

# LCD Module Technical Specification

**G121S1-L01-V467**

TFT-LCD with LED Backlighting



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**Rev. 0**

**February 27, 2008**

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## 1. Revision History

| Date      | Rev. | Author | Description     | Page |
|-----------|------|--------|-----------------|------|
| 27-Feb-08 | 0    | al1    | Initial Release |      |

## 2. General Specifications

G121S1-L01-V467 is a 12.1" TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of an LCD panel, driver ICs, control circuits and LED Backlighting. This module provides 800 x 600 SVGA resolution and can display 262,144 colors. It is fully RoHS compliant and has a wide operating temperature range. This module provides reverse-scan functionality and has very high contrast ratio. SuperMVA technology provides wide viewing angle.

Input power is 3.3/5VDC for the LCD module. Digital type data and control signals are transmitted via a LVDS interface having a (typical) 39.7MHz clock frequency. The power supply for the backlight unit is not integrated into this module.

Specifications are summarized in the following table:

| Item                            | Specification                               |
|---------------------------------|---|
| Display Area (mm)               | 246(H) × 184.5(V) (12.1-inch diagonal)      |
| Number of Dots                  | 800 × 3 (H) × 600 (V)                       |
| Pixel Pitch(mm)                 | 0.3075 (H) × 0.3075 (V)                     |
| Color Pixel Arrangement         | RGB vertical stripe                         |
| Driver Element                  | a-Si TFT active matrix                      |
| Number of Colors                | 262,144 (6 bits/color)                      |
| Brightness (cd/m <sup>2</sup> ) | 530   |
| Display Mode                    | Normally black                              |
| Viewing Angle Technology        | -89~89° (H) -89~89° (V)                     |
| Surface Treatment               | Anti-glare (Haze 25%) and hard-coating (3H) |
| Electrical Interface            | LVDS (6-bits per color)                     |
| Operating Temperature Range     | -30~70°C                                    |
| Module Size (mm)                | 260.5 (W) × 204 (H) × 12.2 (D)              |
| Module Mass (g)                 | 660   |
| Backlight Unit                  | LED, dual edge-lit                          |

Note: A characteristic value shown without any note is a typical value.

### 3. Electrical Specifications

#### 3.1. Absolute Maximum Ratings

| ITEM                                | SYMBOL       | MIN. | MAX | UNIT |
|-------------------------------------|--------------|------|-----|------|
| Power Supply Voltage for LCD        | VCC          | -0.3 | 6.0 | V    |
| LED Forward Current                 | IL           | 0    | 1.3 | A    |
| Operation Temperature (Panel) *1,2) | Top(Panel)   | -30  | 70  | °C   |
| Operation Temperature (Ambient) *2) | Top(Ambient) | -30  | 70  | °C   |
| Storage Temperature *2)             | Tstg         | -30  | 80  | °C   |

[Note]

\*1) Measured at the center of active area and at the center of panel back surface

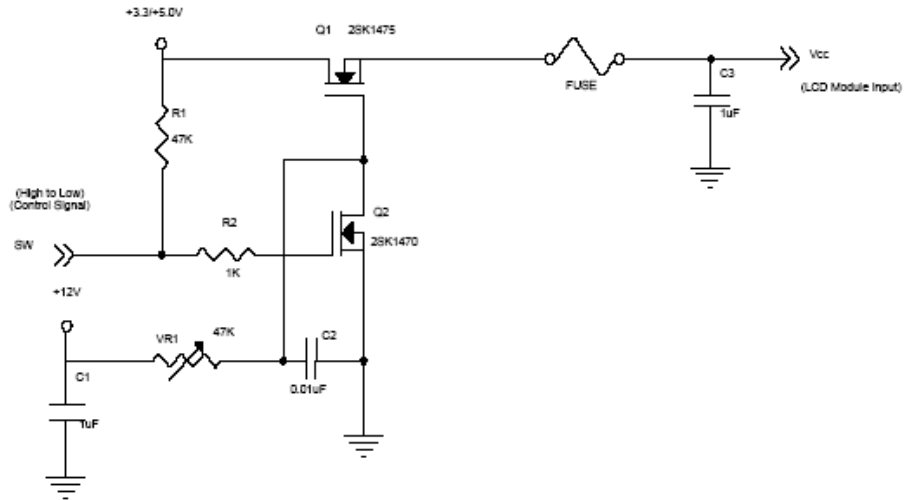
\*2) Top, Tstg ≤ -40°C : 90%RH max. without condensation Top, Tstg > -40°C : Absolute humidity shall be less than the value of 90%RH at -40°C without condensation.

#### 3.2. DC Characteristics

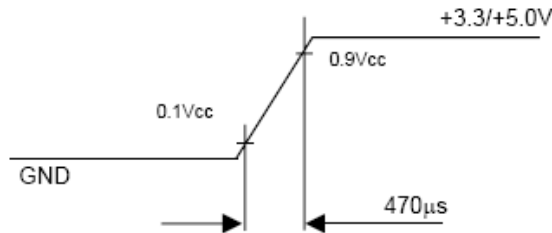
| ITEM   | SYMBOL    | MIN. | TYP.  | MAX. | UNIT  | Remarks |
|--|-----------|------|-------|------|-------|---------|
| Power Supply Voltage for LCD                           | VCC       | 3.0  | 3.3/5 | 5.5  | V     |         |
| Inrush Current   | IRUSH     |      |       | 1.0  | A     | *2)     |
| Power Supply Current                                   | White     | ICC  | 800   |      | mA    | *3a)    |
|  | Black     |      | 440   |      | mA    | *3b)    |
| Permissive Input Ripple Voltage                        | VRP       | --   | --    | 100  | mVp-p |         |
| Differential Input Voltage for LVDS Receiver Threshold | "H" level | VIH  |       | 100  | mV    |         |
|  | "L" level | VIL  | -100  |      | mV    |         |

\*1) The module shall be operated within above ranges.

\*2) Measurement Conditions:



**Vcc rising time is 470 $\mu$ s**

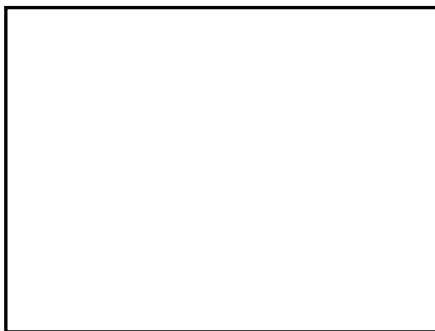


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\*3) The specified power supply current is under the conditions at  $V_{DD} = 5.0V$ ,  $T_a = 25 \pm 2^\circ C$ , DC Current and  $f_v = 60$  Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern

b. Black Pattern



Active Area



Active Area

### 3.3. AC Characteristics

LVDS transmitter input signal

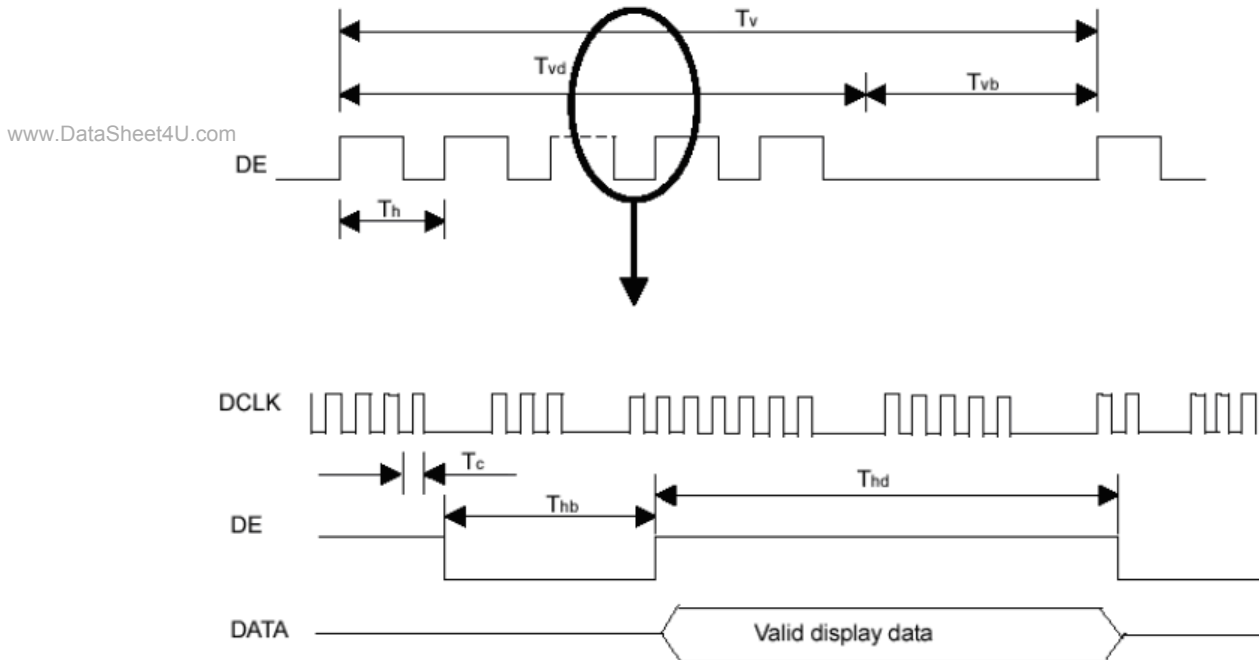
| Signal                         | Item       | Symbol | Min.   | Typ. | Max.   | Unit | Note       |
|--------------------------------|------------|--------|--------|------|--------|------|------------|
| LVDS Clock                     | Frequency  | Fc     | 33.4   | 39.7 | 48.3   | MHz  | -          |
|                                | Period     | Tc     | 20.7   | 25.1 | 29.9   | ns   | -          |
| Vertical Active Display Term   | Frame Rate | Fr     | 56     | 60   | 75     | Hz   | Tv=Tvd+Tvb |
|                                | Total      | Tv     | 606    | 628  | 650    | Th   | -          |
|                                | Display    | Tvd    | 600    | 600  | 600    | Th   | -          |
|                                | Blank      | Tvb    | Tv-Tvd | 28   | Tv-Tvd | Th   | -          |
| Horizontal Active Display Term | Total      | Th     | 920    | 1056 | 1240   | Tc   | Th=Thd+Thb |
|                                | Display    | Thd    | 800    | 800  | 800    | Tc   | -          |
|                                | Blank      | Thb    | Th-Thd | 256  | Th-Thd | Tc   | -          |

The input signal timing specifications are shown as the following table and timing diagram.

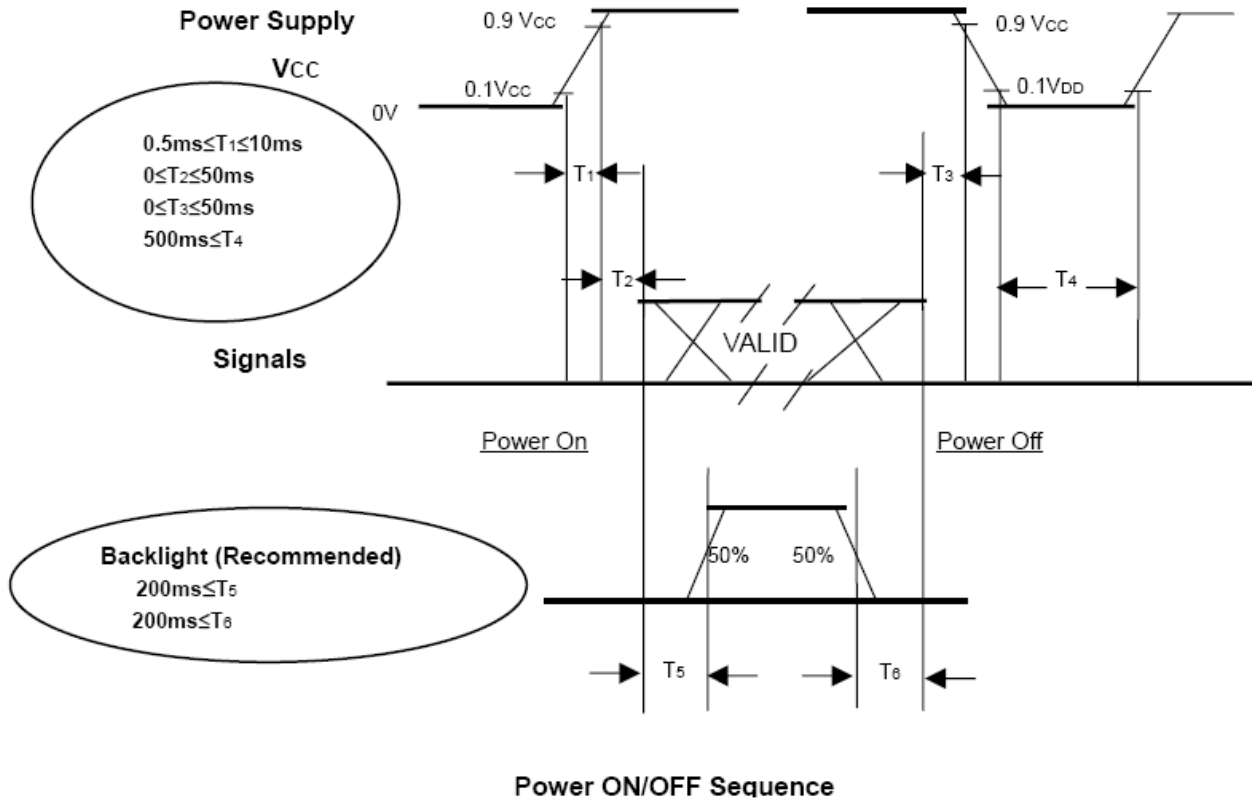
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module may operate abnormally.

#### 3.3.1. Input Signal Timing Diagram

##### INPUT SIGNAL TIMING DIAGRAM



### 3.3.2. Power On/Off Sequence



#### Timing Specifications:

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- 0.5 < t<sub>1</sub> ≤ 10 msec
- 0 < t<sub>2</sub> ≤ 50 msec
- 0 < t<sub>3</sub> ≤ 50 msec
- t<sub>4</sub> ≥ 500 msec
- t<sub>5</sub> ≥ 200 msec
- t<sub>6</sub> ≥ 200 msec

Note (1) Please avoid floating state of interface signal during invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD V<sub>CC</sub> to 0 V.

Note (3) The Backlight power must be turned on after the power supply for the logic and the interface signals are valid. The Backlight power must be turned off before the power supply for the logic and the interface signal is invalid.

### 3.4. Color Data Assignment

| Color               |               | Data Signal |    |    |    |    |    |       |    |    |    |    |    |      |    |    |    |    |    |
|---------------------|---------------|-------------|----|----|----|----|----|-------|----|----|----|----|----|------|----|----|----|----|----|
|                     |               | 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           | 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  |
| Gray Scale Of Red   | Red(0)/Dark   | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Red(1)        | 0           | 0  | 0  | 0  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Red(2)        | 0           | 0  | 0  | 0  | 1  | 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  |    |
|                     | Red(62)       | 1           | 1  | 1  | 1  | 1  | 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  |    |    |
| Gray Scale Of Green | Green(0)/Dark | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Green(1)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Green(2)      | 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  | 1     | 1  | 1  | 1  | 0  | 1  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Green(62)     | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 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  |    |    |
| Gray Scale Of Blue  | Blue(0)/Dark  | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  |    |
|                     | Blue(1)       | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 1  |    |
|                     | Blue(2)       | 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  |    |
|                     | Blue(62)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 0  |    |
| Blue(63)            | 0             | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  |    |    |

[Note]

1) Definition of gray scale: Color (n) --- n indicates gray scale level. Higher n means brighter level.

2) Data 1:High, 0: Low



### 3.5. Backlight Specifications

$T_a = 25^{\circ}\text{C}$

| ITEM                | SYMBOL | MIN | TYP.   | MAX. | UNIT | Remarks               |
|---------------------|--------|-----|--------|------|------|-----------------------|
| LED Forward Voltage | VL     | --  | 8.68   | 9.58 | V    | *1), IL = 760mA       |
| LED Forward Current | IL     | --  | --     | 760  | mA   | *2)                   |
| Power Consumption   | WL     | --  | 6.60   | --   | W    | IL = 760mA            |
| Backlight Lifetime  | BL     | --  | 50,000 | --   | h    | *3), *4), IL = 760 mA |

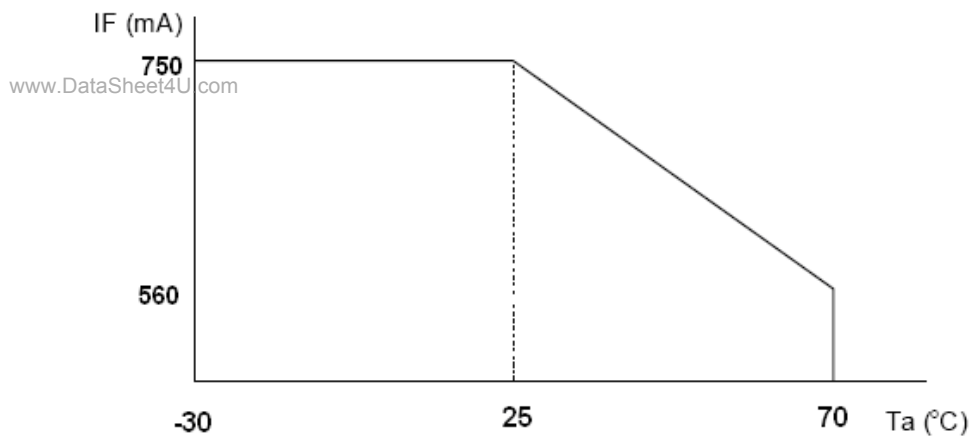
\*1) VL is specified as the sum of the white LED forward voltages.

\*2) LEDs are best driven using a constant current source. To avoid chromaticity shifts while dimming pulse-width modulation (PWM) techniques may be employed (0-100% duty cycle).

\*3) Backlight lifetime is defined as the time when the brightness becomes 50% of the initial value.

\*4) The lifetime of the backlight depends on the ambient temperature. The lifetime will decrease under high temperature unless LED forward current is reduced accordingly.

\*5) LED forward current derating curve:



\*5) Recommended backlight power supply:

| PART NUMBER | MANUFACTURER                      |
|-------------|-----------------------------------|
| CCBR-2-750  | Apollo Display Technologies, LLC. |

## 4. Optical Specifications

Conditions: Ta = 25±2°C, Ambient Humidity 50±10 %RH, VCC = 3.3V, Input Signals: typical values, IL = 760mA

| ITEM                      |            | SYMBOL      | CONDITION                    | MIN    | TYP    | MAX | UNIT              | Remarks    |
|---------------------------|------------|-------------|------------------------------|--------|--------|-----|-------------------|------------|
| Contrast Ratio            |            | CR          | $\theta = \varphi = 0^\circ$ | 700    | 1000   | --  | --                | *1)*2)*9)  |
| Center Luminance of White |            | Lw          | $\theta = \varphi = 0^\circ$ | 470    | 530    | --  | cd/m <sup>2</sup> | *1)*3)*9)  |
| Luminance Uniformity      |            | $\Delta Lw$ | $\theta = \varphi = 0^\circ$ | --     | --     | 28  | %                 | *1)*4)*9)  |
| Cross Talk                |            | CT          |                              |        |        | 5   | %                 | *6)*9)     |
| Response Time             |            | tr          | $\theta = \varphi = 0^\circ$ | --     | 13     | 18  | Ms                | *1)*7)*9)  |
|                           |            | tf          | $\theta = \varphi = 0^\circ$ | --     | 12     | 17  | Ms                | *1)*7)*9)  |
| Viewing Angle             | Horizontal | $\varphi$   | CR ≥ 10                      | -80~80 | -89~89 | --  | °                 | *1)*9)*10) |
|                           | Vertical   | $\theta$    |                              | -80~80 | -89~89 | --  | °                 | *1)*9)*10) |
| Chromaticity              | White      | Wx          | $\theta = \varphi = 0^\circ$ | --     | 0.317  | --  | --                | *1)*9)     |
|                           |            | Wy          |                              | --     | 0.342  | --  | --                |            |

[Note]

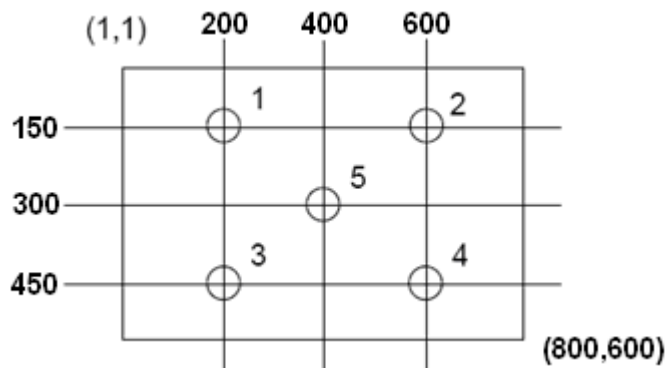
Measured items are measured using CS1000 (MINOLTA) for color coordinates, EZContrast (ELDIM) for viewing angle, and CS1000 or BM-5A (TOPCON) for others under the dark room condition (no ambient light) after more than 30 minutes from turning on the lamp unless noted.

\*1) Measurement Points:

Contrast Ratio, Luminance, Response Time, Viewing Angle, Color Coordinates: Display Center

Luminance Uniformity: points 1-5 shown in a figure below:

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\*2) Definition of Contrast Ratio:

CR=ON (White) Luminance / OFF(Black) Luminance

\*3) Definition of Luminance:

Lw= ON (White) Luminance

\*4) Definition of Luminance Uniformity:

$$\Delta Lw = [Lw(\text{MAX})/Lw(\text{MIN}) - 1] \times 100$$

**\*5) Definition of Luminance of White ( $L_C$ ):**

Measure the luminance of gray level 255 at center point  $L_C = L(5)$

$L(x)$  is corresponding to the luminance of the point  $X$  at Figure in Note\*1).

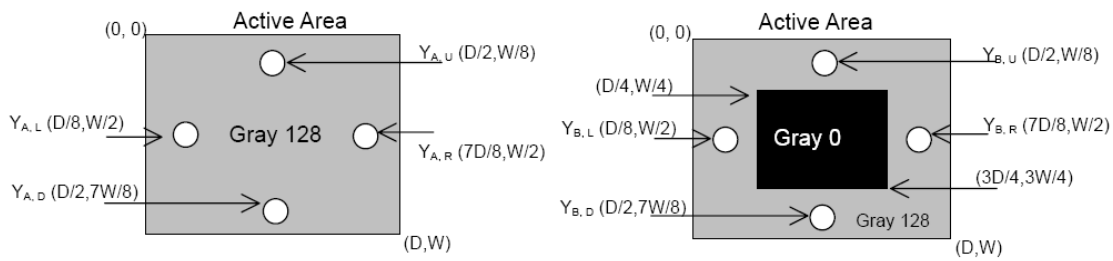
**\*6) Definition of Cross Talk (CT):**

$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

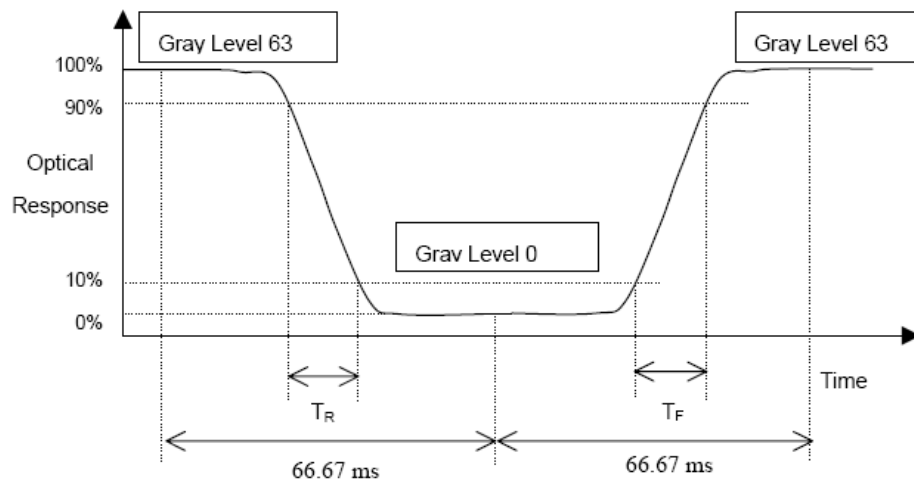
Where:

$Y_A$  = Luminance of measured location without gray level 0 pattern ( $cd/m^2$ )

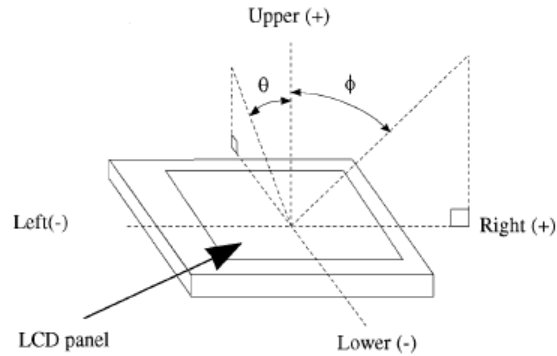
$Y_B$  = Luminance of measured location with gray level 0 pattern ( $cd/m^2$ )



**\*7) Definition of Response Time**

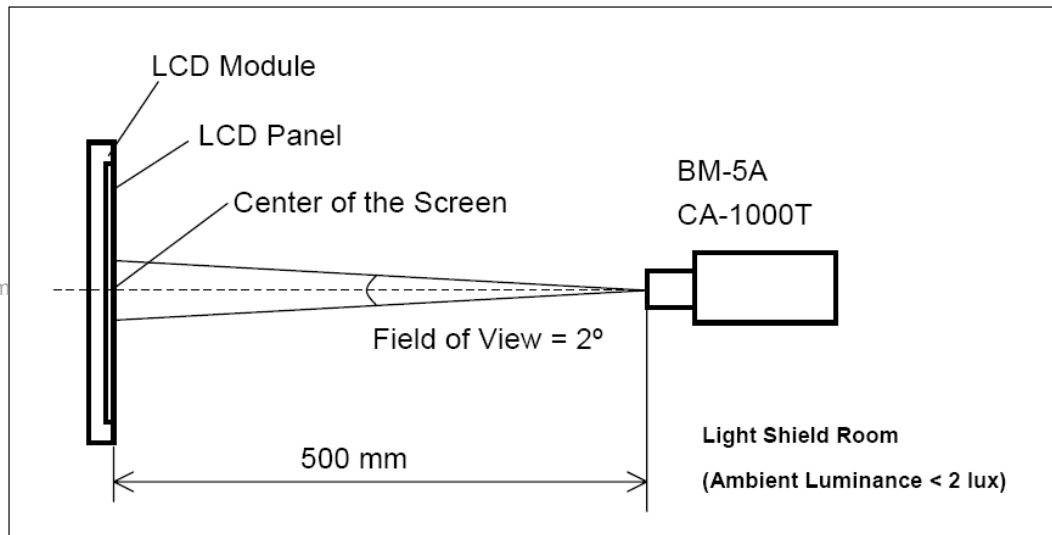


\*8) Definition of Viewing Angle(  $\theta$  ,  $\phi$  )



\*9) Measurement Setup:

The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



\*10) TN type has Gray scale inversion occurring at  $\theta_y = 40^\circ$

## 5. I/O Interface

### 5.1. Pin Assignments

#### (1) CN 1(Interface Signal)

Connector used: JAE FI-SEB20P-HFE

Mating connector: JAE FI-SE20M, FI-S20S or equiv.

| Pin No. | Symbol  | Function                           |
|---------|---------|------------------------------------|
| 1       | VCC     | +5V/+3.3 V Power supply            |
| 2       | VCC     | +5V/+3.3 V Power supply            |
| 3       | GND     | Ground                             |
| 4       | GND     | Ground                             |
| 5       | Link 0- | R0, R1, R2, R3, R4, R5, G0         |
| 6       | Link 0+ | R0, R1, R2, R3, R4, R5, G0         |
| 7       | GND     | Ground                             |
| 8       | Link 1- | G1, G2, G3, G4, G5, B0, B1         |
| 9       | Link 1+ | G1, G2, G3, G4, G5, B0, B1         |
| 10      | GND     | Ground                             |
| 11      | Link 2- | B2, B3, B4, B5, DENA               |
| 12      | Link 2+ | B2, B3, B4, B5, DENA               |
| 13      | GND     | Ground                             |
| 14      | CLKIN-  | Clock -                            |
| 15      | CLKIN+  | Clock +                            |
| 16      | GND     | Ground                             |
| 17      | L/R     | Horizontal Display Mode Select (5) |
| 18      | U/D     | Vertical Display Mode Select (5)   |
| 19      | GND     | Ground                             |
| 20      | GND     | Ground                             |

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#### (2) CN2, CN3 (Backlight)

Connector used: 22-01-3027 (Molex)

Mating connector: 22-05-3021 (Molex)

| Pin No. | Symbol | Function            |
|---------|--------|---------------------|
| 1       | LRH    | VBLH (High voltage) |
| 2       | LRL    | VBLL (Low voltage)  |

Note] VBLH - VBLL = VL

(3) Horizontal/Vertical Display Mode Configurations

L/R=High, U/D=Low



L/R=Low, U/D=Low



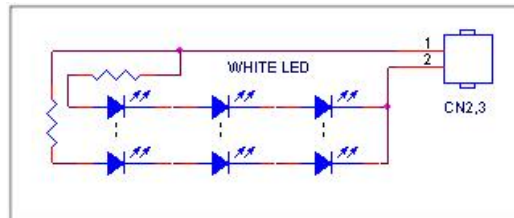
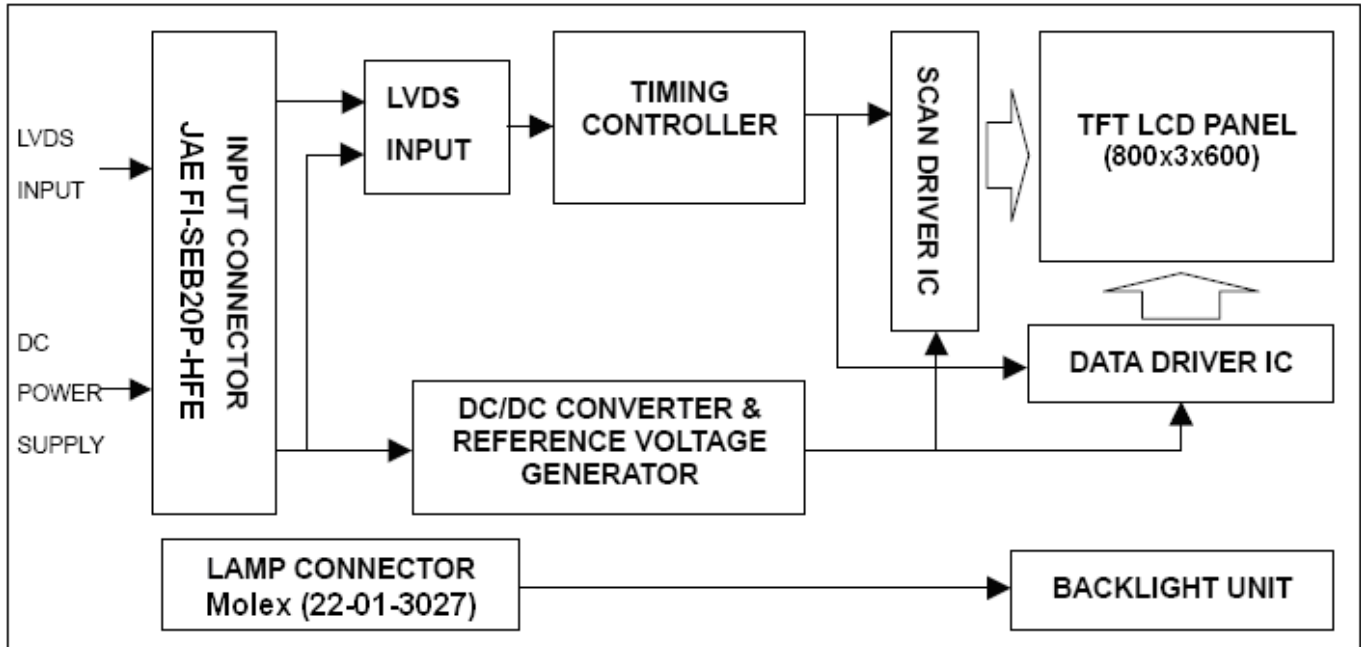
R/L=High, U/D=High



R/L=Low, U/D=High



5.2. Block Diagram



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## 6. Label Definition

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



- (a) Model Name: G121S1-L01-V467
- (b) Revision: Rev. XX, for example: A0, A1... B1, B2... or C1, C2...etc.
- (c) barcode definition:

Serial ID: XX-XX-X-XX-YMD-L-NNNN

| Code | Meaning          | Description   |
|------|------------------|---|
| XX   | internal use     | -   |
| XX   | Revision         | Cover all the change  |
| X    | internal use     | -   |
| YMD  | Year, month, day | Year: 2001=1, 2002=2, 2003=3, 2004=4...<br>Month: 1~12=1, 2, 3, ~, 9, A, B, C<br>Day: 1~31=1, 2, 3, ~, 9, A, B, C, ~, W, X, Y, exclude I, O, U. |
| L    | Product line #   | Line 1=1, Line 2=2, Line 3=3, ...etc.   |
| NNNN | Serial number    | Manufacturing sequence of product   |



## 7. Test Criteria

### (1) Environmental Test Criteria

| Test Item                                       | Test Condition   | Note     |
|---|--|----------|
| High Temperature Storage Test                   | 80°C, 240 hours  | (1), (2) |
| Low Temperature Storage Test                    | -30°C, 240 hours   |          |
| Thermal Shock Storage Test                      | -30°C, 0.5hour $\longleftrightarrow$ 80°C, 0.5hour; 100cycles, 1hour/cycle   |          |
| High Temperature Operation Test                 | 70°C, 240 hours  |          |
| Low Temperature Operation Test                  | -30°C, 240 hours   |          |
| High Temperature & High Humidity Operation Test | 60°C, RH 90%, 240hours   |          |
| Heat Cycle Operation Test                       | -30°C, 1hour $\longleftrightarrow$ 70°C, 1hour; 50cycles, 4hour/cycle  |          |
| ESD Test (Operation)                            | 150pF, 330 $\Omega$ , 1sec/cycle<br>Condition 1 : panel contact, $\pm$ 8KV<br>Condition 2 : panel non-contact $\pm$ 15KV | (2)      |
| Shock (Non-Operating)                           | 220G, 2ms, half sine wave, 1 time for $\pm$ X, $\pm$ Y, $\pm$ Z direction  | (2), (3) |
| Vibration (Non-Operating)                       | 1.5G, 10 ~ 300 Hz, 10min/cycle, 3 cycles each X, Y, Z direction  | (2), (3) |

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Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. ( $T_a \leq 40$  °C).

(b) Wet-bulb temperature should be 39 °C Max. ( $T_a > 40$  °C).

(c) No condensation of water.

Note (2) No display malfunctions.

Note (3) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

Note (4) Temperature of panel display surface area should be 80 °C Max.

(2) Judgment Standard

Judgment of the above tests should be made as follows:

Pass: Normal display image, no damage of the display function (ex. no line defect). Partial transformation of the module parts should be ignored.

Fail: No display image, damage of the display function (ex. line defect).

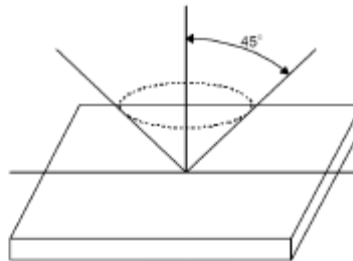
## 8. Appearance Standards

### 8.1. Inspection Conditions

The LCD shall be inspected under 40W white fluorescent light.

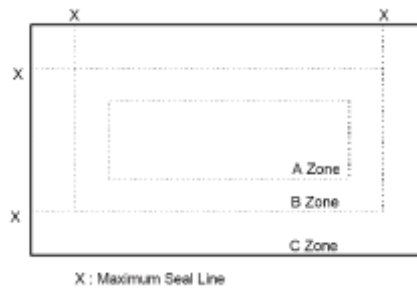
The distance between the eyes and the sample shall be more than 30cm.

All directions for inspecting the sample should be within 45° against perpendicular line.



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### 8.2. Definition of Applicable Zones



Zone A: Active display area

Zone B: Out of active display area up to viewing area

Zone C: Remaining parts

Zone A + Zone B = Viewing area

### 8.3. Standards

| No.                  | Parameter                      | Criteria  |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
|----------------------|--------------------------------|---|------|---|-------------------|--|--|----------------|--------|---|---|---|----------------------|----------------------|------------------|--|--|------------|---------------|---------|--|--|-------|------------|-------------------------|--|--|
| 1                    | Polarizer Scratches            | <table border="1"> <thead> <tr> <th colspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>X (mm)</th> <th>Y (mm)</th> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>L \leq 15</math></td> <td><math>0.01 &lt; W \leq 0.05</math></td> <td colspan="3">4</td> </tr> <tr> <td><math>L &gt; 15</math></td> <td><math>W &gt; 0.01</math></td> <td colspan="3">0</td> </tr> <tr> <td>-</td> <td><math>W &gt; 0.05</math></td> <td colspan="3">0</td> </tr> </tbody> </table> <p>X : Length, Y : Width * : Disregard</p>               | Zone |   | Acceptable Number |  |  | X (mm)         | Y (mm) | A | B | C | $L \leq 15$          | $0.01 < W \leq 0.05$ | 4                |  |  | $L > 15$   | $W > 0.01$    | 0       |  |  | -     | $W > 0.05$ | 0                       |  |  |
| Zone                 |                                | Acceptable Number   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| X (mm)               | Y (mm)                         | A   | B    | C |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| $L \leq 15$          | $0.01 < W \leq 0.05$           | 4   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| $L > 15$             | $W > 0.01$                     | 0   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| -                    | $W > 0.05$                     | 0   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| 2                    | DENT                           | <table border="1"> <thead> <tr> <th colspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th colspan="2">Dimension (mm)</th> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td colspan="2"><math>0.30 &lt; D \leq 0.50</math></td> <td colspan="3">4</td> </tr> <tr> <td colspan="2"><math>0.50 &lt; D</math></td> <td colspan="3">0</td> </tr> </tbody> </table> <p>D : Average Diameter = (long+short)/2 * : Disregard</p>  | Zone |   | Acceptable Number |  |  | Dimension (mm) |        | A | B | C | $0.30 < D \leq 0.50$ |                      | 4                |  |  | $0.50 < D$ |               | 0       |  |  |       |            |                         |  |  |
| Zone                 |                                | Acceptable Number   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Dimension (mm)       |                                | A   | B    | C |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| $0.30 < D \leq 0.50$ |                                | 4   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| $0.50 < D$           |                                | 0   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| 3                    | BLACK and WHITE SPOT BUBBLE    | <table border="1"> <thead> <tr> <th colspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th colspan="2">Dimension (mm)</th> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td colspan="2"><math>0.30 &lt; D \leq 0.50</math></td> <td colspan="3">5</td> </tr> <tr> <td colspan="2"><math>0.50 &lt; D</math></td> <td colspan="3">0</td> </tr> </tbody> </table>   | Zone |   | Acceptable Number |  |  | Dimension (mm) |        | A | B | C | $0.30 < D \leq 0.50$ |                      | 5                |  |  | $0.50 < D$ |               | 0       |  |  |       |            |                         |  |  |
| Zone                 |                                | Acceptable Number   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Dimension (mm)       |                                | A   | B    | C |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| $0.30 < D \leq 0.50$ |                                | 5   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| $0.50 < D$           |                                | 0   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| 4                    | LINT                           | <table border="1"> <thead> <tr> <th colspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>X (mm)</th> <th>Y (mm)</th> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>L \leq 3.0</math></td> <td><math>W \leq 0.15</math></td> <td colspan="3">4</td> </tr> <tr> <td><math>L &gt; 3.0</math></td> <td><math>W \leq 0.15</math></td> <td colspan="3">0</td> </tr> <tr> <td>-</td> <td><math>W &gt; 0.15</math></td> <td colspan="3">According to BLACK SPOT</td> </tr> </tbody> </table> <p>X : Length, Y : Width * : Disregard</p> | Zone |   | Acceptable Number |  |  | X (mm)         | Y (mm) | A | B | C | $L \leq 3.0$         | $W \leq 0.15$        | 4                |  |  | $L > 3.0$  | $W \leq 0.15$ | 0       |  |  | -     | $W > 0.15$ | According to BLACK SPOT |  |  |
| Zone                 |                                | Acceptable Number   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| X (mm)               | Y (mm)                         | A   | B    | C |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| $L \leq 3.0$         | $W \leq 0.15$                  | 4   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| $L > 3.0$            | $W \leq 0.15$                  | 0   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| -                    | $W > 0.15$                     | According to BLACK SPOT   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| 5                    | (a) Bright Dot<br>(b) Dark Dot | <table border="1"> <thead> <tr> <th colspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th colspan="2">Dimension (mm)</th> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td colspan="2">Bright Dot</td> <td colspan="3">7 (<math>G \leq 3</math>)</td> </tr> <tr> <td colspan="2">Dark Dot</td> <td colspan="3">7</td> </tr> <tr> <td colspan="2">Total</td> <td colspan="3">10</td> </tr> </tbody> </table>   | Zone |   | Acceptable Number |  |  | Dimension (mm) |        | A | B | C | Bright Dot           |                      | 7 ( $G \leq 3$ ) |  |  | Dark Dot   |               | 7       |  |  | Total |            | 10                      |  |  |
| Zone                 |                                | Acceptable Number   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Dimension (mm)       |                                | A   | B    | C |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Bright Dot           |                                | 7 ( $G \leq 3$ )  |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Dark Dot             |                                | 7   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Total                |                                | 10  |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| 6                    | TWO Adjacent Dot               | <table border="1"> <thead> <tr> <th colspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th colspan="2">Dimension (mm)</th> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td colspan="2">Bright Dot</td> <td colspan="3">3 PAIRS</td> </tr> <tr> <td colspan="2">Dark Dot</td> <td colspan="3">3 PAIRS</td> </tr> </tbody> </table>   | Zone |   | Acceptable Number |  |  | Dimension (mm) |        | A | B | C | Bright Dot           |                      | 3 PAIRS          |  |  | Dark Dot   |               | 3 PAIRS |  |  |       |            |                         |  |  |
| Zone                 |                                | Acceptable Number   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Dimension (mm)       |                                | A   | B    | C |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Bright Dot           |                                | 3 PAIRS   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Dark Dot             |                                | 3 PAIRS   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| 7                    | Three or More Adjacent Dot     | NOT ALLOWED   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| 8                    |                                | <table border="1"> <thead> <tr> <th colspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th colspan="2">Dimension (mm)</th> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td colspan="2">Bright Dot</td> <td colspan="3">5 mm</td> </tr> <tr> <td colspan="2">Dark Dot</td> <td colspan="3">5 mm</td> </tr> </tbody> </table>   | Zone |   | Acceptable Number |  |  | Dimension (mm) |        | A | B | C | Bright Dot           |                      | 5 mm             |  |  | Dark Dot   |               | 5 mm    |  |  |       |            |                         |  |  |
| Zone                 |                                | Acceptable Number   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Dimension (mm)       |                                | A   | B    | C |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Bright Dot           |                                | 5 mm  |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| Dark Dot             |                                | 5 mm  |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |
| 9                    | Line Defect                    | NOT ALLOWED   |      |   |                   |  |  |                |        |   |   |   |                      |                      |                  |  |  |            |               |         |  |  |       |            |                         |  |  |

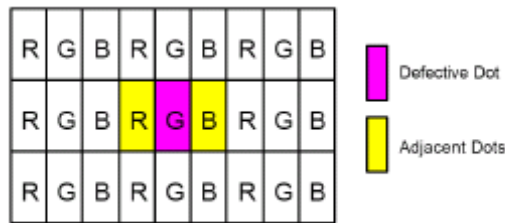
Note 1: Bright Dot is defined as follows:

Visible through 5% transmission ND filter under the condition that black image (color 0) is on the display.

Note 2: Dark Dot is defined as follows:

Recognizable darker than around under the condition that each R(63), G(63), B(63) image is on the display.

Note 3: Definition of adjacent:



## 9. Ordering Information

The ordering code for this module is: G121S1-L01-V467

## 10. Application Precautions

Please contact us when questions and/or new problems not specified in this specification arise.

### 10.1. Product Handling Precautions

The Following precautions will guide you in handling this product correctly.

- 1) Liquid crystal display devices:
  - a) The liquid crystal display device panel used in the liquid crystal display module is made of plate glass. Avoid any strong mechanical shock. Should the glass break, handle it with care.
  - b) The polarizer adhered to the surface of the LCD is made of a soft material. Guard against scratching it. Do not press or scratch the surface harder than a HB pencil lead.
- 2) Take care to guard the liquid crystal display module against static electricity discharge.
  - a) When working with the module, be sure to ground your body and any electrical equipment you may be using. We strongly recommend the use of anti-static mats (made of rubber) to protect sensitive circuits against the hazards of static electricity.
  - b) Avoid the use of work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity treated fibers.
  - c) Slowly and carefully remove the protective film from the LCD module, since this operation can generate static electricity.
- 3) When the LCD module must be stored for long periods of time:
  - a) Protect the module from high temperature and humidity.
  - b) Keep the module out of direct sunlight or direct exposure to ultraviolet rays.
  - c) Protect the module from excessive external forces.
- 4) Use the module with a power supply that is equipped with an over current protection circuit, since the module is not provided with this protective feature.

- 5) Do not ingest the LCD fluid itself should it leak out of a damaged LCD module. Should hands or clothing come in contact with LCD fluid, wash immediately with soap. If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.
- 6) Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used.
- 7) For models which use touch panels:
  - a) Do not stack up modules since they can be damaged by components on neighboring modules.
  - b) Do not place heavy objects on top of the product. This could cause glass breakage.
- 8) For models which use COG, TAB, or COF:
  - a) The mechanical strength of the product is low since the IC chip faces out unprotected from the rear. Be sure to protect the rear of the IC chip from external forces.
  - b) Given the fact that the rear of the IC chip is left exposed, in order to protect the unit from electrical damage avoid installation configurations in which the rear of the IC chip runs the risk of making any electrical contact.
- 9) For models which use flexible cable, heat seal, or TAB:
  - a) In order to maintain reliability, do not touch or hold by the connector area.
  - b) Avoid any bending, pulling, or other excessive force, which can result in broken connections.
- 10) Mechanical stress can have an adverse effect on connecting parts ( LCD panel-TCP / HEAT SEAL / FPC / etc., PCB-TCP / HEAT SEAL / FPC etc., TCP-HEAT SEAL, TCP-FPC, HEAT SEAL-FPC, etc.) depending on the materials used. Please check and evaluate these materials carefully before use.
- 11) In case an acrylic plate is attached to front side of LCD panel, cloudiness (very small cracks) can occur in the acrylic plate, being influenced by some components generated from polarizer film. Please check and evaluate acrylic materials carefully before use.
- 12) The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.
- 13) Assemble or install the module only in a clean area. Dust and oil may cause electrical short or damage the polarizer. Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.
- 14) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. These might permanently damage the polarizer due to chemical reaction.
- 15) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.
- 16) Do not disassemble the module.
- 17) Pins of the interface connector should not be touched directly with bare hands.

### 10.2. Storage Precautions

- 1) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- 2) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- 3) It may reduce the display quality if the ambient temperature is lower than 10 °C. For example, the response time will become slowly, and the starting voltage of lamp will be higher than the room temperature.

### 10.3. Operating Precautions

- (1) Do not insert or remove the I/F connector while the module is operating.
- (2) Always follow the correct power on/off sequence when LCD module is connected and operating. This can prevent the CMOS LSI chips from damage during latch-up.

## 11. Warranty

Apollo Display Technologies, LLC. offers a standard one year parts and labor guarantee on all products sold against manufacturers defect.

Customer is liable for shipping charges associated with shipment of product back to Apollo for return analysis. If product is found to be defective Apollo will repair or replace the part free of charge. Apollo will cover the shipping cost of all warranty items back to the customer (via standard ground service).

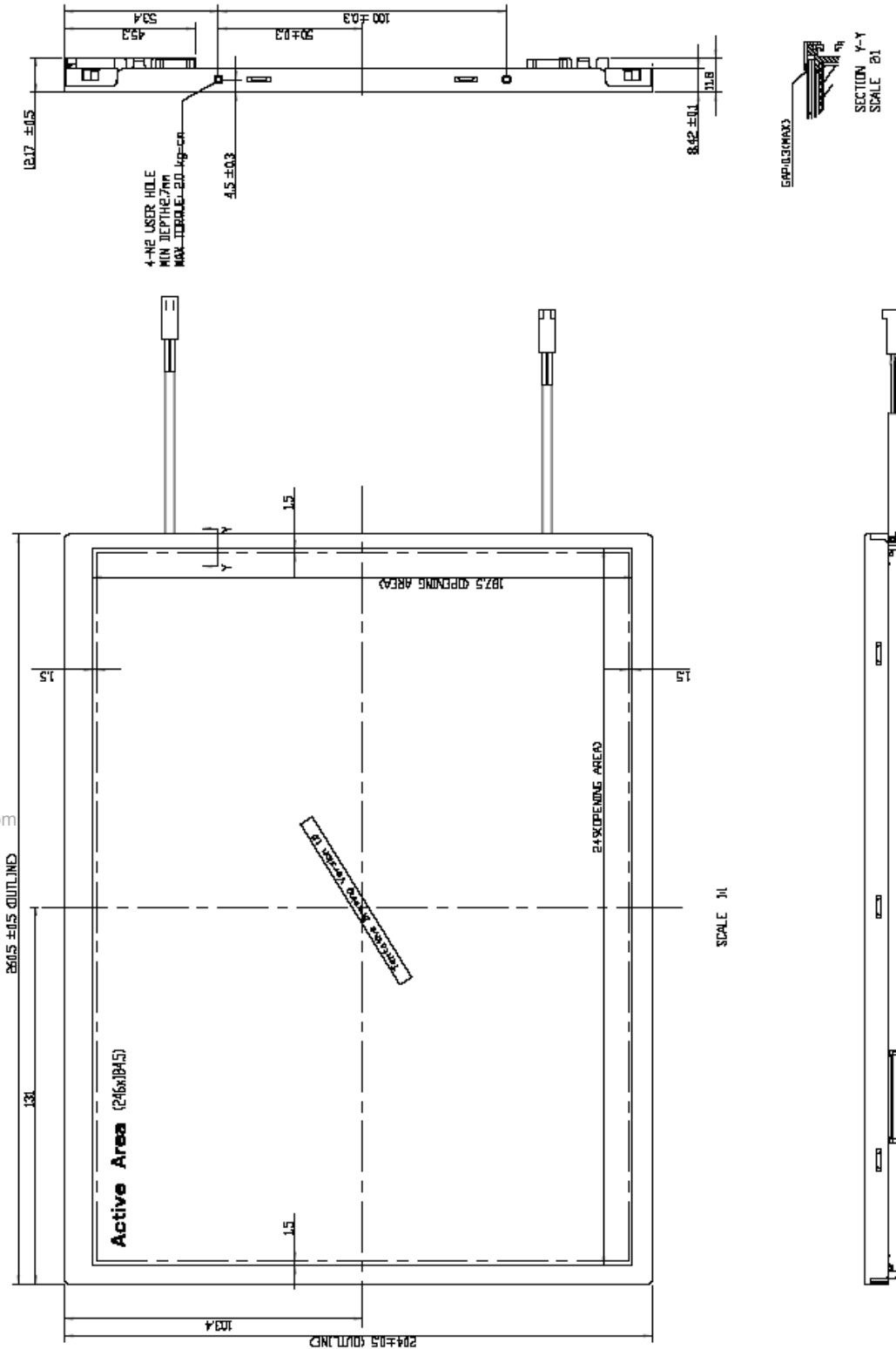
For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life.

1. We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.
2. We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.
3. We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed your company's acceptance inspection procedures.
4. We cannot accept responsibility for intellectual property of a third party, which may arise through the application of our product to your assembly with exception to those issues relating directly to the structure or method of manufacturing of our product.

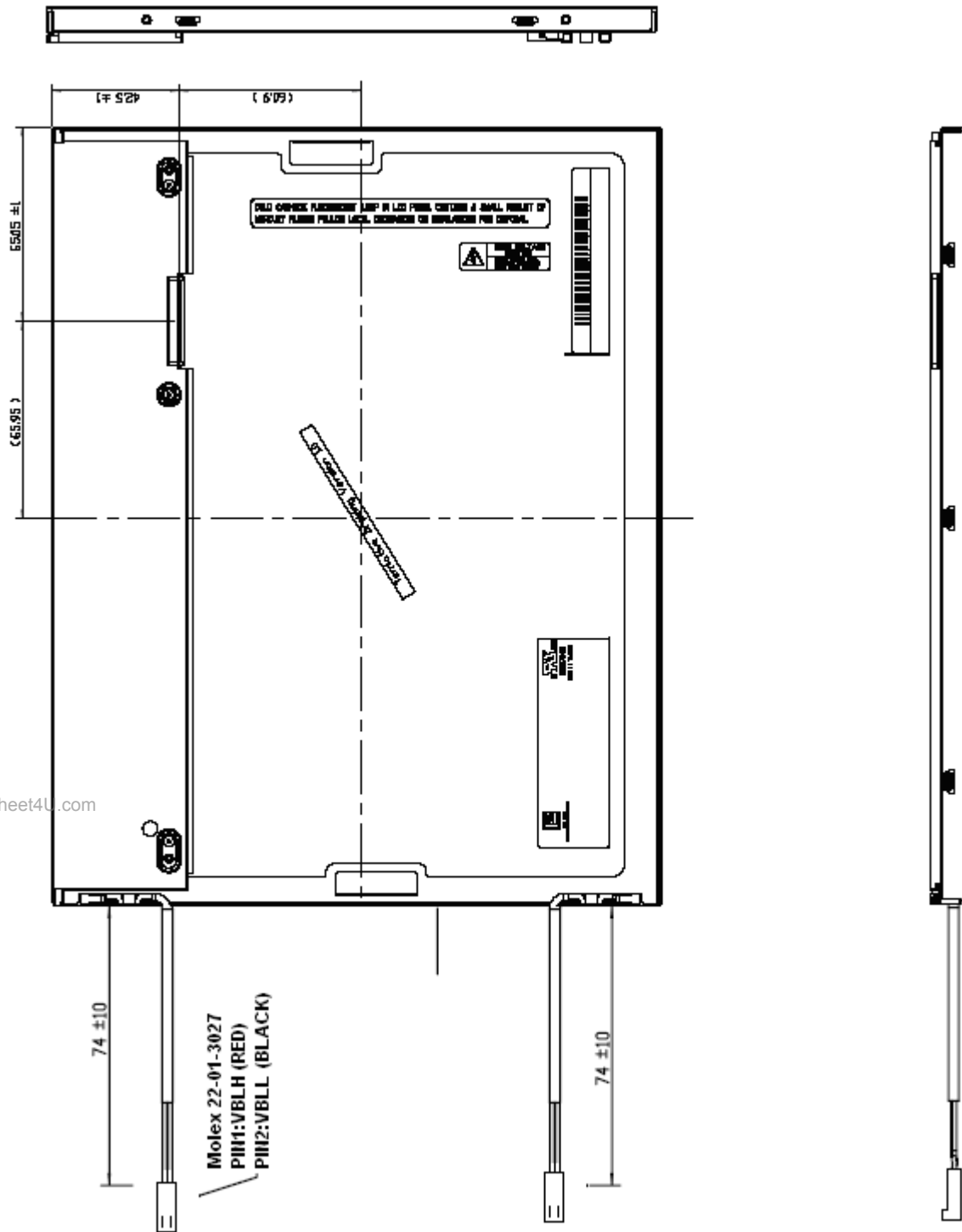
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## 12. Mechanical Specifications

Mechanical specifications are found on the following page(s).



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