# Thin-Film-Transistor LCD Module
# Model: GWTSA4SN9D1E0

| Acceptance |
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| |

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Revise Records

| Rev. | Date | Contents | Written | Approved |
|---|---|---|---|---|
| A | 2009/06/15 | Preliminary Specification | Kobe_Su | David Lee |
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Special Notes

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# Contents

## 1. General Description and Features

GWTSA4SN9D1E0 is a transmissive type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT-LCD module, a driver circuit and a back-light unit. Graphics and texts can be displayed on a WVGA 800 (H) x 3 x 600 (V) dots with 262,144 colors by supplying 6 bits data signal (6bits/each color). The following table described the features of GWTSA4SN9D1E0.

### 1.1 Features

- Transmissive and back-light with 36 LEDs are available.
- TN (Twisted Nematic) mode.
- LVDS (6bits/color) data transfer.

### 1.2 LCD Module

| Item | Specification | Unit |
|---|---|---|
| Screen Size | 10.4 inches | Diagonal |
| Display Resolution | 800 (H) x 600 (V) | Pixel |
| Active Area | 211.2 (H) x 158.4 (V) | mm |
| Outline Dimension | 236.0 (H) x 176.9 (V) x 5.6 (T) | mm |
| Display Mode | Normally white mode/ Transmissive/ Wide view | -- |
| Surface Treatment | Anti-glare , Hard-coating (3H) | -- |
| Pixel Arrangement | Vertical Stripe | -- |
| Pixel Pitch | 0.264 x 0.264 | mm |
| Display Color | Full Colors | -- |
| Viewing Direction | 6 o'clock | -- |

## 2. Mechanical Information

| Item | | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Module Size | Horizontal (H) | -- | 236.0 | -- | mm | (1,2,3) |
| | Vertical (V) | -- | 176.9 | -- | mm | (2) |
| | Thickness (T) | -- | 5.6 | -- | mm | (1,3) |
| Weight | | -- | TBD | -- | g | -- |

Note (1) Not include FPC. Refer to the Outline Dimension Drawing as attached.

(2) Back-light unit is included.

(3) Excluding backlight cables.

## 3. Electrical Specifications

### 3.1 Absolute Max. Ratings

#### 3.1.1 Absolute Ratings of Environment

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

(Ta=25±2°C, $V_{SS}$=GND=0)

| Item | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Storage temperature | $T_{STG}$ | -30 | 80 | °C | (1) |
| Operating temperature | $T_{OPR}$ | -20 | 70 | °C | (1,2,3) |

Note (1) 95 % RH Max. ( 40 °C ≥ Ta ). Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.

Note (2) In case of below 0°, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's character

Note (3) Only operation is guarantied at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

3.1.2 Electrical Absolute Maximum Ratings

($V_{SS}$=GND=0)

| Parameter | Symbol | Min. | Max. | Unit | Remark |
|---|---|---|---|---|---|
| Power supply voltage | $V_{DD}$ | -0.3 | 5.0 | V | -- |
| Signal input voltage | $V_{in}$ | -0.3 | 5.0 | V | Note1 |

Note1: $V_{in}$ represent IN0±,IN1±,IN2±,CLK±

3.2 Electrical Characteristics

3.2.1 DC Electrical Characteristics of the TFT LCD

(Ta=25±2°C, $V_{SS}$=GND=0)

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| LVDS Differential input High threshold | $V_{TH}$ | - | - | +100 | mV | $V_{CMLVDS}$=1.2V |
| LVDS Differential input Low threshold | $V_{TL}$ | -100 | - | - | mV | $V_{CMLVDS}$=1.2V |
| Differential input voltage | $\|V_{ID}\|$ | 0.1 | - | 0.6 | V | |
| LVDS input common mode voltage | $V_{CMLVDS}$ | $\|V_{ID}\|/2$ | - | 1.4-($\|V_{ID}\|/2$) | V | |
| Input current | $I_{IN}$ | -10 | - | 10 | μA | |
| Supply Voltage | $V_{DD}$ | 3.0 | 3.3 | 3.6 | V | |
| Common Electrode Driving Signal | VCOM | - | 4.36 | - | V | Note1 |
| Sync Frequency | FVD | - | 60 | 70 | Hz | |
| VDD Power Consumption | $I_{DD}$ | - | TBD | 380 | mA | Note 2 |

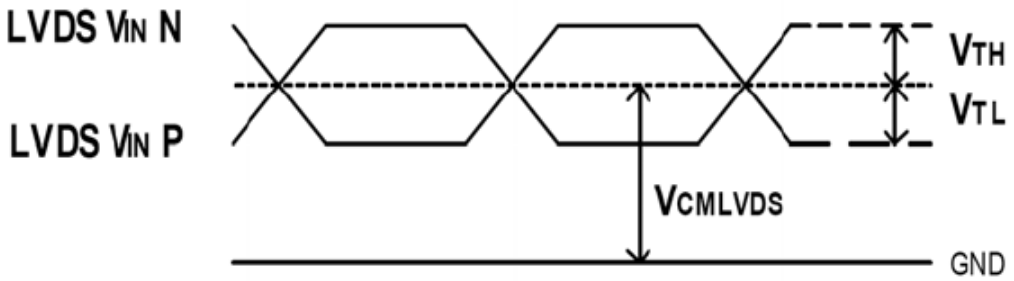



Figure 4.1.1 LVDS DC timing diagram

Note1:The value may be different for different LCM.
Note2:To test the current dissipation,using the "color bar"testing pattern shown as below:

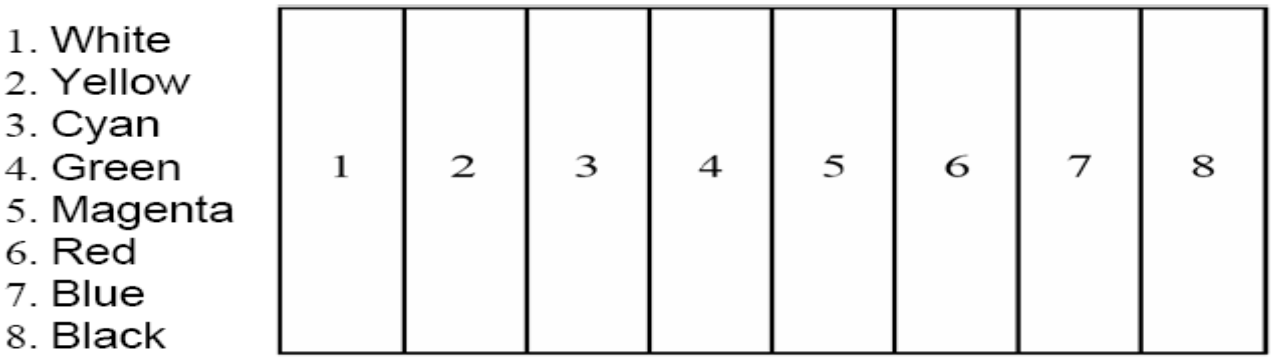


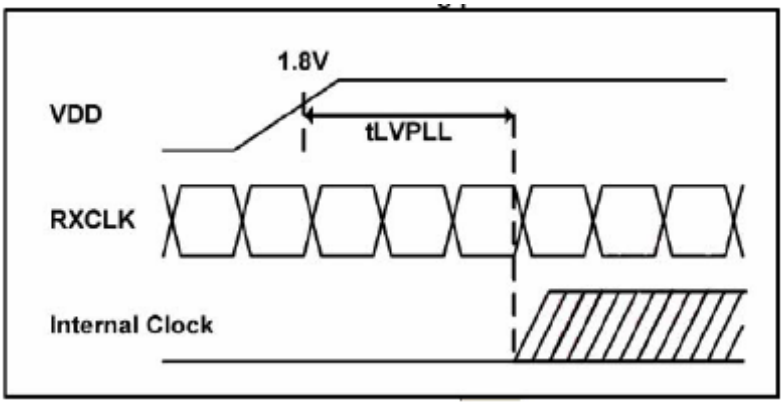

**Figure 4.1.2 Current dissipation testing pattern**

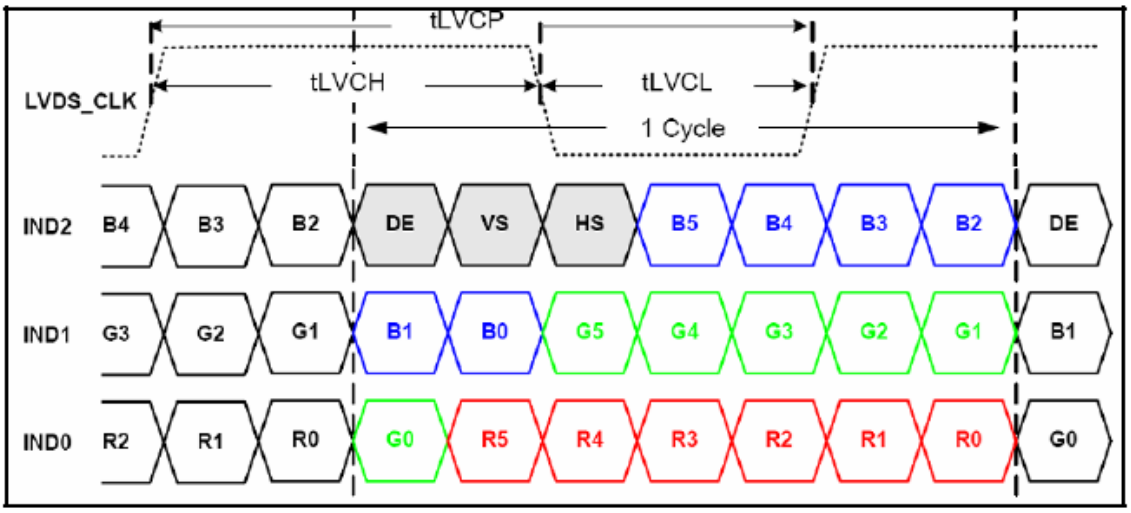
3.3 AC Timing Characteristic of The LCD

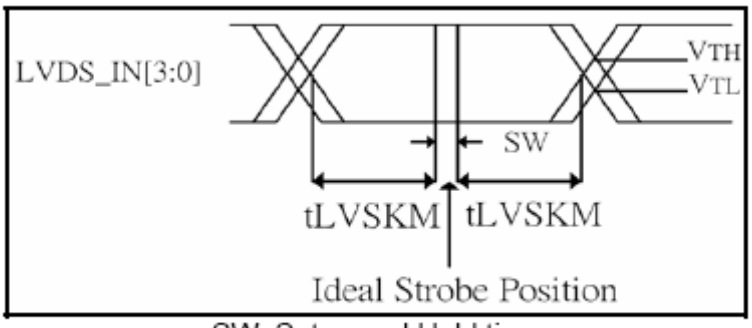
3.3.1 Timing Condition

| Parameter | Symbol | Min. | Typ. | Max. | Unit. | Remark |
|---|---|---|---|---|---|---|
| Clock period | tLVCP | 20.0 | 25 | 31.25 | ns | |
| Clock high time | tLVCH | - | 14.29 | - | ns | |
| Clock low time | tLVCL | - | 10.71 | - | ns | |
| PLL wake-up time | tLVPLL | - | - | 1 | ns | |
| Input skew marign | tLVSKM | 400 | - | - | ns | f=85MHZ |

**Table 5.1 timing parameter**






SW: Setup and Hold time

**Figure 5.1 Input signal data timing**

3.3.2 Power Sequence

| Parameter | Symbol | Min. | Typ. | Max. | Unit. | Remark |
|---|---|---|---|---|---|---|
| VDD 3.0V to signal starting | Tp1 | 0 | - | 30 | ns | |
| Signal starting to backlight on | Tp2 | 0 | - | - | ns | |
| Signal off to VDD 3.0V | Tp3 | 0 | - | 30 | ns | |
| Backlight off to signal off | Tp4 | 0 | - | - | ns | |

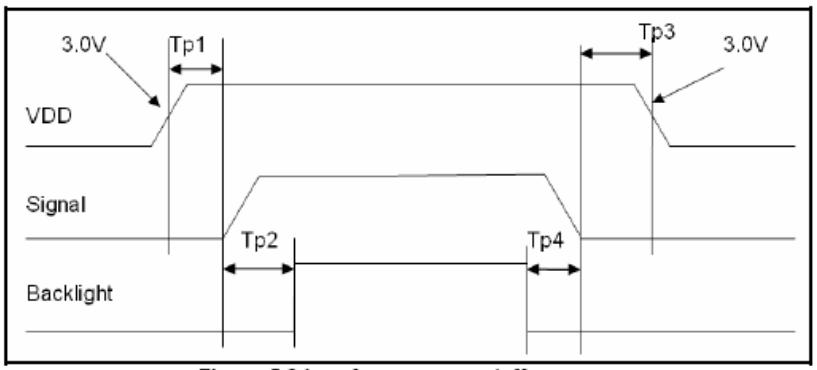



**Figure 5.2 Interface power on/off sequenc**

3.4 Back-Light Unit

The Back-light system is an edge-lighting type with 14 white LED(Light Emitting Diode)s. The characteristics of 14 white LEDs are shown in the following tables.

(Ta= Room Temp)

| Characteristics | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Current | $I_L$ | - | 120 | - | mA | (1) |
| Voltage | VL | - | 19.2 | - | V | |
| Backlight Power Consumption | $W_{BL}$ | - | 2.3 | - | W | |

Note (1) LEDS in 6 series x 6 parallel type.

(2) Where $I_L$= 120mA, $V_L$ = 19.2

## 4. Optical Characteristics

4.1 Optical characteristic of the LCD

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state.

Measuring equipment: BM-5A, BM-7A

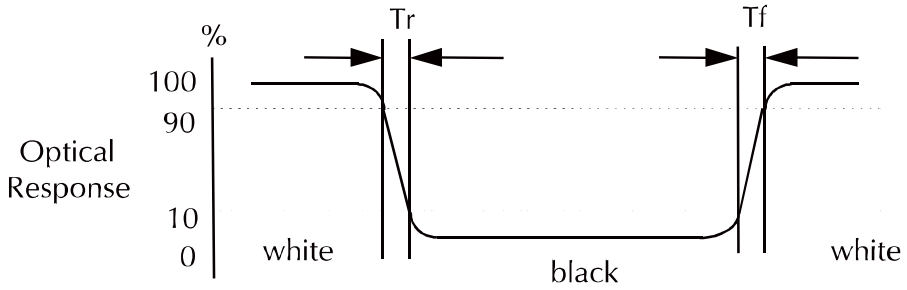
| Item | | Symbol | Condition | Min | Type | Max | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Brightness | | | | (350) | (400) | -- | $cd/m^2$ | |
| Response time | | $T_r$ | θ=0° | -- | (2) | -- | ms | . |
| | | $T_f$ | | -- | (6) | -- | ms | |
| Contrast ratio | | CR | At optimized viewing angle | (300) | (400) | -- | -- | |
| Response Time | | Ton | 25℃ | - | 25 | 50 | ms | |
| | | Toff | | | | | | |
| Chromaticity | White | x | Backlight is on | - | TBD | - | - | |
| | | y | | - | TBD | - | | |
| Uniformity | | U | - | - | 80 | - | % | |
| Color Gamut | | NTSC % | -- | -- | TBD | -- | % | |
| Viewing Angle (6H) | Hor. | $\theta_R$ | CR≥10 | 35 | 45 | -- | Degree | |
| | | $\theta_L$ | | 55 | 65 | -- | | |
| | Ver. | $\phi_H$ | | 55 | 65 | -- | | |
| | | $\phi_L$ | | 55 | 65 | -- | | |

a. Test equipment setup

After stabilizing and leaving the panel alone shall be warmed up for the stable operation of LCM, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7A(fast) with a viewing angle of 2° at a distance of 50cm and normal direction.

b. Definition of response time: Tr and Tf

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

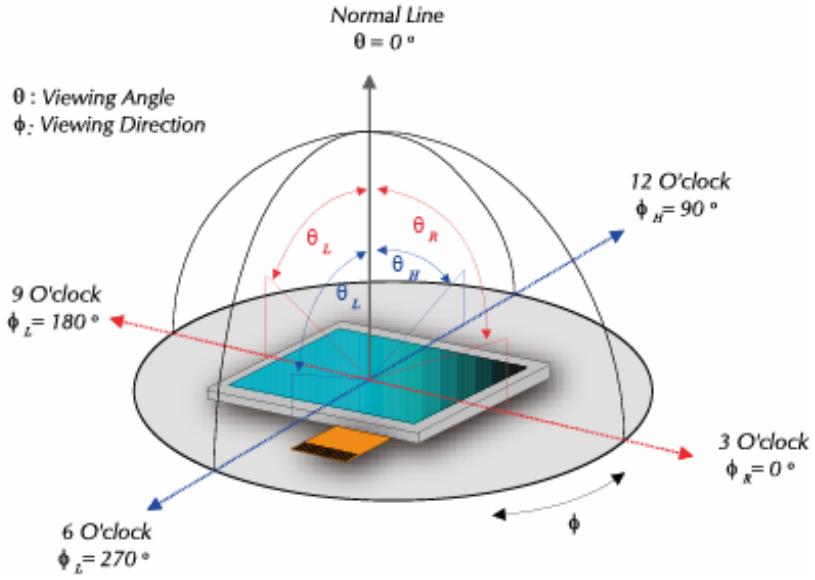



c. Definition of contrast ratio:

$$\text{Contrast Ratio (CR)} = \frac{\text{Brightness measured when LCD is at "white state"}}{\text{Brightness measured when LCD is at "black state"}}$$

d. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

e. View Angle




f. Definition of Luminance of White: Luminance of white at the center points

| Light Source of Back-Light Unit | LED Type |
|---|---|

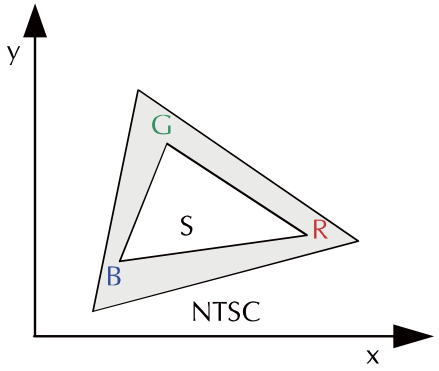
g. Definition of White Uniformity

$$\text{White Uniformity} = \frac{\text{Min. luminance of white among 5-points}}{\text{Max. luminance of white among 5-points}}$$

h. The definition of Color Gamut -Color Chromaticity CIE 1931

Color coordinate of white & red, green, blue at center point.

Color Gamut : NTSC(%) = ( RGB Triangle Area / NTSC Triangle Area ) x 100



## 5. I/O Terminal

### 5.1 Pin Assignment

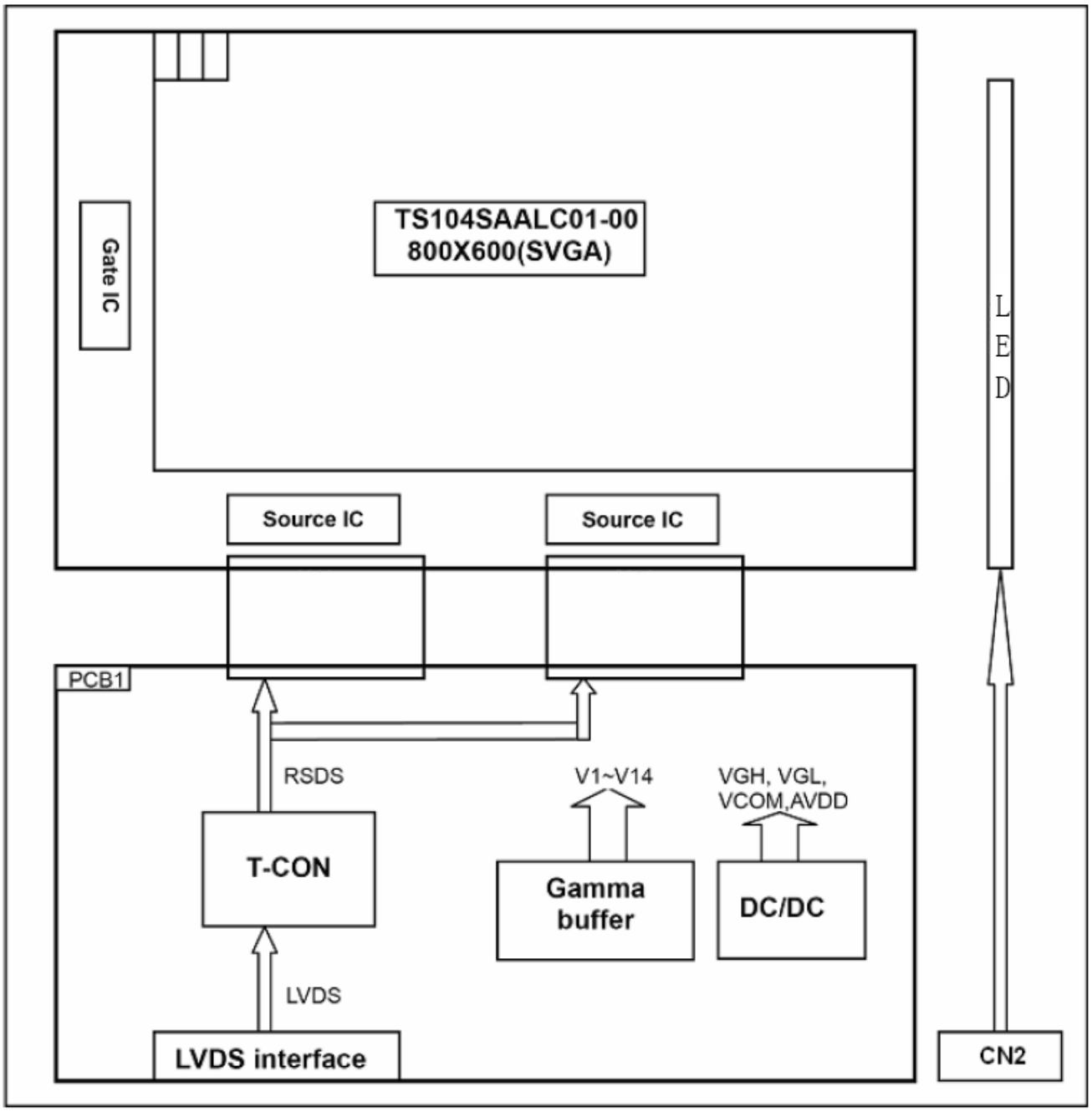
| Pin No. | Symbol | I/O | Function | Remark |
|---|---|---|---|---|
| 1 | VDD | P | Power Supply | |
| 2 | VDD | P | Power Supply | |
| 3 | GND | P | Power ground | |
| 4 | GND | P | Power ground | |
| 5 | IN0- | I | LVDS receiver negative signal channel 0 | |
| 6 | IN0+ | I | LVDS receiver positive signal channel 0 | |
| 7 | GND | P | Power ground | |
| 8 | IN1- | I | LVDS receiver negative signal channel 1 | |
| 9 | IN1+ | I | LVDS receiver positive signal channel 1 | |
| 10 | GND | P | Power ground | |
| 11 | IN2- | I | LVDS receiver negative signal channel 2 | |
| 12 | IN2+ | I | LVDS receiver positive signal channel 2 | |
| 13 | GND | P | Power ground | |
| 14 | CLK- | I | Green data | |
| 15 | CLK+ | I | Green data | |
| 16 | GND | P | Power ground | |
| 17 | NC | - | No connection | |
| 18 | NC | - | No connection | |
| 19 | GND | P | Power ground | |
| 20 | GND | P | Power ground | |

Note: I/O definition: I---- input, O---- output ,P---- power/ground

### 5.2 CN2 (LED connector)

| Pin No. | Symbol | I/O | Function | Remark |
|---|---|---|---|---|
| 1 | VL1 | P | LED power supply (high voltage) | Red |
| 2 | VL2 | P | LED power supply(GND) | White |

5.3 Block Diagram



5.4 Basic Display Color and Gray Scale

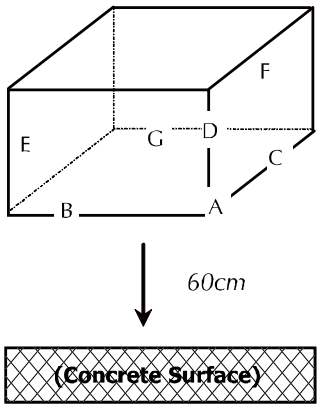
| | Color & Gray Scale | Data Signal | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(0) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 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 | 1 | 1 | 1 | 1 | 1 | 1 |
| Red | Black | 0 | 0 | 0 | 0 | 0 | 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 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(2) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Red(31) | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Red(62) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 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 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green | Black | 0 | 0 | 0 | 0 | 0 | 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 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Green(31) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Green(62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue | Black | 0 | 0 | 0 | 0 | 0 | 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 | 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 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue(31) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue(62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Each basic color can be displayed in 64 gray scales from 6 bit data signals. With the combination of total 18 bit data signals, the 262,144-color display can be achieved on the screen.

## 6. Test

No change on display and in operation under the following test condition.

Condition: Unless otherwise specified, tests will be conducted under the following condition.
Temperature: 20±5°C.
Humidity: 65±5%RH.
Tests will be not conducted under functioning state.

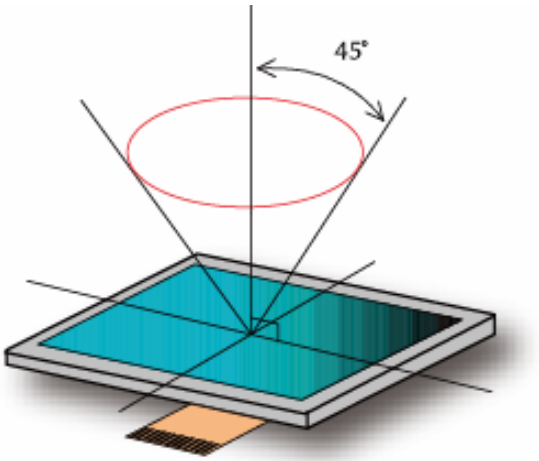
| No. | Parameter | Condition | Notes |
|---|---|---|---|
| 1 | High Temperature Operating | 60°C±2°C, 120hrs (Operation state). | |
| 2 | Low Temperature Operating | -10°C±2°C, 120hrs (Operation state). | 1 |
| 3 | High Temperature Storage | 70°C±2°C, 120hrs. | 2 |
| 4 | Low Temperature Storage | -20°C±2°C, 120hrs. | 1,2 |
| 5 | Damp Proof Test | 40°C±2°C, 90~95%, 120hrs. | 1,2 |
| 6 | Vibration Test | Total fixed amplitude: 1.5mm.<br>Vibration Frequency: 10~55Hz.<br>One cycle 60 seconds to 3 direction of X, Y, Z each 15 minutes. | 3 |
| 7. | Shock Test | To be measured after dropping from 60cm high on the concrete surface in packing state.<br>  <br>*Dropping method corner dropping:*<br>*A corner: Once edge dropping.*<br>*B, C, D edge: Once face dropping.*<br>*E, F, G face: Once.* | |

Notes:
1. No dew condensation to be observed.
2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
3. Vibration test will be conducted to the product itself without putting I in a container.

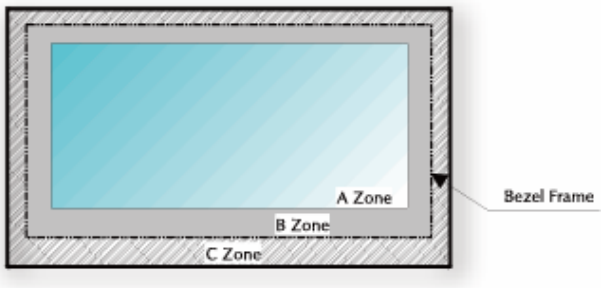
## 7. Appearance

7.1 Inspection

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.




Definition of Applicable Zones




A Zone : Active display area, B Zone : Area from outside of "A Zone" to validity viewing area

C Zone : Rest parts, A Zone + B Zone = Validity viewing area

(a) Operating Inspection

The function and appearance shall be inspected in the condition of

- under 750 lx or over light …….. Reflective Type.
- Using over Backlight unit …….. Transflective Type, Transmissive Type

Condition of judgment

In case of no gradation display it judges by applied On/Off voltage or optimal contrast.

In case of gradation display it judges by contrast that the bad point is able to confirm best.

(b) Appearance Inspection

The appearance shall be inspected in the condition of

- under 500 lx or over light …….. Reflective Type.
- Using over Backlight unit …….. Transflective Type, Transmissive Type

(c) Inspection Environment

Inspection environment it carried out with 250 lx or less in principles.

## 8 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 We cannot accept responsibility for industrial property, which may arise through the use of your product, with exception to those issues relating directly to the structure or method of manufacturing of our product. SGD-origin longer than one year from SGD production.

## 9. Dimensional Outlines