Vertex LCD Inc.

PRELIMINARY PRODUCT INFORMATION

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

Updated: 12/05/2007

# 5.7” VGA High Bright TFT-LCD

## LGB057VD-LAD

(based on KYOCERA : TCG057VG1AC-G00)

**(PRELIMINARY)**

## COLOR LIQUID CRYSTAL DISPLAY


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## CONTENTS




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# Revision History

| Rev | ECN No. | Description of changes | Date | Prepared |
|---|---|---|---|---|
| P0 | | Initial release | 12/05/07 | Eric Kim |
| | | | | |


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## 1. General Description

LGB057VD-LAD is 5.7" Color Active Matrix Liquid Crystal Display with 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 white mode. This TFT-LCD has a 5.7 inch diagonally measured active display area with VGA resolution (640 horizontal by 480 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 LGB057VD-LAD is intended to support applications where high brightness is a critical factor. In combination with the vertical arrangement of the sub-pixels, the LGB057VD-LAD characteristics provide an excellent flat panel display for office or industrial automation products or daylight applications.

### General Specification

General specifications are summarized in the following table:

| ITEM | SPECIFICATION |
|---|---|
| Active screen size | 5.7 inches(14.5cm) diagonal<br>115.2(H) X 86.4(V) mm |
| Outline dimensions | 144.0(H) × 104.8(V) × 16.1(D) mm |
| Pixel pitch | 0.180(H) mm × 0.180(V) mm |
| Pixel format | 640(H) X 480(V) pixels |
| Color Pixel Arrangement | RGB stripe arrangement |
| Color depth | 6-bit, 262,144 colors |
| Brightness(Day Mode) | 500 cd/m$^2$ Min. |
| Brightness(Night Mode) | 200 cd/m$^2$ Min. |
| Power Consumption (LCD & Backlight only)-Day Mode | Total 3.53 Watt,typ (0.7Watt @Vcc, 2.83 Watt @Lamp) |
| Power Consumption (LCD & Backlight only)-Night Mode | Total 3.53 Watt,typ (0.7Watt @Vcc, 2.83 Watt @Lamp) |
| Power Consumption (Heater) | 19.6 watt(28V, 40Ω) |
| Weight | TBDg (typ) |
| Display operating mode | transmissive mode, normally White |
| Surface treatments | Anti Reflector coating on the heater glass |
| Backlight Unit | White LED |

## 2. Absolute Maximum Rating

| Parameter | symbol | Values | | Units | Notes |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Power Input Voltage | $V_{CC}$ | 0 | +4.0 | Vdc | at 25°C |
| Operating Temperature (With Heater) | $T_{OP}$ | TBD | +70 | °C | 1 |
| Storage Temperature | $T_{ST}$ | -30 | +80 | °C | 1 |

Note: Humidity ≦ 85% RH , Temp. ≦40°C No condensation.


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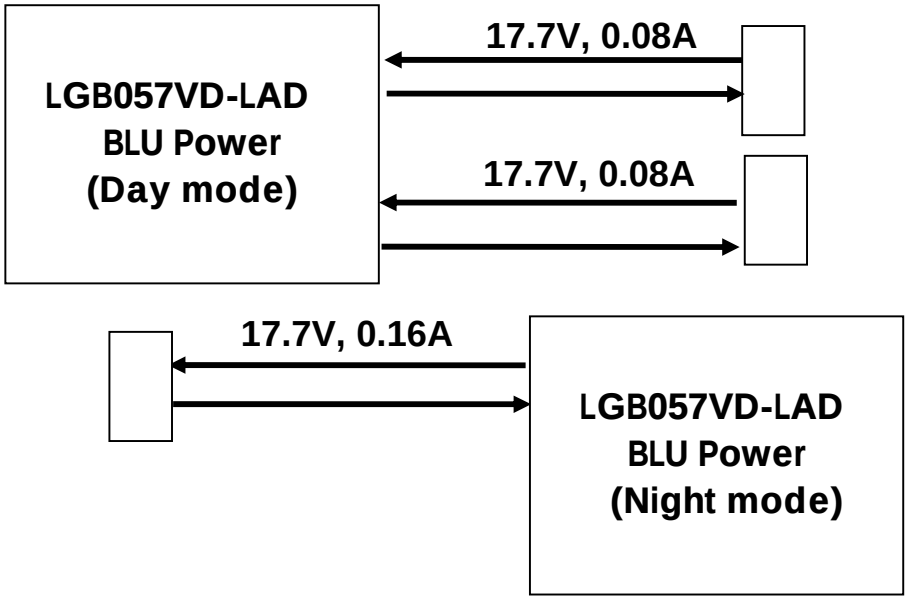
## 3. Electrical Characteristics

The LGB057VD-LAD requires three 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(Day mode), is typically generated by LED driver board. The third input which powers the LED backlight(Night mode), is typically generated by LED driver board. The LED driver board is an external unit to the LCD.

| Parameter | Symbol | Condition | Values | | | Units | Notes |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| MODULE:<br>Power Supply Input Voltage | $V_{CC}$ | | 3.0 | 3.3 | 3.6 | Vdc | Vcc = 3.3 V |
| Power Supply Input Current | $I_{CC}$ | | - | 0.210 | -270 | A | |
| Power Consumption | $P_C$ | | - | 0.7 | - | Watts | |
| LED Backlight:<br>(Day Mode)<br>Operating Voltage<br>Power Consumption | <br><br>$V_{BL}$<br>$P_{BL}$ | <br><br>($I_{BL}$ = 0.16A) | <br><br>17.2 | <br><br>17.7<br>2.83 | <br><br>18.2 | <br><br>Vdc<br>Watts | <br><br>2 |
| (Night Mode)<br>Operating Voltage<br>Power Consumption | <br>$V_{BL}$<br>$P_{BL}$ | <br>($I_{BL}$ = 0.16A) | <br>17.2 | <br>17.7<br>2.83 | <br>18.2 | <br>Vdc<br>Watts | <br>3 |
| Heater Glass | $V_{ht}$<br>$I_{BL}$<br>$P_{BL}$ | | | | 28.0<br>0.7<br>19.6 | Vdc<br>Adc<br>Watts | |
| Life Time | | | 20,000 | 30,000 | | Hrs | 1 |

Notes: 1.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 voltage 17.7V (condition : current 0.16A) & at ambient temperature of 25°C.
2. LGB057VD-LAD load voltage should be about 17.7V at 160mA max current per right top & bottom side. (Day Mode)
3. LGB057VD-LAD load voltage should be about 17.7V at 160mA max current per left. (Night Mode)





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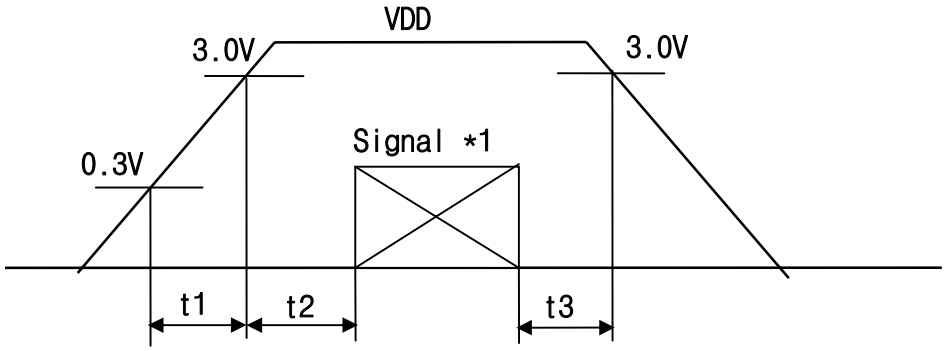
## 4. Power On/Off Sequences

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




- $0 < t1 \leq 20\,ms$
- $0 < t2 \leq 50\,ms$
- $0 < t3 \leq 1\,s$

*1 Input signal : CK, R0~R5, G0~G5, B0~B5, Hsync, Vsync, ENAB, R/L, U/D, V/Q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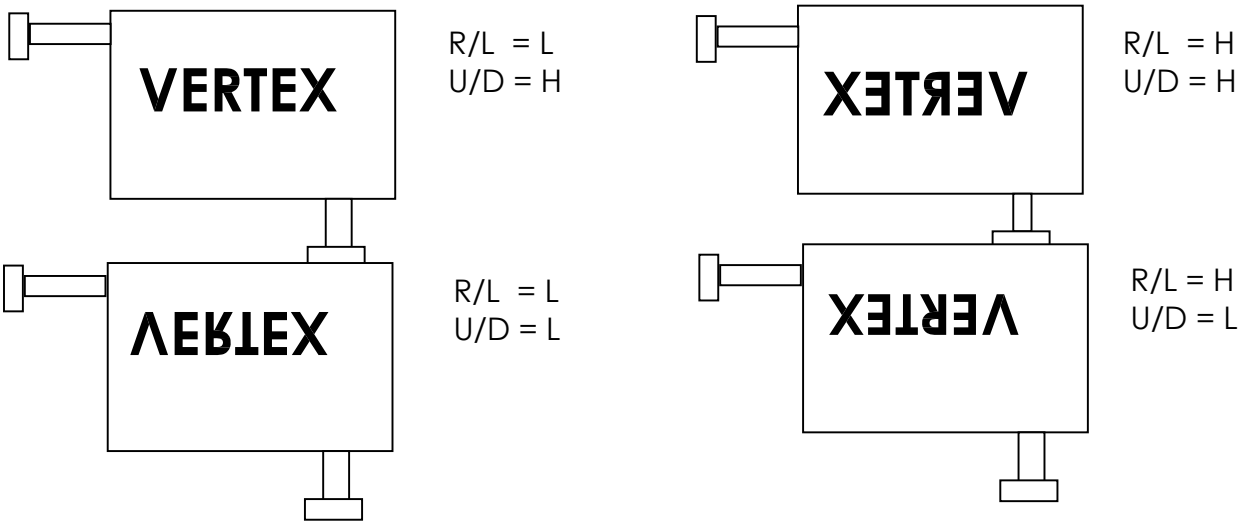
## 5. Interface Connections

CN 1 (interface signal): LGB057VD-LAD uses 33 pin connector for module electronics.
Used connector: 08-6210-033-340-800+ (ELCO) Matching side: 0.5mm pitch FPC or FFC

| Pin | Symbol | Description |
|---|---|---|
| 1 | GND | GND |
| 2 | CK | Clock signal for sampling each data signal |
| 3 | Hsync | Horizontal synchronous signal (negative) |
| 4 | Vsync | Vertical synchronous signal (negative) |
| 5 | GND | GND |
| 6 | R0 | RED data signal (LSB) |
| 7 | R1 | RED data signal |
| 8 | R2 | RED data signal |
| 9 | R3 | RED data signal |
| 10 | R4 | RED data signal |
| 11 | R5 | RED data signal (MSB) |
| 12 | GND | GND |
| 13 | G0 | GREEN data signal (LSB) |
| 14 | G1 | GREEN data signal |
| 15 | G2 | GREEN data signal |
| 16 | G3 | GREEN data signal |
| 17 | G4 | GREEN data signal |
| 18 | G5 | GREEN data signal (MSB) |
| 19 | GND | GND |
| 20 | B0 | BLUE data signal (LSB) |
| 21 | B1 | BLUE data signal |
| 22 | B2 | BLUE data signal |
| 23 | B3 | BLUE data signal |
| 24 | B4 | BLUE data signal |
| 25 | B5 | BLUE data signal (MSB) |
| 26 | GND | GND |
| 27 | ENAB | Signal to settle the horizontal display position (positive) |
| 28 | VDD | 3.3V power supply |
| 29 | VDD | 3.3V power supply |
| 30 | R/L | Horizontal display mode select signal<br>L : Normal , H : Left / Right reverse mode |
| 31 | U/D | Vertical display mode select signal<br>H : Normal , L : Up / Down reverse mode |
| 32 | V/G | H : Normal |
| 33 | GND | GND |





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CN 2,3 (backlight-Day Mode): LGB057VD-LAD employs Molex 51004-0200 or equivalent connectors for the LED backlight.

| Pin | Symbol | Description | Color |
|---|---|---|---|
| 1 | V | Lamp power input | Pink or Red |
| 2 | Ground | Ground | White |

CN 4(backlight-Night Mode): LGB057VD-LAD employs Molex 51004-0200 or equivalent connectors for the LED backlight.

| Pin | Symbol | Description | Color |
|---|---|---|---|
| 1 | V | Lamp power input | Blue or Black |
| 2 | Ground | Ground | White |

# Heater glass connection: Heater glass of LGB057VD-LAD has just HOT wire and GND wire.(No connector)


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## 6. Signal Timing Specification

### 6-1. Timing characteristics

| Item | | Symbols | Min | Typ | Max | Units | Note |
|---|---|---|---|---|---|---|---|
| Horizontal sync. Signal | Cycle | TH | 30.0 | 31.8 | - | μs | V/Q=H |
| | | | 770 | 800 | 900 | Clock | |
| | Pulse width | THp | 2 | 96 | 200 | Clock | |
| Vertical sync. Signal | Cycle | TV | 515 | 525 | 560 | Line | V/Q=H |
| | Pulse width | TVp | 2 | - | 34 | Line | |
| `Clock | Frequency | 1/Tc | - | 25.18 | 28.33 | MHz | V/Q=H |
| | Duty ratio | Tch/Tc | 40 | 50 | 60 | % | |
| Data | Setup Time | Tds | 5 | - | - | Ns | |
| | Hold Time | Tdh | 10 | - | - | Ns | |
| Horizontal Display Period | | THd | 640 | | | Clocks | |
| Hsync.-Clock phase difference | | THc | 10 | - | Tc-10 | Ns | |
| Hsync.-Vsync. phase difference | | TVh | 0 | - | TH-THp | Ns | |
| Vertical sync.signal start position | | TVs | 34 | | | Line | V/Q=H |
| Vertical display period | | TVd | 480 | | | line | |

*In case of lower frequency, the deterioration of the display quality, flicker etc., may occur.

### 6-2. Horizontal display position

The horizontal display position is determined by ENAB signal.

| Item | | Symbols | Min | Typ | Max | Units | Note |
|---|---|---|---|---|---|---|---|
| Enable signal | Setup Time | Tes | 5 | - | Tc-10 | ns | |
| | Pulse width | Tep | 2 | 640 | TH-10 | clock | |
| Hsync.-Enable signal phase difference | | The | 44 | - | 104 | clock | V/Q=H |

* When ENAB is fixed at "Low", the display starts from the data of C104 (clock) as shown in chapter 7.

### 6-3. Vertical display position

The vertical display position (TVs) is fixed at 34th line. (V/Q=H)

Note) ENAB signal is independent of vertical display position.


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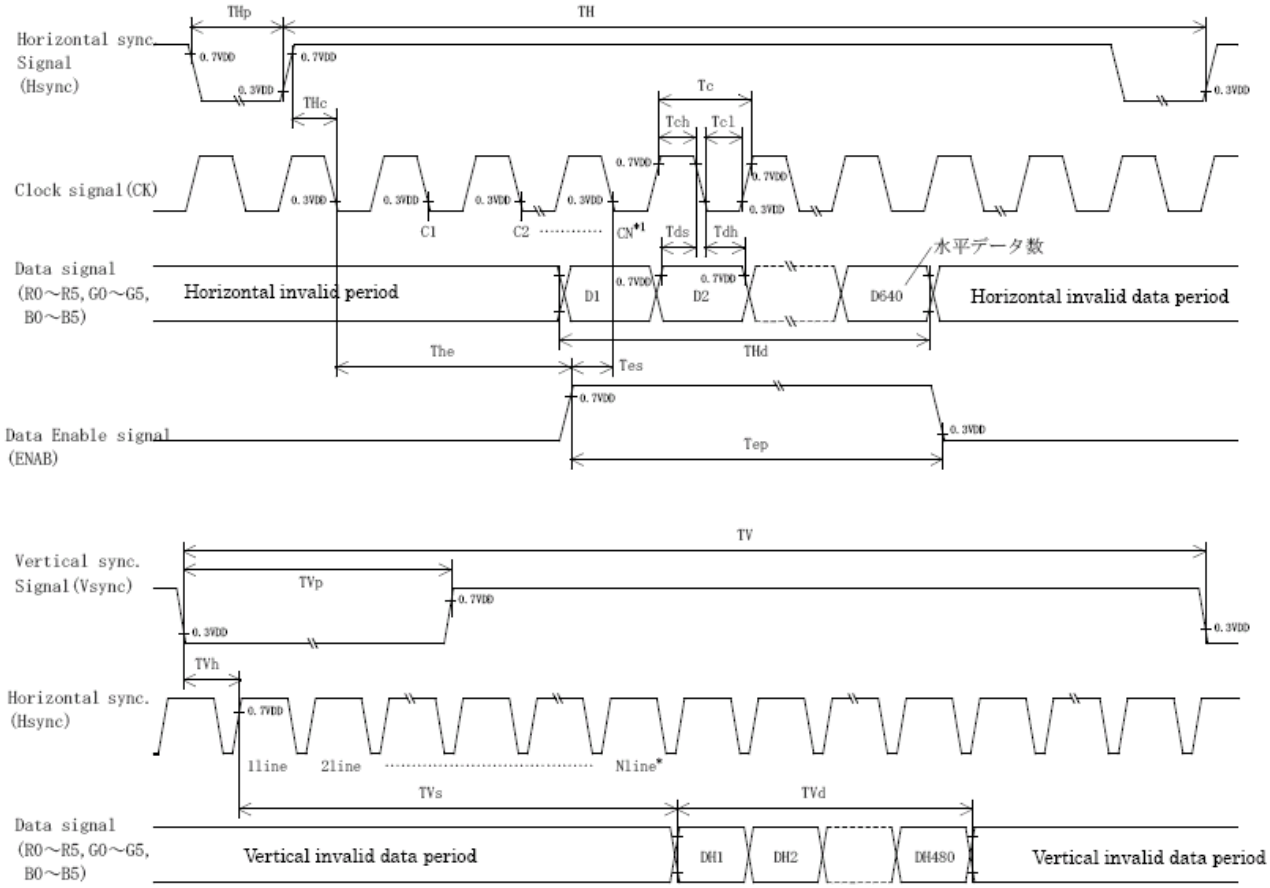
## 7. Input Timing Characteristics




*1 When ENAB is fixed "Low" the display starts from the data of C104(Clock)
*2 The vertical display position(TVs) is fixed at 34th line.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## 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 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Red | Red(00) Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(01) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(02) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Red(61) | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(63) Bright | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green | Green(00)Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(02) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Green(61) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(63)Bright | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue | Blue(00) Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue(02) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue(61) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(63) Bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| Whte & 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 |


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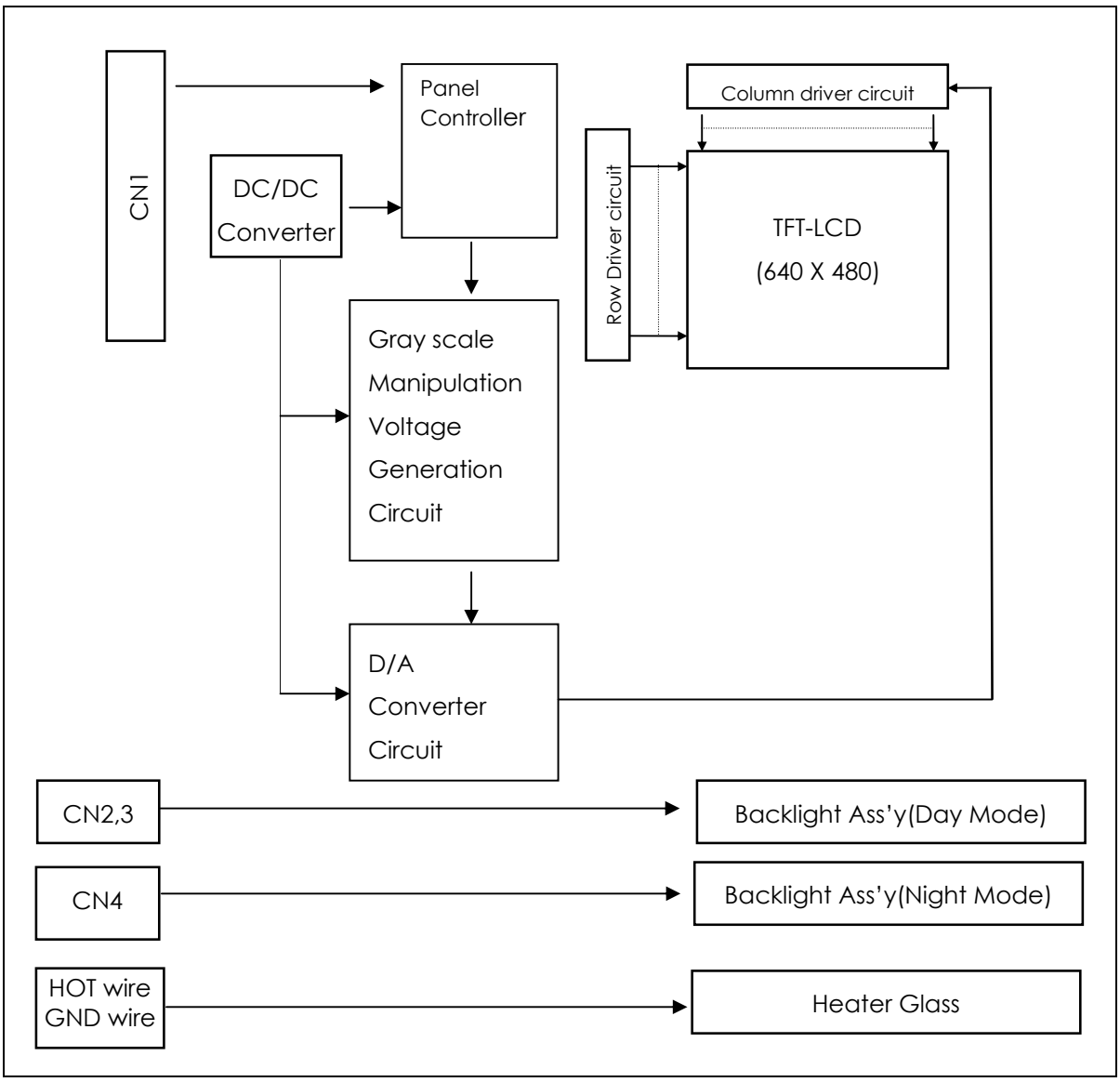
## 9. Block Diagram





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## 10. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of 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. | | |
| Day Mode | | | | | | |
| Contrast Ratio | CR | | 400 | | | 1 |
| Surface Luminance, white | $L_{WH}$ | 500 | | | cd/m² | 2 |
| Luminance Uniformity | $\delta_{WHITE}$ | 70% | | | | 3 |
| Night Mode | | | | | | |
| Contrast Ratio | CR | | 400 | | | 1 |
| Surface Luminance, white | $L_{WH}$ | 200 | | | d/m² | 2 |
| Luminance Uniformity | $\delta_{WHITE}$ | 60% | | | | 3 |
| Response Time | | | | | | |
| Total(Tr + Td) | | | 40 | | msec | 4 |
| Day Mode | | | | | | |
| CIE Color Coordinates | | | | | | |
| Red | $x_R$ | | TBD | | | |
| | $y_R$ | | TBD | | | |
| Green | $x_G$ | | TBD | | | |
| | $y_G$ | | TBD | | | |
| Blue | $x_B$ | | TBD | | | |
| | $y_B$ | | TBD | | | |
| White | $x_W$ | | TBD | | | |
| | $y_W$ | | TBD | | | |
| Night Mode | | | | | | |
| CIE Color Coordinates | | | | | | |
| Red | $x_R$ | | TBD | | | |
| | $y_R$ | | TBD | | | |
| Green | $x_G$ | | TBD | | | |
| | $y_G$ | | TBD | | | |
| Blue | $x_B$ | | TBD | | | |
| | $y_B$ | | TBD | | | |
| White | $x_W$ | | TBD | | | |
| | $y_W$ | | TBD | | | |
| Viewing Angle | | | | | | |
| x axis, right (ø=0°) | θ x | | 80 | - | degree | 5 |
| x axis, left(ø=180°) | θ x | | 80 | - | | |
| y axis, up(ø=90°) | θ y | | 80 | - | | |
| y axis, down (ø=270°) | θ y | | 70 | - | | |

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, $\delta_{WHITE}$ is determined by measuring $L_{ON}$ at each test position 1 through


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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.

$\delta_{WHITE}$ = Minimum ($L_{ON1}$, $L_{ON2}$, ....$L_{ON9}$) * 100 / Maximum ($L_{ON1}$, $L_{ON2}$, ....$L_{ON9}$)

4. Response time is the time required for the display to transition from white to black (Rise Time, $Tr_R$) and from black to white (Decay Time, $Tr_D$). For additional information see 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. NVIS(NIGHT VISION IMAGING SYSTEM) SPECIFICATION

| | |
|---|---|
| NVIS Type | TYPE I |
| NVIS CLASS | B CLASS |
| Military Standard | MIL-STD-3009 |

## 12. Mechanical Characteristics

The chart below provides general mechanical characteristics for the model LGB057VD-LAD. 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 | 144.00 ± 0.5 mm |
| Vertical | 104.80 ± 0.5 mm |
| Depth | 16.1 ± 0.5 mm |

Bezel area:

| | |
|---|---|
| Horizontal | 119.80 mm |
| Vertical | 91.00 mm |

Active Display area:

| | |
|---|---|
| Horizontal | 115.20 mm |
| Vertical | 86.40 mm |

Weight (approximate): TBD g


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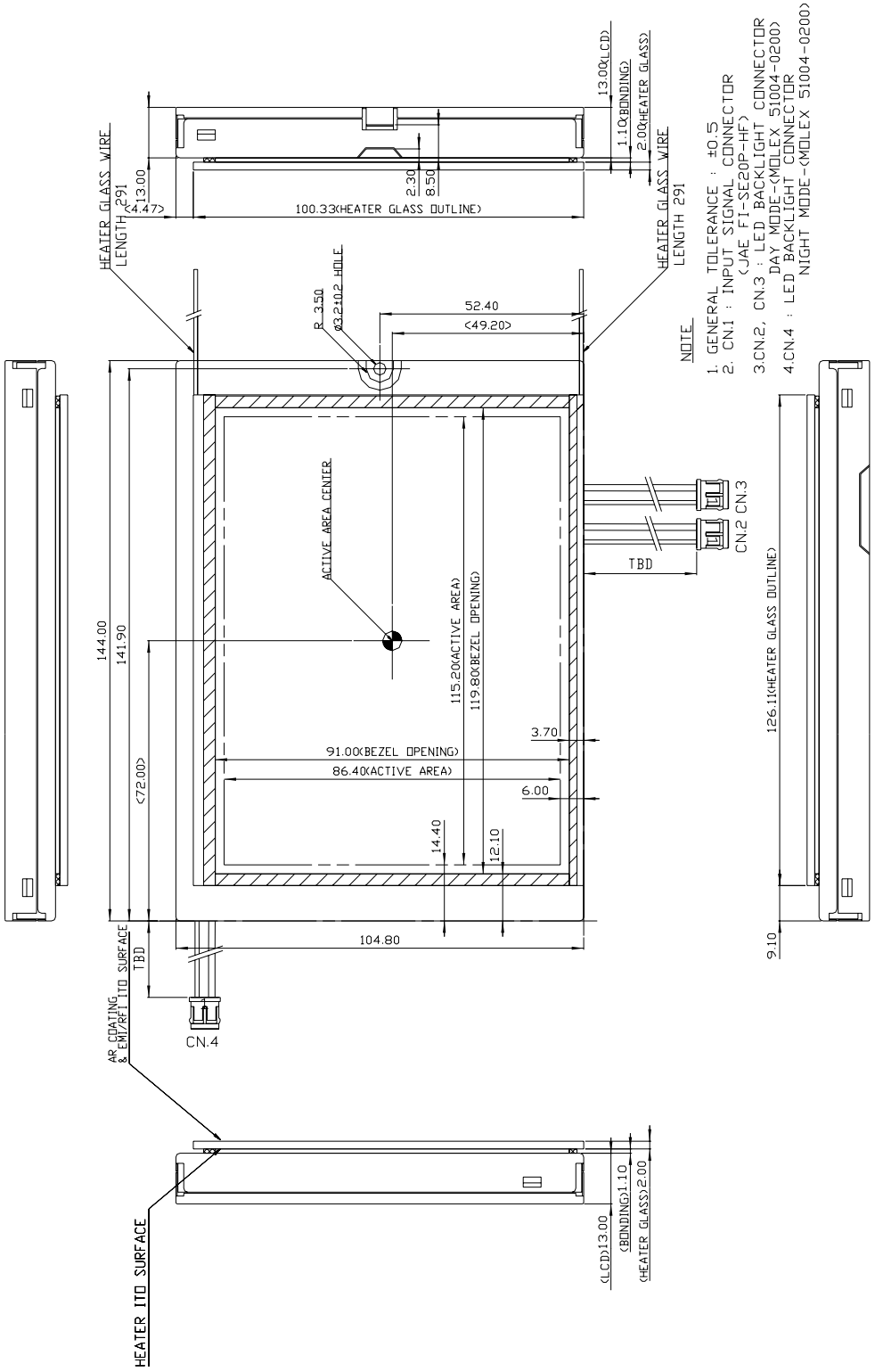
## 13. Mechanical Specification

**< FRONT VIEW >**





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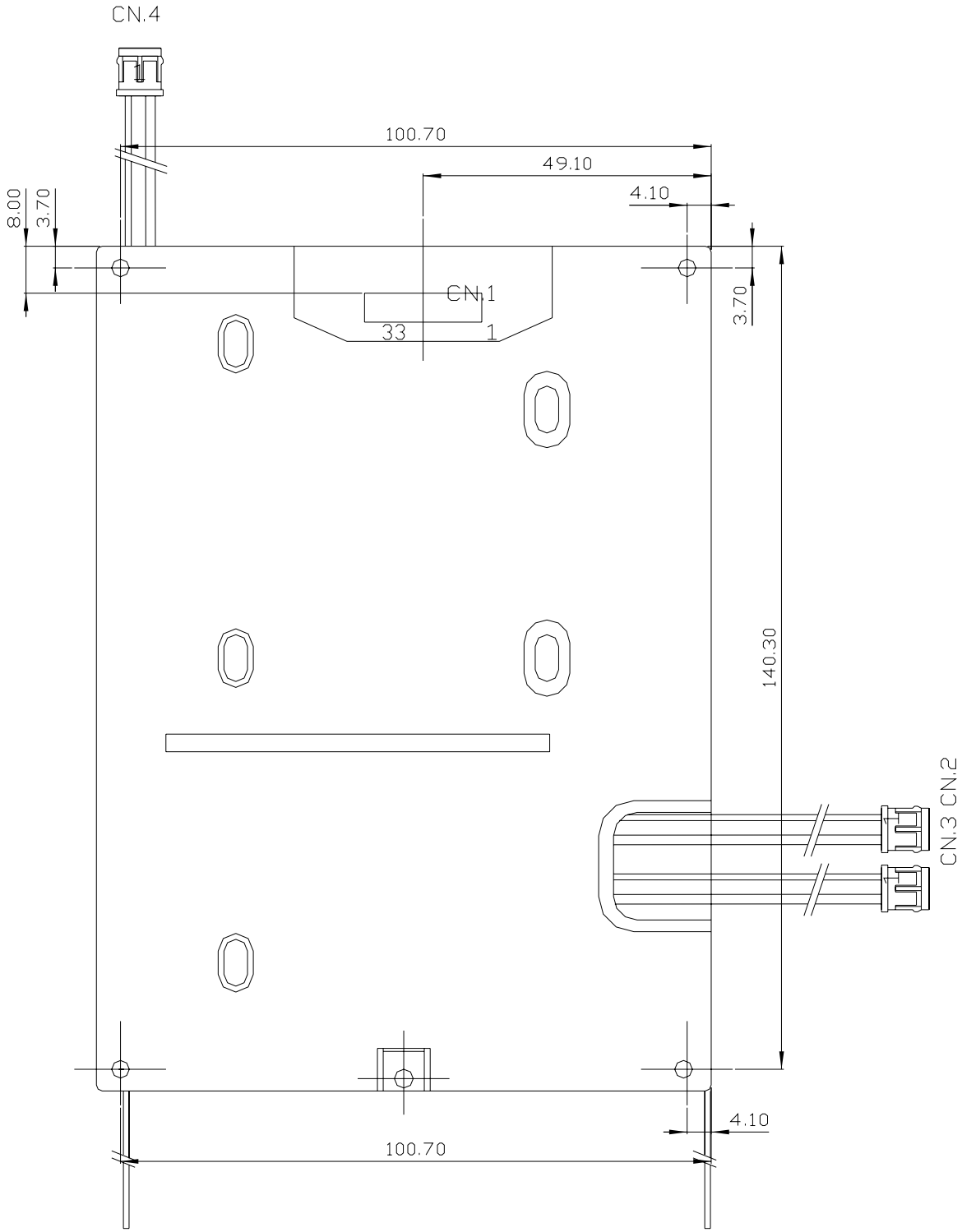
**<Rear View>**





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## 14. Reliability

- Environment test condition on backlight only.

| No. | Test ITEM | Conditions |
|---|---|---|
| 1 | High temperature storage test | Ta = 80°C, 72hr |
| 2 | Low temperature storage test | Ta = -30°C, 72hr |
| 3 | High temperature & high humidity operation test | Ta = 40°C, 85%RH 72hrs (no condensation) |
| 4 | High temperature operation test | Ta = 70°C, 72h |
| 5 | Low temperature operation test | Ta = -10°C, 72h |
| 6 | Thermal Shock | Ta = -30°C(2 Hour) ~ 80°C (2 Hour), 6cycles |
| 7 | Shock test (non-operating) | Gravity : 50G<br>Pulse width: 11ms, half sine wave for X, Y, Z once each direction |
| 8 | Vibration test (non-operating) | Frequency 10 ~ 55 ~10 Hz<br>Gravity/AMP: 1.5G Period: X, Y, Z 30 min. , 1Cycle |

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 (Lamp 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%.

## 15. Packing Form

a) Package quantity in one box : TBD
b) Box Size : TBD

## 16. PRECAUTIONS

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

### 16.1 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.


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Do not touch the surface of polarizer with 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, toluen 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.

## 16.2 OPERATING PRECAUTIONS

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage : V = ± 200mV (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) A module has high frequency circuit. It might be necessary to shield the electromagnetic noise in your integrating system.

(7) When a Backlight unit is operating, it may make sounds. It might be necessary to shield your integrating system to cut down the noise.

## 16.3 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.

## 16.4 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.

## 16.5 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


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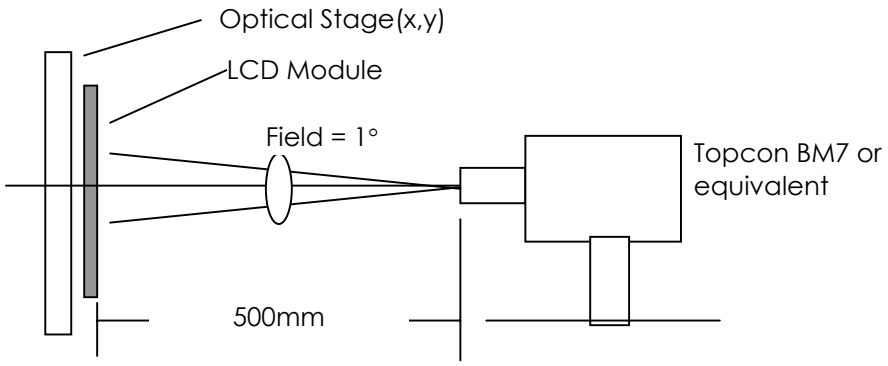
there remains a very small amount of glue still on the polarizer after the protection film is peeled off.

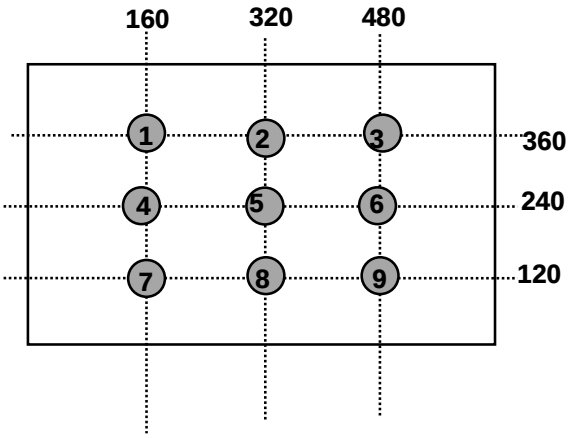
(4) You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal- hexane.

## A. Optical Characteristic Measurement Equipment and Method

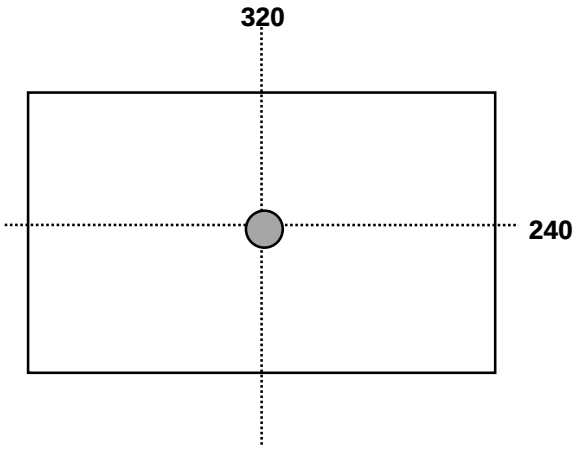



## B. Luminance

<measuring point for luminance variation>




<measuring point for surface luminance >





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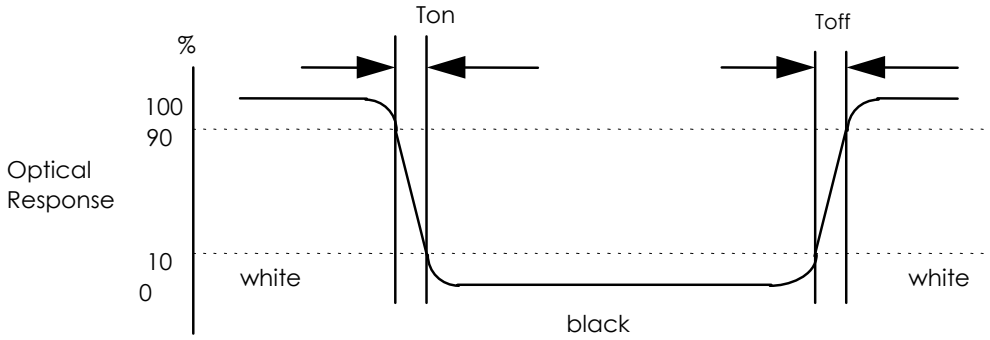
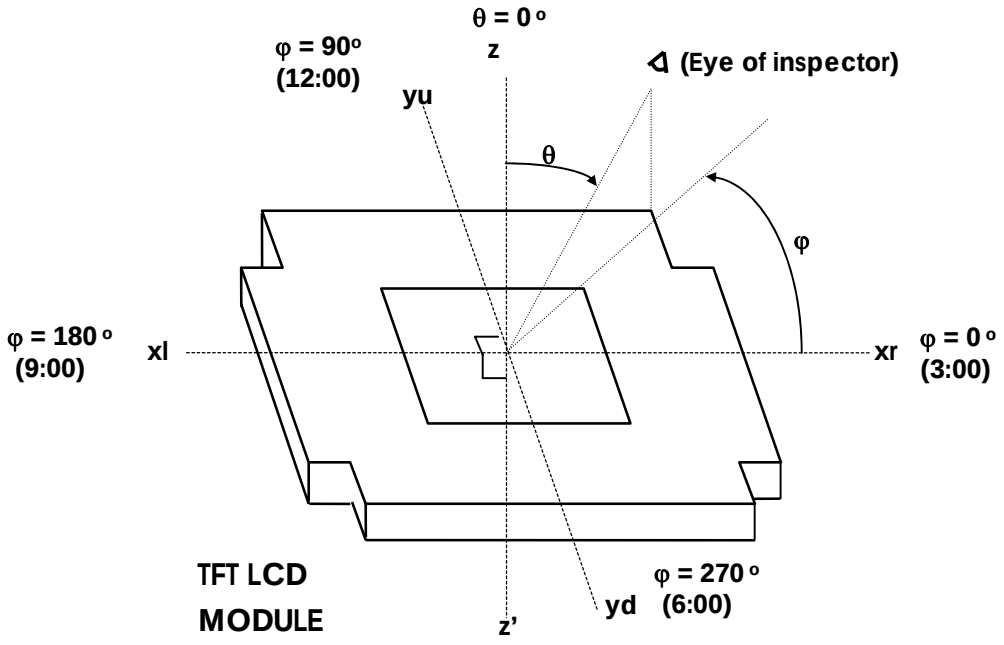
## C. Response Time

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>





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