

Product Specification

SPECIFICATION FOR APPROVAL

- () Preliminary Specification
(◆) Final Specification

| | |
|-------|-------------------|
| Title | 15.0" XGA TFT LCD |
|-------|-------------------|




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

| | |
|----------|--------------------------|
| SUPPLIER | LG.Philips LCD Co., Ltd. |
| *MODEL | LP150X08 |
| Suffix | A5 |

*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.

| SIGNATURE | DATE |
|---|---|
| APPROVED BY S. H. Kang / S.Manager |  |
| REVIEWED BY J. H. Lee / Manager D. J. You / Manager |  |
| PREPARED BY J. S. Kim / Engineer T. S. Yun / Engineer |  |

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

Product Specification

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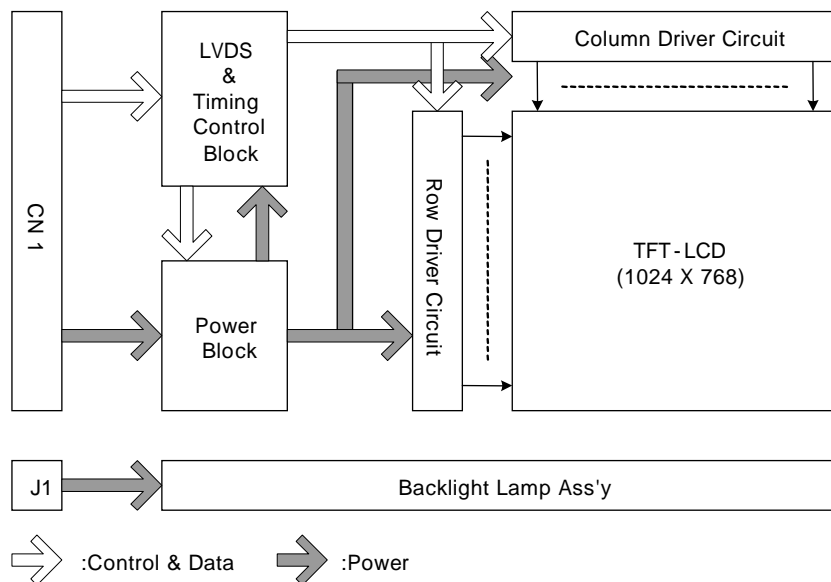
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1. General Description

The LP150X08 is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp(CCFL) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. This TFT-LCD has 15.0 inches 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.

The LP150X08 has been designed to apply the interface method that enables low power, high speed, low EMI.

The LP150X08 is intended to support applications where thin thickness, low power are critical factors and graphic display are important. In combination with the vertical arrangement of the sub-pixels, the LP150X08 characteristics provide an excellent flat display for office automation products such as Notebook PC.



General Features

| | |
|------------------------|--|
| Active Screen Size | 15.0 inches(38.1cm) diagonal |
| Outline Dimension | 317.3(H) x 241.5(V) x 5.7(D) mm(Typ.) |
| Pixel Pitch | 0.297 mm x 0.297 mm |
| Pixel Format | 1024 horiz. By 768 vert. Pixels RGB strip arrangement |
| Color Depth | 6-bit, 262,144 colors |
| Luminance, White (5P) | 150 cd/m ² (Typ.) |
| Power Consumption | 4.66W |
| Weight | 540 g (Typ.) |
| Display Operating Mode | Transmissive mode, normally white |
| Surface Treatment | Hard coating(3H) Anti-glare treatment of the front polarizer |

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2. Absolute Maximum Ratings

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

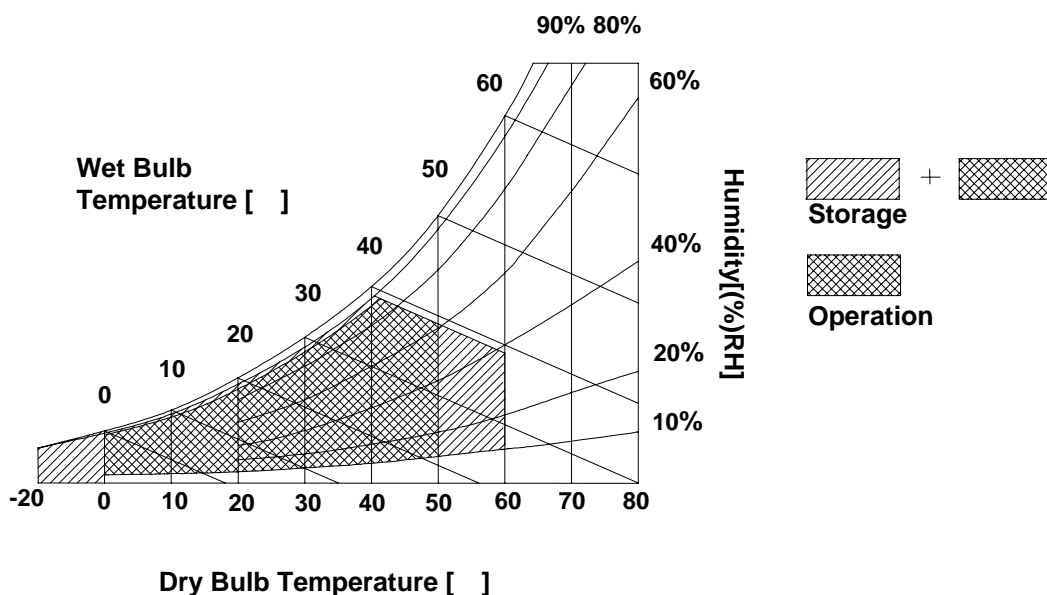
Table 1. ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Values | | Units | Notes |
|--------------------------------|--------|--------|-----|-------|-------------|
| | | Min | Max | | |
| Power Input Voltage-ON | VCC | 2.7 | 4.0 | Vdc | at 25 ± 5°C |
| Power Input Voltage-OFF | GND | -0.3 | 0.3 | Vdc | at 25 ± 5°C |
| Operating Temperature | TOP | 0 | 50 | °C | 1 |
| Storage Temperature | TST | -20 | 60 | °C | 1 |
| Operating Ambient Humidity | HOP | 10 | 90 | %RH | 1 |
| Storage Humidity | HST | 10 | 90 | %RH | 1 |
| Electrostatic Durability (ESD) | VESD | ± 8.0 | | kV | 2 |

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. Condition 1) Non-operation, 150pF-330 , 25 , 40~60%RH
 2) I/F Connector pins are subjected.
 3) The surface of Metal bezel and LCD are subjected.
 4) Discharge interval time 1sec, 10 times each place



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3. Electrical Specifications

3-1. Electrical Characteristics

The LP150X08 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input which powers the CCFL, is typically generated by an inverter. The inverter is an external unit to the LCD.

Table 2. ELECTRICAL CHARACTERISTICS

| Parameter | Symbol | Values | | | Unit | Notes | |
|------------------------------|-----------------|-----------------|--------|------|-------------------|-------|---|
| | | Min | Typ | Max | | | |
| MODULE : | | | | | | | |
| Power Supply Input Voltage | VCC | 3.0 | 3.3 | 3.6 | Vdc | | |
| Power Supply Input Current | I _{CC} | - | 230 | 265 | mA | 1 | |
| Power Consumption | Pc | - | 0.76 | 0.87 | Watt | 1 | |
| Differential Impedance | Zm | 90 | 100 | 110 | ohm | 2 | |
| | | | | | | | |
| LAMP : | | | | | | | |
| Operating Voltage | V _{BL} | 655 | 685 | 805 | V _{RMS} | 3 | |
| Operating Current | I _{BL} | 3.0 | 5.0 | 6.0 | mA _{RMS} | | |
| Established Starting Voltage | | Vs | | | | 4 | |
| | at 25 °C | - | - | 1140 | V _{RMS} | | |
| | at 0 °C | - | - | 1370 | V _{RMS} | | |
| Operating Frequency | | f _{BL} | 45 | 58 | 80 | kHz | 5 |
| Discharge Stabilization Time | | Ts | - | - | 3 | Min | 6 |
| Power Consumption | | P _{BL} | - | 3.9 | 4.3 | Watt | 7 |
| Life Time | | | 10,000 | - | - | Hrs | 8 |

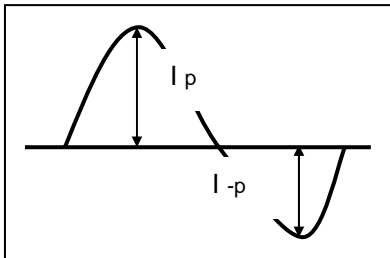
Note : The design of the inverter must have specifications for the lamp in LCD Assembly.

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 you instrument.

1. The specified current and power consumption are under the VCC=3.3V, 25°C, f_v=60Hz condition whereas Mosaic pattern is displayed and f_v is the frame frequency.
2. This impedance value is needed to proper display and measured from LVDS T_x to the mating connector.
3. The variance of the voltage is ± 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. The used lamp current is the lamp typical current.

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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 interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.
 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%.
 7. The lamp power consumption shown above does not include loss of external inverter.
The used lamp current is the maximum lamp current ($6.0\text{mA}_{\text{RMS}}$).
 8. The life is determined as the time at which brightness of the lamp is 50% compared to that of initial value at the maximum lamp current($6.0\text{mA}_{\text{RMS}}$) on condition of continuous operating at $25 \pm 2^\circ\text{C}$
 9. Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp, are following.
It shall help increase the lamp lifetime and reduce leakage current.
 - a. The asymmetry rate of the inverter waveform should be less than 10%.
 - b. The distortion rate of the waveform should be within $\sqrt{2} \pm 10\%$.
- * Inverter output waveform had better be more similar to ideal sine wave.



* Asymmetry rate:

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

* Distortion rate

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

Do not attach a conducting tape to lamp connecting wire.

If the lamp wire attach to a conducting tape, TFT-LCD Module has a low luminance and the inverter has abnormal action. Because leakage current is occurred between lamp wire and conducting tape.

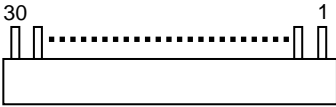
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3-2. Interface Connections

The interface connections are compatible with **ISP (Industry Standard Panels) 15.0" Mounting and Top Level Interface Requirements (Version2, June,2000)** defined by **SPWG (Standard Panels Working Group)**. This LCD employs two interface connections, a 30 pin connector is used for the module electronics and the other connector is used for the integral backlight system.

The electronics interface connector is a model GT101-30S-HR11 manufactured by LG Cable. The pin configuration for the connector is shown in the table below.

Table 3. MODULE CONNECTOR PIN CONFIGURATION (CN1)

| Pin | Symbol | Description | Notes |
|-----|---------------------|--|---|
| 1 | VSS | Ground | [LVDS Transmitter] TI, SN75LVDS84 or equivalent |
| 2 | VCC | Power Supply, 3.3V Typ. | |
| 3 | VCC | Power Supply, 3.3V Typ. | |
| 4 | VEDID | DDC 3.3V power | [LVDS Receiver] THINE, THC63LVDF64A |
| 5 | NC | No Connection | |
| 6 | ClkEDID | DDC Clock | |
| 7 | DATAEDID | DDC Data | [Connector] LCD : GT101-30S-HR11, LG Cable * Hirose KN07LR-30S-1H / JAE FI-XB30SR-HF or equivalent. Matching : JAE FI-X30M or equivalent |
| 8 | R _{IN} 0 - | - LVDS differential data input (R0-R5, G0) | |
| 9 | R _{IN} 0 + | + LVDS differential data input (R0-R5, G0) | |
| 10 | VSS | Ground | [Connector pin arrangement] |
| 11 | R _{IN} 1 - | - LVDS differential data input (G1-G5, B0-B1) | |
| 12 | R _{IN} 1 + | + LVDS differential data input (G1-G5, B0-B1) | |
| 13 | VSS | Ground |  <p>LCD rear view</p> |
| 14 | R _{IN} 2 - | - LVDS differential data input (B2-B5, HS, VS, DE) | |
| 15 | R _{IN} 2 + | + LVDS differential data input (B2-B5, HS, VS, DE) | |
| 16 | VSS | Ground | |
| 17 | ClkIN - | - LVDS differential clock input | |
| 18 | ClkIN + | + LVDS differential clock input | |
| 19 | VSS | Ground | |
| 20 | NC | No Connection | |
| 21 | NC | No Connection | |
| 22 | VSS | Ground | |
| 23 | NC | No Connection | |
| 24 | NC | No Connection | |
| 25 | VSS | Ground | |
| 26 | NC | No Connection | |
| 27 | NC | No Connection | |
| 28 | VSS | Ground | |
| 29 | NC | No Connection | |
| 30 | NC | No Connection | |

Note: All GND(ground) pins should be connected together and to GND which should also be connected to the LCD's metal frame. All VCC (power input) pins should be connected together.

The backlight interface connector is JST BHSR-02VS-1 or equivalent. The mating connector part number is SM02B-BHSS-1 or equivalent.

Table 4. BACKLIGHT CONNECTOR PIN CONFIGURATION (J1)

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

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

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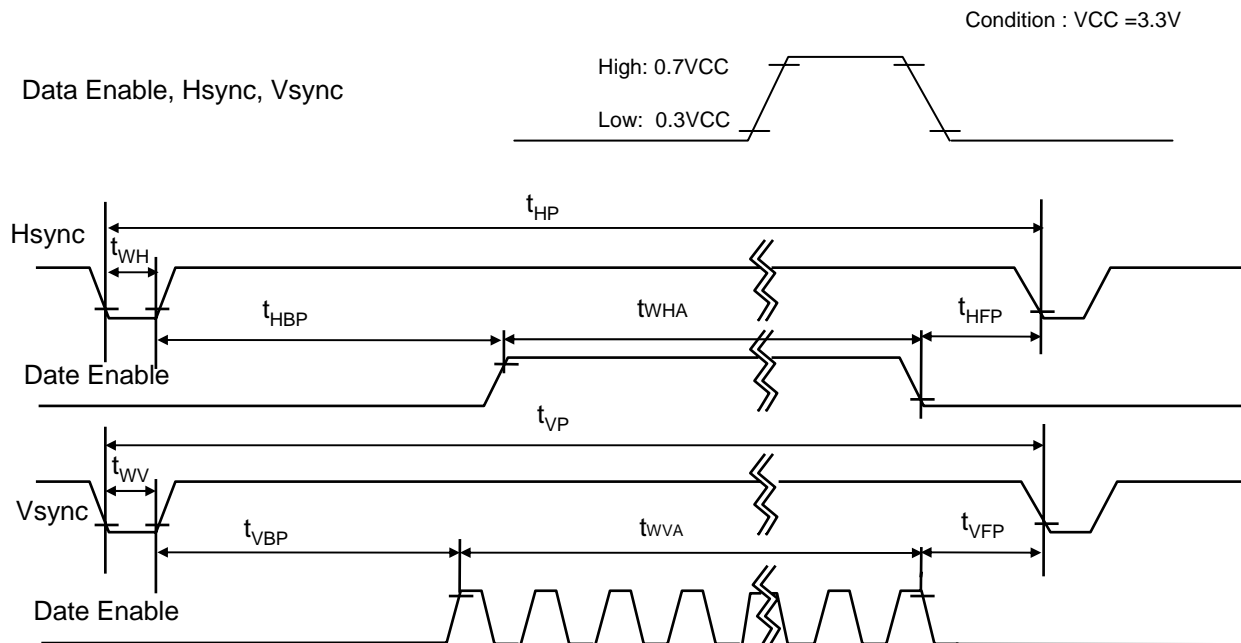
3-3. Signal Timing Specifications

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

Table 5. TIMING TABLE

| ITEM | Symbol | | Min | Typ | Max | Unit | Note |
|-------------|------------------------|------|------|------|------|------|--------|
| DCLK | Frequency | fCLK | 65 | 65 | 65 | MHz | 15.4ns |
| Hsync | Period | tHP | 1206 | 1344 | 1364 | tCLK | |
| | Width | tWH | 8 | 136 | - | | |
| Vsync | Period | tVP | 780 | 806 | 830 | tHP | |
| | Frequency | fv | 60 | 60 | 60 | | |
| | Width | tWV | 1 | 6 | 24 | | |
| Data Enable | Horizontal back porch | tHBP | 10 | 160 | - | tCLK | |
| | Horizontal front porch | tHFP | 10 | 24 | - | | |
| | Vertical back porch | tVBP | 7 | 29 | - | tHP | |
| | Vertical front porch | tVFP | 1 | 3 | - | | |

3-4. Signal Timing Waveforms



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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 6. COLOR DATA REFERENCE

| Color | | Input Color Data | | | | | | | | | | | | | | | | | |
|-------------|------------|------------------|-----|-----|-----|-----|-----|-------|-----|-----|-----|-----|-----|------|-----|-----|-----|-----|-----|
| | | RED | | | | | | GREEN | | | | | | BLUE | | | | | |
| | | MSB | | | LSB | | | MSB | | | LSB | | | MSB | | | LSB | | |
| | | R 5 | R 4 | R 3 | R 2 | R 1 | R 0 | G 5 | G 4 | G 3 | G 2 | G 1 | G 0 | B 5 | B 4 | B 3 | B 2 | B 1 | B 0 |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| RED | RED (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED (01) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ... | ... | | | | | | ... | | | | | | ... | | | | | |
| | RED (62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED (63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| GREEN | GREEN (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN (01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ... | ... | | | | | | ... | | | | | | ... | | | | | |
| | GREEN (62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN (63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| BLUE | BLUE (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | BLUE (01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | ... | ... | | | | | | ... | | | | | | ... | | | | | |
| | BLUE (62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | BLUE (63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

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3-6. Power Sequence

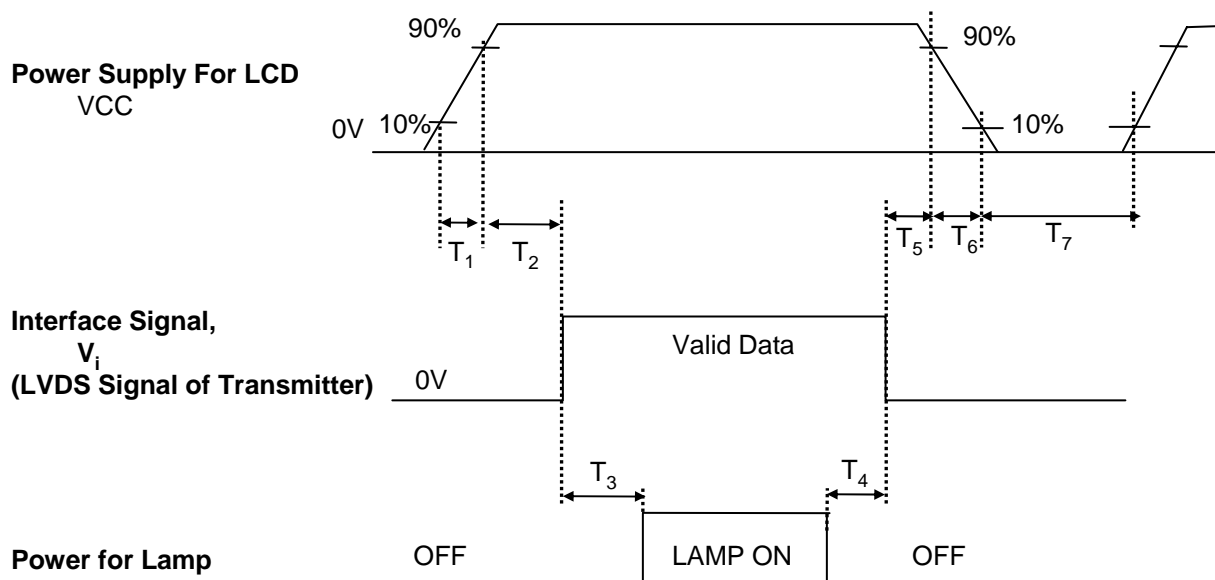


Table 7. POWER SEQUENCE TABLE

| Parameter | Value | | | Unit |
|----------------|-------|------|------|------|
| | Min. | Typ. | Max. | |
| T ₁ | - | - | 10 | ms |
| T ₂ | 0 | - | 50 | ms |
| T ₃ | 200 | - | - | ms |
| T ₄ | 200 | - | - | ms |
| T ₅ | 0 | - | 50 | ms |
| T ₆ | 0 | - | 10 | ms |
| T ₇ | 400 | - | - | ms |

- 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 VCC to 0V.
 3. Lamp power must be turn on after power supply for LCD and interface signal are valid.

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4. Optical Specification

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

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

FIG. 1 Optical Characteristic Measurement Equipment and Method

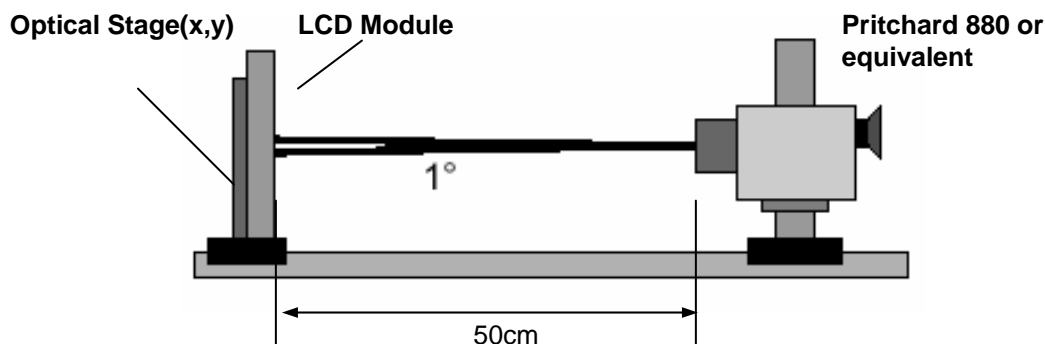


Table 8. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, fv=60Hz
Dclk= 65MHz, IBL= 6.0mA

| Parameter | | Symbol | Values | | | Units | Notes |
|-------------------------------|-----------------------|--------------------|--------|-------|-------|-------------------|---------------------|
| | | | Min | Typ | Max | | |
| Contrast Ratio | | CR | 175 | 250 | - | | 1 |
| Surface Luminance, white (5P) | | L _{WH} | 125 | 150 | | cd/m ² | 2 |
| Luminance Variation (13P) | | δ _{WHITE} | - | - | 1.65 | | 3 |
| Response Time | | | | | | | 4 |
| | Rise Time | Tr _R | - | 10 | 20 | ms | PR650 or equivalent |
| | Decay Time | Tr _D | - | 20 | 30 | ms | |
| Color Coordinates | | | | | | | |
| | RED | RX | 0.557 | 0.587 | 0.617 | | |
| | | RY | 0.313 | 0.343 | 0.373 | | |
| | GREEN | GX | 0.291 | 0.321 | 0.351 | | |
| | | GY | 0.500 | 0.530 | 0.565 | | |
| | BLUE | BX | 0.129 | 0.159 | 0.189 | | |
| | | BY | 0.110 | 0.140 | 0.170 | | |
| | WHITE | WX | 0.283 | 0.313 | 0.343 | | |
| | | WY | 0.299 | 0.329 | 0.359 | | |
| Viewing Angle | | | | | | | 5 |
| | x axis, right(Φ=0°) | Θ _r | 40 | 45 | - | degree | |
| | x axis, left (Φ=180°) | Θ _l | 40 | 45 | - | degree | |
| | y axis, up (Φ=90°) | Θ _u | 10 | 15 | - | degree | |
| | y axis, down (Φ=270°) | Θ _d | 30 | 35 | - | degree | |
| Gray Scale | | | | | | | 6 |

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

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

2. Surface luminance is the average of 5 points across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 1., When $I_{BL}=6.0\text{mA}$.

3. The variation in surface luminance , The Panel total variation (δ_{WHITE}) is determined by measuring L_{ON} at each test position 1 through 13, and then dividing the maximum L_{ON} of 13 points luminance by minimum L_{ON} of 13 points luminance. For more information see FIG 2.

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

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

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

6. Gray scale specification

* $f_v=60\text{Hz}$

| Gray Level | Luminance [%] (Typ) |
|------------|---------------------|
| L0 | 0.39 |
| L7 | 1.20 |
| L15 | 4.50 |
| L23 | 11.3 |
| L31 | 22.0 |
| L39 | 38.0 |
| L47 | 57.5 |
| L55 | 80.0 |
| L63 | 100 |

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FIG. 2 Luminance

<measuring point for surface luminance>

POINTS: 5 POINT (1~5)

<measuring point for luminance variation>

POINTS: 13 POINTS (1~13)

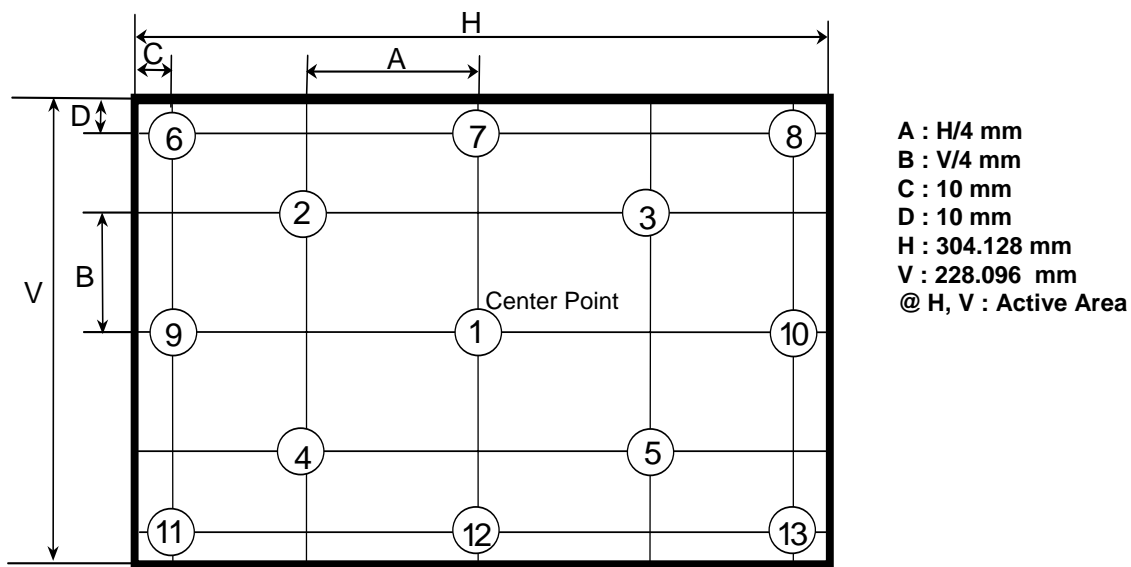
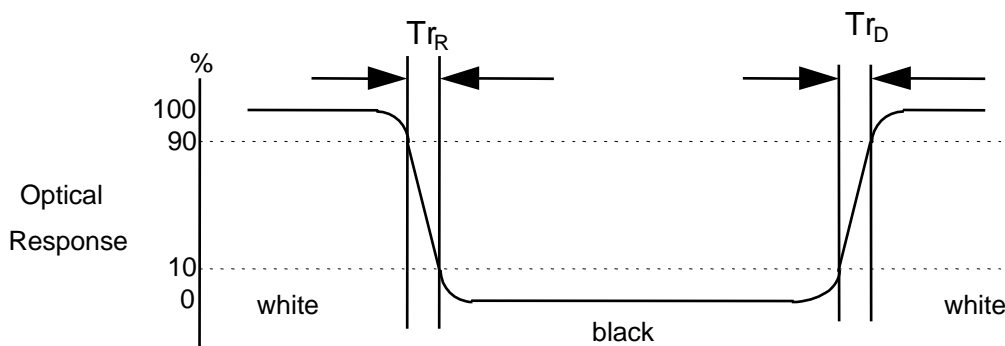


FIG. 3 Response Time

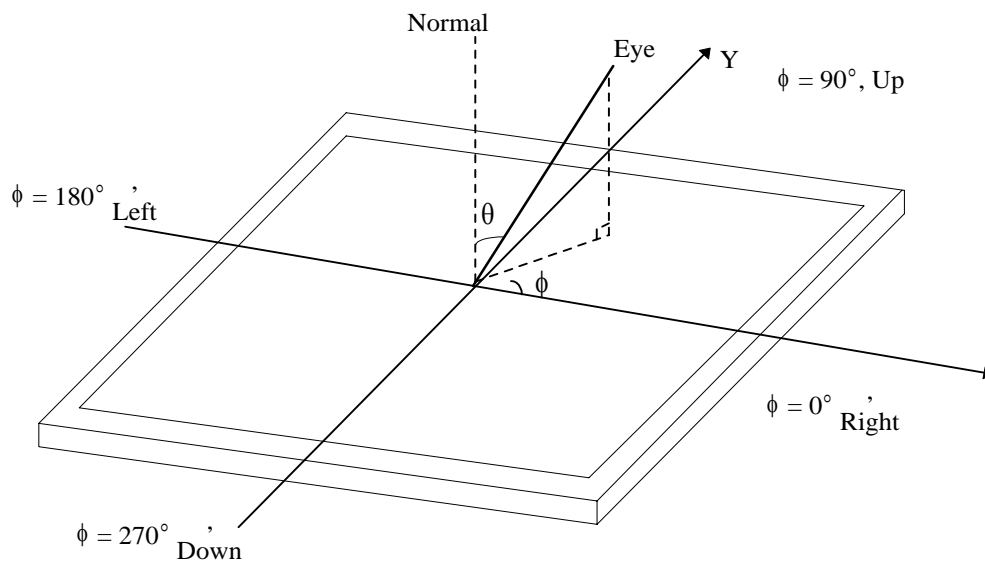
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



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FIG. 4 Viewing angle

<Dimension of viewing angle range>



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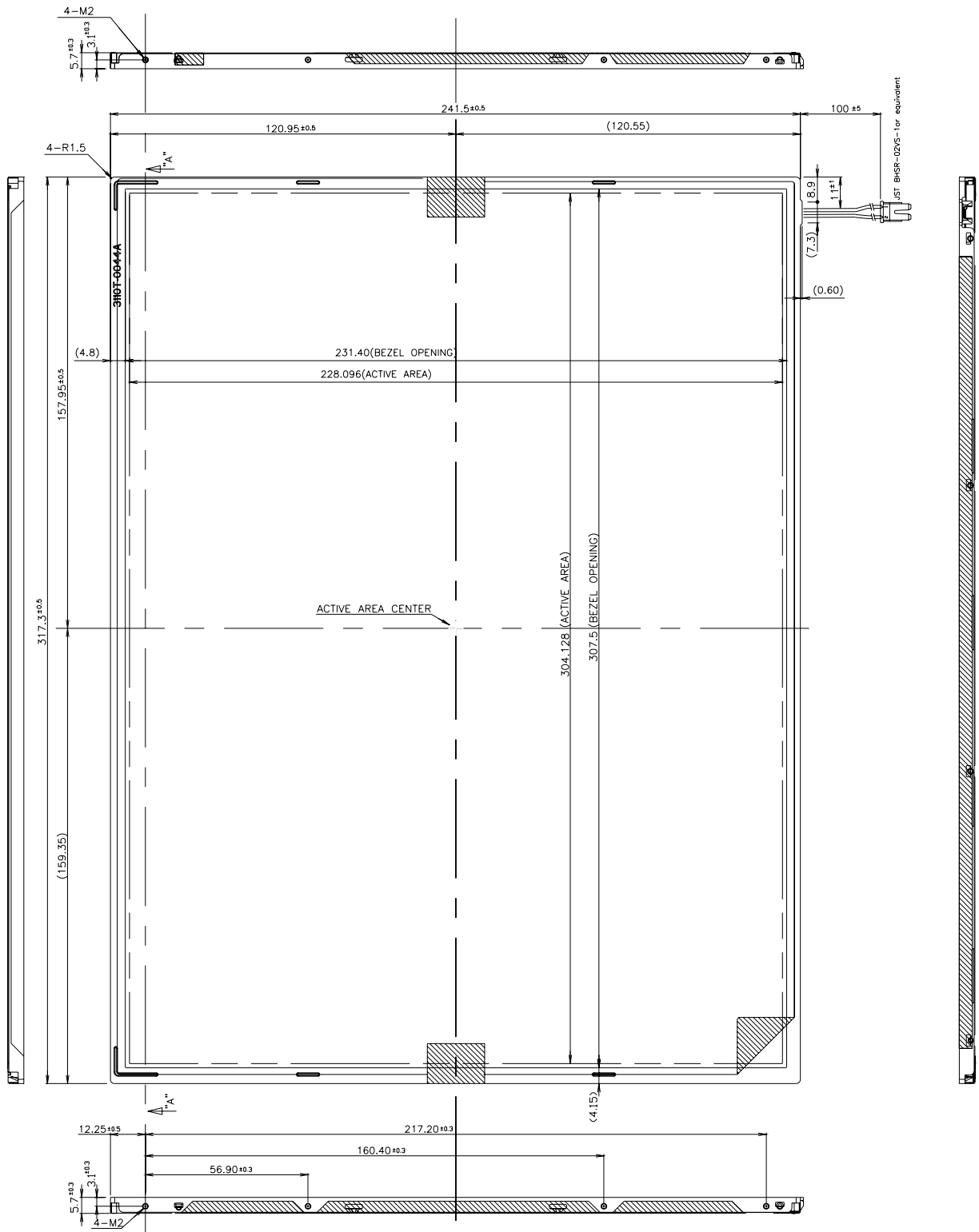
5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LP150X08. In addition the figures in the next page are detailed mechanical drawing of the LCD.

| | | |
|---------------------|---|--------------------------|
| Outline Dimension | Horizontal | $317.3 \pm 0.5\text{mm}$ |
| | Vertical | $241.5 \pm 0.5\text{mm}$ |
| | Depth | $5.7 \pm 0.3\text{mm}$ |
| Bezel Area | Horizontal | $307.5 \pm 0.5\text{mm}$ |
| | Vertical | $231.4 \pm 0.5\text{mm}$ |
| Active Display Area | Horizontal | 304.128 mm |
| | Vertical | 228.096 mm |
| Weight | 540g (Typ.) 555g (Max.) | |
| Surface Treatment | Hard coating(3H) Anti-glare treatment of the front polarizer | |

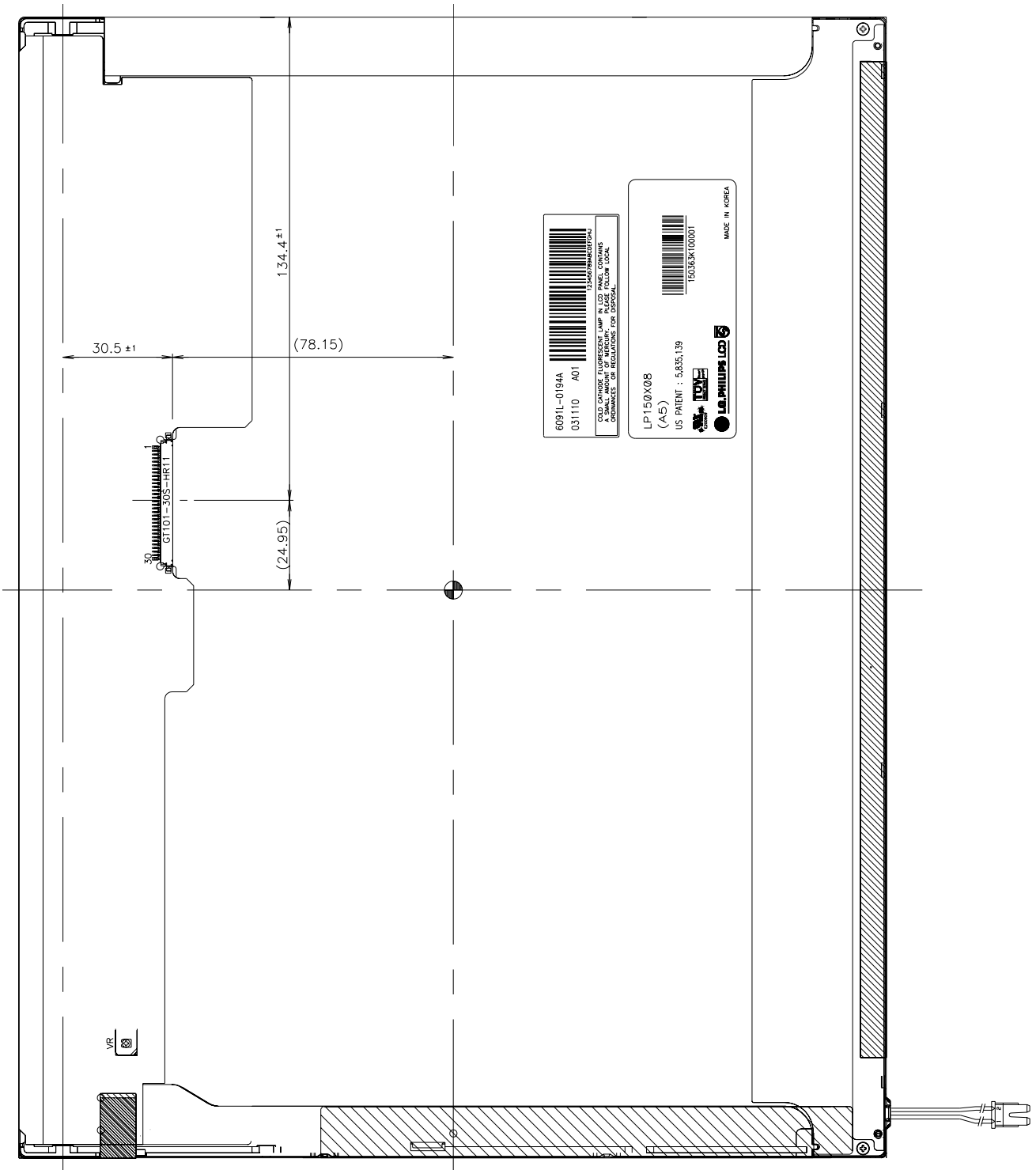
Product Specification

<FRONT VIEW>



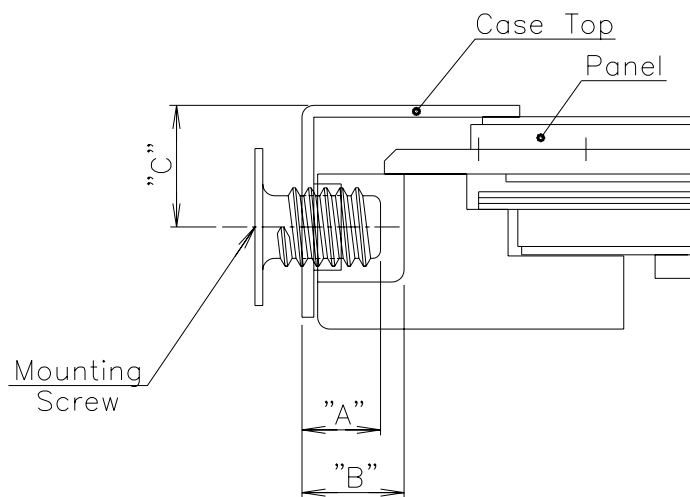
Product Specification

<REAR VIEW>



Product Specification

[DETAIL DESCRIPTION OF SIDE MOUNTING SCREW]



- * Mounting Screw depth
 depth Min. : "A" =2.0
 depth Max : "B" =2.5
- * Mounting hole location : "C" = 3.1 (typ.)
- * Torque : 2 kgf.cm(Max)
 (Measurement gauge : torque meter)

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

Product Specification

6. Reliability

Environment test condition

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

{ Result Evaluation Criteria }

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

7. International Standards

7-1. Safety

- a) UL 60950, Third Edition, Underwriters Laboratories, Inc., Dated Dec. 11, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
- b) CAN/CSA C22.2, No. 60950, Third Edition, Canadian Standards Association, Dec. 1, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
- c) EN 60950 : 2000, Third Edition
IEC 60950 : 1999, Third Edition
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 Electrical Equipment in the Range of 9kHz to 40GHz. "American National Standards Institute(ANSI), 1992
- b) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special Committee on Radio Interference.
- c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electrotechnical Standardization.(CENELEC), 1998
(Including A1: 2000)

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 : SIZE(INCH)

D : YEAR

F : PANEL CODE

H : ASSEMBLY CODE

E : MONTH

G : FACTORY 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 |

3. PANEL CODE

| | | | | | | |
|------------|------------|------------|------------|------------|------------|-------------|
| Panel Code | P1 Factory | P2 Factory | P3 Factory | P4 Factory | P5 Factory | Hydis Panel |
| Mark | 1 | 2 | 3 | 4 | 5 | H |

4. FACTORY CODE

| | | | |
|--------------|----------|-------------|---------|
| Factory Code | LPL Gumi | LPL Nanjing | Heesung |
| Mark | K | C | D |

5. SERIAL NO.

| | | |
|------|---------------|------------------------------|
| Year | 1 ~ 99999 | 100000 ~ |
| Mark | 00001 ~ 99999 | A0001 ~ A9999, , Z9999 |

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 : 15 pcs
- b) Box Size : 374mm × 329mm × 311mm

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 the surface 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) The protection film is attached to the bezel with a small masking tape.
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) 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 bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

Product Specification
APPENDIX [A] - Enhanced Extended Display Identification Data (EEDID™)

| Byte# (decimal) | Byte# (HEX) | Field Name and Comments | Value (HEX) | Value (binary) | |
|--------------------|----------------|---|----------------|-------------------|---|
| 0 | 00 | Header | 0 0 | 0000 0000 | Header |
| 1 | 01 | | F F | 1111 1111 | |
| 2 | 02 | | F F | 1111 1111 | |
| 3 | 03 | | F F | 1111 1111 | |
| 4 | 04 | | F F | 1111 1111 | |
| 5 | 05 | | F F | 1111 1111 | |
| 6 | 06 | | F F | 1111 1111 | |
| 7 | 07 | | 0 0 | 0000 0000 | Vender/ Product ID |
| 8 | 08 | EISA manufacturer code = LGP | 3 0 | 0011 0000 | |
| 9 | 09 | Compressed ASCII | F 0 | 1111 0000 | |
| 10 | 0A | Panel Supplier Reserved -Product code=5XF | 5 7 | 0101 0111 | |
| 11 | 0B | (Hex, LSB first) | 0 6 | 0000 0110 | |
| 12 | 0C | ID(32-bit) serial number = don't care | 0 0 | 0000 0000 | |
| 13 | 0D | | 0 0 | 0000 0000 | |
| 14 | 0E | | 0 0 | 0000 0000 | EDID Version/ Revision |
| 15 | 0F | | 0 0 | 0000 0000 | |
| 16 | 10 | Week of manufacture = don't care | 0 0 | 0000 0000 | |
| 17 | 11 | Year of manufacture = don't care | 0 0 | 0000 0000 | |
| 18 | 12 | EDID Structure version # = "1" | 0 1 | 0000 0001 | |
| 19 | 13 | EDID Revision # = "3" | 0 3 | 0000 0011 | |
| 20 | 14 | Video input definition = Digital I/p.non TMDS CRGB | 8 0 | 1000 0000 | Display Parameter |
| 21 | 15 | Max H image size(cm)= 30.4128cm(30) | 1 E | 0001 1110 | |
| 22 | 16 | Max V image size(cm)= 22.8096cm(23) | 1 7 | 0001 0111 | |
| 23 | 17 | Display gamma = 2.2 | 7 8 | 0111 1000 | |
| 24 | 18 | Feature support(DPMS) = Active off, RGB Color | 0 A | 0000 1010 | |
| 25 | 19 | Red/Green low Bits (RxRy/GxGy) | 7 2 | 0111 0010 | |
| 26 | 1A | Blue/White Low Bits (BxBY/WxWy) | B 0 | 1011 0000 | |
| 27 | 1B | Red X Rx = 0.587 | 9 6 | 1001 0110 | Color Characteristic |
| 28 | 1C | Red Y Ry = 0.343 | 5 7 | 0101 0111 | |
| 29 | 1D | Green X Gx = 0.321 | 5 2 | 0101 0010 | |
| 30 | 1E | Green Y Gy = 0.530 | 8 7 | 1000 0111 | |
| 31 | 1F | Blue X Bx = 0.159 | 2 8 | 0010 1000 | |
| 32 | 20 | Blue Y By = 0.140 | 2 3 | 0010 0011 | |
| 33 | 21 | White X Wx = 0.313 | 5 0 | 0101 0000 | |
| 34 | 22 | White Y Wy = 0.329 | 5 4 | 0101 0100 | Established Timings |
| 35 | 23 | Established Timing I | 0 0 | 0000 0000 | |
| 36 | 24 | Established Timing II | 0 0 | 0000 0000 | |
| 37 | 25 | Manufacturer's Timings | 0 0 | 0000 0000 | |
| 38 | 26 | Standard Timing ID1 (01h if not used) | 0 1 | 0000 0001 | |
| 39 | 27 | Standard Timing ID1 (01h if not used) | 0 1 | 0000 0001 | |
| 40 | 28 | Standard Timing ID2 (01h if not used) | 0 1 | 0000 0001 | Standard Timing ID |
| 41 | 29 | Standard Timing ID2 (01h if not used) | 0 1 | 0000 0001 | |
| 42 | 2A | Standard Timing ID3 (01h if not used) | 0 1 | 0000 0001 | |
| 43 | 2B | Standard Timing ID3 (01h if not used) | 0 1 | 0000 0001 | |
| 44 | 2C | Standard Timing ID4 (01h if not used) | 0 1 | 0000 0001 | |
| 45 | 2D | Standard Timing ID4 (01h if not used) | 0 1 | 0000 0001 | |
| 46 | 2E | Standard Timing ID5 (01h if not used) | 0 1 | 0000 0001 | |
| 47 | 2F | Standard Timing ID5 (01h if not used) | 0 1 | 0000 0001 | |
| 48 | 30 | Standard Timing ID6 (01h if not used) | 0 1 | 0000 0001 | |
| 49 | 31 | Standard Timing ID6(01h if not used) | 0 1 | 0000 0001 | |
| 50 | 32 | Standard Timing ID7(01h if not used) | 0 1 | 0000 0001 | |
| 51 | 33 | Standard Timing ID7 (01h if not used) | 0 1 | 0000 0001 | |
| 52 | 34 | Standard Timing ID8 (01h if not used) | 0 1 | 0000 0001 | |
| 53 | 35 | Standard Timing ID8 (01h if not used) | 0 1 | 0000 0001 | |
| 54 | 36 | Detailed Timing Descriptor #1 | 6 4 | 0110 0100 | Detailed Timing Description #1 |
| 55 | 37 | 1024X768 @ 60 Hz mode : pixel clock = 65.00 MHz | 1 9 | 0001 1001 | |
| 56 | 38 | Horizontal Active = 1024 pixels | 0 0 | 0000 0000 | |
| 57 | 39 | Horizontal Blanking = 320 pixels | 4 0 | 0100 0000 | |
| 58 | 3A | Horizontal Active : Horizontal Blanking | 4 1 | 0100 0001 | |
| 59 | 3B | Vertical Active = 768 lines | 0 0 | 0000 0000 | |
| 60 | 3C | Vertical Blanking = 38 lines | 2 6 | 0010 0110 | |
| 61 | 3D | Vertical Active : Vertical Blanking | 3 0 | 0011 0000 | |
| 62 | 3E | Horizontal Sync. Offset = 24 pixels | 1 8 | 0001 1000 | |
| 63 | 3F | Horizontal Sync. Pulse Width = 136 pixels | 8 8 | 1000 1000 | |
| 64 | 40 | Vertical Sync. Offset = 3 lines : Sync. Width = 6 lines | 3 6 | 0011 0110 | |

Product Specification

| Byte# (decimal) | Byte# (HEX) | Field Name and Comments | Value (HEX) | Value (binary) | |
|--------------------|----------------|---|----------------|-------------------|---|
| 65 | 41 | Horizontal Vertical Sync. Offset/Width upper 2bits | 0 0 | 0000 0000 | Detailed Timing Description #1 |
| 66 | 42 | Horizontal Image Size = 304.128 mm(304) | 3 0 | 0011 0000 | |
| 67 | 43 | Vertical Image Size = 228.096 mm(228) | E 4 | 1110 0100 | |
| 68 | 44 | Horizontal & Vertical Image Size | 1 0 | 0001 0000 | |
| 69 | 45 | Horizontal Border = 0 | 0 0 | 0000 0000 | |
| 70 | 46 | Vertical Border = 0 | 0 0 | 0000 0000 | |
| 71 | 47 | Non-interlaced,Normal display,no stereo,Digital separate sync,H/V pol | 1 8 | 0001 1000 | |
| 72 | 48 | Detailed Timing Descriptor #2 was not used | 0 0 | 0000 0000 | Detailed Timing Description #2 |
| 73 | 49 | | 0 0 | 0000 0000 | |
| 74 | 4A | | 0 0 | 0000 0000 | |
| 75 | 4B | | 0 0 | 0000 0000 | |
| 76 | 4C | | 0 0 | 0000 0000 | |
| 77 | 4D | | 0 0 | 0000 0000 | |
| 78 | 4E | | 0 0 | 0000 0000 | |
| 79 | 4F | | 0 0 | 0000 0000 | |
| 80 | 50 | | 0 0 | 0000 0000 | |
| 81 | 51 | | 0 0 | 0000 0000 | |
| 82 | 52 | | 0 0 | 0000 0000 | |
| 83 | 53 | | 0 0 | 0000 0000 | |
| 84 | 55 | | 0 0 | 0000 0000 | |
| 85 | 55 | | 0 0 | 0000 0000 | |
| 86 | 56 | | 0 0 | 0000 0000 | |
| 87 | 57 | | 0 0 | 0000 0000 | |
| 88 | 58 | | 0 0 | 0000 0000 | |
| 89 | 59 | | 0 0 | 0000 0000 | Detailed Timing Description #3 |
| 90 | 5A | Detailed Timing Descriptor #3 | 0 0 | 0000 0000 | |
| 91 | 5B | | 0 0 | 0000 0000 | |
| 92 | 5C | ASCII Data String Tag (Supplier Name) | 0 0 | 0000 0000 | |
| 93 | 5D | | 0 0 | 0000 0000 | |
| 94 | 5E | | 0 0 | 0000 0000 | |
| 95 | 5F | | 4 C | 0100 1100 | |
| 96 | 60 | [L] | 4 7 | 0100 0111 | |
| 97 | 61 | [P] | 5 0 | 0101 0000 | |
| 98 | 62 | [h] | 6 8 | 0110 1000 | |
| 99 | 63 | [i] | 6 9 | 0110 1001 | |
| 100 | 64 | [I] | 6 C | 0110 1100 | |
| 101 | 65 | [i] | 6 9 | 0110 1001 | |
| 102 | 66 | [p] | 7 0 | 0111 0000 | |
| 103 | 67 | [s] | 7 3 | 0111 0011 | |
| 104 | 68 | [L] | 4 C | 0100 1100 | |
| 105 | 69 | [C] | 4 3 | 0100 0011 | |
| 106 | 6A | [D] | 4 4 | 0100 0100 | Detailed Timing Description #4 |
| 107 | 6B | [^] Line Feed | 0 A | 0000 1010 | |
| 108 | 6C | Detailed Timing Descriptor #4 | 0 0 | 0000 0000 | |
| 109 | 6D | | 0 0 | 0000 0000 | |
| 110 | 6E | ASCII Data String Tag (Supplier P/N) | 0 0 | 0000 0000 | |
| 111 | 6F | | 0 0 | 0000 0000 | |
| 112 | 70 | | 0 0 | 0000 0000 | |
| 113 | 71 | | 4 C | 0100 1100 | |
| 114 | 72 | [P] | 5 0 | 0101 0000 | |
| 115 | 73 | [1] | 3 1 | 0011 0001 | |
| 116 | 74 | [5] | 3 5 | 0011 0101 | |
| 117 | 75 | [0] | 3 0 | 0011 0000 | |
| 118 | 76 | [X] | 5 8 | 0101 1000 | |
| 119 | 77 | [0] | 3 0 | 0011 0000 | |
| 120 | 78 | [8] | 3 8 | 0011 1000 | |
| 121 | 79 | [-] | 2 D | 0010 1101 | |
| 122 | 7A | [A] | 4 1 | 0100 0001 | |
| 123 | 7B | [5] | 3 5 | 0011 0101 | |
| 124 | 7C | | 0 0 | 0000 0000 | Extension Flag Checksum |
| 125 | 7D | | 0 0 | 0000 0000 | |
| 126 | 7E | Extension flag = 00 | 0 0 | 0000 0000 | |
| 127 | 7F | Checksum | 2 3 | 0010 0011 | |