

# SPECIFICATION FOR APPROVAL

- Preliminary Specification
- Final Specification

|       |                            |
|-------|----------------------------|
| Title | <b>2.2” TFT LCD MODULE</b> |
|-------|----------------------------|

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

|          |                |
|----------|----------------|
| SUPPLIER |                |
| *MODEL   | <b>LB02201</b> |

| SIGNATURE | DATE  |
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| APPROVAL BY        | DATE  |
|--------------------|-------|
| Team Leader: _____ | _____ |
| <b>REVIEWED BY</b> |       |
| Part Leader: _____ | _____ |
| <b>PREPARED BY</b> |       |
| RD Engineer: _____ | _____ |

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RECORDS OF REVISION

| DATE       | REVISED NO. | REVISED DESCRIPTIONS | PREPARED | CHECKED | APPROVED |
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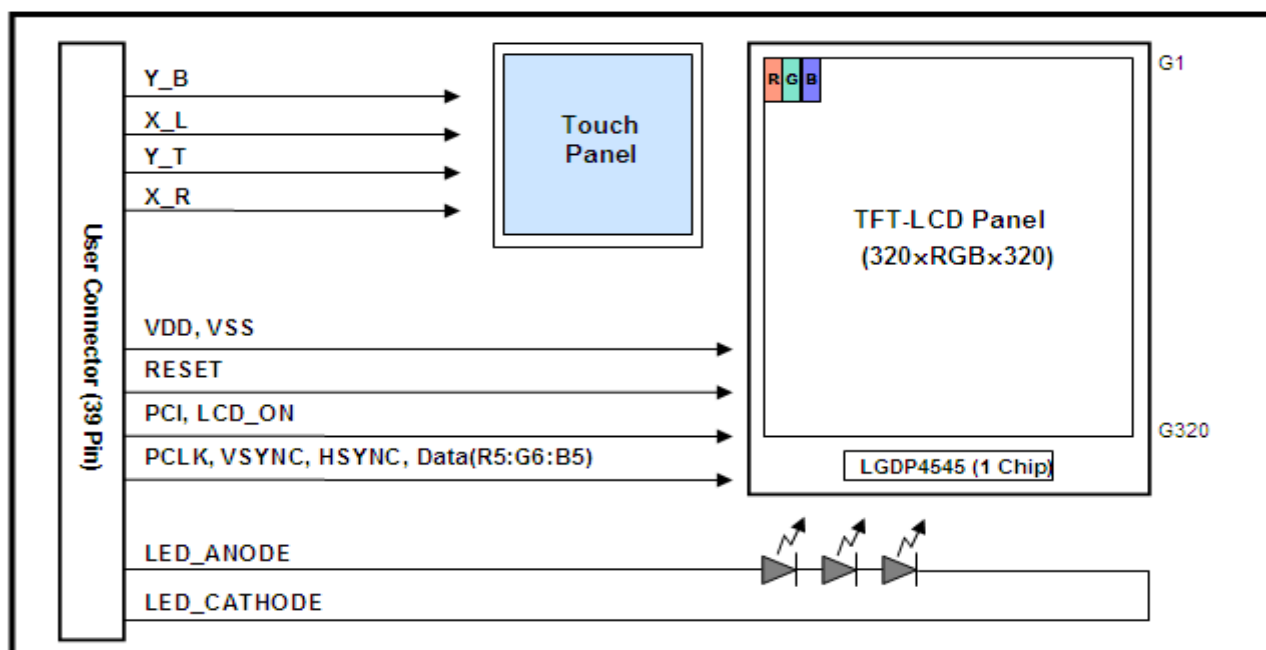
# LB02201 LCD Module

## ■ GENERAL SPECIFICATIONS

The LB02201 is a Color Active Matrix Liquid Crystal Display with Light Emission Diode(LED) backlight system. The matrix employs a-Si Thin Film Transistor as the active element.

It is transfective type display operating in the normally white mode. This TFT-LCD has 2.2 inch diagonally measured active display area with (320\*RGB\*320) resolution. Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes.

### Block Diagram



Mating User Connector: Hirose FH23-39S-0.3SHW(05)

**Fig 1.1 Block Diagram of TFT-LCD Module with LED Backlight Unit**

### General Features

|                    |  |
|--------------------|--|
| Active screen size | 2.2" diagonal                            |
| Outline Dimension  | 47.4 (H) X 51.85 (V) X 3.5 (T) MM (TYP.) |
| Pixel Pitch        | 0.123 (H) X 0.123 (V) mm                 |
| Pixel format       | 320(H) X 320 (V) (RGB Stripe)            |
| Color depth        | 16-bits (R5, G6, B5)                     |
| Interface          | 16-bit RGB I/F                           |
| Power Consumption  | 161mW (typ. BL on), 36mW (typ. BL off)   |
| Luminance          | 160nit(typ.) @13mA                       |
| Viewing Direction  | 6~7 0'clock                              |
| Weight             | 18 g(typ.)                               |
| Surface hardness   | 3H                                       |
| LCD Driver         | COG 1Chip                                |

## 2. ABSOLUTE MAXIMUM RATINGS

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

Table 2.1 Absolute Maximum Ratings

| Parameter             | Symbol | Values |     | Units | Notes |
|-----------------------|--------|--------|-----|-------|-------|
|                       |        | Min.   | Max |       |       |
| Power Supply Input    | VDD    | -0.3   | 4.2 | V     | 1     |
| LED Power Consumption | PLED   | -      | 120 | mW    | 2     |
| LED Current           | ILED   | -      | 30  | mA    | 2, 3  |

Notes:

1. Applies to VDD, RESET, PCLK, HSYNC, VSYNC, LCD\_ON, PCI, Data.
2. Applies to each LED individually.
3. Allowable forward current is refer to Fig 2.1

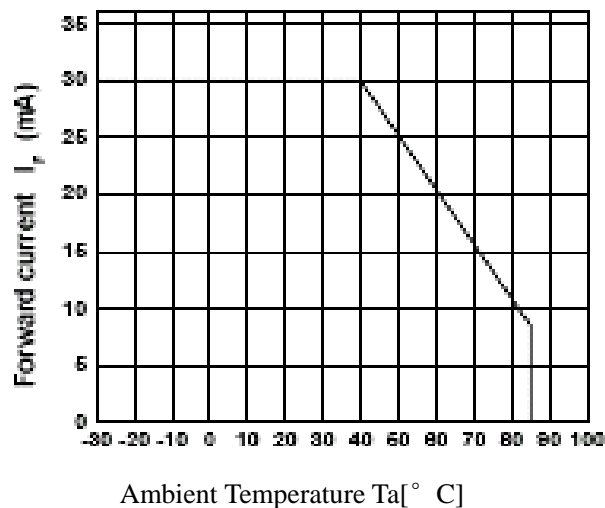


Fig 2.1 Ambient Temperature vs. Allowable Forward Current

### 3. ELECTRICAL SPECIFICATIONS

#### 3-1. ELECTRICAL CHARACTERISTICS

**Table 3.1 Electrical Characteristics Of TFT-LCD Module**

| Parameter                  | Symbol | Values  |      |        | Units | Notes |
|----------------------------|--------|---------|------|--------|-------|-------|
|                            |        | Min     | Typ. | Max    |       |       |
| LCD Power Supply Voltage   | VDD    | 2.9     | 3.0  | 3.1    | V     |       |
| “H”Level Input Voltage     | VIH    | 0.8 VDD | -    | VDD    | V     | 2     |
| “L”Level Input Voltage     | VIL    | 0       | -    | 0.2VDD | V     | 2     |
| Current Consumption, Panel | Ivdd   |         | 12   | 19.5   | mA    | 1     |

Notes:

1. The specified current consumption are under the conditions at VDD = 3.0V, Ta=25° C, and fv=54 Hz, 16 gray steps is displayed and fv is the frame frequency.
2. Input mode of Data, PCLK,HSYNC,VSYNC,LCD\_ON,PCI,RESET.

#### 3-2. BACK LIGHT UNIT

The edge-lighting type of back light unit consists of 3 LEDs which is connected in serial

**Table 3.2 Electrical Characteristics Of Back Light Unit**

| Parameter             | Symbol | Values |      |      | Units | Notes |
|-----------------------|--------|--------|------|------|-------|-------|
|                       |        | Min    | Typ. | Max  |       |       |
| LED Current           | ILED   | -      | 13   | 30   | mA    |       |
| LED Forward Voltage   | VLED   | -      | 9.6  | 10.5 | V     |       |
| LED Power Consumption | PLED   | -      | 125  | 137  | mW    |       |

#### 3-3. TOUCH PANEL

**Table 3.3 Touch Panel Electrical and Optical Specifications (GND=0V, Ta=25 °C)**

| Parameter             | Min. | Typ. | Max. | Unit | Remarks       |
|-----------------------|------|------|------|------|---------------|
| Linearity             | -1.5 | -    | 1.5  | %    |               |
| Terminal Resistance   | 100  | -    | 1100 | Ω    | X-axis        |
|                       | 100  | -    | 1100 | Ω    | Y-axis        |
| Insulation Resistance | 20   | -    | -    | MΩ   | DC 25V        |
| Voltage               | -    | 5    | 7    | V    | DC            |
| Chattering            | -    | -    | 20   | ms   | DC 5V, 100 kΩ |
| Transparency          | 78   | 80   | -    | %    |               |

3-4. INTERFACE CONNECTIONS

The pin connections are provided in Table 3.3 The mating connector for the flex tail is Hirose FH23-39S-0.3SHW(05) Or equivalent.

**Table 3.4 Module Connector Pin Configuration**

| Pin | SYMBOL      | I/O, Power, Analog | Comment                      |
|-----|-------------|--------------------|------------------------------|
| 1   | Y_Bottom    | Analog             | Touch Panel Y-Bottom         |
| 2   | X_Left      | Analog             | Touch Panel X-Left           |
| 3   | Y_Top       | Analog             | Touch Panel Y-Top            |
| 4   | X_Right     | Analog             | Touch Panel X-Right          |
| 5   | RESET       | I                  | LCD Reset                    |
| 6   | PCI         | I                  | Power Control In             |
| 7   | Vss         | Power              | Ground reference (0V)        |
| 8   | PCLK        | I                  | Pixel Clock                  |
| 9   | Vss         | Power              | Ground reference (0V)        |
| 10  | HSYNC       | I                  | Horizontal Sync Signal       |
| 11  | VSYNC       | I                  | Vertical Sync Signal         |
| 12  | Vss         | Power              | Ground reference (0V)        |
| 13  | R5          | I                  | Red Data                     |
| 14  | R4          | I                  | Red Data                     |
| 15  | R3          | I                  | Red Data                     |
| 16  | R2          | I                  | Red Data                     |
| 17  | R1/ID1      | I/O                | Red Data / ID Bit 1          |
| 18  | Vss         | Power              | Ground reference (0V)        |
| 19  | G5          | I                  | Green Data                   |
| 20  | G4          | I                  | Green Data                   |
| 21  | G3          | I                  | Green Data                   |
| 22  | G2          | I                  | Green Data                   |
| 23  | G1          | I                  | Green Data                   |
| 24  | G0          | I                  | Green Data                   |
| 25  | Vss         | Power              | Ground reference (0V)        |
| 26  | B5          | I                  | Blue Data                    |
| 27  | B4          | I                  | Blue Data                    |
| 28  | B3          | I                  | Blue Data                    |
| 29  | B2          | I                  | Blue Data                    |
| 30  | B1/ID2      | I/O                | Blue Data / ID Bit 2         |
| 31  | LCD_ON      | I                  | Switches LCD on (active low) |
| 32  | LED_Anode   | I                  | LED Anode                    |
| 33  | LED_Cathode | I                  | LED Cathode                  |
| 34  | Vss         | Power              | Ground reference (0V)        |
| 35  | VDD         | Power              | Digital Power Supply (3.0V)  |

|    |     |       |                       |
|----|-----|-------|-----------------------|
| 36 | Vss | Power | Ground reference (0V) |
| 37 | Vss | Power | Ground reference (0V) |
| 38 | Vss | Power | Ground reference (0V) |
| 39 | Vss | Power | Ground reference (0V) |

### 3-5. SIGNAL TIMING SPECIFICATIONS

**Table 3.5 Timing Parameters**

| Item                                       | Symbol        | Minimum | Typical | Maximum | Unit | Note |
|--|---------------|---------|---------|---------|------|------|
| Input clock voltage                        | VIL           | -0.3    | 0       | 0.2*VDD | V    |      |
|  | VIH           | 0.8*VDD | -       | VDD     | V    |      |
| Vertical frequency                         | fv            | 50.5    | 54.1    | 57.8    | Hz   |      |
| Horizontal frequency                       | fh            | 17.0    | 18.1    | 19.2    | KHz  |      |
| PCLK frequency                             | ftch          | 6.25    | 6.5     | 6.75    | MHz  |      |
| PCLK pulse width                           | telk          | 148     | 154     | 160     | ns   |      |
| PCLK Low/High pulse width                  | PWDL,<br>PWDH | 32      | 0.5telk | -       | ns   |      |
| PCLK cycle time                            | tCYCD         | 80      | -       | -       | ns   |      |
| Hsync low pulse width                      | thsw          | 4       | 5       | 8       | dots |      |
| Vsync low pulse width                      | thsw          | 1       | 1       | 4       | line |      |
| Hsync setup time                           | tSYNCS        | 20      | -       | -       | ns   |      |
| Hsync hold time                            | tSYNCH        | 20      | -       | -       | ns   |      |
| Data setup time                            | tPDS          | 20      | -       | -       | ns   |      |
| Data hold time                             | tPDH          | 20      | -       | -       | ns   |      |
| Number of Horizontal                       |               | 352     | 360     | 368     | dots |      |
| Horizontal blanking period                 | thblk         | 32      | 40      | 48      | clk  |      |
| Hsync falling edge<br>◇ 1st data start     | thbp          | -       | 24.5    | -       | dots |      |
| Hsync front porch                          | thfp          | 7.5     | 15.5    | 23.5    | dots |      |
| Number of vertical                         |               | 332     | 334     | 336     | line |      |
| Vertical blanking period                   | tvblk         | 12      | 14      | 16      | line |      |
| Vsync falling edge<br>◇ 1st data start     | tvbp          | -       | 8       | -       | line |      |
| Vsync front porch                          | tvfp          | 4       | 6       | 8       | line |      |
| Vsync falling edge<br>◇ Hsync falling edge | tvhde         | -5      | -4      | 100     | clk  |      |
| Fast clock rise time                       | trgbr         | -       | -       | 25      | ns   | 1    |
| Fast clock fall time                       | trgbf         | -       | -       | 25      | ns   | 1    |
| Slow clock rise time                       | trscclk       | -       | -       | 100     | ns   | 2    |
| Slow clock fall time                       | tfscclk       | -       | -       | 100     | ns   | 2    |



- Notes: 1. PCLK, VSYNC, HSYNC
- 2. LCD\_ON, PCI

3-6. SIGNAL TIMING WAVEFORMS

Fig 3.1 Horizontal Timing chart

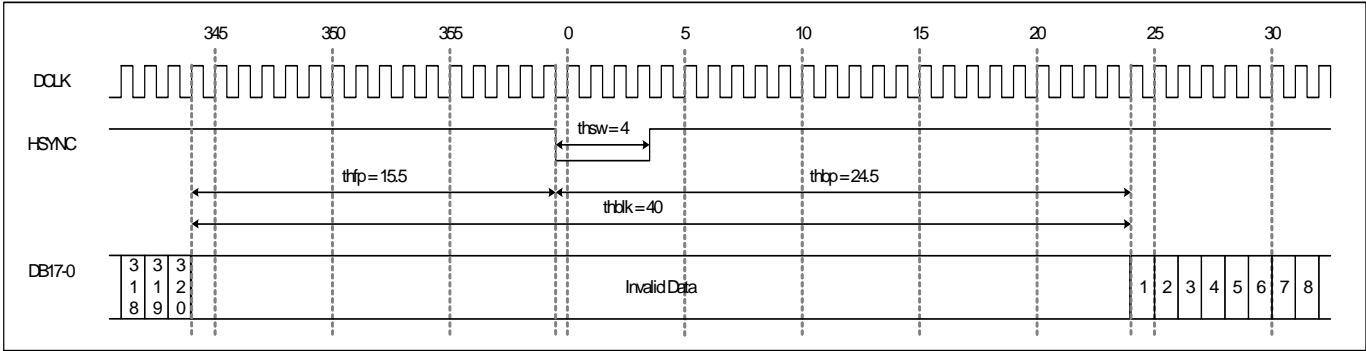


Fig 3.2 Vertical Timing chart

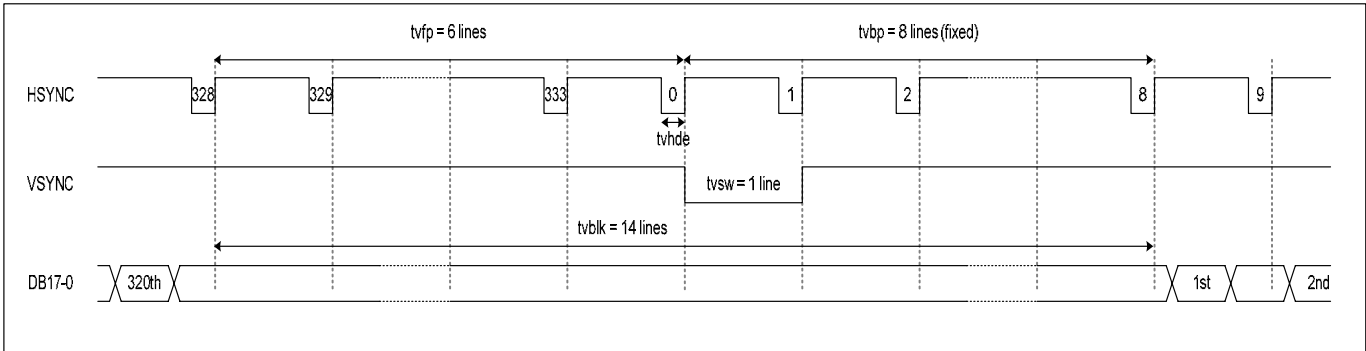
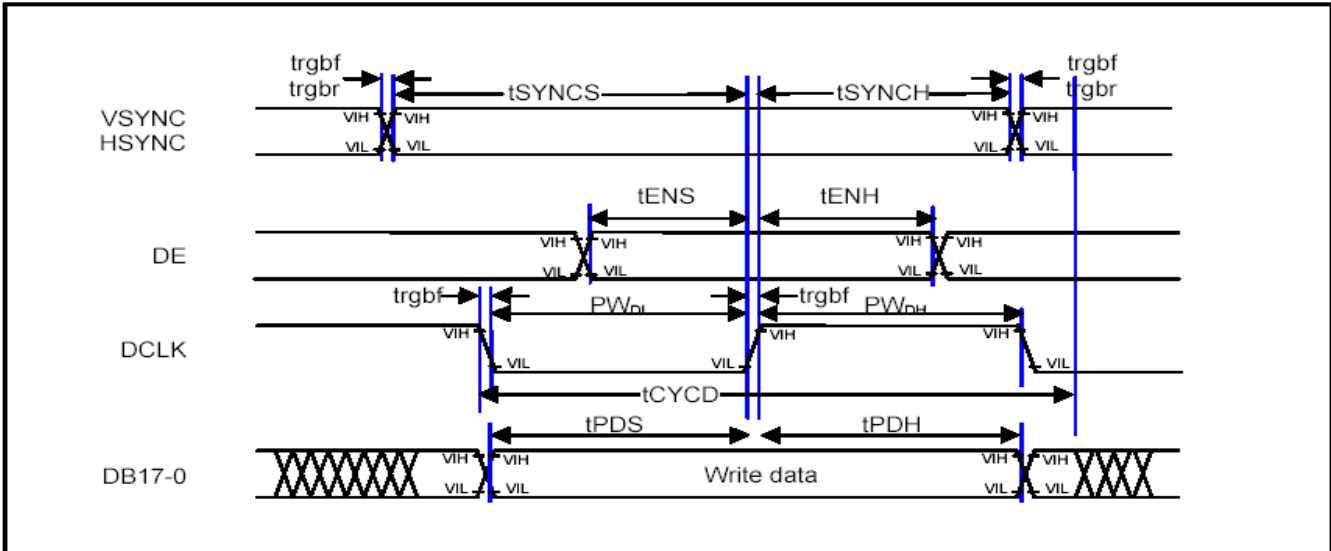


Fig 3.3 Timing Characteristics



3-7. COLOR INPUT DATA REFERENCE

| Display Colors   |                  | Data Signal |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------------------|------------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                  |                  | R5          | R4 | R3 | R2 | R1 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 |
| Basic Color      | Black            | 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  | 1  | 1  | 1  | 1  | 1  |
|                  | Green            | 0           | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  |
|                  | Cyan             | 0           | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                  | Red              | 1           | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Magenta          | 1           | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  |
|                  | Yellow           | 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  |
| Red Gray Scale   | Black            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Darker<br>↑<br>↓ | 0           | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  |                  | •           | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  |
|                  |                  | 1           | 1  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Brighter         | 1           | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  |                  | 1           | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Red              | 1           | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Green Gray Scale | Black            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Darker<br>↑<br>↓ | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  |
|                  |                  | •           | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  |
|                  |                  | 0           | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 0  |
|                  | Brighter         | 0           | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  |                  | 0           | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Green            | 0           | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  |
| Blue Gray Scale  | Black            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | Darker<br>↑<br>↓ | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  |
|                  |                  | •           | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  | •  |
|                  |                  | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 0  | 1  |
|                  | Brighter         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 0  |
|                  |                  | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 0  |
|                  | Blue             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  |

4. OPTICAL CHARACTERISTICS

4-1. Optical Characteristics – Backlight Off

| Parameter           | Symbol            | Condition              | Min.  | Typ.  | Max.  | Unit       | Remarks                   |
|---------------------|-------------------|------------------------|-------|-------|-------|------------|---------------------------|
| Viewing angle range | ⊕ UP              | CR ≥ 2                 | 60    | 75    | -     | ° (degree) | Note 3                    |
|                     | ⊕ DOWN            |                        |       |       |       | ° (degree) | Note 3                    |
|                     | ⊕ LEFT            |                        | 50    | 65    | -     | ° (degree) | Note 3                    |
|                     | ⊕ RIGHT           |                        |       |       |       | ° (degree) | Note 3                    |
| Contrast ratio      | CR                | Optimal                | 3     | 5     | -     |            | Note 2<br>(Spot light)    |
| Reflectivity        | R                 | Optimal                | 2.5   | 3.5   | -     | %          | Note 1<br>(Diffuse light) |
| Response time       | $\tau_f + \tau_r$ | ⊖ = 0 °<br>Ta = 25 ° C | -     | 40    | 60    | ms         | Note 4                    |
| White Chromaticity  | Wx                |                        | 0.290 | 0.325 | 0.360 | CIE        | Note 1<br>(Diffuse light) |

1. Optical Test Equipment & method refer to Note1,2,3,4.

**LB02201**  
**LCD Module**

4-2. Optical Characteristics – Backlight On

| Parameter                   | Symbol            | Condition              | Min.  | Typ.  | Max.  | Unit              | Remarks           |   |
|-----------------------------|-------------------|------------------------|-------|-------|-------|-------------------|-------------------|---|
| Viewing angle range         | ⊕ UP              | CR ≥ 5                 | 25    | 40    |       | ° (degree)        | Note 3            |   |
|                             | ⊕ DOWN            |                        | 35    | 50    |       | ° (degree)        | Note 3            |   |
|                             | ⊕ LEFT            |                        | 60    | 90    |       | ° (degree)        | Note 3            |   |
|                             | ⊕ RIGHT           |                        |       |       |       | ° (degree)        | Note 3            |   |
| Contrast ratio              | CR                | Optimal                | 100   | 120   |       | --                | Note 2            |   |
| Brightness                  | Y                 | ILED=13mA              | 110   | 160   |       | cd/m <sup>2</sup> | Note 1<br>[PR880] |   |
| Brightness Uniformity       | Y                 | ILED=13mA              | 80    |       |       | %                 | Note 5<br>[PR880] |   |
| Backlight Power Consumption | PLED              | ILED=13mA              |       | 125   |       | mW                |                   |   |
| Response time               | $\tau_f + \tau_r$ | ⊕ = 0 °<br>Ta = 25 ° C |       | 35    | 50    | ms                | Note 4            |   |
| White Chromaticity          | Wx                | ⊕ = 0 °<br>Ta = 25 ° C | 0.240 | 0.290 | 0.340 |                   | Note 1<br>[PR650] |   |
|                             | Wy                |                        | 0.263 | 0.313 | 0.363 |                   |                   |   |
| Red Chromaticity            | Rx                |                        | 0.528 | 0.578 | 0.628 |                   |                   |   |
|                             | Ry                |                        | 0.289 | 0.339 | 0.389 |                   |                   |   |
| Green Chromaticity          | Gx                |                        | 0.254 | 0.304 | 0.354 |                   |                   |   |
|                             | Gy                |                        | 0.494 | 0.544 | 0.594 |                   |                   |   |
| Blue Chromaticity           | Bx                |                        | 0.099 | 0.149 | 0.199 |                   |                   |   |
|                             | By                |                        | 0.068 | 0.118 | 0.168 |                   |                   |   |
| Color Gamut                 | NTSC              |                        |       | 45    |       |                   |                   | % |

1. Optical Test Equipment & method refer to Note1,2,3,4.

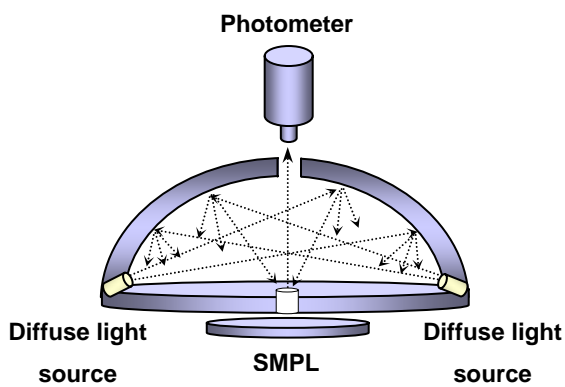
[Note 1] Optical Test Equipment Setup

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.

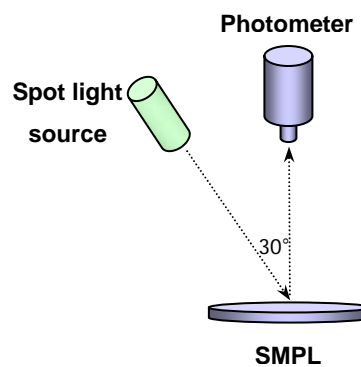
In case of backlight on, measured on the center area of the panel by PHOTO RESEARCH photometer PR-880&PR650 or Equivalent.

In case of backlight off, measured on the center area of the panel by DMS-803

**Diffuse light**



**Spot light**



**DMS-803 or equivalent**

Fig 4.1 Backlight Off (Optical Characteristic Measurement Equipment and Method)

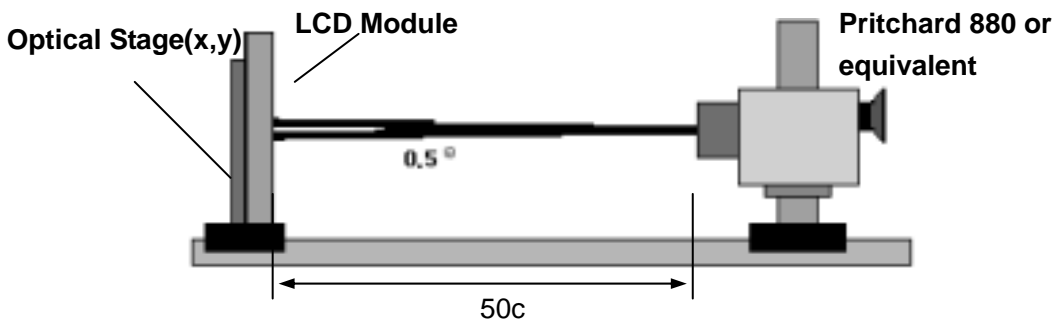


Fig 4.2 Backlight On (Optical Characteristic Measurement Equipment and Method)

[Note 2]

Contrast ratio is defined as follows ;

$$\text{Contrast Ratio(CR)} = \frac{\text{Photo detector output with LCD being "white"}}{\text{Photo detector output with LCD being "black"}}$$

[Note 3]

Viewing angle range is defined as follows;

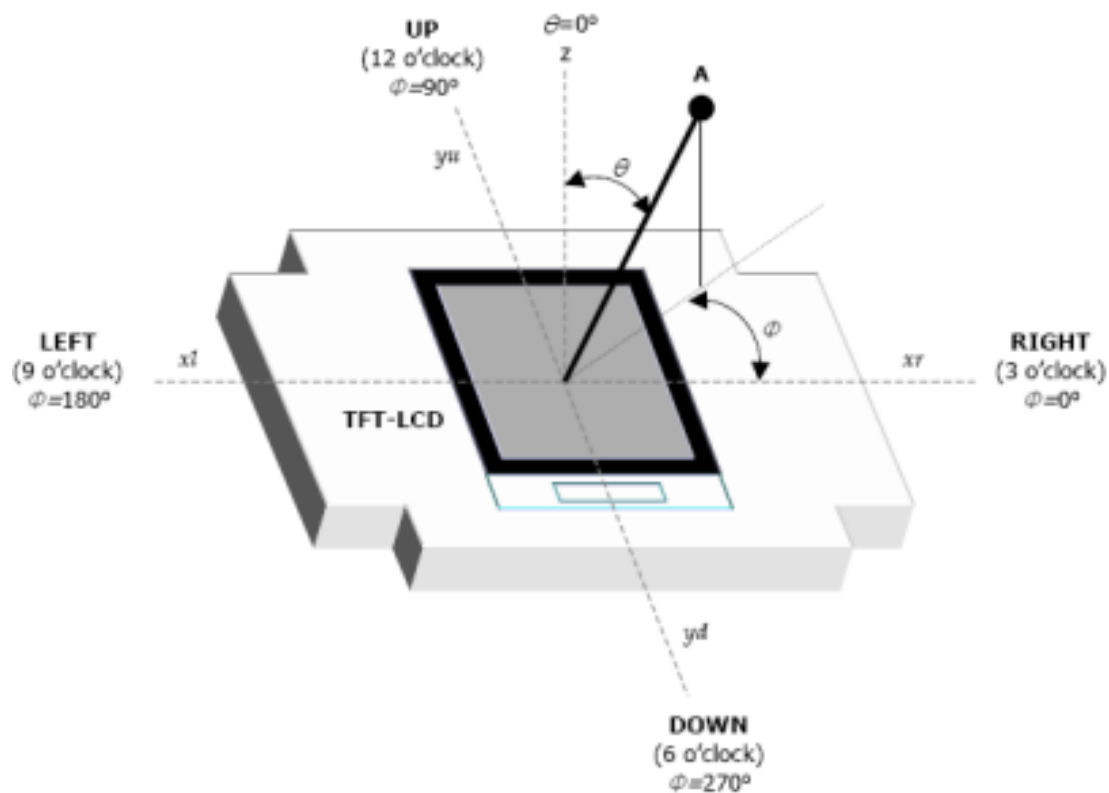


Fig 4.3 Viewing Angle Definitions

[Note 4]

Response time is obtained by measuring the transition time of photo detector output, when input signals are applied so as to make the area “black” to and from “white”.

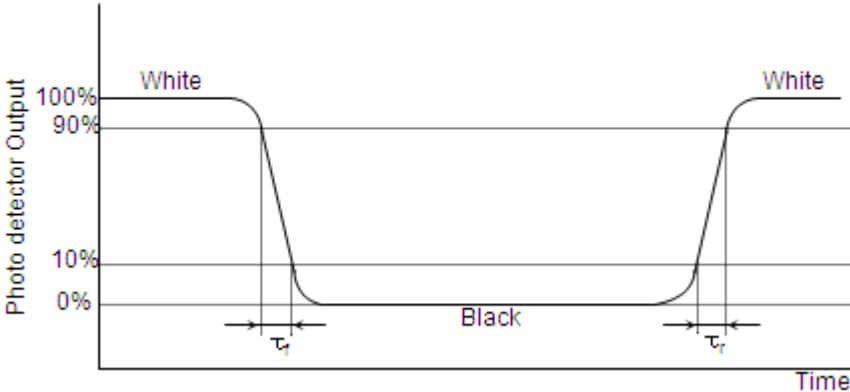


Fig 4.4 Response Time Definition

[Note 5]

The brightness measurement is taken at point B5.

$$\text{Brightness Uniformity} = \frac{\text{Minimum Photo detector output for B1-B9 with all pixels white}}{\text{Maximum Photo detector output for B1-B9 with all pixels white}} \times 100$$

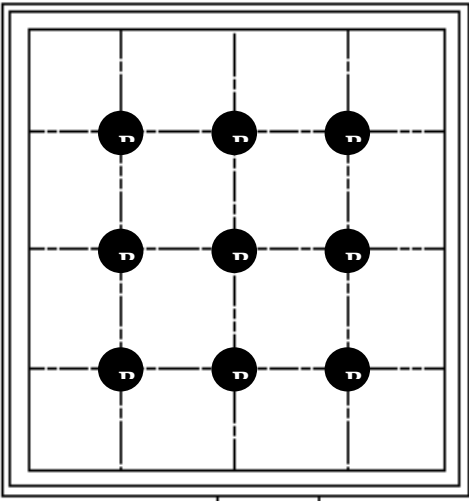


Fig 4.5 Brightness measurement points

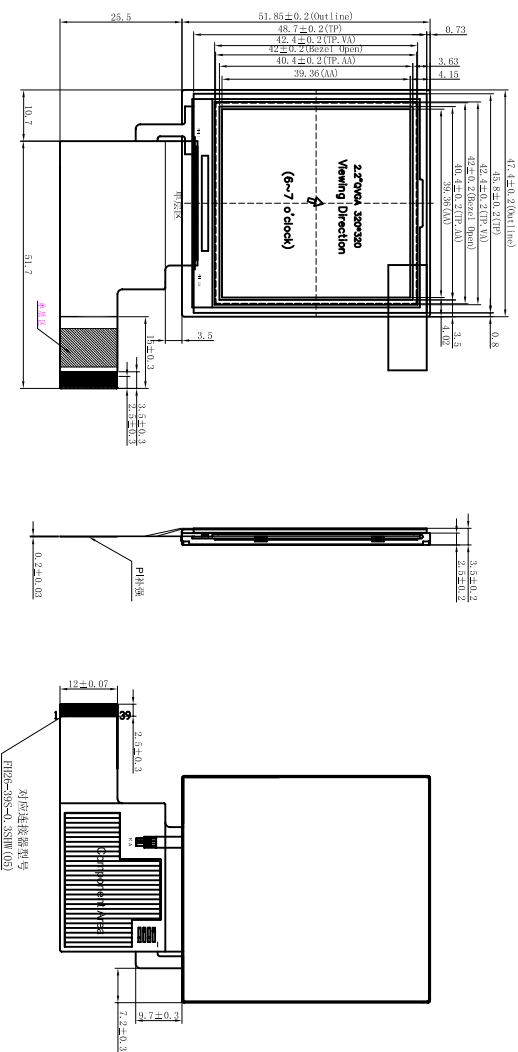
## 5. MECHANICAL CHARACTERISTICS

The contents provide general mechanical characteristics for the model LH220Q32.  
In addition the figures in the next page are detailed mechanical drawing of the LCD.

| DIMENSION      | MIN   | TYP   | MAX   | UNIT |
|----------------|-------|-------|-------|------|
| HORIZONTAL (H) | 47.2  | 47.4  | 47.6  | MM   |
| VERTICAL (V)   | 51.65 | 51.85 | 52.05 | MM   |
| THICKNESS (T)  | -     | 3.5   | 3.8   | MM   |



| NO | Pad Name |
|----|----------|
| 1  | V0       |
| 2  | XL       |
| 3  | YU       |
| 4  | XR       |
| 5  | RESET    |
| 6  | PCI      |
| 7  | VSS      |
| 8  | PCLK     |
| 9  | VSS      |
| 10 | HSYNC    |
| 11 | VSYNC    |
| 12 | VSS      |
| 13 | R5       |
| 14 | R4       |
| 15 | R3       |
| 16 | R2       |
| 17 | R1/ID1   |
| 18 | VSS      |
| 19 | G5       |
| 20 | G4       |
| 21 | G3       |
| 22 | G2       |
| 23 | G1       |
| 24 | G0       |
| 25 | VSS      |
| 26 | B5       |
| 27 | B4       |
| 28 | B3       |
| 29 | B2       |
| 30 | B1/ID2   |
| 31 | LCD_ON   |
| 32 | LEDA     |
| 33 | LEDK     |
| 34 | VSS      |
| 35 | VDD      |
| 36 | VSS      |
| 37 | VSS      |
| 38 | VSS      |
| 39 | VSS      |



LED\_A LED\_K

NOTES:

1. DISPLAY MODE: 16.7M Color TFT, Transmissive, Normally Black Mode
2. OPERATING TEMPERATURE: -10°C TD 60°C
3. STORAGE TEMPERATURE: -20°C TD 70°C
3. DRIVE IC : LG4545
4. VIEWING DIRECTION: 6~7 o'clock
5. GENERAL TOLERANCE ±0.20

| REV | DESCRIPTION | DATE       | PRODUCT NO.    | D/WN | UNIT: mm |
|-----|-------------|------------|----------------|------|----------|
| V0  |             | 2015.05.07 | STR-LB02201.V0 | CHK  |          |
|     |             |            |                | APP  |          |
|     |             |            |                |      |          |

6. POWER SUPPLY & Display SEQUENCE

[ Power-up Sequence ]

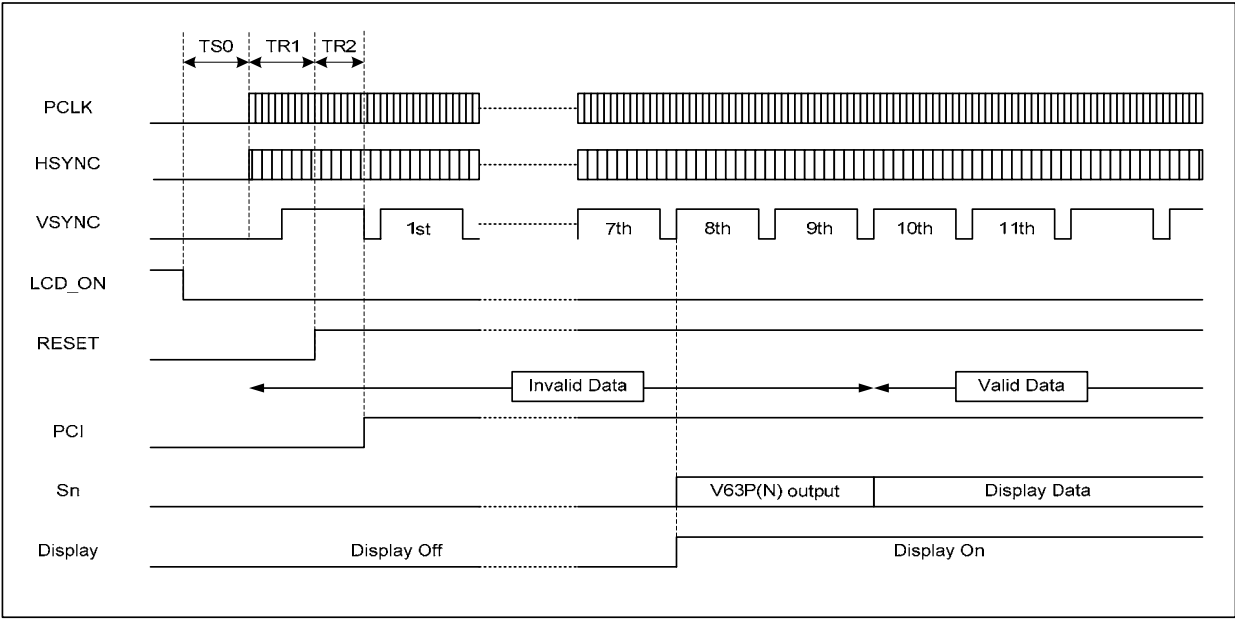


Fig 6.1 Power-up Sequence

[ Power-down Sequence ]

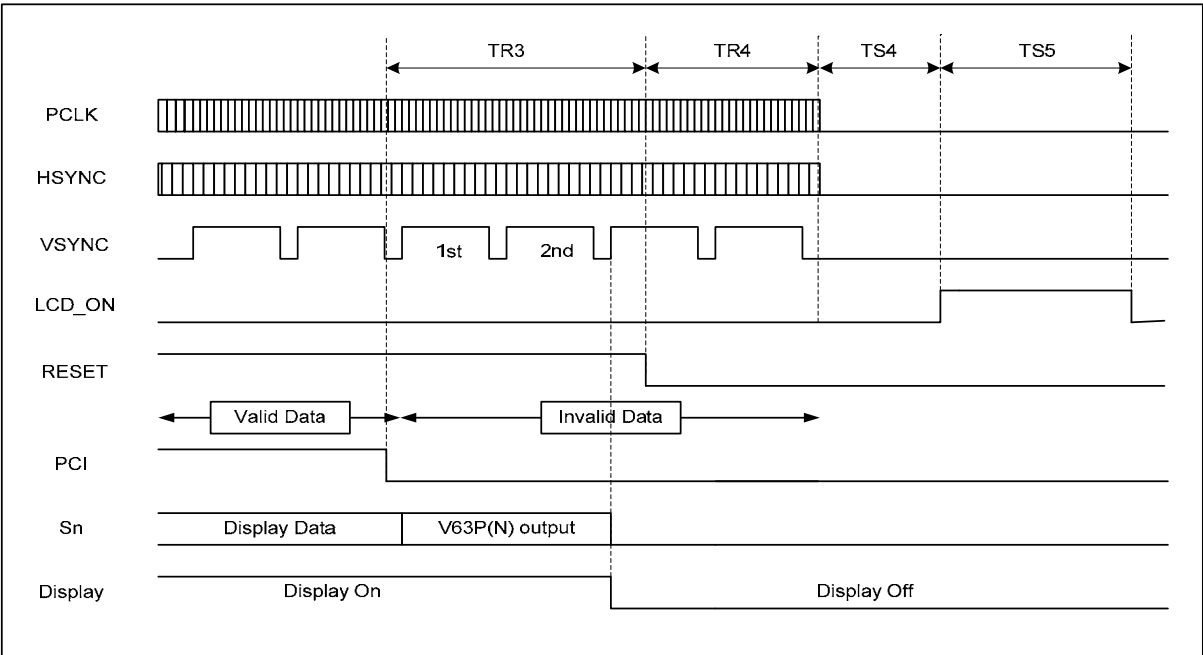


Fig 6.2 Power-down Sequence

[ Power-up/down Sequence Timing Condition]

| Symbol | Minimum | Typical | Maximum | Unit  | Remarks      |
|--------|---------|---------|---------|-------|--------------|
| TS0    | 4       | -       | 200     | ms    |              |
| TR1    | 2       | -       | 5       | frame | 2-5 frames   |
| TR2    | 2       | -       | 5       | frame | 2-5 frames   |
| TR3    | 2.5     | -       | 5       | frame | 2.5-5 frames |
| TR4    | 2       | -       | 5       | frame | 2-5 frames   |
| TS4    | 17.2    | -       | 59.4    | ms    |              |
| TS5    | 100     | -       | -       | ms    |              |

Table 6.1 Power-up/down Sequence Timing Conditions

7. RELIABILITY TEST

7-1. RELIABILITY TEST

| No. | Test Items                                   | Test Condition   | Remark |
|-----|--|--|--------|
| 1   | Low Temperature Storage                      | Ta=-30°C 240hrs  |        |
| 2   | High Temperature Storage                     | Ta=70°C 240hrs   |        |
| 3   | Low Temperature Operation                    | Ta=-10°C 240hrs  |        |
| 4   | High Temperature Operation                   | Ta=60°C 240hrs   |        |
| 5   | High Temperature and High Humidity Operation | Ta=40°C 95%RH 240hrs   |        |
| 6   | High temperature and Humidity Storage        | Ta=60°C 90%RH 240hrs   |        |
| 7   | Low Pressure Non-operating                   | 303hpa(40,000ft), RT, 48hrs  |        |
| 8   | Heat Shock                                   | -30C to +70C, 10 cycles, 1.5h  |        |
| 9   | Shock Test                                   | Half sine wave, 180G, 2ms,<br>1 time shock of X, Y, Z axis   |        |
| 10  | Vibration Test                               | - X, Y, Z : 1hr(axis, sweep)<br>- Acceleration : 10mm/4.4G/2.5G<br>the amplitude is 10mm<br>- Sweep range: 5~15Hz/10mm P-P/<br>16~30Hz/4.4G, 30~300Hz/2.5G |        |

{ Result Evaluation Criteria }

TFT-LCD Panel should be at room temperature for 2 hours after the reliability test is over.

There should be no particular change which might affect the practical display function and the display quality should be conducted under normal operating condition.

7-2. TOUCH PANEL RELIABILITY TEST

| PARAMETER                          | MIN.              | TYP. | MAX. | UNIT    | REMARK                          |
|------------------------------------|-------------------|------|------|---------|---------------------------------|
| Activation force                   | -                 | 15   | 80   | g       | R0.8mm polyacetal Pen or Finger |
| Durability<br>(Surface scratching) | 200,000<br>cycles |      |      | -       | Note 1                          |
| Durability<br>(Surface pitting)    | 1,000,000         |      |      | Touches | Note 2                          |
| Surface hardness                   | 3                 | -    | -    | H       | Judgment ref.JIS-K5400          |

[Note 1] Measurement for Surface area

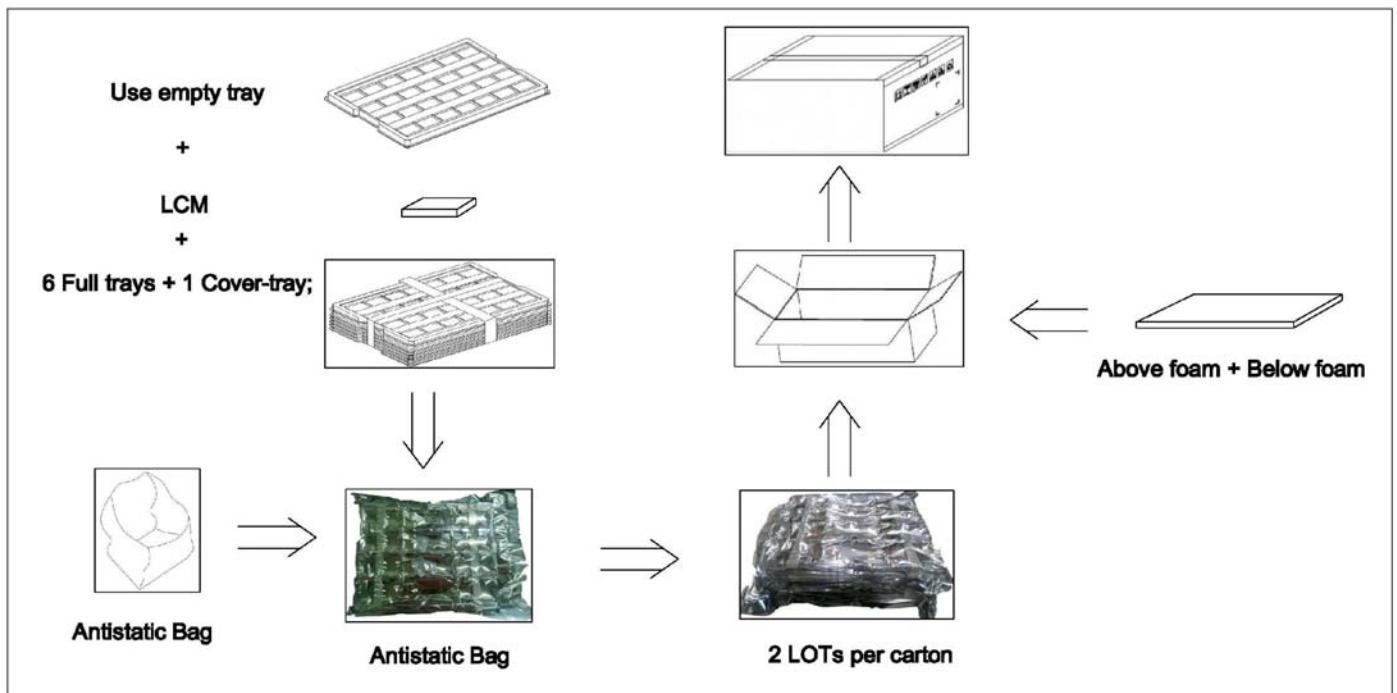
- Force : 250gf
- Speed : 60mm/sec
- Stylus : R0.8 poly-acetal resin
- Judgment
  - Terminal Resistance : According to section 3-3
  - Linearity : According to section 3-3

[Note 2] Pit 1,000,000 times on the Film with a R0.8 Poly-acetal resin

- Force : 250gf
- Frequency : 60 cycles/min.
- Judgment
  - Terminal Resistance : According to section 3-3
  - Linearity : According to section 3-3

## 8. PACKING

### (1) Packing Process



### (2) Packing Notice

- LCM should be placed upwardly while in the tray.
- Every eight full trays with a blank one while twining twice on both sides by adhesive tape.
- Every tray should be put crossly.
- LCMs should be packed in a vacuum with PE (anti-ESD) bag.

## 9. PRECAUTIONS

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

### 9-1. ASSEMBLY PRECAUTIONS

- (1) Please attach a transparent protective plate to the surface in order to protect the polarizer.  
Transparent protective plate should have sufficient strength in order to resist external force.
- (2) You should adopt radiation structure to satisfy the temperature specification.
- (3) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (4) 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 deteriorate the polarizer.)
- (5) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaked with petroleum benzine. 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.
- (6) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (7) Do not open the case because inside circuits do not have sufficient strength.
- (8) The metal case of a module should be contacted to electrical ground of your system.

### 9-2. OPERATING PRECAUTIONS

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :  
 $V = \pm 200\text{mV}$  (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)  
And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

### 9-3. ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

### 9-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter

### 9-5. STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

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

### 9-6. HANDLING PRECAUTIONS FOR PROTECTION FILM

- (1) 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.