

TENTATIVE PRODUCT INFORMATION

(All information in this technical data sheet is tentative and subject to change without notice.)

Updated: 4/25/2006

12.1" XGA Very High Bright TFT-LCD

LVM121XSB-411-L01
(based on HYDIS:HV121X02)

COLOR LIQUID CRYSTAL DISPLAY

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Revision History

| Rev | ECN No. | Description of changes | Date | Prepared |
|-----|---------|------------------------|---------|----------|
| 0 | | Preliminary | 4/25/06 | Brian Yi |
| | | | | |
| | | | | |

1. General Description

LVM121XSB-411-L01 is 12.1" Color Active Matrix Liquid Crystal Display with an integral LED backlight system. The matrix employs amorphous silicon Thin Film Transistor as the active element. It is a transmissive type display operating in the normally black mode. This TFT-LCD has a 12.1 inch diagonally measured active display area with XGA resolution (1024 horizontal by 768 vertical 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 LVM121XSB-411-L01 is intended to support applications where high brightness is a critical factor. In combination with the vertical arrangement of the sub-pixels, the LVM121XSB-411-L01 characteristics provide an excellent flat panel display for avionics (general & military), rugged environment, outdoor or anywhere daylight applications required.

General Specification

General specifications are summarized in the following table:

| ITEM | SPECIFICATION |
|--|--|
| Active screen size | 12.1 inches(30.7cm) diagonal 245.76(H) X 184.32(V) mm |
| Outline dimensions | 274.0(H) × 206.3(V) × 13.6(D) mm |
| Pixel pitch | 0.240(H) mm × 0.240(V) mm |
| Pixel format | 1024(H) X 768(V) pixels |
| Color Pixel Arrangement | RGB stripe arrangement |
| Color depth | 6-bit, 262,144 colors |
| Brightness | 1,200 cd/m ² |
| Power Consumption (LCD & Backlight only) | Total 13.5 Watt, typ. (0.8Watt @V _{cc} , 12.7 Watt @Lamp) |
| Weight | 900g (typ) |
| Display operating mode | transmissive mode, normally Black |
| Surface treatments | hard coating(3H), anti-reflective, clear |
| Backlight Unit | White LED |

2. Absolute Maximum Rating

| Parameter | symbol | Values | | Units | Notes |
|---|-----------------|--------|-------|-------|---------|
| | | Min. | Max. | | |
| Power Input Voltage Display Backlight | V _{CC} | -0.3 | +4.0 | Vdc | at 25°C |
| | V _{cc} | 0.0 | +12.0 | Vdc | |
| | I _{cc} | 0.0 | 2.16 | A | |
| Operating Temperature | T _{OP} | -25 | +85 | °C | 1 |
| Storage Temperature | T _{ST} | -25 | +85 | °C | 2 |

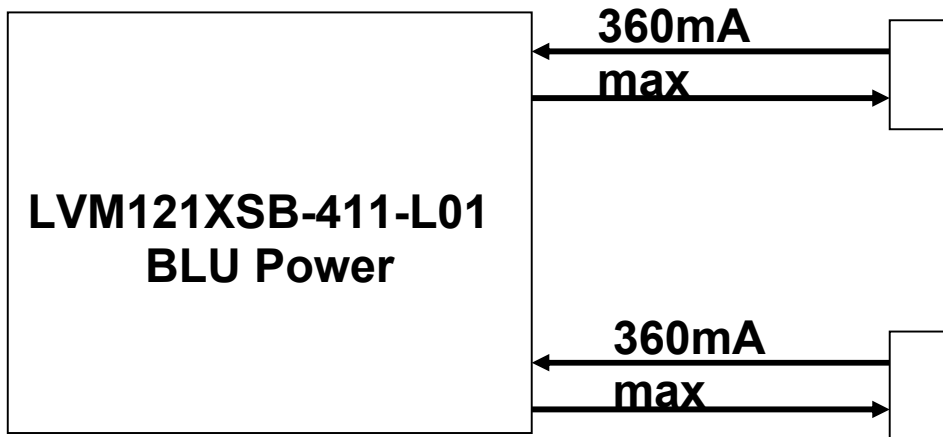
Note 1: Humidity ≤ 90% RH. No condensation.

3. Electrical Characteristics

The LVM121XSB-411-L01 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 LED backlight, is typically generated by LED driver board. The LED driver board is an external unit to the LCD.

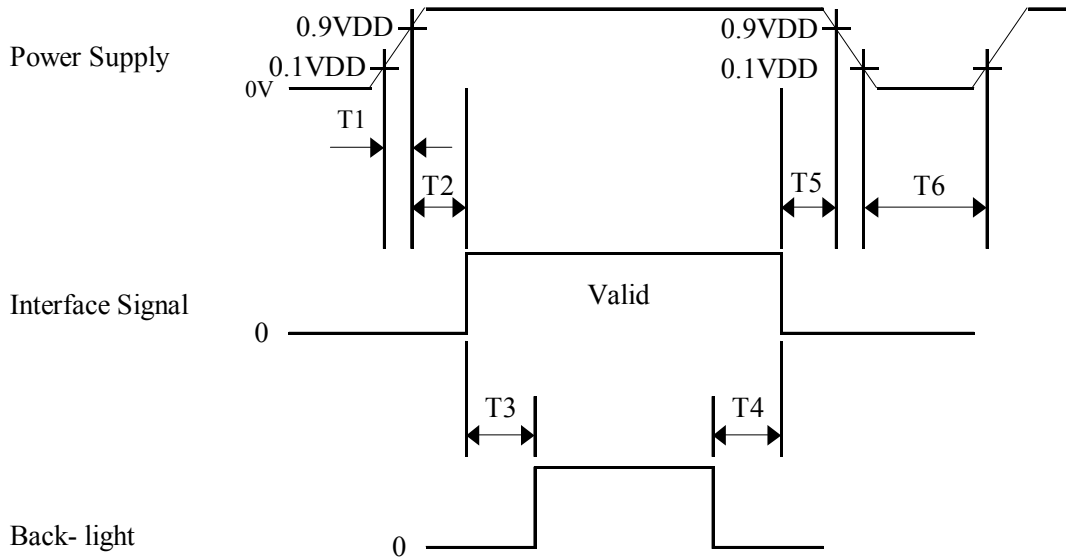
| Parameter | Symbol | Values | | | Units | Notes |
|---------------------------------------|-----------------|--------|--------|-------|--------------|-------------------------|
| | | Min. | Typ. | Max. | | |
| MODULE: Power Supply Input Voltage | V _{CC} | 3.0 | 3.3 | 3.6 | Vdc | V _{CC} = 3.3 V |
| Power Supply Input Current | I _{CC} | - | 0.240 | - | A | 1, 2 |
| Power Consumption | P _c | - | 0.7 | - | Watts | 1, 2 |
| LED Backlight: Operating Voltage | V _{BL} | | | 17.7 | Vdc | 4 |
| Operating Current | I _{BL} | | | 0.72 | Adc | 4 |
| Power Consumption Life Time | | 40,000 | 50,000 | 12.74 | Watts Hrs | 3 |

- Notes: 1. The current draw and power consumption specified is for 3.3 Vdc at 25°C and fv at 60Hz. (at Black pattern displayed)
2. Logic level are specified for V_{CC} of 3.3 Vdc at 25°C. The values specified apply to all logic inputs; Hsync, Vsync, Clock, data signals, etc.
3. The life time is determined as the time at which brightness of lamp is 50% compare to that of initial value at the typical LED current & at ambient temperature of 25°C.
4. LVM121XSB-411-L01 load voltage should be about 17.7V at 360mA max current per top and bottom sides.



4. Power On/Off Sequences

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as shown below.



- $0 < T1 \leq 10 \text{ ms}$
- $0 < T2 \leq 50 \text{ ms}$
- $100 \text{ ms} \leq T3, T4$
- $0 < T5 \leq 50 \text{ ms}$
- $1 \text{ sec} < T6$

- Note:
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 0 Vcd.
 3. Backlight power must be turn on after power supply for LCD and interface signal is valid.

5. Interface Connections

CN 1(interface signal): LVM121XSB-411-L01 uses 20 pin connector for module electronics.

Used connector: DF19L-20P-1H (HIROSE Electric Co. LTD) Matching side: DF19G-20S-1C (HIROSE)

| Pin | Symbol | Description |
|-----|------------------|----------------------------------|
| 1 | V _{DD1} | Power supply +3.3V |
| 2 | V _{DD2} | Power supply +3.3V |
| 3 | V _{SS} | Ground |
| 4 | V _{SS} | Ground |
| 5 | RIN0- | Transmission Data of Pixel 0 (-) |
| 6 | RIN0+ | Transmission Data of Pixel 0 (+) |
| 7 | V _{SS} | Ground |
| 8 | RIN1- | Transmission Data of Pixel 1 (-) |
| 9 | RIN1+ | Transmission Data of Pixel 1 (+) |
| 10 | V _{SS} | Ground |
| 11 | RIN2- | Transmission Data of Pixel 2 (-) |
| 12 | RIN2+ | Transmission Data of Pixel 2 (+) |
| 13 | V _{SS} | Ground |
| 14 | RCLK IN- | Sampling Clock (-) |
| 15 | RCLK IN+ | Sampling Clock (+) |
| 16 | V _{SS} | Ground |
| 17 | NC | No Connection |
| 18 | NC | No Connection |
| 19 | V _{SS} | Ground |
| 20 | V _{SS} | Ground |

CN 2(backlight): LVM121XSB-411-L01 employs Molex 51004-0200 or equivalent connectors for the LED backlight.

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

5.1. Recommended Transmitter to LVM121XSB-411-L01

6Bit Transmitter (THC63LVDM63A)

| THC63LVDM63A | | | | LVM121XSB-411-L01 Interface (CN1) | | |
|--------------------|--------------|---|-----------------------------------|-----------------------------------|------------------|----------------------|
| Input Terminal No. | | Input Signal (Graphic controller output signal) | | Output Signal Symbol | Terminal | Symbol |
| Symbol | THC63LVDM63A | Symbol | Function | | | |
| TIN0 | 44 | R0 | Red Pixels Display Data (LSB) | OUT0 - OUT0+ | No. 5 No. 6 | IN0 - IN0 + |
| TIN1 | 45 | R1 | Red Pixels Display Data | | | |
| TIN2 | 47 | R2 | Red Pixels Display Data | | | |
| TIN3 | 48 | R3 | Red Pixels Display Data | | | |
| TIN4 | 1 | R4 | Red Pixels Display Data | | | |
| TIN5 | 3 | R5 | Red Pixels Display Data (MSB) | | | |
| TIN6 | 4 | G0 | Green Pixels Display Data (LSB) | OUT1 - OUT1 + | No. 7 No. 8 | IN1 - IN1 + |
| TIN7 | 6 | G1 | Green Pixels Display Data | | | |
| TIN8 | 7 | G2 | Green Pixels Display Data | | | |
| TIN9 | 9 | G3 | Green Pixels Display Data | | | |
| TIN10 | 10 | G4 | Green Pixels Display Data | | | |
| TIN11 | 12 | G5 | Green Pixels Display Data (MSB) | | | |
| TIN12 | 13 | B0 | Blue Pixels Display Data (LSB) | OUT2 - OUT2 + | No. 9 No. 10 | IN2 - IN2 + |
| TIN13 | 15 | B1 | Blue Pixels Display Data | | | |
| TIN14 | 16 | B2 | Blue Pixels Display Data | | | |
| TIN15 | 18 | B3 | Blue Pixels Display Data | | | |
| TIN16 | 19 | B4 | Blue Pixels Display Data | | | |
| TIN17 | 20 | B5 | Blue Pixels Display Data (MSB) | | | |
| TIN18 | 22 | Hsync | Horizontal Synchronization Signal | CLK OUT - CLK OUT + | No. 11 No. 12 | CLK IN - CLK IN + |
| TIN19 | 23 | Vsync | Vertical Synchronization Signal | | | |
| TIN20 | 25 | DE | Compound Synchronization Signal | | | |
| CLK IN | 26 | NCLK | Data Sampling Clock | | | |

8 Bit Transmitter (THC63LVDM83A)

| THC63LVDM83A | | | | LVM121XSB-411-L01 Interface (CN1) | | |
|--------------------|-------------|--|-----------------------------------|-----------------------------------|------------------|----------------------|
| Input Terminal No. | | Input Signal (Graphic controller output signal) | | Output Signal Symbol | Terminal | Symbol |
| Symbol | THC63LVDM83 | Symbol | Function | | | |
| TIN0 | 51 | R0 | Red Pixels Display Data (LSB) | OUT0 – OUT0 + | No. 5 No. 6 | IN0 – IN0 + |
| TIN1 | 52 | R1 | Red Pixels Display Data | | | |
| TIN2 | 54 | R2 | Red Pixels Display Data | | | |
| TIN3 | 55 | R3 | Red Pixels Display Data | | | |
| TIN4 | 56 | R4 | Red Pixels Display Data | | | |
| TIN6 | 3 | R5 | Red Pixels Display Data (MSB) | | | |
| TIN7 | 4 | G0 | Green Pixels Display Data (LSB) | OUT1 – OUT1 + | No. 7 No. 8 | IN1 – IN1 + |
| TIN8 | 6 | G1 | Green Pixels Display Data | | | |
| TIN9 | 7 | G2 | Green Pixels Display Data | | | |
| TIN12 | 11 | G3 | Green Pixels Display Data | | | |
| TIN13 | 12 | G4 | Green Pixels Display Data | | | |
| TIN14 | 14 | G5 | Green Pixels Display Data (MSB) | | | |
| TIN15 | 15 | B0 | Blue Pixels Display Data (LSB) | OUT2 – OUT2 + | No. 9 No. 10 | IN2 – IN2 + |
| TIN18 | 19 | B1 | Blue Pixels Display Data | | | |
| TIN19 | 20 | B2 | Blue Pixels Display Data | | | |
| TIN20 | 22 | B3 | Blue Pixels Display Data | | | |
| TIN21 | 23 | B4 | Blue Pixels Display Data | | | |
| TIN22 | 24 | B5 | Blue Pixels Display Data (MSB) | | | |
| TIN24 | 27 | Hsync | Horizontal Synchronization Signal | OUT3 – OUT3 + | | |
| TIN25 | 28 | Vsync | Vertical Synchronization Signal | | | |
| TIN26 | 30 | DE | Compound Synchronization Signal | | | |
| TIN27 | 50 | NC | Non Connection (open) | | | |
| TIN5 | 2 | NC | Non Connection (open) | | | |
| TIN10 | 8 | NC | Non Connection (open) | | | |
| TIN11 | 10 | NC | Non Connection (open) | CLK OUT – CLK OUT + | No. 11 No. 12 | CLK IN – CLK IN + |
| TIN16 | 16 | NC | Non Connection (open) | | | |
| TIN17 | 18 | NC | Non Connection (open) | | | |
| TIN23 | 25 | NC | Non Connection (open) | | | |
| CLK IN | 31 | NCLK | Data Sampling Clock | | | |

6. Signal Timing Specification

The 12.1XGA LCM is only operated by the DE mode

| Item | Symbols | Min | Typ | Max | Units |
|---------------------------|------------|------|------|------|--------|
| Clock | Frequency | 1/Tc | - | 65 | MHz |
| | High Time | Tch | 4.5 | - | Ns |
| | Low Time | Tcl | 4.5 | - | Ns |
| Data | Setup Time | Tds | 2.7 | - | Ns |
| | Hold Time | Tdh | 0 | - | Ns |
| Data Enable Setup Time | Tes | 2.7 | - | - | Ns |
| Frame Period | Tv | 772 | 806 | 1022 | Lines |
| Vertical Display Period | Tvd | 768 | 768 | 768 | Lines |
| One Line Scanning Period | Th | 1100 | 1344 | 2046 | Clocks |
| Horizontal Display Period | Thd | 1024 | 1024 | 1024 | Clocks |

Note 1) Refer to TIMING CHART and LVDS (THC63LVDF64A) specifications by Thine Electronics Inc.

Note 2) If NCLK is fixed to "H" or "L" level for certain period, the panel may be damaged.

Note 3) Please adjust LCD operating signal timing and FL driving frequency, to optimize the display quality.

note 4) Do not hold NCLK on "H" level nor "L" level during VDD (+3.3V) is supplied. When it holds on, DC voltage supplies to liquid crystal materials and it may cause damage to liquid crystal materials.

note 5) Do not make tv, tvhd and tvds fluctuate.

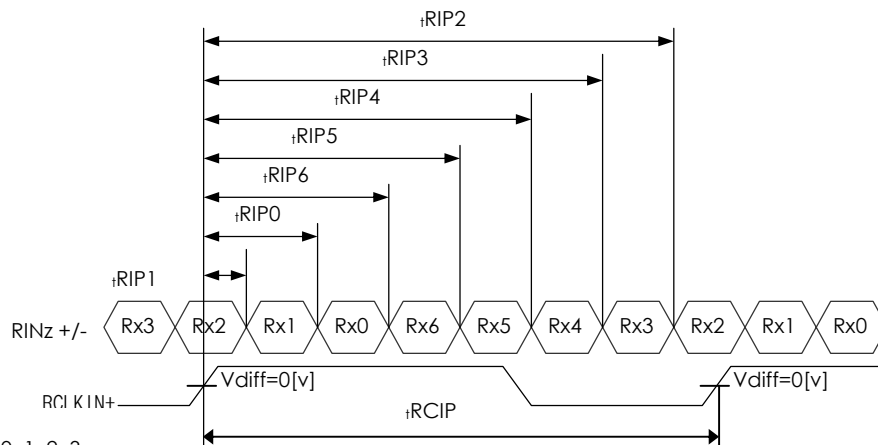
If tv, tvhd and tvds are fluctuated, then panel displays black.

note 6) NCLK count of each Horizontal Scanning Time should be always the same.

V-Blanking period should be "n" X "Horizontal Scanning Time". (n: integer)

-LVDS Rx interface timing parameter

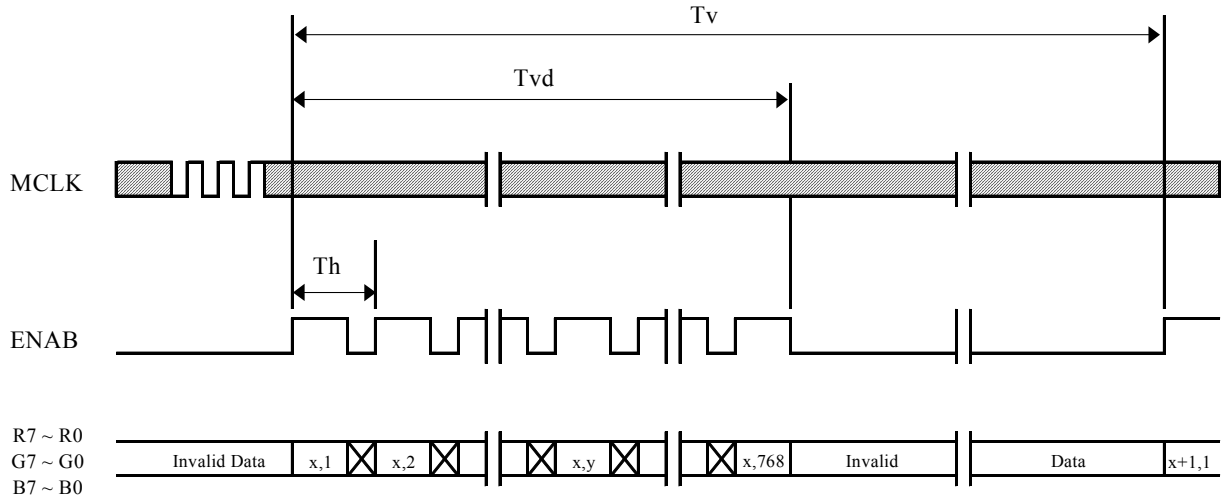
| Item | Symbol | Min | Typ. | Max | Unit | Remark |
|--------------|--------|-----------------|-------------|-----------------|------|--------|
| CLKIN Period | iRCIP | 12.5 | 15.38 | - | nsec | |
| Input data 0 | iRIP1 | -0.4 | 0.0 | +0.4 | nsec | |
| Input data 1 | iRIP0 | 1 * iRIPC/7-0.4 | 1 * iRIPC/7 | 1 * iRIPC/7+0.4 | nsec | |
| Input data 2 | iRIP6 | 2 * iRIPC/7-0.4 | 2 * iRIPC/7 | 2 * iRIPC/7+0.4 | nsec | |
| Input data 3 | iRIP5 | 3 * iRIPC/7-0.4 | 3 * iRIPC/7 | 3 * iRIPC/7+0.4 | nsec | |
| Input data 4 | iRIP4 | 4 * iRIPC/7-0.4 | 4 * iRIPC/7 | 4 * iRIPC/7+0.4 | nsec | |
| Input data 5 | iRIP3 | 5 * iRIPC/7-0.4 | 5 * iRIPC/7 | 5 * iRIPC/7+0.4 | nsec | |
| Input data 6 | iRIP2 | 6 * iRIPC/7-0.4 | 6 * iRIPC/7 | 6 * iRIPC/7+0.4 | nsec | |



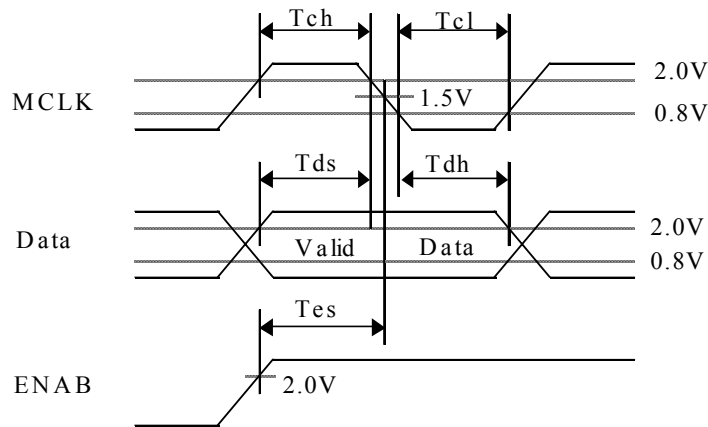
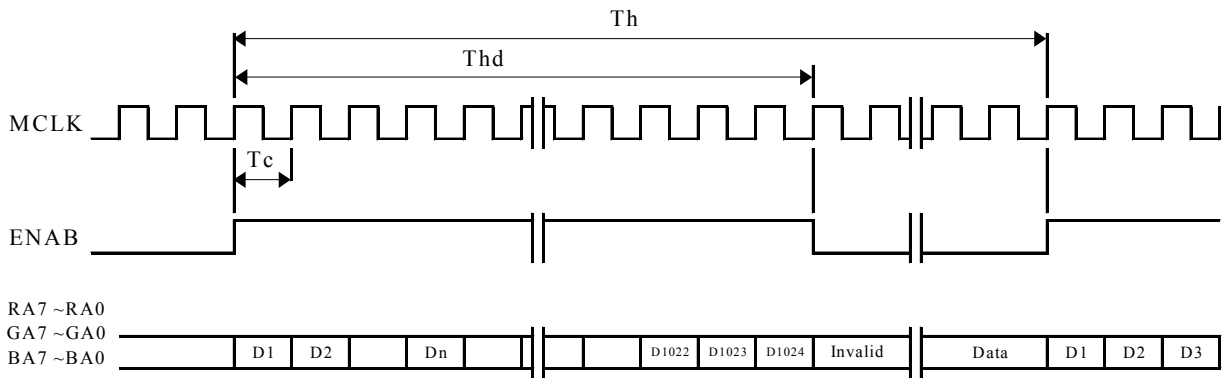
* Z=0, 1, 2, 3

7. Timing Wave Form(DE Mode)

Vertical Timing Waveforms



Horizontal Timing Waveforms

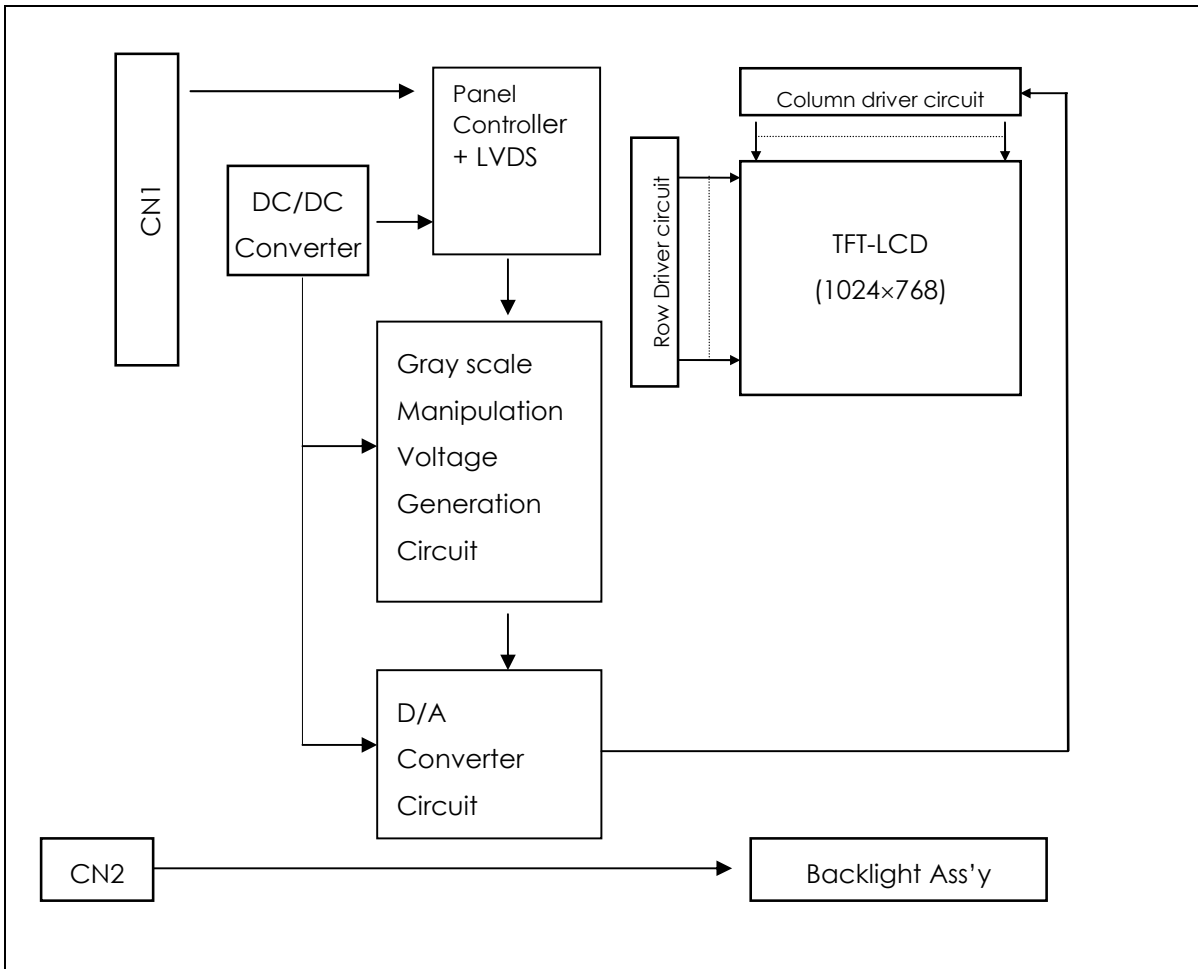


8. Color Input Data Reference

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.

| | Display | 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 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Light Blue | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Purple | 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 | 1 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red | Red(00) Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Red(01) | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Red(02) | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| : | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| Red(61) | | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Red(62) | | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Red(63) Bright | | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green | Green(00)Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(02) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | Green(61) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(63)Bright | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue | Blue(00) Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue(02) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | Blue(61) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(63) Bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| White & Black | Black(00) Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (01) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | (02) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | (61) | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | (62) | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | White(63) Bright | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

9. Block Diagram



10. Optical Specifications

Optical characteristics are determined 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°.

Appendix A presents additional information concerning the measurement equipment and method.

| Parameter | Symbol | Values | | | Units | Notes |
|-------------------------------------|-------------------------|--------|-------|------|-------------------|-------|
| | | Min. | Typ. | Max. | | |
| Contrast Ratio | CR | - | 400 | - | | 1 |
| Surface Luminance, white | L _{WH} | 1000 | 1200 | | cd/m ² | 2 |
| Luminance Uniformity | δ_{WHITE} | | 70% | | | 3 |
| Response Time Total (Tr + Td) | | | 40 | | msec | 4 |
| CIE Color Coordinates | | - | | | | |
| Red | X _R | - | 0.543 | - | | |
| | Y _R | - | 0.334 | - | | |
| Green | X _G | - | 0.317 | - | | |
| | Y _G | - | 0.500 | - | | |
| Blue | X _B | - | 0.156 | - | | |
| | Y _B | - | 0.151 | - | | |
| White | X _W | - | 0.312 | - | | |
| | Y _W | - | 0.343 | - | | |
| Viewing Angle | | | | | | |
| x axis, right ($\theta=0^\circ$) | θ_x | - | 80 | - | degree | 5 |
| x axis, left ($\theta=180^\circ$) | θ_x | - | 80 | - | | |
| y axis, up ($\theta=90^\circ$) | θ_y | - | 80 | - | | |
| y axis, down ($\theta=270^\circ$) | θ_y | - | 80 | - | | |

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 center point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see Appendix B.
3. The uniformity in surface Luminance, δ_{WHITE} is determined by measuring L_{ON} at each test position 1 through 9, and then dividing the minimum L_{ON} of 9 points luminance by maximum L_{ON} of 9 points luminance and multiply by 100 for percentage value. For more information see Appendix B.
 $\delta_{\text{WHITE}} = \text{Minimum} (L_{ON1}, L_{ON2}, \dots, L_{ON9}) * 100 / \text{Maximum} (L_{ON1}, L_{ON2}, \dots, L_{ON9})$
4. Response time is the time required for the display to transition from white to black (Rise Time, Tr) and from black to white (Decay Time, Td). For additional information see Appendix C.
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 D.

11. Mechanical Characteristics

The chart below provides general mechanical characteristics for the model LVM121XSB-411-L01. In addition, the figure below is a detailed mechanical drawing of the LCD. Note that dimensions are given for reference purposes only.

Outside dimensions:

| | |
|------------|-----------------|
| Horizontal | 274.00 ± 0.5 mm |
| Vertical | 206.30 ± 0.5 mm |
| Depth | 13.60 ± 0.5 mm |

Bezel area:

| | |
|------------|-----------|
| Horizontal | 250.40 mm |
| Vertical | 188.90 mm |

Active Display area:

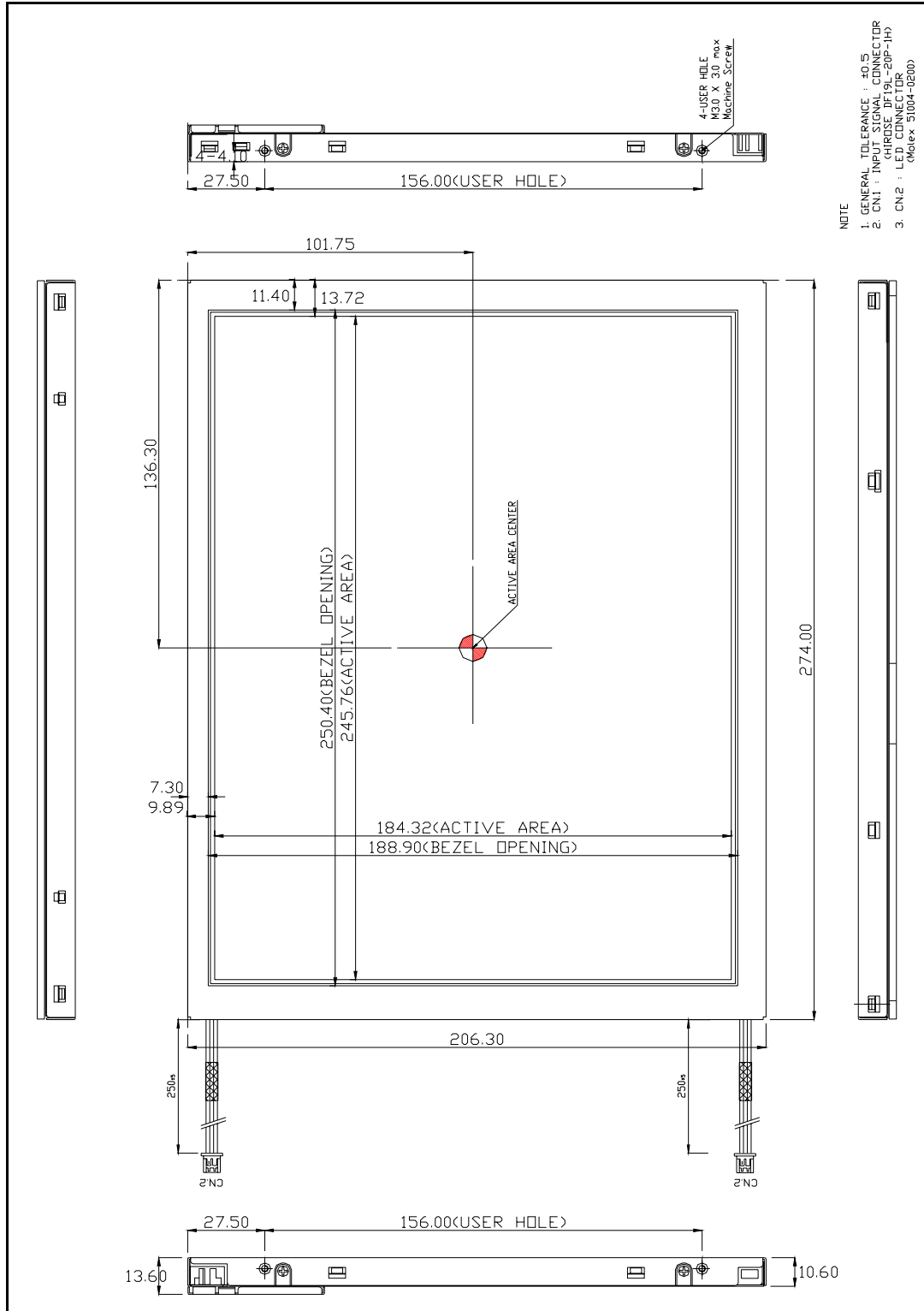
| | |
|------------|-----------|
| Horizontal | 254.76 mm |
| Vertical | 184.32 mm |

Weight (approximate): 900 g

Surface Treatment: Hard coating 3H clear.
Anti-reflective treatment of the front polarizer.

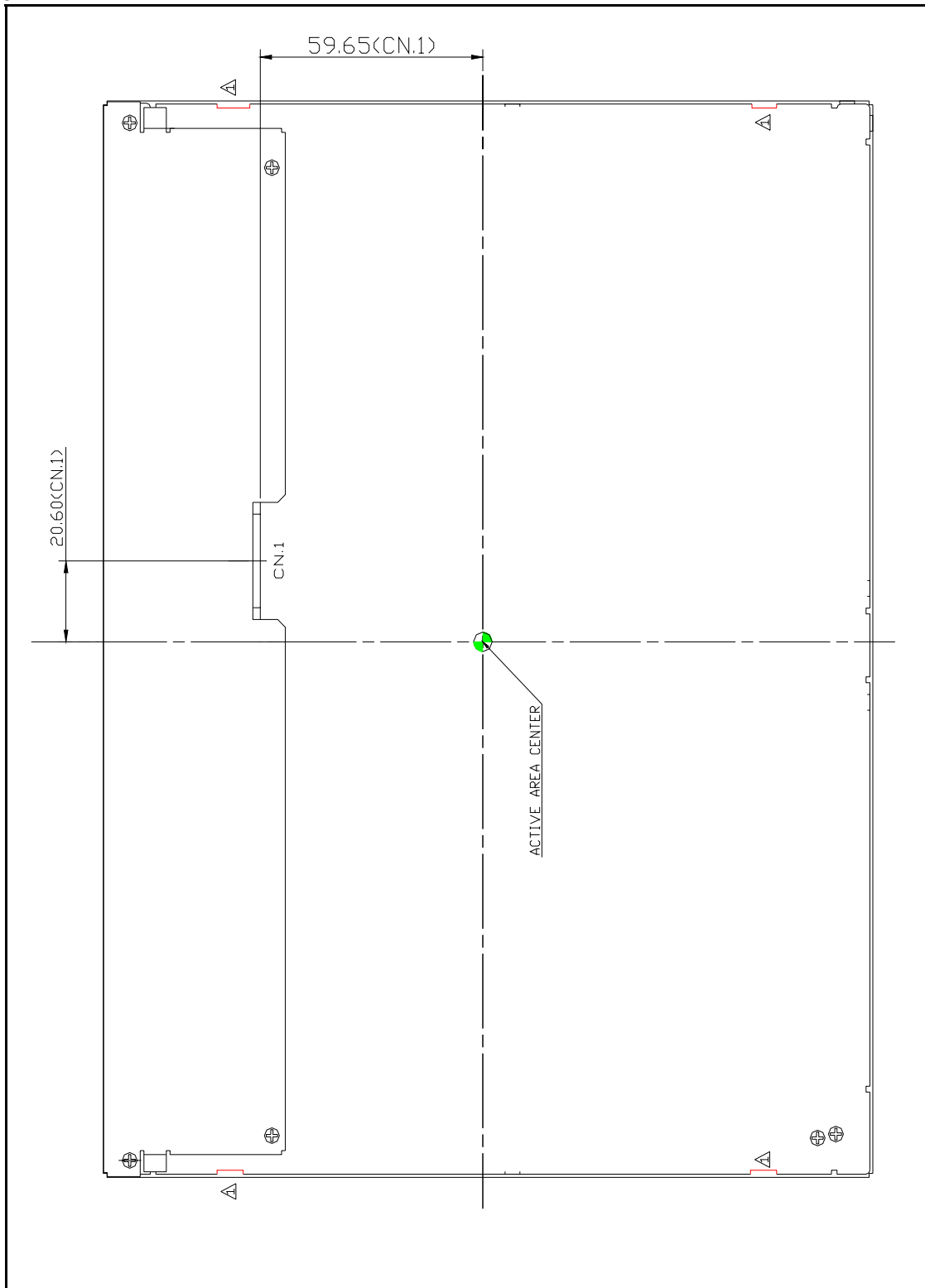
12. Mechanical Specification

< FRONT VIEW >



NOTE
 1. GENERAL TOLERANCE : ±0.5
 2. CN1 : INPUT SIGNAL CONNECTOR (MORSE JF191-20P-1H)
 3. CN2 : LED CONNECTOR (Molex 51004-020)

<Rear View>



13. Reliability

- Environment test condition on backlight only.

| No. | Test ITEM | Conditions |
|-----|---|--|
| 1 | High temperature storage test | Ta = 85 °C, 240hr |
| 2 | Low temperature storage test | Ta = -25 °C, 240hr |
| 3 | High temperature & high humidity operation test | Ta = 85 °C, 80%RH 240hrs (no condensation) |
| 4 | High temperature operation test | Ta = 85 °C, 240h |
| 5 | Low temperature operation test | Ta = - 25 °C, 240h |
| 6 | Thermal Shock | Ta = - 25 °C ~ 85 °C (30 min), 100 cycles |
| 7 | Shock test (non-operating) | Gravity : 120G Pulse width: 2ms, half sine wave for X, Y, Z direction |
| 8 | Vibration test (non-operating) | Frequency 10 ~ 300 Hz Gravity/AMP: 1.5G Period: X, Y, Z 30 min. |

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.

- ON/OFF Cycle
: The display module will be capable of being operated over 24,000 ON/OFF cycles (backlight power & Vcc ON/OFF)
- Mean Time between Failure
: The LCD Panel and interface board assembly (excluding the Backlight) shall have a mean time between failures of 35,000 hours with a confidence level 90%.

14. Packing Form

- a) Package quantity in one box : 6 pcs
- b) Box Size : 298 x 298x 335

15. PRECAUTIONS

Please pay attention to the followings when you use this TFT/LCD module.

15.1 MOUNTING PRECAUTIONS

- (1) You must mount a module using holes arranged in four corners.
- (2) You should consider the mounting structure so that uneven force (ex. twisted stress) is not applied to the module.
And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface with a transparent protective plate in order to protect the polarizer LC cell.
Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter cause 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.

15.2 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) 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.
- (4) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (5) A module has high frequency circuit. It might be necessary to shield the electromagnetic noise in your integrating system.

15.3 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 wristband etc . . . And don't touch I/F pin directly.

15.4 STORAGE

When storing modules for a long time, the following precautions should be followed.

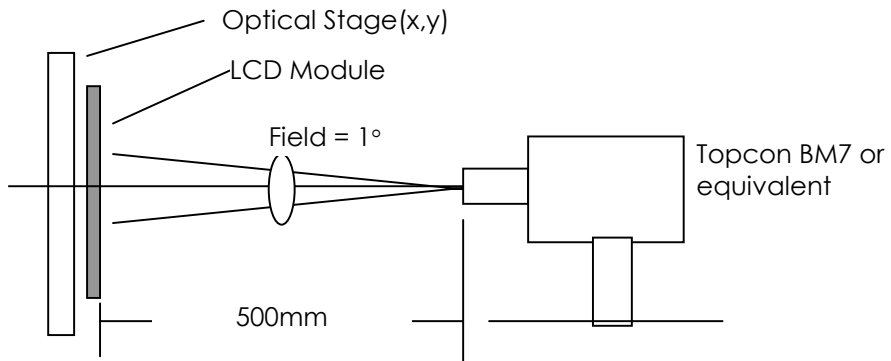
- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

15.5 HANDLING PRECAUTIONS FOR PROTECTION FILM

- (1) When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion- blown equipment or in such a condition, etc..
- (2) The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt to remain on the polarizer.
Please carefully peel off the protection film without rubbing it against the polarizer.
- (3) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
- (4) You can remove the glue easily. When the glue remains on the polarizer surface or its

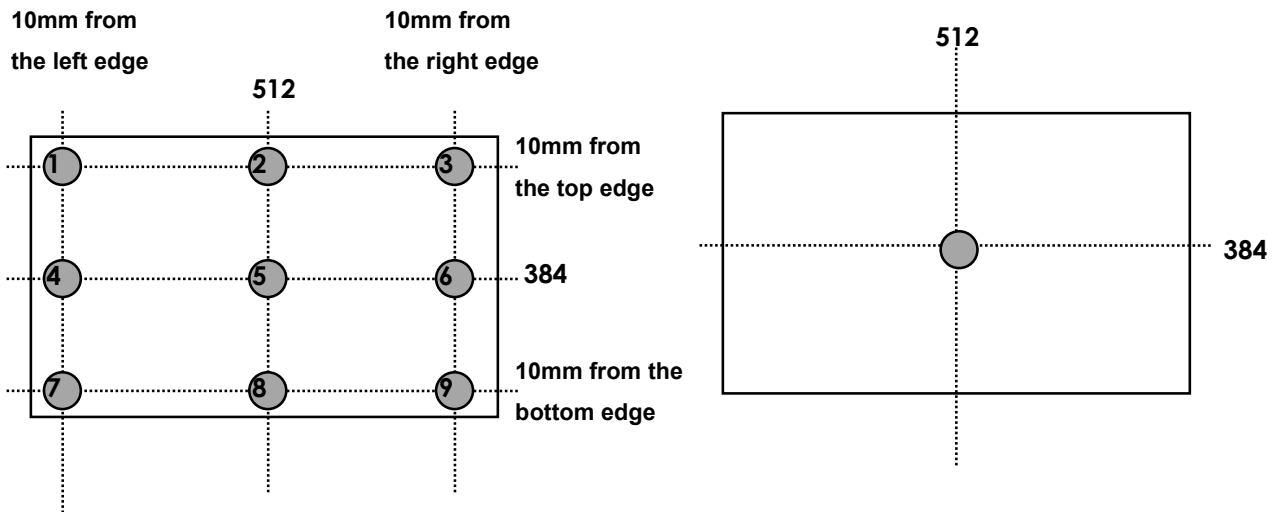
vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal- hexane.

A. Optical Characteristic Measurement Equipment and Method



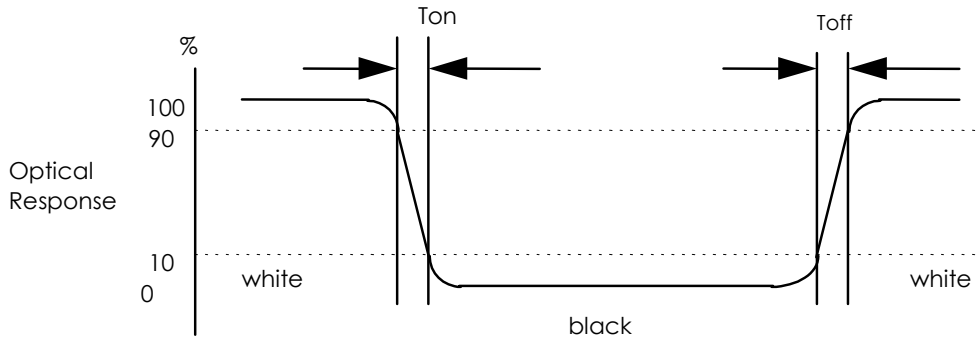
B. Luminance

<measuring point for luminance variation> <measuring point for surface luminance >



C. Response Time

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



D. Viewing angle

<Definition of viewing angle range>

