

# LCD Module Technical Specification

First Edition  
Aug. 18, 2011  
Final Revision  
Sep. 28, 2011

Type No. **T-55548GD057JU-LW-ACN**

Customer : **OPTREX STANDARD**

Customer's Product No : -----

## OPTREX CORPORATION

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By

Signature :

Date :

Please return this specification within two month with your signature.  
If not returned within two month, specification will be considered  
as having been accepted.

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## Revision History

| Rev.                        | Date          | Page | Comment                                                                                                                                              |
|-----------------------------|---------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                           | Sep. 28, 2011 | 13   | <p>7.7.1.Absolute Maximum Ratings</p> <p>Correct: LED Life cycle → B/L Life time</p> <p>50000hrs Max.→ Min.</p> <p>Add: 70000hrs Typ, Note 2,3,4</p> |
| T-55548GD057JU-LW-ACN Rev.1 |               |      | <p>OPTREX CORPORATION</p> <p>Page 2/26</p>                                                                                                           |

## 1. Application

This specification applies to 5.7" color TFT-LCD module (T-55548GD057JU-LW-ACN).

## 2. General Specifications

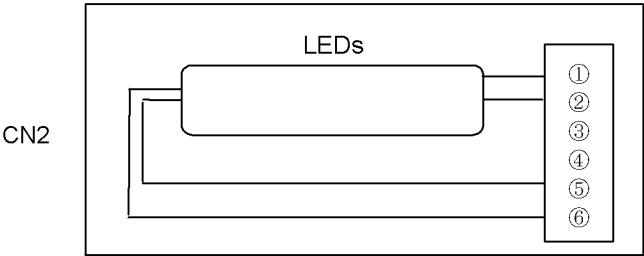
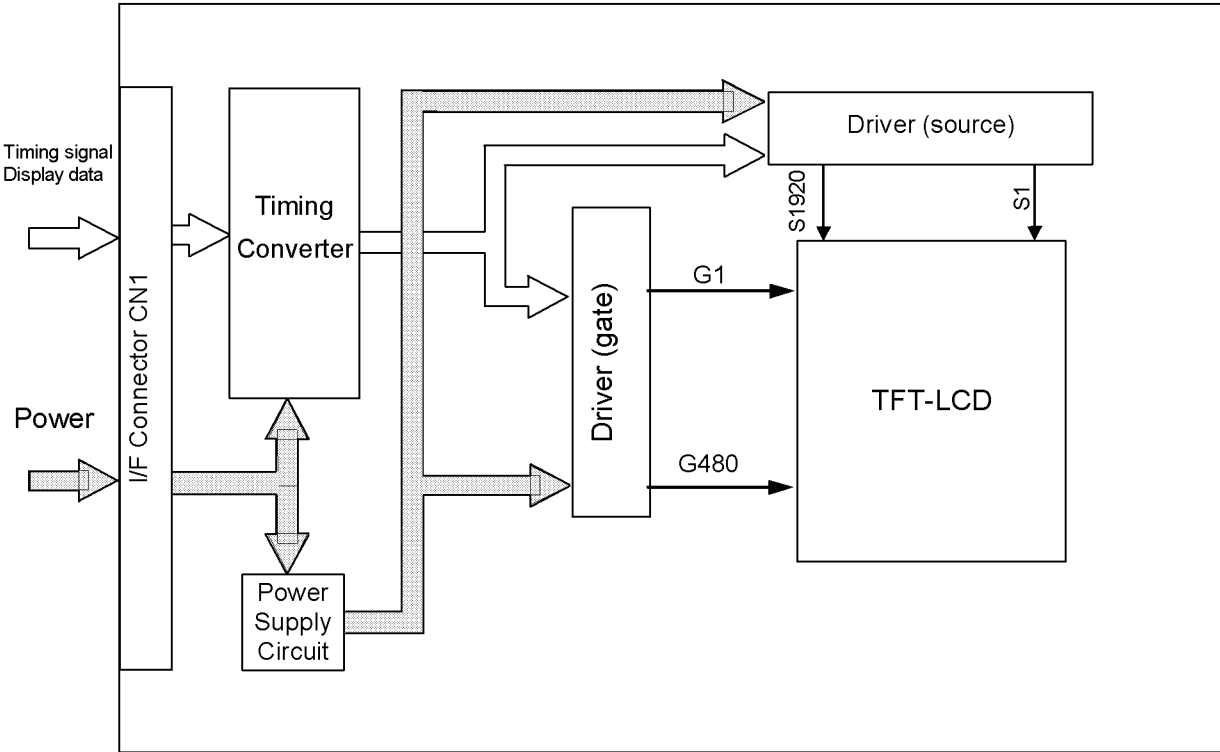
|                    |   |                                                                                                                                                                                                                                                                                                |
|--------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dot Pixels         | : | 640×3 [R.G.B] (W) × 480 (H) dots                                                                                                                                                                                                                                                               |
| Dot Size           | : | 0.06×3 [R.G.B] (W) × 0.18 (H) mm                                                                                                                                                                                                                                                               |
| Pixel Arrangement  | : | RGB-Stripe                                                                                                                                                                                                                                                                                     |
| Color Depth        | : | 262,144 colors                                                                                                                                                                                                                                                                                 |
| Viewing Area       | : | 117.0 (W) × 88.2 (H) mm                                                                                                                                                                                                                                                                        |
| Outline Dimensions | : | 143.2 (W) × 103.8* (H) × 11.6max.(D) mm<br>* Without LED Cable                                                                                                                                                                                                                                 |
| Weight             | : | 250.5g max.                                                                                                                                                                                                                                                                                    |
| LCD Type           | : | ATS-26424<br>(TFT / Normally white-mode / Transmissive)                                                                                                                                                                                                                                        |
| Viewing Angle      | : | 12:00 (The Angle of Least Color Inversion)                                                                                                                                                                                                                                                     |
| Interface          | : | 18-bit RGB interface (6-bit / color)                                                                                                                                                                                                                                                           |
| Backlight          | : | LED Backlight / White                                                                                                                                                                                                                                                                          |
| Lead free          | : | Our product corresponds to lead free.<br>Lead free is defined as below:<br>1) The solder used in the LCD module.<br>2) Electrical components (Terminal section) used in the LCD module.<br>Any lead used within the electrical component does not apply to our module definition of lead free. |
| RoHS regulation    | : | To our best knowledge, this product satisfies material requirement of RoHS regulation.<br>Our company is doing the best efforts to obtain the equivalent certificate from our suppliers.                                                                                                       |

## 3. Operating Conditions

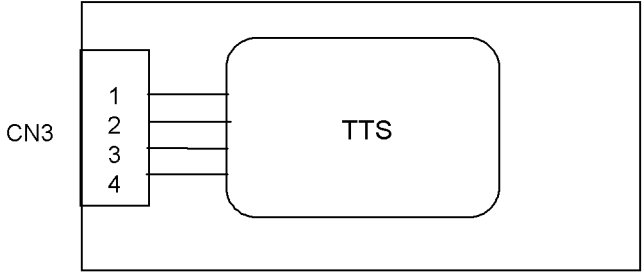
| Item                        | Conditions      | Temperature Range | Remark |
|-----------------------------|-----------------|-------------------|--------|
| Operating Temperature Range | Display Surface | -20~70°C          | Note1  |
| Storage Temperature Range   | Display Surface | -30~80°C          |        |

Note1: Operating temperature range defines the operation only and the contrast, response time and other display optical characteristics are set at Ta=+25°C.

4. Block Diagram



BackLight



Touch Panel

## 5. I/O Terminal

### 5.1. CN1 Pin Assignment (INTERFACE SIGNAL)

Used connector 08-6260-033-340-829+

Corresponding FPC: P0.5, 33pin, t=0.3mm

| No. | Symbol    | Functional Description                                        |
|-----|-----------|---------------------------------------------------------------|
| 1   | GND       | Power Supply (0V, GND)                                        |
| 2   | CK        | Clock Signal                                                  |
| 3   | HSYC      | Horizontal Sync Input                                         |
| 4   | VSYC      | Vertical Sync Input                                           |
| 5   | GND       | Power Supply (0V, GND)                                        |
| 6   | R0        | Red Data Signal                                               |
| 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                                               |
| 12  | GND       | Power Supply (0V, GND)                                        |
| 13  | G0        | Green Data Signal                                             |
| 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                                             |
| 19  | GND       | Power Supply (0V, GND)                                        |
| 20  | B0        | Blue Data Signal                                              |
| 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                                              |
| 26  | GND       | Power Supply (0V, GND)                                        |
| 27  | ENAB      | Input Data Enable Control                                     |
| 28  | VCC(3.3V) | Power Supply for Logic                                        |
| 29  | VCC(3.3V) | Power Supply for Logic                                        |
| 30  | R/L       | Control the shift direction of device internal shift register |
| 31  | U/D       | Set the Up/Down scan direction                                |
| 32  | NC        | Non Connection                                                |
| 33  | GND       | Power Supply (0V, GND)                                        |

### 5.2.CN2 Pin Assignment (Backlight)

Used connector : SHLP-06V-S-B(JST)

Corresponding connector : SM06B-SHLS-TF(LF)(SN) (JST)

| No. | Symbol    | Functional Description |
|-----|-----------|------------------------|
| 1   | Anode-1   | CABLE COLOR RED        |
| 2   | Anode-2   | CABLE COLOR RED        |
| 3   | NC        | Non-Connection         |
| 4   | NC        | Non-Connection         |
| 5   | Cathode 1 | CABLE COLOR BLACK      |
| 6   | Cathode 2 | CABLE COLOR BLACK      |

### 5.3.CN3 Pin Assignment (Touch Panel)

Used FPC: P1.0mm, 4Pin, T=0.3mm

Corresponding connector: 6227 Series(ELCO)

| No. | Symbol | Functional Description |
|-----|--------|------------------------|
| 1   | XR     | X Right Side           |
| 2   | YU     | Y 12o`Clock Side       |
| 3   | XL     | X Left Side            |
| 4   | YD     | Y 6o`Clock Side        |

## 6. Electrical Specifications

### 6.1. Absolute Maximum Ratings

Ta=-20~70°C, VSS=0V

| Parameter              | Symbol | Conditions | Min. | Max. | Units |
|------------------------|--------|------------|------|------|-------|
| Supply Voltage for LCD | VCC    | -          | -0.3 | +7.0 | V     |

### 6.2. DC Characteristics

Ta=-20~70°C, VSS=0V

| Parameter                       | Symbol          | Min.   | Typ. | Max.   | Units |
|---------------------------------|-----------------|--------|------|--------|-------|
| Supply Voltage for LCD          | VCC             | 3.0    | 3.3  | 3.6    | V     |
| High Level<br>Input Voltage     | V <sub>IH</sub> | 0.8VCC | -    | VCC    | V     |
| Low Level<br>Input Voltage      | V <sub>IL</sub> | 0      | -    | 0.2VCC | V     |
| Power Supply Current<br>for LCD | ICC             | -      | 60   | 150    | mA    |

#### A) Typical current condition

All black pattern with frame 480 line mode.

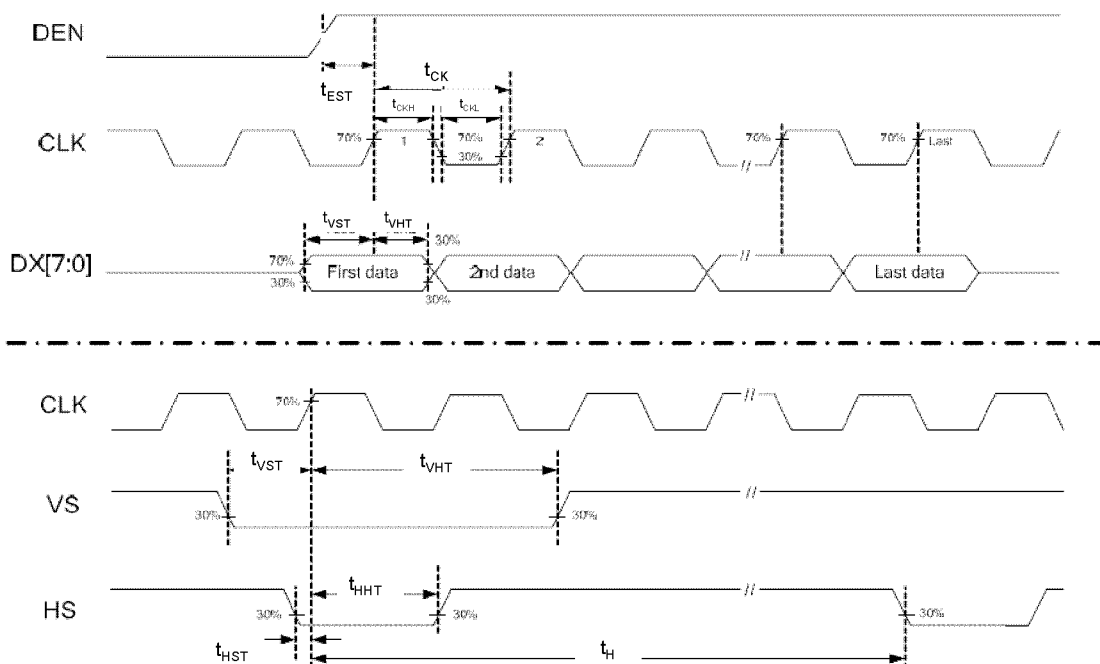
VCC=+3.3V, f<sub>H</sub>=31.468kHz, f<sub>V</sub>=59.59Hz, f<sub>CLK</sub>=25.175MHz

### 6.3.AC Characteristics

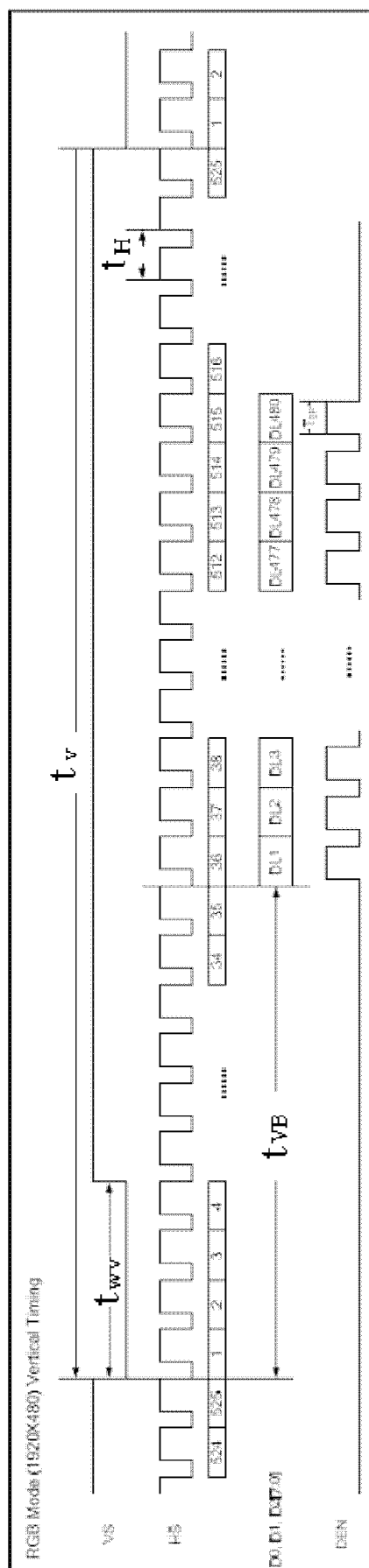
#### 6.3.1.Digital Parallel RGB Interface Timing

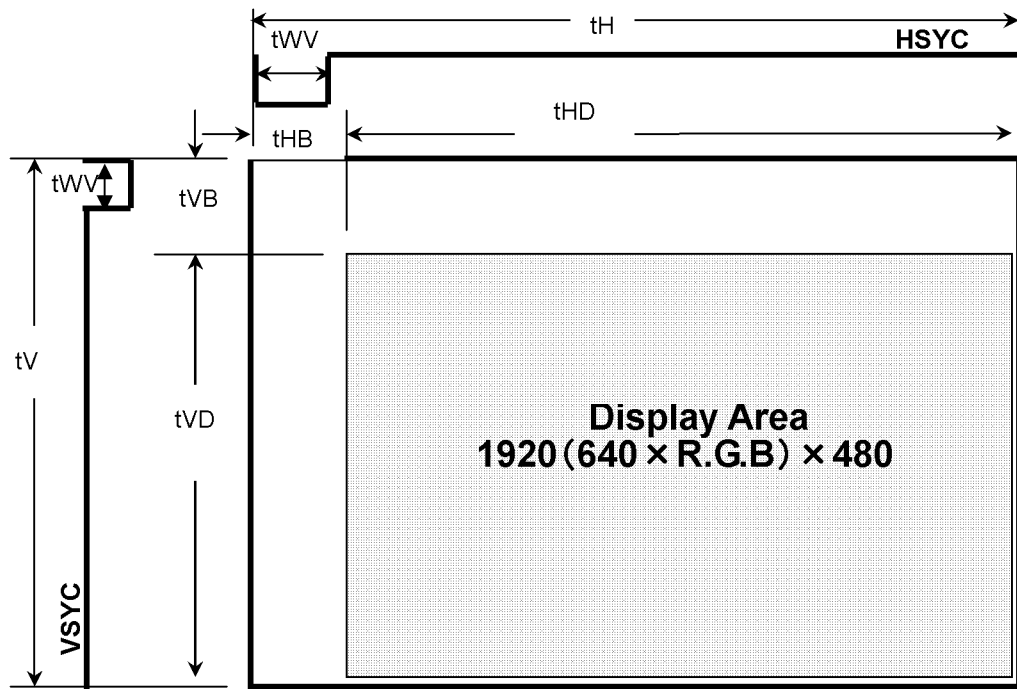
Ta=-20~70°C, VCC=3.0~3.6V

| Parameter              | Symbol             | Min.  | Typ.   | Max.  | Units |
|------------------------|--------------------|-------|--------|-------|-------|
| CK Frequency           | 1/tCK              | 22.66 | 25.175 | 27.69 | MHz   |
| CK Period              | tCK                | 36.11 | 39.7   | 44.13 | ns    |
| CK Pulse Duty          | tCKH /(tCKH+ tCKL) | 40    | 50     | 60    | %     |
| HSYC Setup Time        | tHST               | 10    | -      | -     | ns    |
| HSYC Hold Time         | tHHT               | 10    | -      | -     | ns    |
| HSYC Period            | tH                 | 750   | 800    | 850   | tCK   |
| HSYC Pulse Width       | tWH                | 5     | 30     | -     | tCK   |
| HSYC Back Porch        | tHB                | 112   | 144    | 175   | tCK   |
| HSYC Display Term      | tHD                | -     | 640    | -     | tCK   |
| VSYS Setup Time        | tVST               | 10    | -      | -     | ns    |
| VSYS Hold Time         | tVHT               | 10    | -      | -     | ns    |
| VSYS Period            | tV                 | 515   | 525    | 535   | tH    |
| VSYS Pulse Width       | tWV                | 1     | 3      | 5     | tH    |
| VSYS Back Porch        | tVB                | 5     | 35     | -     | tH    |
| VSYS Display Term      | tVD                | -     | 480    | -     | tH    |
| ENAB Setup Time        | tDST               | 10    | -      | -     | ns    |
| ENAB Pulse Width       | tEP                | -     | 640    | -     | tCK   |
| ENAB Frame Active time | tDEA               | -     | 480    | -     | tH    |
| Data Setup Time        | tDST               | 10    | -      | -     | ns    |
| Data Hold Time         | tDHT               | 10    | -      | -     | ns    |

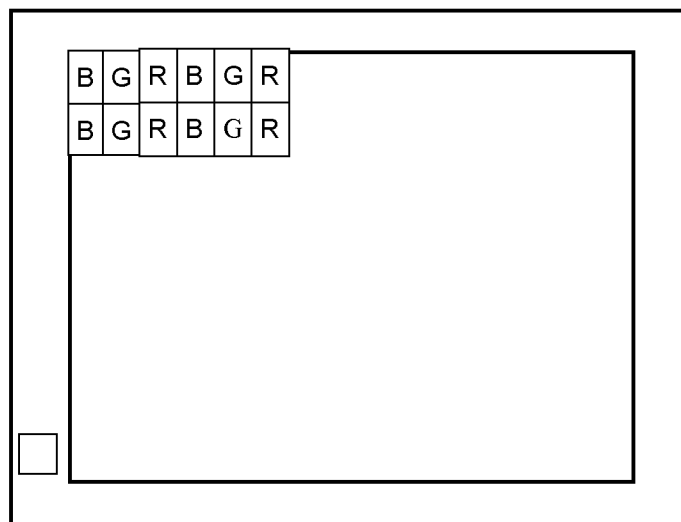


### 6.3.2. Input Signal Timing





#### 6.4.Pixel Alignment



## 6.5.Color Data Assignment

| COLOR          | INPUT<br>DATA | R DATA |    |    |     |    |    | G DATA |    |    |     |    |    | B DATA |    |    |     |    |    |
|----------------|---------------|--------|----|----|-----|----|----|--------|----|----|-----|----|----|--------|----|----|-----|----|----|
|                |               | MSB    |    |    | LSB |    |    | MSB    |    |    | LSB |    |    | MSB    |    |    | LSB |    |    |
|                |               | R5     | R4 | R3 | R2  | R1 | R0 | G5     | G4 | G3 | G2  | G1 | G0 | B5     | B4 | B3 | B2  | B1 | B0 |
| BASIC<br>COLOR | BLACK         | 0      | 0  | 0  | 0   | 0  | 0  | 0      | 0  | 0  | 0   | 0  | 0  | 0      | 0  | 0  | 0   | 0  | 0  |
|                | RED (63)      | 1      | 1  | 1  | 1   | 1  | 1  | 0      | 0  | 0  | 0   | 0  | 0  | 0      | 0  | 0  | 0   | 0  | 0  |
|                | GREEN (63)    | 0      | 0  | 0  | 0   | 0  | 0  | 1      | 1  | 1  | 1   | 1  | 1  | 0      | 0  | 0  | 0   | 0  | 0  |
|                | BLUE (63)     | 0      | 0  | 0  | 0   | 0  | 0  | 0      | 0  | 0  | 0   | 0  | 0  | 1      | 1  | 1  | 1   | 1  | 1  |
|                | CYAN          | 0      | 0  | 0  | 0   | 0  | 0  | 1      | 1  | 1  | 1   | 1  | 1  | 1      | 1  | 1  | 1   | 1  | 1  |
|                | MAGENTA       | 1      | 1  | 1  | 1   | 1  | 1  | 0      | 0  | 0  | 0   | 0  | 0  | 1      | 1  | 1  | 1   | 1  | 1  |
|                | YELLOW        | 1      | 1  | 1  | 1   | 1  | 1  | 1      | 1  | 1  | 1   | 1  | 1  | 0      | 0  | 0  | 0   | 0  | 0  |
|                | WHITE         | 1      | 1  | 1  | 1   | 1  | 1  | 1      | 1  | 1  | 1   | 1  | 1  | 1      | 1  | 1  | 1   | 1  | 1  |
| RED            | RED (0)       | 0      | 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  | 0  |
|                | RED (2)       | 0      | 0  | 0  | 0   | 1  | 0  | 0      | 0  | 0  | 0   | 0  | 0  | 0      | 0  | 0  | 0   | 0  | 0  |
|                |               |        |    |    |     |    |    |        |    |    |     |    |    |        |    |    |     |    |    |
|                |               |        |    |    |     |    |    |        |    |    |     |    |    |        |    |    |     |    |    |
|                | RED (62)      | 1      | 1  | 1  | 1   | 1  | 0  | 0      | 0  | 0  | 0   | 0  | 0  | 0      | 0  | 0  | 0   | 0  | 0  |
|                | RED (63)      | 1      | 1  | 1  | 1   | 1  | 1  | 0      | 0  | 0  | 0   | 0  | 0  | 0      | 0  | 0  | 0   | 0  | 0  |
| GREEN          | GREEN (0)     | 0      | 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   | 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  | 0  |
|                |               |        |    |    |     |    |    |        |    |    |     |    |    |        |    |    |     |    |    |
|                |               |        |    |    |     |    |    |        |    |    |     |    |    |        |    |    |     |    |    |
|                | GREEN (62)    | 0      | 0  | 0  | 0   | 0  | 0  | 1      | 1  | 1  | 1   | 1  | 0  | 0      | 0  | 0  | 0   | 0  | 0  |
|                | GREEN (63)    | 0      | 0  | 0  | 0   | 0  | 0  | 1      | 1  | 1  | 1   | 1  | 1  | 0      | 0  | 0  | 0   | 0  | 0  |
| BLUE           | BLUE (0)      | 0      | 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   | 0  | 1  |
|                | BLUE (2)      | 0      | 0  | 0  | 0   | 0  | 0  | 0      | 0  | 0  | 0   | 0  | 0  | 0      | 0  | 0  | 0   | 1  | 0  |
|                |               |        |    |    |     |    |    |        |    |    |     |    |    |        |    |    |     |    |    |
|                |               |        |    |    |     |    |    |        |    |    |     |    |    |        |    |    |     |    |    |
|                | BLUE (62)     | 0      | 0  | 0  | 0   | 0  | 0  | 0      | 0  | 0  | 0   | 0  | 0  | 1      | 1  | 1  | 1   | 1  | 0  |
|                | BLUE (63)     | 0      | 0  | 0  | 0   | 0  | 0  | 0      | 0  | 0  | 0   | 0  | 0  | 1      | 1  | 1  | 1   | 1  | 1  |

[Note]

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

2) R Data 1:High, 0: Low

Relation of IC and LCD Module Data Bus

| LCD Module | R5  | R4  | R3  | R2  | R1  | R0  | GND  | GND  |
|------------|-----|-----|-----|-----|-----|-----|------|------|
| IC         | D07 | D06 | D05 | D04 | D03 | D02 | D01* | D00* |

\*Connected to "L" in the LCD Module

3) G Data 1:High, 0: Low

| LCD Module | G5  | G4  | G3  | G2  | G1  | G0   | GND | GND |
|------------|-----|-----|-----|-----|-----|------|-----|-----|
| IC         | D17 | D16 | D15 | D14 | D13 | D102 | D11 | D10 |

4) B Data 1:High, 0: Low

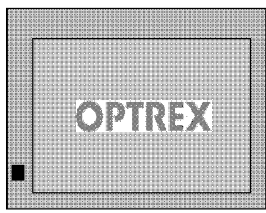
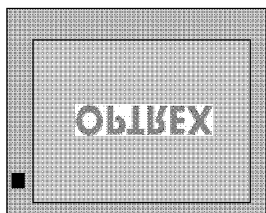
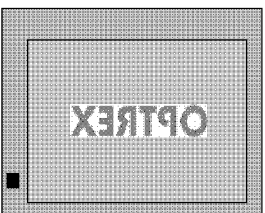
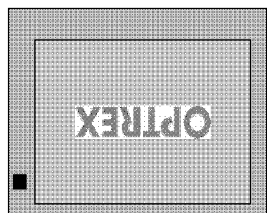
| LCD Module | B5  | B4  | B3  | B2  | B1  | B0  | GND | GND |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
| IC         | D27 | D26 | D25 | D24 | D23 | D22 | D21 | D20 |

## 6.6. Inverted Scan Capability

This module has the capability of inverting scan direction by signaling from controller.

Note that scan direction cannot be changed during operation.

The following drawing shows the relationship between the viewing direction and the scan direction.

| U/D = H<br>R/L = L                                                                  | U/D = L<br>R/L = L                                                                  | U/D = H<br>R/L = H                                                                   | U/D = L<br>R/L = H                                                                    |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|  |  |  |  |

## 6.7. Lighting Specifications

### 6.7.1. Absolute Maximum Ratings

Ta=25°C

| Parameter       | Symbol | Conditions       | Min.   | Typ.   | Max. | Units |
|-----------------|--------|------------------|--------|--------|------|-------|
| Forward Current | IF     | Note1            | -      | 80     | 150  | mA    |
| Forward Voltage | VF     | IF=80mA / 1 line | -      | (16.0) | -    | V     |
| Power           | PL     | IF=80mA / 1 line |        | 1.28   | 2.7  | W     |
| B/L Life time   | -      | Note 2,3,4       | 50,000 | 70,000 | -    | Hrs   |

Note1: Current of LED par chip must be lower than 150mA at 70 degC.

The current of LED must be tuned to satisfy as Forward Current Derating Curve mentioned relationship

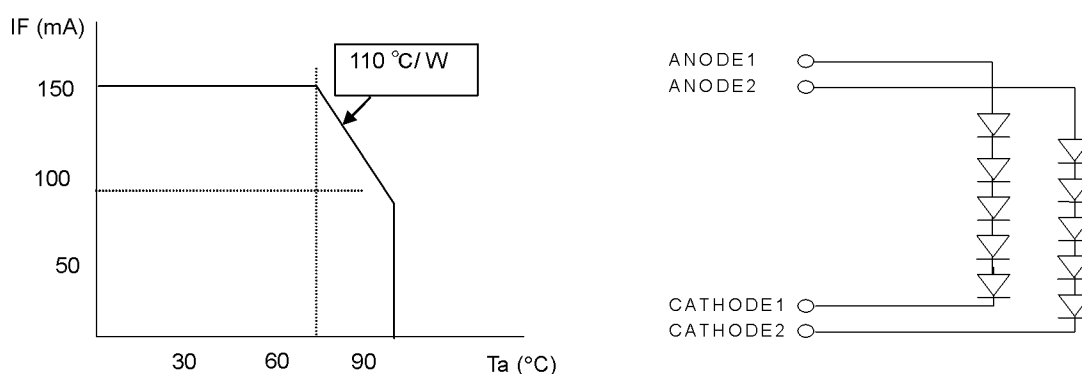
Note2: B/L Life time is defined as time period that the actual luminance becomes 50% or lower of its initial value.

Note3: B/L Life time depends on the ambient temperature.

The term "Backlight Life Time" is defined as room temperature, or 25°C.

Note4: B/L Life time will decrease under high temperature.

【Forward Current Derating Curve】



## 6.8. Touch Panel Specifications

### 6.8.1. Touch Panel Characteristics

Ta=-10~60°C

| Parameter                     |       | Min.              | Typ. | Max. | Units | Conditions             |
|-------------------------------|-------|-------------------|------|------|-------|------------------------|
| Max Voltage                   |       | -                 | -    | 5    | V     |                        |
| Resistor between<br>Terminals | XL-XR | 350               | -    | 950  | Ω     |                        |
|                               | YU-YD | 200               |      | 550  | Ω     |                        |
| Line Linearity                |       | -                 | -    | ±1.5 | %     | Initial Value          |
| Insulation Resistance         |       | 10                | -    | -    | MΩ    | At DC25V               |
| Operation Force               |       | 10                | -    | 100  | g     | Initial Value          |
| Operation life                |       | > 1,000,000 times |      |      |       | Tapping durability     |
|                               |       | > 100,000 times   |      |      |       | Pen sliding durability |

## 7. Optical Specifications

### 7.1. Optical Characteristics

| Item                  |       | Symbol     | Conditions   |        |          | Standard Value |       |       | Unit              | Method of Measure | Remark |
|-----------------------|-------|------------|--------------|--------|----------|----------------|-------|-------|-------------------|-------------------|--------|
|                       |       |            | $\theta$     | $\phi$ | C        | Min.           | Typ.  | Max.  |                   |                   |        |
| Brightness            |       | B          | 0°           | 0°     |          | 224            | 400   | -     | cd/m <sup>2</sup> | (Fig.1)           | Note1  |
| Contrast              |       | CR         | Best Viewing |        |          | 150            | 500   | -     | -                 |                   |        |
| Color Coordinates     | Red   | Rx         | 0°           | 0°     |          | 0.561          | 0.611 | 0.661 | -                 |                   |        |
|                       |       | Ry         | 0°           | 0°     |          | 0.310          | 0.360 | 0.410 | -                 |                   |        |
|                       | Green | Gx         | 0°           | 0°     |          | 0.308          | 0.358 | 0.408 | -                 |                   |        |
|                       |       | Gy         | 0°           | 0°     |          | 0.517          | 0.567 | 0.617 | -                 |                   |        |
|                       | Blue  | Bx         | 0°           | 0°     |          | 0.097          | 0.147 | 0.197 | -                 |                   |        |
|                       |       | By         | 0°           | 0°     |          | 0.051          | 0.101 | 0.151 | -                 |                   |        |
|                       | White | Wx         | 0°           | 0°     |          | 0.279          | 0.329 | 0.379 | -                 |                   |        |
|                       |       | Wy         | 0°           | 0°     |          | 0.289          | 0.339 | 0.389 | -                 |                   |        |
| Brightness Uniformity |       | -          | 0°           | 0°     |          | 60             | 65    | -     | %                 | (Fig.2)           |        |
| Vertical              | Up    | $\theta_U$ | -            | 90°    | $\geq 5$ | -              | 70    | -     | Degree            | (Fig.3)           |        |
| Viewing Angle         | Down  | $\theta_D$ | -            | 270°   | $\geq 5$ | -              | 70    | -     | Degree            |                   |        |
| Horizontal            | Left  | $\phi_L$   | 180°         | -      | $\geq 5$ | -              | 70    | 180°  | Degree            |                   |        |
| Viewing Angle         | Right | $\phi_R$   | 0°           | -      | $\geq 5$ | -              | 70    | 0°    | Degree            |                   |        |
| Response              | Rise  | $\tau_r$   | 0°           | 0°     |          | -              | 23    | -     | ms                | (Fig.4)           |        |
| Time                  | Decay | $\tau_d$   | 0°           | 0°     |          | -              | 6     | -     | ms                |                   |        |

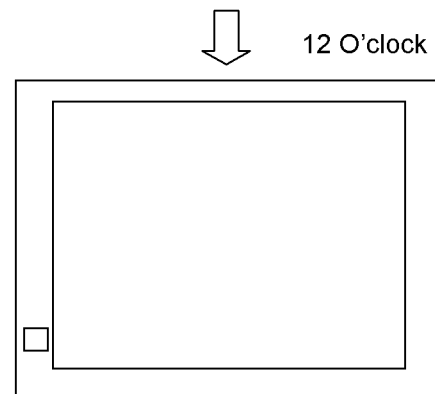
Note1: Under the condition of maximum brightness.

◆ Conditions for Measuring

- ◇ Environment: Dark room with no light or close to no light.
- ◇ Temperature: 25±5°C
- ◇ Humidity: 40~70%RH
- ◇ Driving voltage is set for optimal contrast to measure center of display.
- ◇ LED Backlight driving condition: IF =80.0 (mA)

◆ Optimal viewing angle

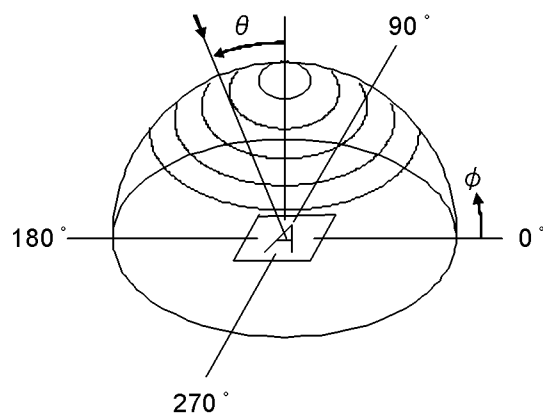
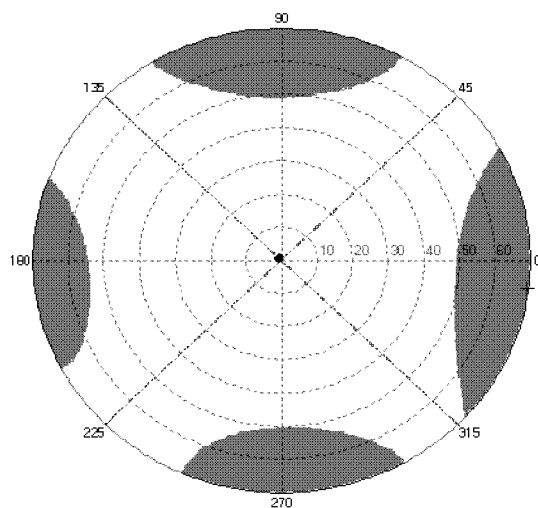
(The angle of Least Color Inversion)



## 7.2. Definition of Viewing Angle and Optimum Viewing Area

\*Point • shows the point where contrast ratio is measured. :  $\theta = 0^\circ$ ,  $\phi = 0^\circ$

\*Driving condition:  $F_r = 60\text{Hz}$



\*Area  shows typ.  $CR \geq 30$

\*Area  shows typ.  $CR \leq 30$

◆ Method of Brightness Measurement (Fig.1)

(1) Measuring Device

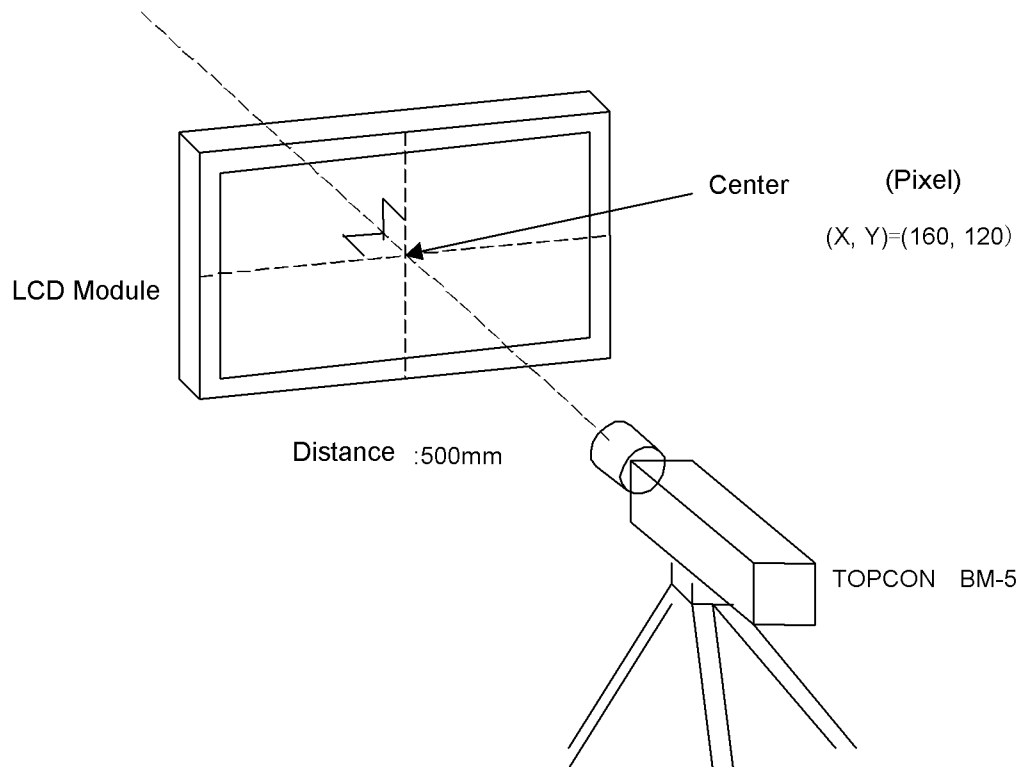
TOPCON: BM-5

(2) Measuring Point

Center of Display:  $\theta=0^\circ$ ,  $\phi=0^\circ$

On condition  $\theta$  : A vertical angle from measuring direction to perpendicular.

$\phi$  : A horizontal angle from measuring direction to perpendicular.



**Fig. 1**

(3) Method of Measuring

Apply signal voltage (displayed in white) to maximize brightness and measure brightness  $B$  ( $\text{cd}/\text{m}^2$ ).

The distance between BM-5's front lens to surface panel is 500mm.

Measured after backlight has been lit for more than 30 minutes.

◆ Method of Contrast Measurement (Fig.1)

(1) Measuring Device

TOPCON: BM-5, Measuring Field:  $1^\circ$

(2) Measuring Point

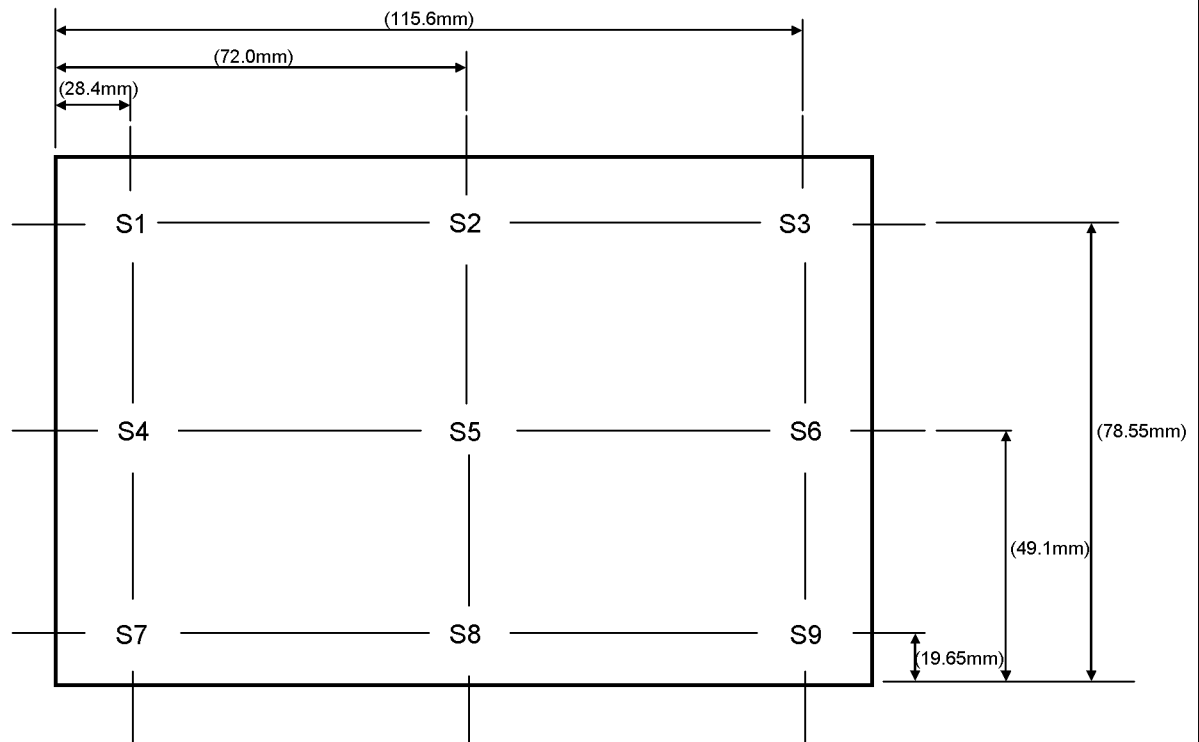
Center of display: same as Method of Brightness Measurement

(3) Method of Measuring

- Set LCD module to  $\theta=0^\circ$ ,  $\phi=0^\circ$ .
- Change signal voltage to measure maximum brightness  $Y1$  and minimum brightness  $Y2$ .
- Contrast is derived from  $CR=Y1/Y2$ .

◆ Definition of Brightness Uniformity (Fig.2)

Definition is calculated from the 9 points (S1-S9) on the diagram below.



$$\text{Standard Value of Brightness Uniformity}[\%] = \frac{\text{Minimum Value of S1-S9}}{\text{Maximum Value of S1-S9}} \times 100$$

**Fig. 2**

◆ Method of Viewing Angle Measurement (Fig.3)

(1) Measuring Device

ELDIM: EZ CONTRAST

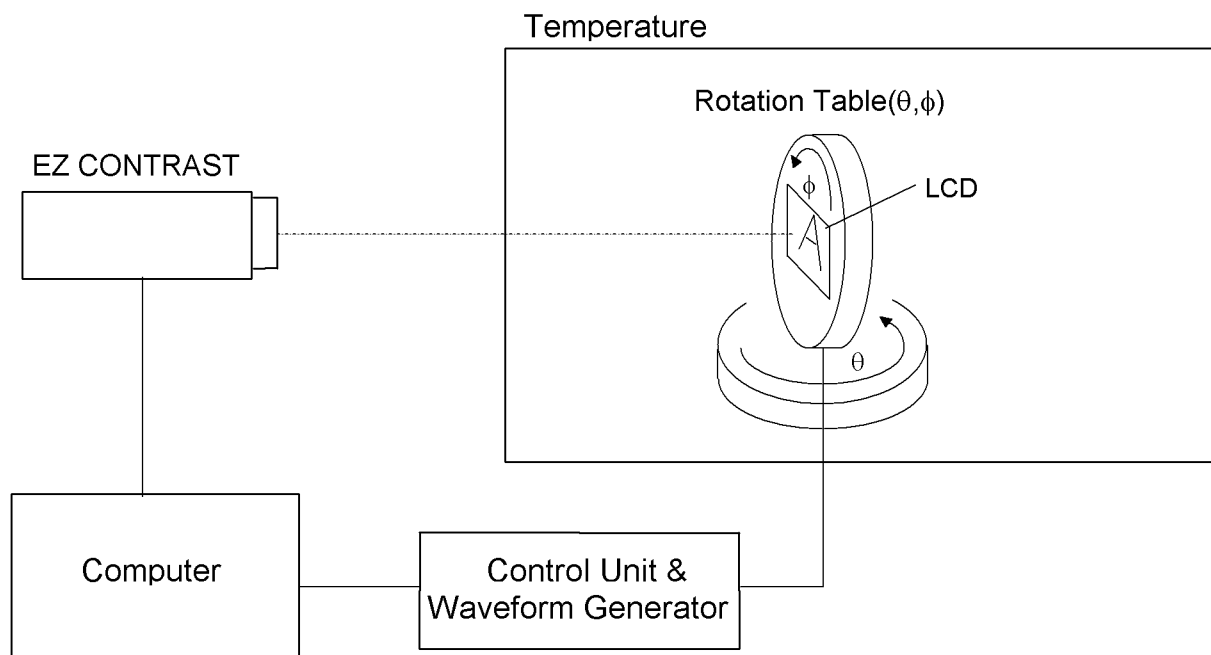
(2) Measuring Point

Center of display: Same as Method of Brightness Measurement

(3) Angle of Measuring

$\theta$ : An angle vertical to perpendicular line from the viewing direction.

$\phi$ : An angle horizontal to perpendicular from the viewing direction.



**Fig. 3**

(4) Method of Measuring

Set the module on the rotation table and measure a vertical axis direction in the state that fixed  $\phi = 0$  degrees horizontal axis direction to  $\theta = 90$  degrees.

(Viewing angle is measured automatically by EZ CONTRAST)

◆ Measuring Response Time (Fig.4)

(1) Measuring Device

TOPCON BM-5, Measuring Field: 1°

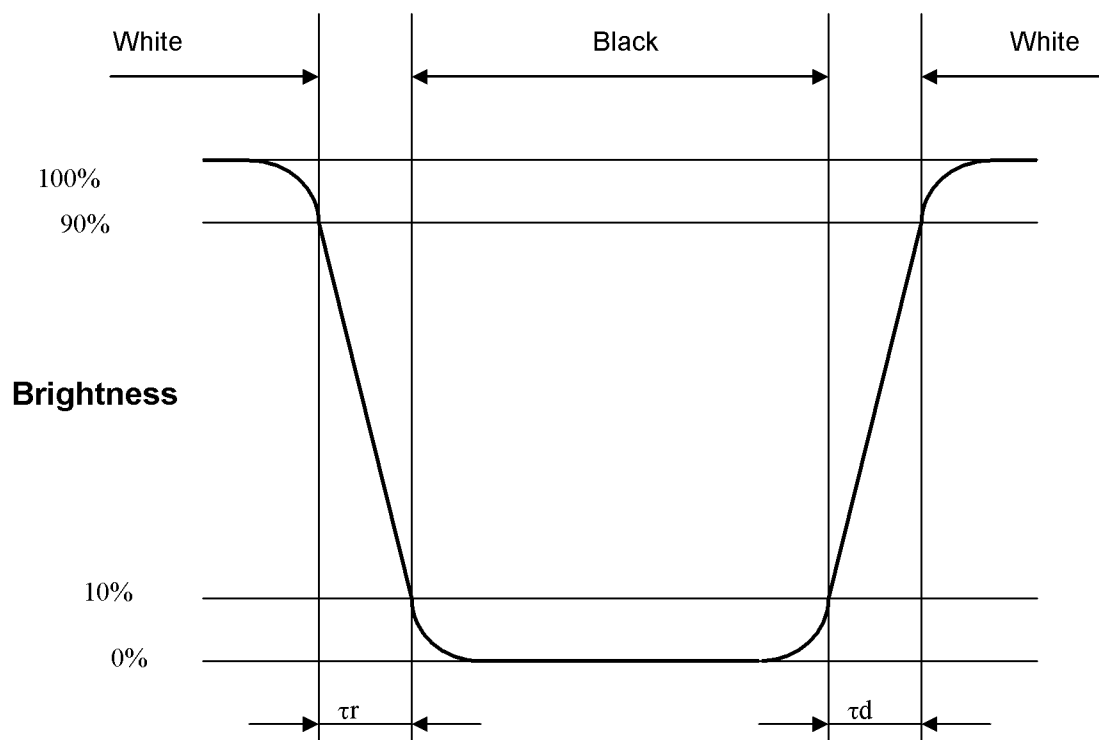
Tektronix Digital Oscilloscope

(2) Measuring Point

Center of display, same as Method of Brightness Measurement

(3) Method of Measuring

- Set LCD panel to  $\theta=0^\circ$ , and  $\phi=0^\circ$ .
- Input white→black→white to display by switching signal voltage.
- If the luminance is 0% and 100% immediately before the change of signal voltage, then  $\tau_r$  is optical response time during the change from 90% to 10% immediately after rise of signal voltage, and  $\tau_d$  is optical response time during the change from 10% to 90% immediately after decay of signal voltage.



**Fig. 4**

## 8. Test

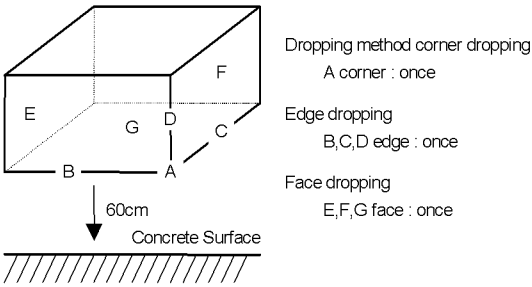
No abnormal function and appearance are found after the following tests.

Conditions: Unless otherwise specified, tests will be conducted under the following condition.

Temperature:  $20\pm5^{\circ}\text{C}$

Humidity :  $65\pm5\%\text{RH}$

tests will not be conducted under functioning state.

| No. | Parameter                  | Conditions                                                                                                                                                                     | Notes |
|-----|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1   | High Temperature Operating | $70^{\circ}\text{C}\pm2^{\circ}\text{C}$ , 96hrs (operation state)                                                                                                             |       |
| 2   | Low Temperature Operating  | $-20^{\circ}\text{C}\pm2^{\circ}\text{C}$ , 96hrs (operation state)                                                                                                            | 1     |
| 3   | High Temperature Storage   | $80^{\circ}\text{C}\pm2^{\circ}\text{C}$ , 96hrs                                                                                                                               | 2     |
| 4   | Low Temperature Storage    | $-30^{\circ}\text{C}\pm2^{\circ}\text{C}$ , 96hrs                                                                                                                              | 1,2   |
| 5   | Damp Proof Test            | $40^{\circ}\text{C}\pm2^{\circ}\text{C}$ , 90%RH, 96hrs                                                                                                                        | 1,2   |
| 6   | Vibration Test             | Total fixed amplitude : 1.5mm<br>Vibration Frequency : 10~55Hz<br>One cycle 60 seconds to 3 directions of X, Y, Z<br>each 15 minutes                                           | 3     |
| 7   | Shock Test                 | To be measured after dropping from 60cm high<br>the concrete surface in packing state.<br> |       |

Note 1 :No dew condensation to be observed.

Note 2 :The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after removed from the test chamber.

Note 3 :Vibration test will be conducted to the product itself without putting it in a container.

## 9. Appearance Standards

### 9.1. Inspection conditions

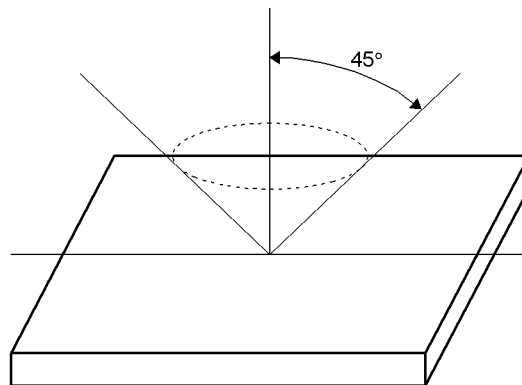
The LCD shall be inspected under the white fluorescent light.

Appearance Inspection: Illuminans > 500 [lx]

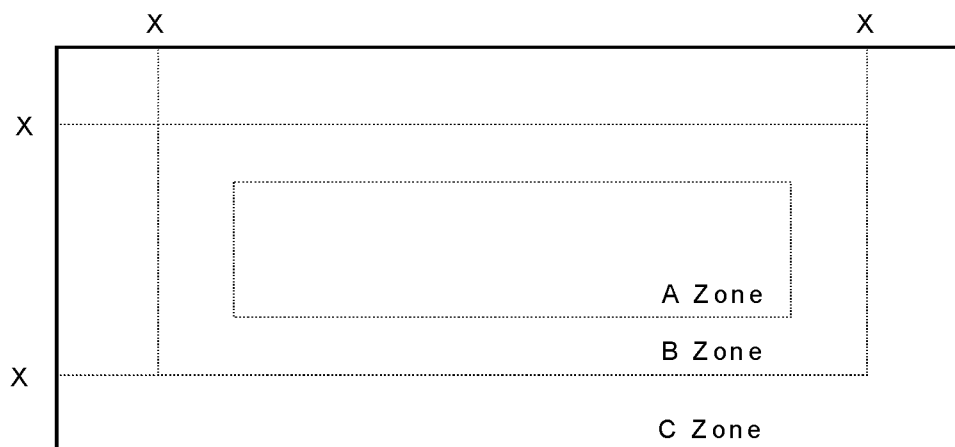
Operating Inspection: Illuminance < 250 [lx]

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.



### 9.2. Definition of applicable Zones



X : Metal Holder Opening

A Zone: Active display area

B Zone = (Viewing Area) – (Active Area)

C Zone: Rest parts

### 9.3.Standards (Only the display part)

| No. | Parameter                          | Criteria                                              |             |                         |   |   |
|-----|------------------------------------|-------------------------------------------------------|-------------|-------------------------|---|---|
| 1   | Polarizer Scratches                | <div><div>Zone</div><div>X(mm)Y(mm)</div></div>       |             | Acceptable Number       |   |   |
|     |                                    |                                                       |             | A                       | B | C |
|     |                                    | L ≤ 15                                                | 0.01<W≤0.05 | 4                       |   | * |
|     |                                    | L > 15                                                | W > 0.01    | 0                       |   | * |
|     |                                    | -                                                     | W > 0.05    | 0                       |   | * |
|     |                                    | X : Length, Y : Width    *: Disregard                 |             |                         |   |   |
| 2   | DENT                               | <div><div>Zone</div><div>Dimension (mm)</div></div>   |             | Acceptable Number       |   |   |
|     |                                    |                                                       |             | A                       | B | C |
|     |                                    | 0.30 < D ≤ 0.50                                       |             | 4                       |   | * |
|     |                                    | 0.50 < D                                              |             | 0                       |   | * |
|     |                                    | D : Average Diameter = (long+short)/2    *: Disregard |             |                         |   |   |
| 3   | BLACK SPOT<br>WHITE SPOT<br>BUBBLE | <div><div>Zone</div><div>Dimension (mm)</div></div>   |             | Acceptable Number       |   |   |
|     |                                    |                                                       |             | A                       | B | C |
|     |                                    | 0.30 < D ≤ 0.50                                       |             | 5                       |   | * |
|     |                                    | 0.50 < D                                              |             | 0                       |   | * |
|     |                                    |                                                       |             |                         |   |   |
| 4   | LINT                               | <div><div>Zone</div><div>X(mm)Y(mm)</div></div>       |             | Acceptable Number       |   |   |
|     |                                    |                                                       |             | A                       | B | C |
|     |                                    | L ≤ 3.0                                               | W ≤ 0.15    | 4                       |   | * |
|     |                                    | L > 3.0                                               | W ≤ 0.15    | 0                       |   | * |
|     |                                    | -                                                     | W > 0.15    | According to BLACK SPOT |   | * |
|     |                                    | X : Length, Y : Width    *: Disregard                 |             |                         |   |   |

| No.                               | Parameter                                 |                         | Criteria                                  |         |                   |   |   |
|-----------------------------------|-------------------------------------------|-------------------------|-------------------------------------------|---------|-------------------|---|---|
| 5                                 | Dot Defect                                | (a)<br>Bright Dot       | <div>Zone</div> <div>Dimension (mm)</div> |         | Acceptable Number |   |   |
|                                   |                                           |                         |                                           |         | A                 | B | C |
|                                   |                                           |                         | Bright Dot                                | Note1   | 4                 |   | * |
|                                   |                                           |                         | Dark Dot                                  | Note2   | 5                 |   | * |
|                                   |                                           |                         | TOTAL                                     |         | 5                 |   |   |
|                                   |                                           | * : Disregard           |                                           |         |                   |   |   |
|                                   |                                           | (b)<br>Dark Dot         |                                           |         |                   |   |   |
|                                   |                                           |                         |                                           |         |                   |   |   |
|                                   |                                           |                         |                                           |         |                   |   |   |
|                                   |                                           |                         |                                           |         |                   |   |   |
|                                   |                                           |                         |                                           |         |                   |   |   |
|                                   |                                           | (c)<br>TWO Adjacent Dot | <div>Zone</div> <div>Dimension (mm)</div> |         | Acceptable Number |   |   |
|                                   |                                           |                         |                                           |         | A                 | B | C |
|                                   |                                           |                         | Bright Dot                                | Note1,3 | 2 PAIRS           |   | * |
|                                   |                                           |                         | Dark Dot                                  | Note2,3 | 3 PAIRS           |   | * |
|                                   |                                           |                         | * : Disregard                             |         |                   |   |   |
| (d)<br>Three or More Adjacent Dot |                                           | NOT ALLOWED             |                                           |         |                   |   |   |
|                                   |                                           |                         |                                           |         |                   |   |   |
|                                   |                                           |                         |                                           |         |                   |   |   |
|                                   |                                           |                         |                                           |         |                   |   |   |
|                                   |                                           |                         |                                           |         |                   |   |   |
| (e)<br>Distance                   | <div>Zone</div> <div>Dimension (mm)</div> |                         | Acceptable Level                          |         |                   |   |   |
|                                   |                                           |                         | A                                         | B       | C                 |   |   |
|                                   | Bright Dot                                |                         | 5 mm ≤                                    |         | *                 |   |   |
|                                   | Dark Dot                                  |                         | 5 mm ≤                                    |         | *                 |   |   |
|                                   | * : Disregard                             |                         |                                           |         |                   |   |   |
| 6                                 | Line Defect                               |                         | NOT ALLOWED                               |         |                   |   |   |

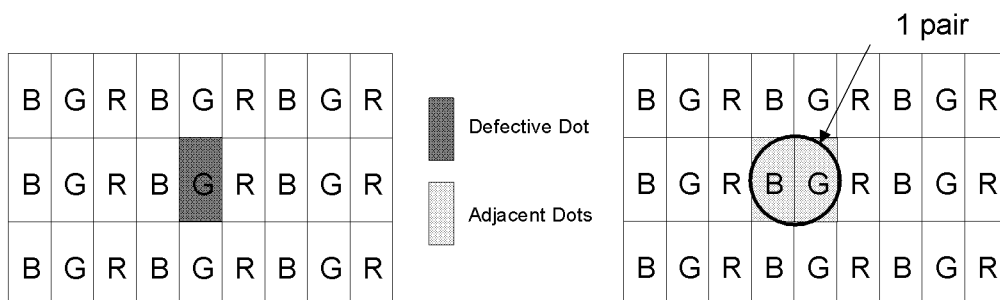
Note 1: Bright Dot is defined as follows:

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:

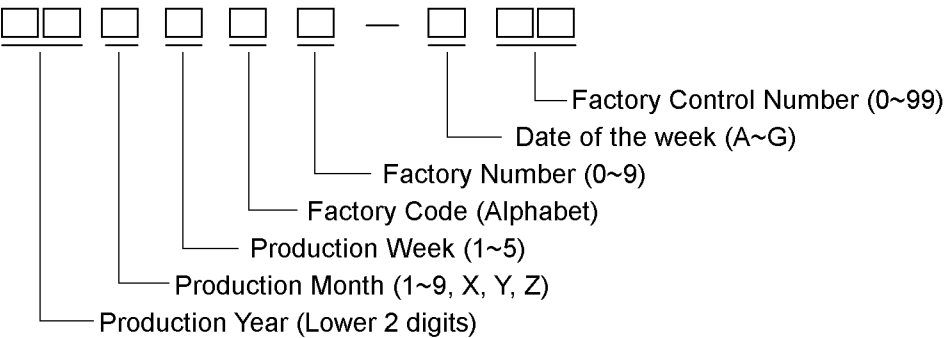
Recognizable darker than around under the condition that each R(63), G(63), B(63) image is on the display.

Note 3: Definition of adjacent



10. Code System of Production Lot

The production lot of module is specified as follows.



11. Type Number

The type number of module is specified as follows.

355548AC

12. Applying Precautions

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

### 13. Precautions Relating Product Handling

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

- 1) Liquid crystal display devices
  - (1) The liquid crystal display 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. The polarizer adhering to the surface of the LCD is made of a soft material. Guard against scratching it.
- 2) Care of the liquid crystal display module against static electricity discharge.
  - (1) 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 worktables against the hazards of electrical shock.
  - (2) Avoid the use of work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
  - (3) 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:
  - (1) Protect the modules from high temperature and humidity.  
Conditions: Temperature: 0°C~40°C, Humidity: Less than 60%RH  
No dew condensation to be observed.
  - (2) Keep the modules out of direct sunlight or direct exposure to ultraviolet rays.
  - (3) Protect the modules from excessive external forces.
- 4) Use the module with a power supply that is equipped with an overcurrent protector 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.
- 6) Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used.  
Please contact us to discuss appropriate ways to assure conductivity.
- 7) For models which use CFL:
  - (1) High voltage of 1000V or greater is applied to the CFL cable connector area.  
Care should be taken not to touch connection areas to avoid burns.
  - (2) Protect CFL cables from rubbing against the unit and thus causing the wire jacket to become worn.
  - (3) The use of CFLs for extended periods of time at low temperatures will significantly shorten their service life.
  - (4) After storing the product (or LCD) under low temperature and/or in dark atmosphere for a long period of time, CCFL may take longer time to reach its specified brightness.
- 8) For models which use touch panels:
  - (1) Do not stack up modules since they can be damaged by components on neighboring modules.
  - (2) Do not place heavy objects on top of the product. This could cause glass breakage.
- 9) For models which use COG, TCP, or COF:
  - (1) 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.
  - (2) 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.

- 10) Models which use flexible cable, heat seal, or TCP:
  - (1) In order to maintain reliability, do not touch or hold by the connector area.
  - (2) Avoid any bending, pulling, or other excessive force, which can result in broken connections.
- 11) In case of buffer material such as cushion / gasket is assembled into LCD module, it may 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 its materials. Please check and evaluate these materials carefully before use.
- 12) In case of acrylic plate is attached to front side of LCD panel, cloudiness (very small cracks) can occur on acrylic plate, being influenced by some components generated from polarizer film. Please check and evaluate those acrylic materials carefully before use.
- 13) Flickering due to optical interference may occur by combination of a) LCD driving frame frequency decided by either internal oscillator in driver IC or external clock input by the customer and b) lighting frequency of either backlight or other light sources. Please evaluate enough at the environment of actual use, and decide the driving condition that does not cause flickering.
- 14) Please be advised that do not apply Direct Current (DC) voltage to the LCD. If DC voltage is applied to the LCD, then it may cause poor display quality.

#### 14. Warranty

This product has been manufactured to your company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. 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 and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

- 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) When the product is in CFL models, CFL service life and brightness will vary according to the performance of the inverter used, leaks, etc. We cannot accept responsibility for product performance, reliability, or defect, which may arise.
- 5) 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.
- 6) Optrex will not be held responsible for any quality guarantee issue for defect products judged as Optrex-origin in 2 (two) years from Optrex production or 1(one) year from Optrex Group delivery which ever is shorter.