

## Product Specification

## LG Electronics Inc.

Date : 13. Apr. 1996

LP104S2

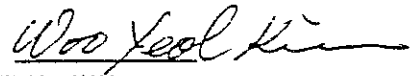
Customer's Acceptance Specifications.

CONTENTS

| NO. | ITEM                                 | Page  |
|-----|--------------------------------------|-------|
| -   | COVER                                | 1     |
| -   | RECORD of REVISION                   | 2     |
| 1.  | GENERAL DESCRIPTION                  | 3     |
| 2.  | MAXIMUM RATINGS                      | 4     |
| 3.  | ELECTRICAL SPECIFICATIONS            | 4     |
| 4.  | OPTICAL SPECIFICATIONS               | 5     |
| 5.  | INTERFACE CONNECTION                 | 6-7   |
| 6.  | SIGNAL TIMING SPECIFICATIONS         | 8     |
| 7.  | SIGNAL TIMING WAVE FORMS             | 9     |
| 8.  | COLOR INPUT DATA REFERENCE           | 10    |
| 9.  | POWER SEQUENCE                       | 11    |
| 10. | MECHANICAL CHARACTERISTICS           | 12    |
| 11. | PAGES 13 - 18 MISSING FROM THIS SPEC | 13    |
| 12. |                                      | 14    |
| -   |                                      | 15-18 |

Please return 1 copy with your signature on this page for approval.

Accepted By : \_\_\_\_\_

Proposed By : 

W.Y. KIM

General Manager

Product Engineering Department

LCD-SBU

LG Electronics Inc.

Product Specification

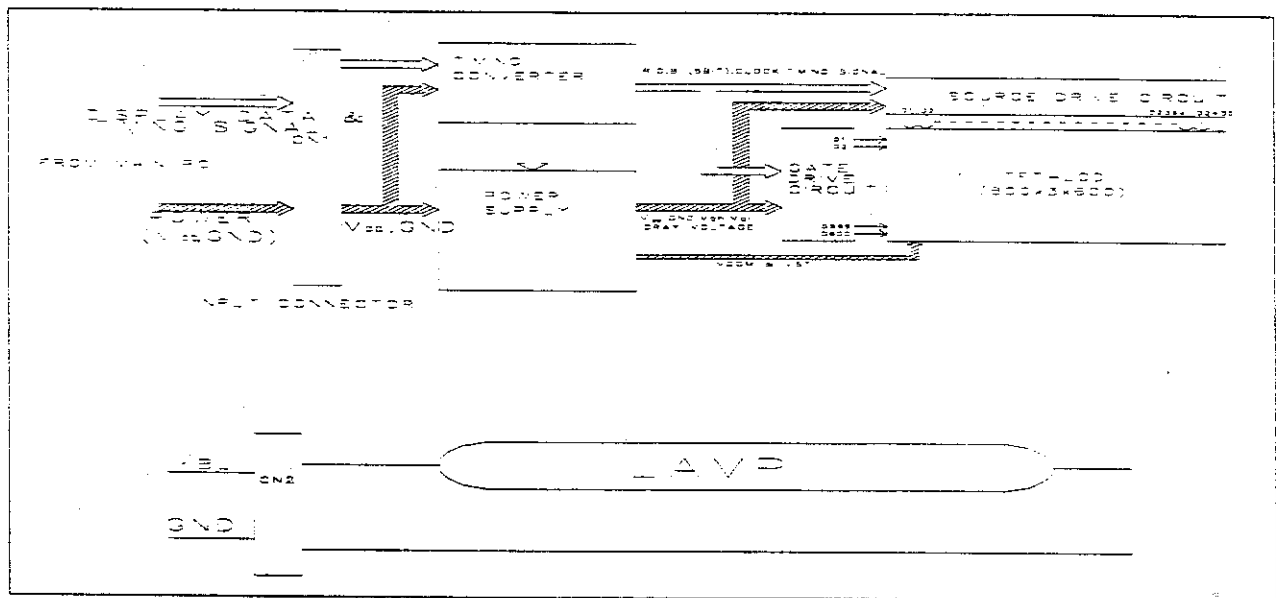
Record of Revision

## Product Specification

1. General Description

The LG Electronics model LCA4SE12A 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 10.4 inch 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 262,000 colors.

The LCA4SE12A LCD is intended to support applications where low power consumption, weight and thickness are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LCA4SE12A characteristics provide an excellent flat panel display for office automation products such as portable computers.

General Display Characteristics

The following are general feature of the model LCA4SE12A LCD;

|                        |                                                                  |
|------------------------|------------------------------------------------------------------|
| Active display area    | 10.4 inches(26cm) diagonal                                       |
| Outsize dimensions     | 246.5w * 179.4h * 8.5t mm                                        |
| Pixel pitch            | 0.264 mm * 0.264 mm                                              |
| Pixel format           | 800 horiz. By 600 vert. pixels                                   |
|                        | RGB stripe arrangement                                           |
| Color depth            | 6-bit, 262,140 colors                                            |
| Display operating mode | transmissive mode, normally white                                |
| Surface treatments     | hard coating(2H),<br>anti-glare treatment of the front polarizer |

## Product Specification

**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     | +6       | Vdc   | at 25 °C |
| Logic Input Voltage   | $V_{L/H}$ | $V_{SS}$ | $V_{DD}$ | Vdc   | at 25 °C |
| Operating Temperature | $T_{OP}$  | 0        | +50      | °C    | 1        |
| Storage Temperature   | $T_{ST}$  | -20      | +60      | °C    | 1        |

Note: 1. The Relative Humidity must not exceed 95% non-condensing at temperatures of 40 °C or less. At temperatures greater than 40 °C, the wet bulb temperature must not exceed 39 °C.  
2. Under no condition should the unit be exposed to corrosive chemicals.

**3. Electrical Specifications**

The LCA4SE01A requires two power inputs. One is employed to power the LCD electronics and to derive the voltages to drive the TFT array and liquid crystal. The second input which powers the backlight CCFT, 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.            |                  |           |
| MODULE:                    |                 |                 |      |                 |                  |           |
| Power Supply Input Voltage | V <sub>DD</sub> | 4.5             | 5.00 | 5.5             | V <sub>dc</sub>  |           |
| Power Supply Input Current | I <sub>DD</sub> | -               | 200  | 320             | mA               | 1         |
| Ripple/Noise               | -               | -               | 100  |                 | mV               |           |
| Logic Input Level, High    | V <sub>IH</sub> | 2.0             | -    | V <sub>DD</sub> | V <sub>dc</sub>  | 2         |
| Logic Input Level, Low     | V <sub>IL</sub> | V <sub>SS</sub> | -    | 0.8             | V <sub>dc</sub>  | 2         |
| Power Consumption          | P <sub>C</sub>  |                 | 1.0  | 1.6             | Watts            | 1         |
| BACKLIGHT                  |                 |                 |      |                 |                  |           |
| Backlight Input voltage    | V <sub>BL</sub> | 430             | 475  | 520             | V <sub>RMS</sub> |           |
| Backlight Current          | I <sub>BL</sub> | 3.0             | 4.0  | 5.0             | mA               |           |
| Lamp Kick-Off Voltage      |                 | -               | 385  | 500             | V <sub>RMS</sub> | 25 ± 2 °C |
| Operating Frequency        | F <sub>BL</sub> | 30              | 45   | 60              | KHz              |           |
| Power Consumption          | P <sub>BL</sub> | -               | 1.9  | -               | Watts            | 3         |

Notes: 1. The current draw and power consumption specified is for 5 Vdc at 25 °C and fv at 60Hz.  
2. Logic levels are specified for  $V_{DD}$  of 5 Vdc at 25 °C. The values specified apply to all logic inputs; Hsync, Vsync, clock, data signals, etc.  
3. The backlight power 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 °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°. Appendix A presents additional information concerning the specified characteristics.

Table 2 OPTICAL CHARACTERISTICS

| Parameter                         | Symbol           | Values |      |      | Units             | Notes |
|-----------------------------------|------------------|--------|------|------|-------------------|-------|
|                                   |                  | Min.   | Typ. | Max. |                   |       |
| Contrast Ratio                    | CR               | 80     | 100  | -    |                   | 1     |
| Surface Brightness, white         | SB <sub>WH</sub> | 60     | 70   |      | cd/m <sup>2</sup> | 2     |
| Brightness Variation              | SB <sub>V</sub>  |        | 1.20 | 1.35 | %                 | 3     |
| Response Time                     | Tr               |        |      |      | msec              | 4     |
| Rise Time                         | Tr <sub>R</sub>  |        |      | 30   |                   |       |
| Decay Time                        | Tr <sub>D</sub>  |        |      | 50   |                   |       |
| CIE Color Coordinates             |                  |        |      |      |                   |       |
| Red                               | X <sub>R</sub>   | 0.56   | 0.59 | 0.62 |                   |       |
|                                   | Y <sub>R</sub>   | 0.30   | 0.33 | 0.36 |                   |       |
| Green                             | X <sub>G</sub>   | 0.29   | 0.32 | 0.35 |                   |       |
|                                   | Y <sub>G</sub>   | 0.50   | 0.53 | 0.56 |                   |       |
| Blue                              | X <sub>B</sub>   | 0.12   | 0.15 | 0.18 |                   |       |
|                                   | Y <sub>B</sub>   | 0.10   | 0.13 | 0.16 |                   |       |
| White                             | X <sub>W</sub>   | 0.29   | 0.32 | 0.35 |                   |       |
|                                   | Y <sub>W</sub>   | 0.29   | 0.32 | 0.35 |                   |       |
| Viewing Angle                     |                  |        |      |      | degree, °         | 5     |
| x axis, right ( $\Phi=0^\circ$ )  | $\theta$         |        | 40   |      |                   |       |
| x axis, left ( $\Phi=180^\circ$ ) | $\theta$         |        | 40   |      |                   |       |
| y axis, up ( $\Phi=90^\circ$ )    | $\theta$         |        | 10   |      |                   |       |
| y axis, down ( $\Phi=270^\circ$ ) | $\theta$         |        | 30   |      |                   |       |

Notes 1. Contrast Ratio (CR) is defined mathematically as:

$$\frac{\text{(Surface Brightness with all white pixels)}}{\text{(Surface Brightness with all black pixels)}}$$

2. Surface brightness is the average of 9 measurement across the LCD surface 50cm from the surface with all pixels displaying white. For more information see Appendix A.

3. The variation in surface brightness, SB<sub>V</sub> is determined by measuring B<sub>ON</sub> at each test position 0 through 9, and then dividing the maximum B<sub>ON</sub> by the minimum B<sub>ON</sub>.

$$\frac{\text{Maximum (B}_{0\text{ON}}, \text{B}_{1\text{ON}}, \dots, \text{B}_{9\text{ON}})}{\text{Minimum (B}_{0\text{ON}}, \text{B}_{1\text{ON}}, \dots, \text{B}_{9\text{ON}})}$$

4. Response time is the time required for the display to transition from white to black(Rise Time, Tr<sub>R</sub>) and from black to white (Decay Time, Tr<sub>D</sub>). For additional information see Appendix A.

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 Appendix A.

## Product Specification

**5. Interface Connections**

This LCD employs two interface connections, a 41 pin connector is used for the module electronics and a three pin connector is used for the integral backlight system.

The electronics interface connector is a model DF9-41P-1V, manufactured by Hirose. The mating connector part number is DF9-41S-1V or equivalent. The pin configuration for the connector is shown in the table below.

Table 3 MODULE CONNECTOR PIN CONFIGURATION

| Pin | Symbol          | Description        | Notes                                 |
|-----|-----------------|--------------------|---------------------------------------|
| 1   | GND             | Ground             | Connect to Vss, see Note 1            |
| 2   | CLK             | Main clock         |                                       |
| 3   | GND             | Ground             | Connect to Vss, see Note 1            |
| 4   | GND             | Ground             | Connect to Vss, see Note 1            |
| 5   | Hsync           | Horizontal sync.   |                                       |
| 6   | Vsync           | Vertical sync.     |                                       |
| 7   | GND             | Ground             | Connect to Vss, see Note 1            |
| 8   | R0              | Red data           | Red data least significant bit(LSB)   |
| 9   | R1              | Red data           |                                       |
| 10  | R2              | Red data           |                                       |
| 11  | R3              | Red data           |                                       |
| 12  | R4              | Red data           |                                       |
| 13  | R5              | Red data           | Red data most significant bit(MSB)    |
| 14  | GND             | Ground             | Connect to Vss, see Note 1            |
| 15  | GND             | Ground             | Connect to Vss, see Note 1            |
| 16  | GND             | Ground             | Connect to Vss, see Note 1            |
| 17  | G0              | Green data         | Green data least significant bit(LSB) |
| 18  | G1              | Green data         |                                       |
| 19  | G2              | Green data         |                                       |
| 20  | G3              | Green data         |                                       |
| 21  | G4              | Green data         |                                       |
| 22  | G5              | Green data         | Green data most significant bit(MSB)  |
| 23  | GND             | Ground             | Connect to Vss, see Note 1            |
| 24  | GND             | Ground             | Connect to Vss, see Note 1            |
| 25  | GND             | Ground             | Connect to Vss, see Note 1            |
| 26  | B0              | Blue data          | Blue data least significant bit(LSB)  |
| 27  | B1              | Blue data          |                                       |
| 28  | B2              | Blue data          |                                       |
| 29  | B3              | Blue data          |                                       |
| 30  | B4              | Blue data          |                                       |
| 31  | B5              | Blue data          | Blue data most significant bit(MSB)   |
| 32  | GND             | Ground             | Connect to Vss, see Note 1            |
| 33  | GND             | Ground             | Connect to Vss, see Note 1            |
| 34  | GND             | Ground             | Connect to Vss, see Note 1            |
| 35  | DTMG            | Data timing signal |                                       |
| 36  | V <sub>DD</sub> | Power input        | +5Vdc power supply input, see Note 2  |
| 37  | V <sub>DD</sub> | Power input        | +5Vdc power supply input, see Note 2  |
| 38  | NC              | No connect         |                                       |
| 39  | NC              | No connect         |                                       |
| 40  | GND             | Ground             | Connect to Vss, see Note 1            |
| 41  | GND             | Ground             | Connect to Vss, see Note 1            |

- Notes:
1. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.
  2. All V<sub>DD</sub>(power input) pins should be connected together.

## Product Specification

## Interface Connections (cont'd)

The backlight interface connector is a model BHR-03VS-1, manufactured by JST. The mating connector part number is SM02(8.0)B-BHS-1-TB 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     | Ground           | 1     |
| 2   | NC     | No connect       |       |
| 3   | LV     | Lamp power input | 2     |

Notes: 1. The backlight ground should be common with Vss.  
2. The input power terminal is colored pink.

Product Specification

6. Signal Timing Specification

| Parameter                     |                 | Symbol                | Value |      |              | Units   | Notes |
|-------------------------------|-----------------|-----------------------|-------|------|--------------|---------|-------|
|                               |                 |                       | Min.  | Typ. | Max.         |         |       |
| Main Clock                    | Frequency       | $f_{CLK}(=1/t_{CLK})$ | -     | 40.0 | (42.0)       | MHz     | 1     |
|                               | High duration   | $t_{CLKH}$            | 5     | -    | -            | ns      |       |
|                               | Low duration    | $t_{CLKL}$            | 10    | -    | -            | ns      |       |
| Data                          | Set-up duration | $t_{DS}$              | 5     | -    | -            | ns      |       |
|                               | Hold duration   | $t_{DH}$              | 10    | -    | -            | ns      |       |
| ENAB                          | Set-up duration | $t_{ES}$              | 5     | -    | $t_{CLK}-10$ | ns      | 2     |
|                               | Pulse Width     | $t_{EP}$              | 2     | 800  | $t_H-10$     | clock   |       |
| Hsync                         | Period          | $t_H$                 | 20.8  | 26.4 | -            | $\mu s$ |       |
|                               |                 |                       | 832   | 1056 | -            | clock   |       |
|                               | Pulse Width     | $t_{HP}$              | 2     | 128  | 200          | clock   |       |
| Vsync                         | Period          | $t_V$                 | 628   | 666  | 798          | lines   |       |
|                               |                 |                       | -     | 16.7 | -            | msec    |       |
|                               | Pulse Width     | $t_{VP}$              | 2     | 4    | 6            | lines   |       |
| Horizontal Display            | Start           | $t_{HS}$              | 88    | 88   | 88           | clock   |       |
|                               | Period          | $t_{HD}$              | 800   | 800  | 800          | clock   |       |
| Vertical Display              | Start           | $t_{VS}$              | 23    | 23   | 23           | lines   |       |
|                               | Period          | $t_{VD}$              | 600   | 600  | 600          | lines   |       |
| Hsync-Clock phase difference  |                 | $t_{HC}$              | 10    | -    | $t_{CLK}-10$ | ns      |       |
| Hsync-ENAB phase difference   |                 | $t_{HE}$              | 58    | 88   | 170          | clock   |       |
| Hsync--Vsync phase difference |                 | $t_{HV}$              | 0     | -    | $t_H-t_{HP}$ | ns      |       |

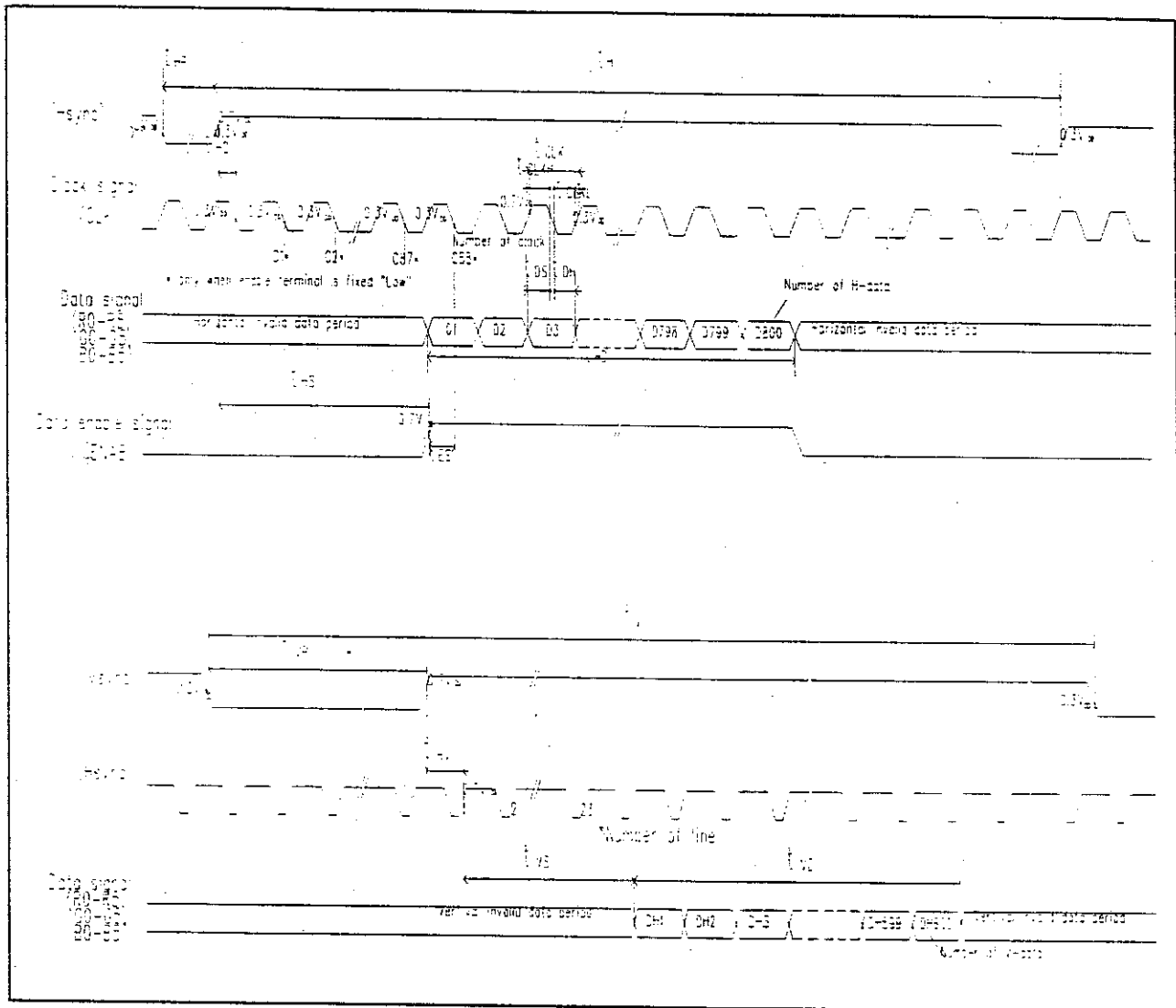
Notes : 1. In case of lower frequency, the deterioration of display, flicker etc. may be occurred.

2. The ENAB should not be fixed 'High'



Product Specification

7. Signal Timing Wave forms



input signal waveform

## Product Specification

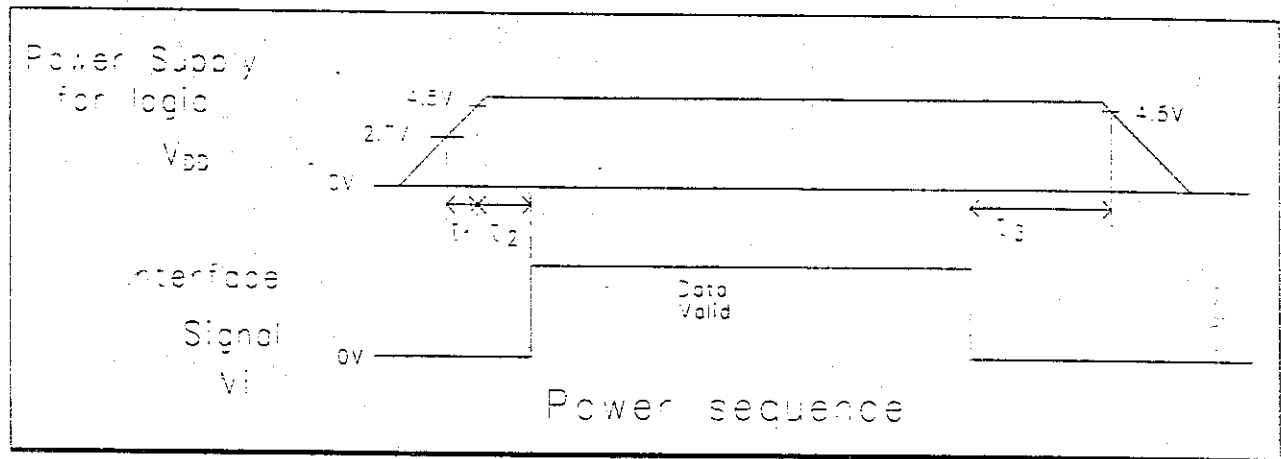
**8. Color Input Data Reference**

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 5 COLOR DATA REFERENCE

| Color        |                 | Input Color Data |    |    |    |    |    |       |    |    |    |    |    |      |    |    |    |    |    |
|--------------|-----------------|------------------|----|----|----|----|----|-------|----|----|----|----|----|------|----|----|----|----|----|
|              |                 | Red              |    |    |    |    |    | Green |    |    |    |    |    | Blue |    |    |    |    |    |
|              |                 | R5               | R4 | R3 | R2 | R1 | R0 | G5    | G4 | G3 | G2 | G1 | G0 | B5   | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black           | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Red(00)         | 1                | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Green(00)       | 0                | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Blue(00)        | 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(63) Black   | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Red(62)         | 0                | 0  | 0  | 0  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Red(61)         | 0                | 0  | 0  | 0  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | :               | :                | :  | :  | :  | :  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Red(02)         | 1                | 1  | 1  | 1  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Red(01)         | 1                | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Red(00)         | 1                | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
| Green        | Green(63) Black | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Green(62)       | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Green(61)       | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | :               | :                | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Green(02)       | 0                | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 0  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Green(01)       | 0                | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Green(00)       | 0                | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |
| Blue         | Blue(63) Black  | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Blue(62)        | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 1  |
|              | Blue(61)        | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 1  | 0  |
|              | :               | :                | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|              | Blue(02)        | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 0  | 1  |
|              | Blue(01)        | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 0  |
|              | Blue(00)        | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  |

## Product Specification

9. Power Sequence

\* Set  $0 \text{ Volt} < V_i(t) < V_{DD}(t)$

Here  $V_i(t)$ ,  $V_{DD}(t)$  indicate the transitive state of  $V_i$ ,  $V_{DD}$  when power supply is turned ON or OFF

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.

## 10. Mechanical Characteristics

The chart below provides general mechanical characteristics for the model LCA4SE12A LCD. The surface of the LCD has an anti-glare coating to minimize reflection and a 2H hard coating to reduce scratching. 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      | 246.5 mm |
|                      | Height     | 179.4 mm |
|                      | Thickness  | 8.5 mm   |
| Active Display area  | Width      | 211.2 mm |
|                      | Height     | 158.4 mm |
|                      | Diagonal   | 264.0 mm |
| Weight (approximate) | < 400 gram |          |

