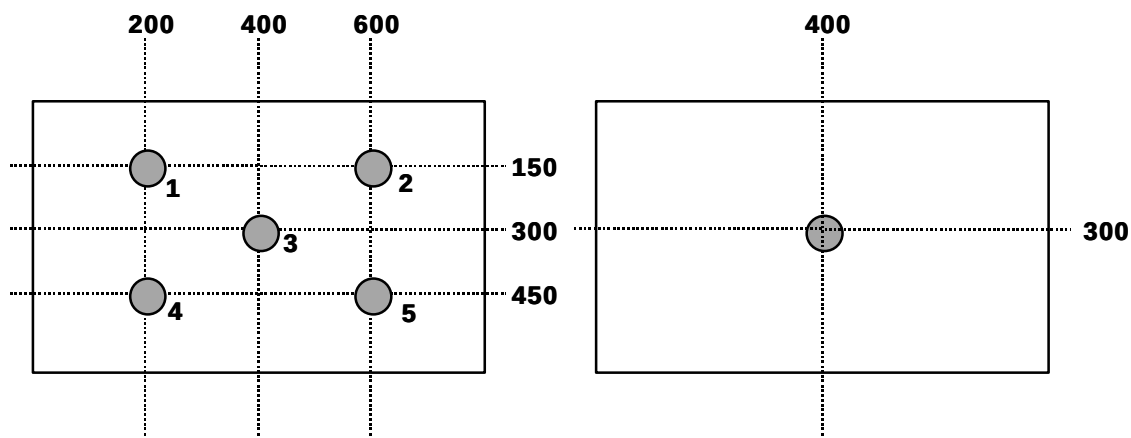
\* Gamma Value = 2.2

| Gray Level | Luminance(%) (Typ.) |
|------------|---------------------|
| L0         | <b>TBD</b>          |
| L7         | <b>TBD</b>          |
| L15        | <b>TBD</b>          |
| L23        | <b>TBD</b>          |
| L31        | <b>TBD</b>          |
| L39        | <b>TBD</b>          |
| L47        | <b>TBD</b>          |
| L55        | <b>TBD</b>          |
| L63        | <b>100</b>          |

**FIG. 2 Luminance**

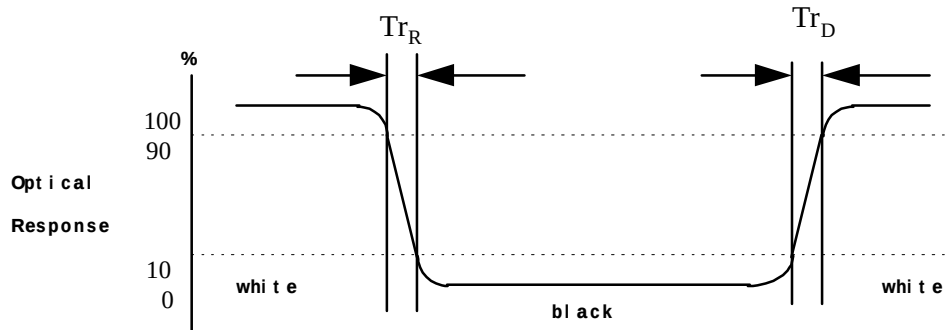
<measuring point for luminance variation>

<measuring point for surface luminance >

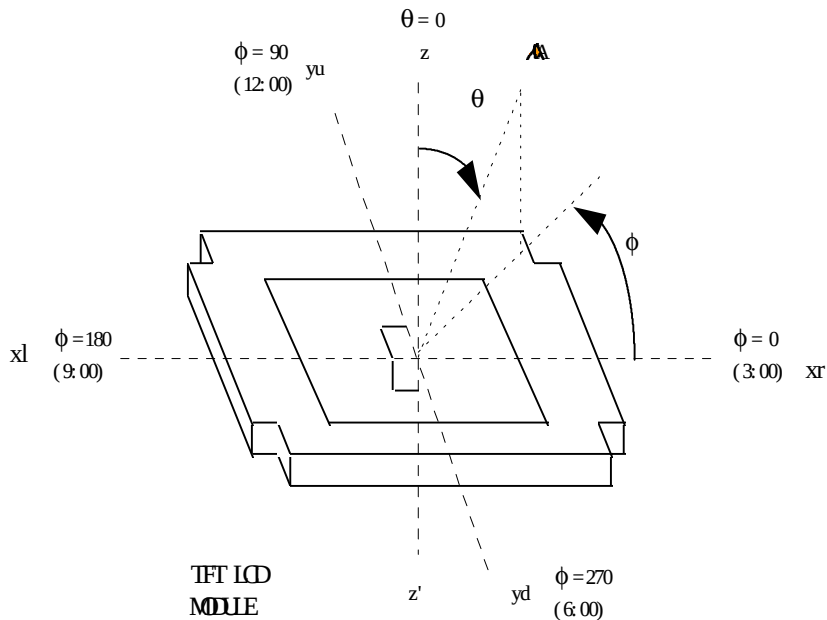


**Product Specification**
**FIG. 3 Response Time**

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


**FIG. 4 Viewing angle**

<Definition of viewing angle range>



**A: E**

**Product Specification****5. Mechanical Characteristics**

The contents provide general mechanical characteristics for the model LP104S5-B2AP LCD. In addition, the figures in the next page are detailed mechanical drawings of the LCD.

Outside dimensions :

|            |                    |
|------------|--------------------|
| Horizontal | $224.5 \pm 0.5$ mm |
| Vertical   | $172.0 \pm 0.5$ mm |
| Depth      | $5.7 \pm 0.3$ mm   |

Bezel area :

|            |                    |
|------------|--------------------|
| Horizontal | $214.2 \pm 0.5$ mm |
| Vertical   | $161.8 \pm 0.5$ mm |

Active Display area :

|            |          |
|------------|----------|
| Horizontal | 211.2 mm |
| Vertical   | 158.4 mm |

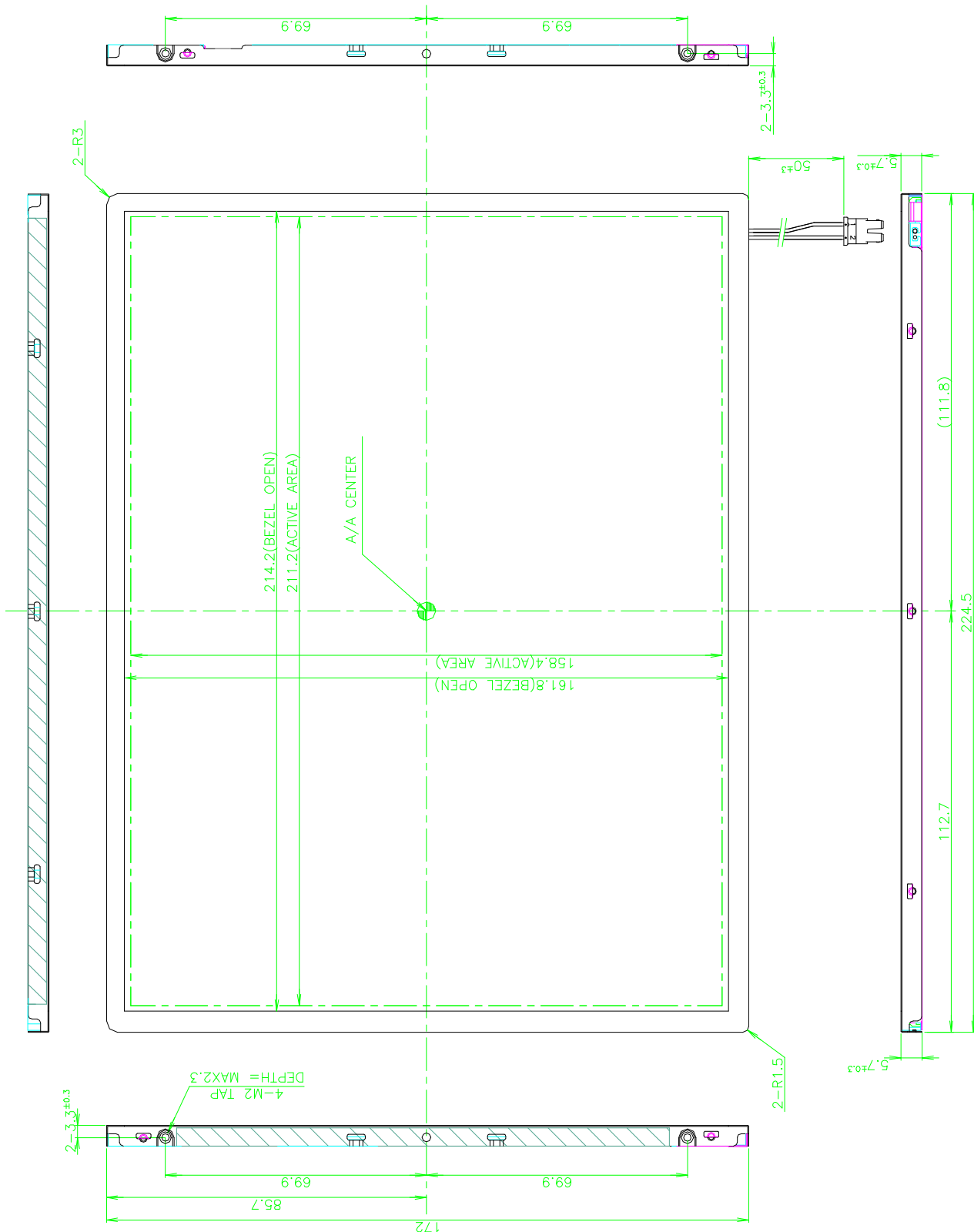
Weight (approximate) : 310g (Typ.), 320g(Max.)

Surface Treatment : Hard coating (3H)  
Anti-glare treatment of the front polarizer



Product Specification

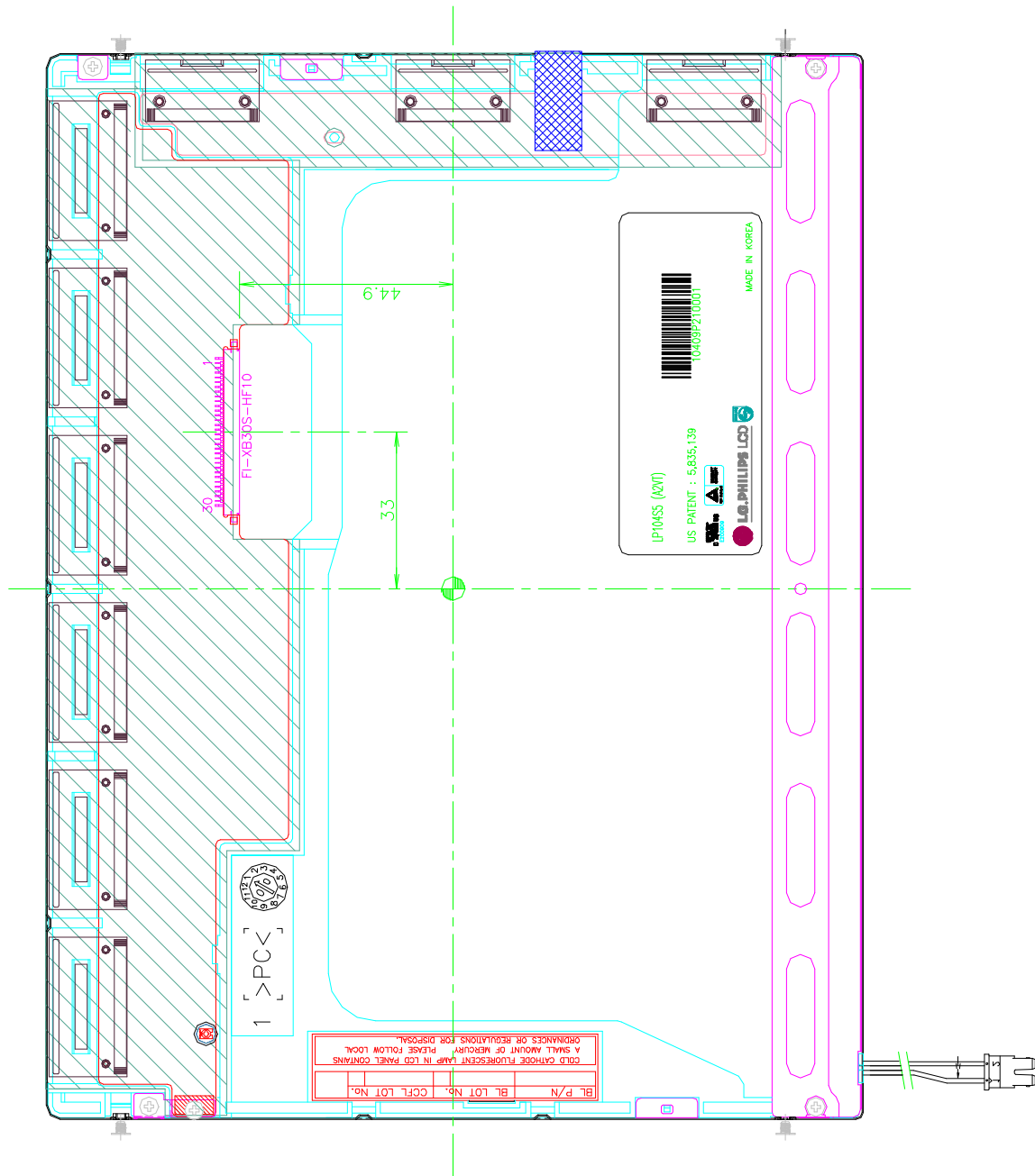
< FRONT VIEW >



1. UNSPECIFIED DIMENSIONAL TOLERANCES ARE  $\pm 0.5\text{mm}$ .

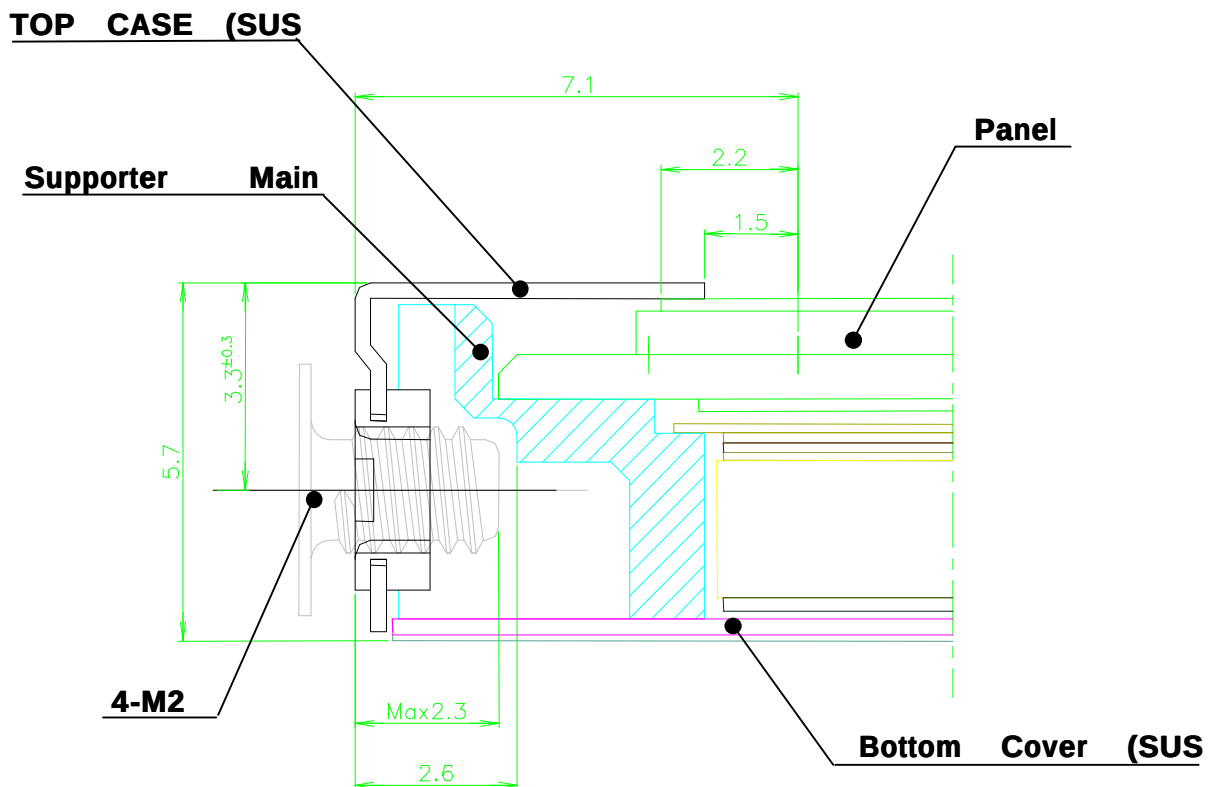
## Product Specification

< REAR VIEW >



<DETAIL DESCRIPTION OF SIDE MOUNTING SCREW>

Product Specification



\*Mounting screw depth : Max 2.3mm

\*Screw(4ea) Torque : Max 2kgf/cm

|                              |
|------------------------------|
| <b>Product Specification</b> |
|------------------------------|

## **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<br>(non-operating) | Sine wave, 10~500~10Hz, 1.5G, 0.37oct/min,<br>3 axis, 1 hour/axis                                   |
| 6   | Shock test<br>(non-operating)     | Half sine wave, 180G, 2ms,<br>one shock of each six faces (i.e. run 180G 2ms for<br>all six faces.) |
| 7   | Altitude                          |                                                                                                     |
|     | operating                         | 0 - 10,000 feet (3048m)                                                                             |
|     | storage/shipment                  | 0 - 40,000 feet (12192m)                                                                            |

{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.

**Product Specification****7. International Standards****7-1. Safety**

- a) UL 1950 Third Edition, Underwriters Laboratories, Inc. Jan. 28, 1995.  
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.
- b) CAN/CSA C22.2 No. 950-95 Third Edition, Canadian Standards Association, Jan. 28, 1995.  
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.
- c) EN 60950 : 1992 + A1 : 1993 + A2 : 1993 + A3 : 1995 + A4 : 1997 + A11 : 1997  
IEC 950 : 1991 + A1 : 1992 + A2 : 1993 + A3 : 1995 + A4 : 1996  
European Committee for Electrotechnical Standardization (CENELEC)  
EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical Business Equipment.

**7-2. EMC**

- a) ANSI C63.4 'Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic 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 Interference Characteristics of Information Technology Equipment.' International Special Committee on Radio Interference
- c) EN 55022 'Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment.' European Committee for Electrotechnical Standardization (CENELEC),1988

**Product Specification**
**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 : INCH CODE  
D : YEAR  
E : MONTH  
F, G : PANEL CODE  
H : ASSEMBLY CODE  
I, J, K, L, M : SERIAL NO.

Note : 1. YEAR

| YEAR | 97 | 98 | 99 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|------|----|----|----|------|------|------|------|------|------|------|------|
| Mark | 7  | 8  | 9  | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    |

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 : 10 pcs

b) Box Size : 371mm X 239mm X 300mm

**Product Specification****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 a transparent protective plate to the surface in order to protect the polarizer.  
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 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 soaked 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 :  
 $V = \pm 200\text{mV}$  (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 minimize the interference.

**Product Specification****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.