

## ***TFT-Display Datenblatt***

Modell LM200WD4

### **Kurzdaten**

|             |                      |
|-------------|----------------------|
| Hersteller  | LG Display           |
| Diagonale   | 20" / 50,8 cm        |
| Format      | wide                 |
| Auflösung   | 1600 x 900           |
| Backlight   | LED / 250 cd/m²      |
| Interface   | LVDS                 |
| Touchscreen | nein                 |
| Temperatur  | 0... +50°C (Betrieb) |

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Vertrieb durch:



**LM200WD4**  
**Liquid Crystal Display**

Product Specification

# SPECIFICATION FOR APPROVAL

- ( ) Preliminary Specification  
( ● ) Final Specification

|       |                 |
|-------|-----------------|
| Title | 20" HD+ TFT LCD |
|-------|-----------------|

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

|          |                      |
|----------|----------------------|
| SUPPLIER | LG Display Co., Ltd. |
| *MODEL   | LM200WD4             |
| SUFFIX   | SLB1                 |

\*When you obtain standard approval,  
please use the above model name without suffix

| APPROVED BY | SIGNATURE | DATE |
|-------------|-----------|------|
| /           |           |      |
| /           |           |      |
| /           |           |      |

Please return 1 copy for your confirmation with  
your signature and comments.

| APPROVED BY               | SIGNATURE | DATE |
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**IT/Mobile Development Division 1**  
**LG Display Co., Ltd**

## Product Specification

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## RECORD OF REVISIONS

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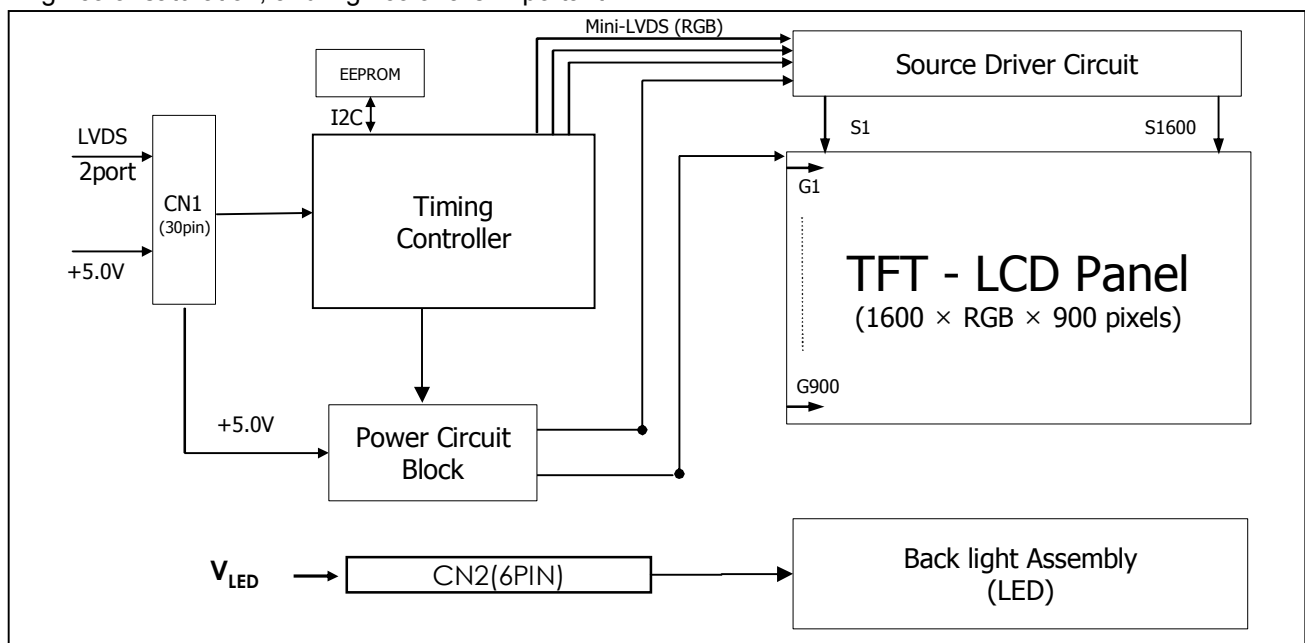
## Product Specification

### 1. General Description

LM200WD4 is a Color Active Matrix Liquid Crystal Display with a Light Emitting Diode ( White LED) backlight system without LED driver. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally black mode. It has a 20 inch diagonally measured active display area with HD+ resolution (900 vertical by 1600horizontal pixel array) Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16,7M colors with A-FRC(Advanced Frame Rate Control).

It has been designed to apply the 8Bit 2 port LVDS interface.

It is intended to support displays where high brightness, super wide viewing angle, high color saturation, and high color are important.



**[ Figure 1 ] Block diagram**

### General Features

|                        |                                                                                          |
|------------------------|------------------------------------------------------------------------------------------|
| Active Screen Size     | 20.0 inches (508.05mm) diagonal                                                          |
| Outline Dimension      | 462.8(H) x 272.0(V) x 10.2(D) mm(Typ.)                                                   |
| Pixel Pitch            | 0.2766x 0.2766(V)mm                                                                      |
| Pixel Format           | 1600 horiz. By 900 vert. Pixels RGB stripes arrangement                                  |
| Color Depth            | 16.7M colors (6bit + A FRC)                                                              |
| Luminance, White       | 250 cd/m <sup>2</sup> ( Center 1 points)                                                 |
| Viewing Angle(CR>10)   | View Angle Free (R/L 178(Typ.), U/D 178(Typ.))                                           |
| Power Consumption      | Total 20.17 Watt (Typ.) (3.27 Watt @V <sub>LCD</sub> , 16.9 Watt @I <sub>s</sub> =110mA) |
| Weight                 | 1120 g (typ.)                                                                            |
| Display Operating Mode | Transmissive mode, normally black                                                        |
| Surface Treatment      | Hard coating(3H), Anti-glare treatment of the front polarizer                            |

## Product Specification

### 2. Absolute Maximum Ratings

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

**Table 1. ABSOLUTE MAXIMUM RATINGS**

| Parameter                  | Symbol           | Values |     | Units           | Notes       |
|----------------------------|------------------|--------|-----|-----------------|-------------|
|                            |                  | Min    | Max |                 |             |
| Power Input Voltage        | V <sub>LCD</sub> | -0.3   | 6.0 | V <sub>dc</sub> | at 25 ± 2°C |
| Operating Temperature      | T <sub>OP</sub>  | 0      | 50  | °C              | 1, 2, 3     |
| Storage Temperature        | T <sub>ST</sub>  | -20    | 60  | °C              |             |
| Operating Ambient Humidity | H <sub>OP</sub>  | 10     | 90  | %RH             |             |
| Storage Humidity           | H <sub>ST</sub>  | 10     | 90  | %RH             |             |

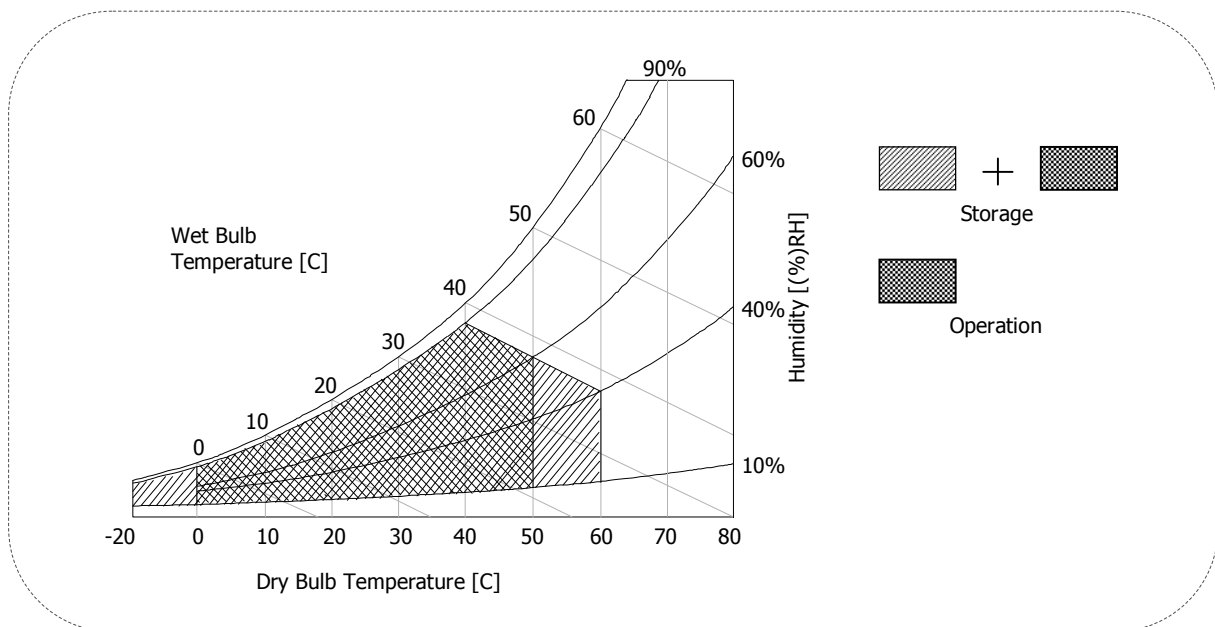
Note : 1. Temperature and relative humidity range are shown in the figure below.

Wet bulb temperature should be 39 °C Max, and no condensation of water.

2. Maximum Storage Humidity is up to 40°C, 70% RH only for 4 corner light leakage Mura.

3. Storage condition is guaranteed under packing condition

**[ Figure 2 ] Temperature and relative humidity**



## Product Specification

### 3. Electrical Specifications

#### 3-1. Electrical Characteristics

It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input power for the LED, is typically generated by an inverter. The inverter is an external unit to the LCDs.

**Table 2-1. ELECTRICAL CHARACTERISTICS**

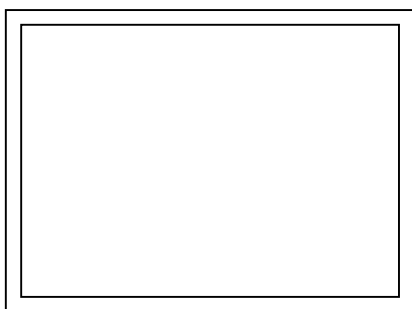
| Parameter                     | Symbol             | Values |      |      | Unit              | Notes |
|-------------------------------|--------------------|--------|------|------|-------------------|-------|
|                               |                    | Min    | Typ  | Max  |                   |       |
| MODULE :                      |                    |        |      |      |                   |       |
| Power Supply Input Voltage    | V <sub>LCD</sub>   | 4.5    | 5.0  | 5.5  | V <sub>dc</sub>   |       |
| Permissive Power Input Ripple | V <sub>dRF</sub>   |        |      | 200  | mV <sub>p-p</sub> | 1     |
| Power Supply Input Current    | I <sub>LCD</sub>   | -      | 653  | 750  | mA                | 2     |
|                               |                    | -      | 752  | 865  | mA                | 3     |
| Power Consumption             | P <sub>C</sub> TYP | -      | 3.27 | 3.75 | Watt              | 2     |
|                               | P <sub>C</sub> MAX | -      | 3.76 | 4.33 | Watt              | 3     |
| Rush current                  | I <sub>RUSH</sub>  | -      | -    | 3.0  | A                 | 4     |

Note :

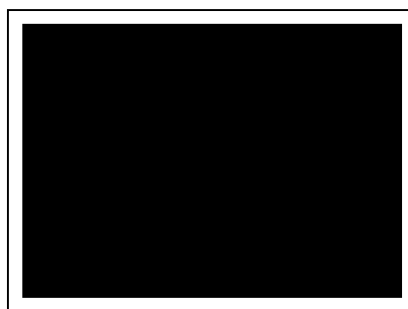
1. Permissive power ripple should be measured under V<sub>LCD</sub> = 5.0V, 25°C, f<sub>V</sub>(frame frequency)=MAX condition and At that time, we recommend the bandwidth configuration of oscilloscope is to be under 20Mhz. See the next page.
2. The specified current and power consumption are under the V<sub>LCD</sub> = 5.0V, 25 ± 2°C, f<sub>V</sub> = 60Hz condition whereas Mosaic and max power pattern shown in the [ Figure 3 ] is displayed.
3. The current is specified at the maximum current pattern.
4. Maximum Condition of Inrush current :  
The duration of rush current is about 5ms and rising time of power Input is 500us ± 20%.(min.).

Product Specification

- **Permissive Power input ripple** ( $V_{LCD} = 5.0V$ ,  $25^{\circ}C$ ,  $fV$ (frame frequency)=MAX condition)

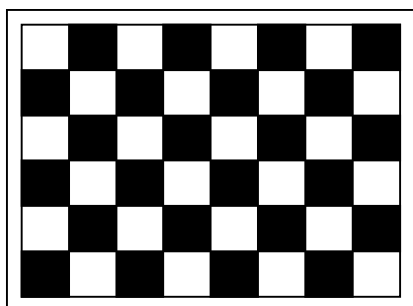


**White pattern**

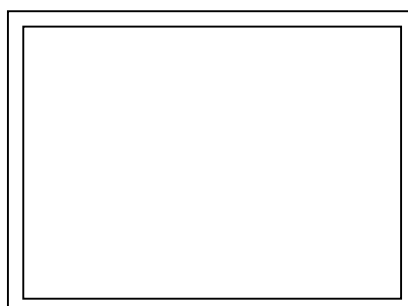


**Black pattern**

- **Power consumption** ( $V_{LCD} = 5.0V$ ,  $25^{\circ}C$ ,  $fV$  (frame frequency)=60Hz condition)



**Typical power Pattern**



**Maximum power Pattern**

**[ Figure 3 ] Mosaic pattern & White Pattern for power consumption measurement**

## Product Specification

**Table 2-2. LED Bar ELECTRICAL CHARACTERISTICS**

| Parameter          | Symbol | Condition | Values |      |      | Unit | Notes |
|--------------------|--------|-----------|--------|------|------|------|-------|
|                    |        |           | Min.   | Typ. | Max. |      |       |
| LED :              |        |           |        |      |      |      | 1,7   |
| LED String Current | Is     |           | -      | 110  | 120  | mA   | 2,7   |
| LED String Voltage | Vs     |           | 34.8   | 38.4 | 42.0 | V    | 3,7   |
| Power Consumption  | PBar   |           | -      | 16.9 | 18.5 | Watt | 4,6,7 |
| LED Life Time      | LED_LT |           | 30,000 | -    | -    | Hrs  | 5,7   |

### LED driver design guide

: The design of the LED driver must have specifications for the LED in LCD Assembly.

The performance of the LED in LCM, for example life time or brightness, is extremely influenced by the characteristics of the LED driver.

So all the parameters of an LED driver should be carefully designed and output current should be Constant current control.

Please control feedback current of each string individually to compensate the current variation among the strings of LEDs.

When you design or order the LED driver, please make sure unwanted lighting caused by the mismatch of the LED and the LED driver (no lighting, flicker, etc) never occurs.

When you confirm it, the LCD module should be operated in the same condition as installed in your instrument.

1. Specified values are for a single LED bar.
2. The specified current is input LED chip 100% duty current.
3. The specified voltage is input LED string and Bar voltage at typical 110 mA 100% duty current.
4. The specified power consumption is input LED bar power consumption at typical 110 mA 100% duty current.
5. The life is determined as the time at which luminance of the LED is 50% compared to that of initial value at the typical LED current on condition of continuous operating at  $25 \pm 2^{\circ}\text{C}$ .
6. The LED bar power consumption shown above does not include loss of external driver.  
 The used LED bar current is the LED typical current.  
 Min Power Consumption is calculated with  $P_{\text{Bar}} = V_{\text{s}}(\text{Min.}) \times I_{\text{s}}(\text{Typ.}) \times N_{\text{string}}$   
 Max Power Consumption is calculated with  $P_{\text{Bar}} = V_{\text{bar}}(\text{Max.}) \times I_{\text{s}}(\text{Typ.}) \times N_{\text{string}}$

## Product Specification

### 3-2. Interface Connections

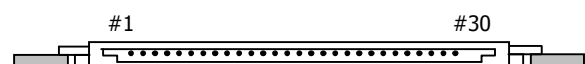
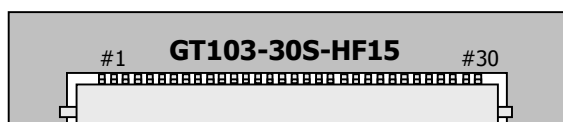
#### 3-2-1. LCD Module

- LCD Connector(CN1). : GT103-30S-HF15 (LSM) , IS100-L300-C23 (UJU)
- Mating Connector : FI-X30C2L (Manufactured by JAE) or Equivalent

**Table 3. MODULE CONNECTOR(CN1) PIN CONFIGURATION**

| No | Symbol  | Description                              | No | Symbol           | Symbol                                       |
|----|---------|------------------------------------------|----|------------------|----------------------------------------------|
| 1  | FR0M    | Minus signal of odd channel 0 (LVDS)     | 16 | SR1P             | Plus signal of even channel 1 (LVDS)         |
| 2  | FR0P    | Plus signal of odd channel 0 (LVDS)      | 17 | GND              | Ground                                       |
| 3  | FR1M    | Minus signal of odd channel 1 (LVDS)     | 18 | SR2M             | Minus signal of even channel 2 (LVDS)        |
| 4  | FR1P    | Plus signal of odd channel 1 (LVDS)      | 19 | SR2P             | Plus signal of even channel 2 (LVDS)         |
| 5  | FR2M    | Minus signal of odd channel 2 (LVDS)     | 20 | SCLKINM          | Minus signal of even clock channel (LVDS)    |
| 6  | FR2P    | Plus signal of odd channel 2 (LVDS)      | 21 | SCLKINP          | Plus signal of even clock channel (LVDS)     |
| 7  | GND     | Ground                                   | 22 | SR3M             | Minus signal of even channel 3 (LVDS)        |
| 8  | FCLKINM | Minus signal of odd clock channel (LVDS) | 23 | SR3P             | Plus signal of even channel 3 (LVDS)         |
| 9  | FCLKINP | Plus signal of odd clock channel (LVDS)  | 24 | GND              | Ground                                       |
| 10 | FR3M    | Minus signal of odd channel 3 (LVDS)     | 25 | NC               | No Connection (I2C Serial interface for LCM) |
| 11 | FR3P    | Plus signal of odd channel 3 (LVDS)      | 26 | NC               | No Connection.(I2C Serial interface for LCM) |
| 12 | SR0M    | Minus signal of even channel 0 (LVDS)    | 27 | PWM_OUT          | For Control Burst frequency of Inverter      |
| 13 | SR0P    | Plus signal of even channel 0 (LVDS)     | 28 | V <sub>LCD</sub> | Power Supply +5.0V                           |
| 14 | GND     | Ground                                   | 29 | V <sub>LCD</sub> | Power Supply +5.0V                           |
| 15 | SR1M    | Minus signal of even channel 1 (LVDS)    | 30 | V <sub>LCD</sub> | Power Supply +5.0V                           |

- Note: 1. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.
2. All V<sub>LCD</sub> (power input) pins should be connected together.
3. Input Level of LVDS signal is based on the IEA 664 Standard.
4. PWM\_OUT signal controls the burst frequency of a inverter.  
This signal is synchronized with vertical frequency.  
It's frequency is 3 times of vertical frequency, and it's duty ratio is 50%.  
If you don't use this pin, it is no connection.



**Rear view of LCM**

**[ Figure 4 ] Connector diagram**

**Product Specification**
**Table 4. REQUIRED SIGNAL ASSIGNMENT FOR Flat Link (TI:SN75LVDS83) Transmitter**

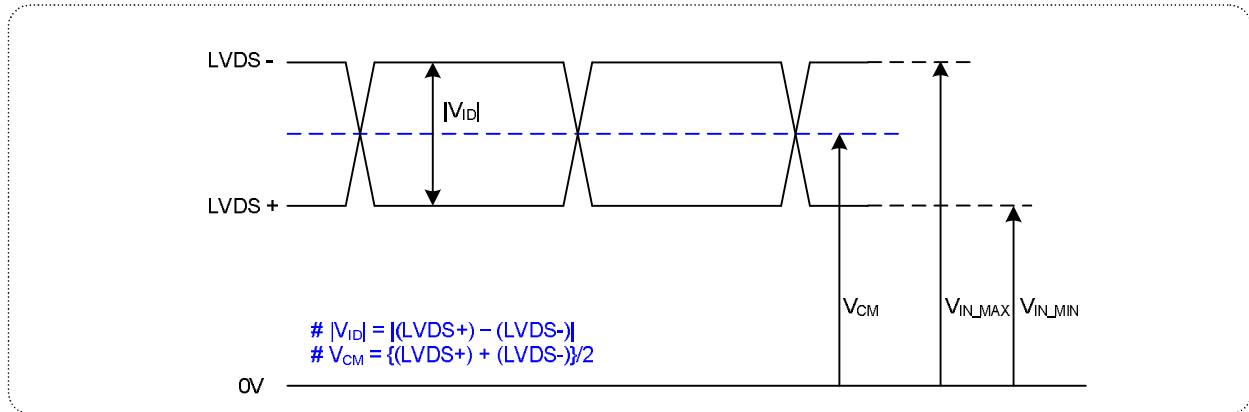
| Pin # | Pin Name | Require Signal             | Pin # | Pin Name                | Require Signal                           |
|-------|----------|----------------------------|-------|-------------------------|------------------------------------------|
| 1     | Vcc      | Power Supply for TTL Input | 29    | GND                     | Ground pin for TTL                       |
| 2     | D5       | TTL Input (R7)             | 30    | D26                     | TTL Input (DE)                           |
| 3     | D6       | TTL Input (R5)             | 31    | T <sub>x</sub> CLKIN    | TTL Level clock Input                    |
| 4     | D7       | TTL Input (G0)             | 32    | PWR DWN                 | Power Down Input                         |
| 5     | GND      | Ground pin for TTL         | 33    | PLL GND                 | Ground pin for PLL                       |
| 6     | D8       | TTL Input (G1)             | 34    | PLL Vcc                 | Power Supply for PLL                     |
| 7     | D9       | TTL Input (G2)             | 35    | PLL GND                 | Ground pin for PLL                       |
| 8     | D10      | TTL Input (G6)             | 36    | LVDS GND                | Ground pin for LVDS                      |
| 9     | Vcc      | Power Supply for TTL Input | 37    | T <sub>x</sub> OUT3 +   | Positive LVDS differential data output 3 |
| 10    | D11      | TTL Input (G7)             | 38    | T <sub>x</sub> OUT3 –   | Negative LVDS differential data output 3 |
| 11    | D12      | TTL Input (G3)             | 39    | T <sub>x</sub> CLKOUT + | Positive LVDS differential clock output  |
| 12    | D13      | TTL Input (G4)             | 40    | T <sub>x</sub> CLKOUT – | Negative LVDS differential clock output  |
| 13    | GND      | Ground pin for TTL         | 41    | T <sub>x</sub> OUT2 +   | Positive LVDS differential data output 2 |
| 14    | D14      | TTL Input (G5)             | 42    | T <sub>x</sub> OUT2 –   | Negative LVDS differential data output 2 |
| 15    | D15      | TTL Input (B0)             | 43    | LVDS GND                | Ground pin for LVDS                      |
| 16    | D16      | TTL Input (B6)             | 44    | LVDS Vcc                | Power Supply for LVDS                    |
| 17    | Vcc      | Power Supply for TTL Input | 45    | T <sub>x</sub> OUT1 +   | Positive LVDS differential data output 1 |
| 18    | D17      | TTL Input (B7)             | 46    | T <sub>x</sub> OUT1 –   | Negative LVDS differential data output 1 |
| 19    | D18      | TTL Input (B1)             | 47    | T <sub>x</sub> OUT0 +   | Positive LVDS differential data output 0 |
| 20    | D19      | TTL Input (B2)             | 48    | T <sub>x</sub> OUT0 –   | Negative LVDS differential data output 0 |
| 21    | GND      | Ground pin for TTL Input   | 49    | LVDS GND                | Ground pin for LVDS                      |
| 22    | D20      | TTL Input (B3)             | 50    | D27                     | TTL Input (R6)                           |
| 23    | D21      | TTL Input (B4)             | 51    | D0                      | TTL Input (R0)                           |
| 24    | D22      | TTL Input (B5)             | 52    | D1                      | TTL Input (R1)                           |
| 25    | D23      | TTL Input (RSVD)           | 53    | GND                     | Ground pin for TTL                       |
| 26    | Vcc      | Power Supply for TTL Input | 54    | D2                      | TTL Input (R2)                           |
| 27    | D24      | TTL Input (HSYNC)          | 55    | D3                      | TTL Input (R3)                           |
| 28    | D25      | TTL Input (VSYNC)          | 56    | D4                      | TTL Input (R4)                           |

Notes : 1. Refer to LVDS Transmitter Data Sheet for detail descriptions.  
2. 7 means MSB and 0 means LSB at R,G,B pixel data

## Product Specification

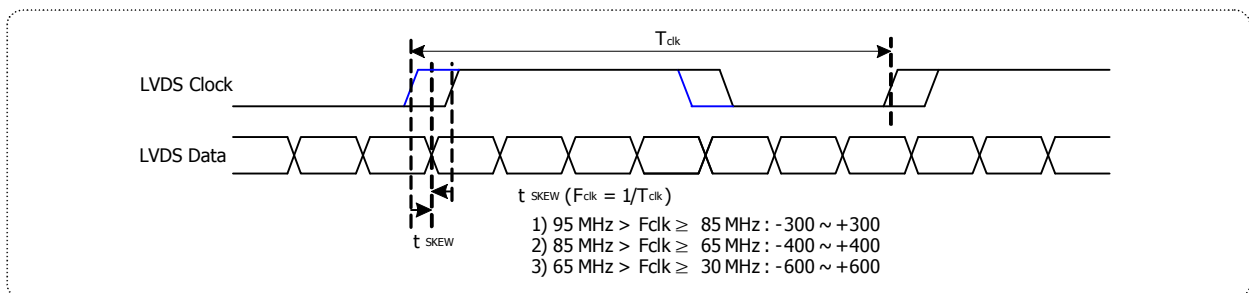
### LVDS Input characteristics

#### 1. DC Specification



| Description                   | Symbol          | Min | Max | Unit | Notes |
|-------------------------------|-----------------|-----|-----|------|-------|
| LVDS Differential Voltage     | $ V_{ID} $      | 200 | 600 | mV   | -     |
| LVDS Common mode Voltage      | $V_{CM}$        | 1.0 | 1.5 | V    | -     |
| LVDS Input Voltage Range      | $V_{IN}$        | 0.7 | 1.8 | V    | -     |
| Change in common mode Voltage | $\Delta V_{CM}$ | -   | 250 | mV   | -     |

#### 2. AC Specification

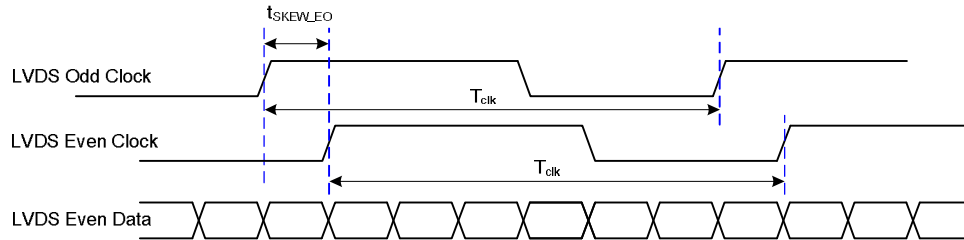


| Description                                            | Symbol         | Min                        | Max                        | Unit      | Notes |
|--------------------------------------------------------|----------------|----------------------------|----------------------------|-----------|-------|
| LVDS Clock to Data Skew Margin                         | $t_{SKEW}$     | $- 1/7T_{clk} \times 0.25$ | $+ 1/7T_{clk} \times 0.25$ | ps        | -     |
| LVDS Clock to Clock Skew Margin (Even to Odd)          | $t_{SKEW\_EO}$ | $- 1/7$                    | $+ 1/7$                    | $T_{clk}$ | -     |
| Maximum deviation of input clock frequency during SSC  | $F_{DEV}$      | -                          | ± 3                        | %         | 1     |
| Maximum modulation frequency of input clock during SSC | $F_{MOD}$      | -                          | 200                        | KHz       | 1     |

#### Note 1 :

This SSC specifications are just T-CON operation specification. In case of various system condition, the optimum setting value of SSC can be different. LGD recommend the SI should be adjust the SSC deviation and modulation frequency in order not to happen any kinds of defect phenomenon.

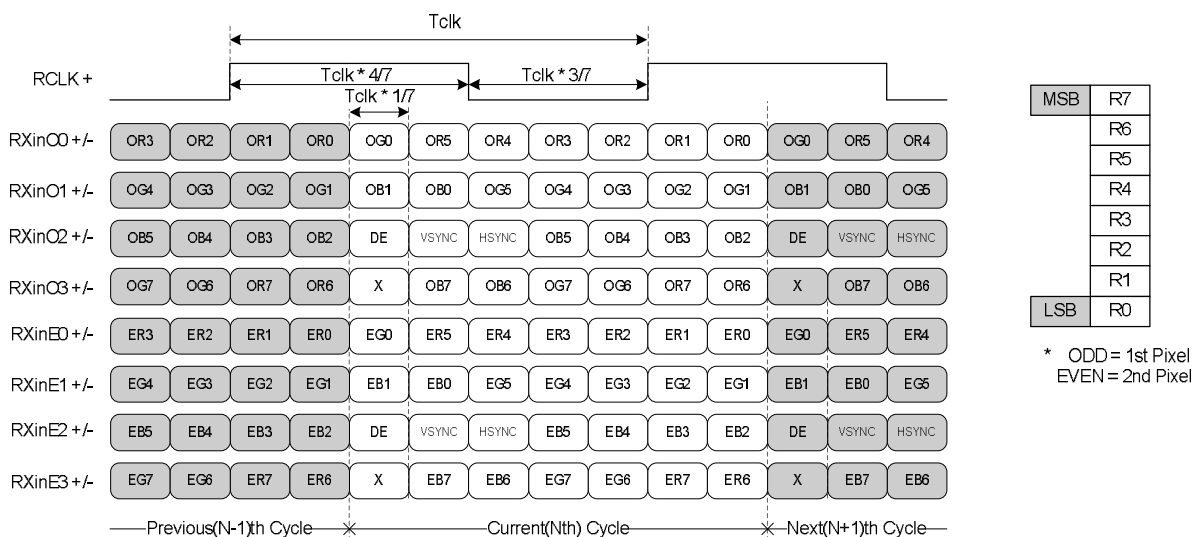
## Product Specification



< Clock skew margin between channel >

### 3. Data Format

#### 1) LVDS 2 Port



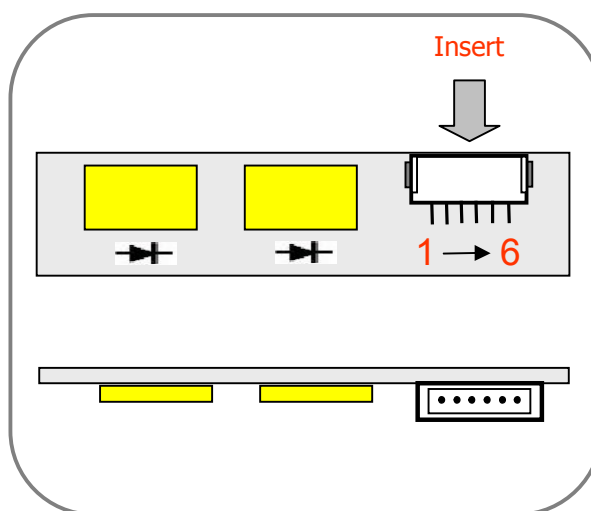
< LVDS Data Format >

## Product Specification

**Table 5. BACKLIGHT CONNECTOR PIN CONFIGURATION(CN2)**

The LED interface connector is a model 10019HR-H06B manufactured by Yeonho.  
 The pin configuration for the connector is shown in the table below.

| Pin | Symbol | Description               | Notes |
|-----|--------|---------------------------|-------|
| 1   | FB1    | Channel1 Current Feedback |       |
| 2   | FB2    | Channel2 Current Feedback |       |
| 3   | VLED   | LED Power Supply          |       |
| 4   | VLED   | LED Power Supply          |       |
| 5   | FB3    | Channel3 Current Feedback |       |
| 6   | FB4    | Channel4 Current Feedback |       |



[ Figure 5 ] Backlight connector diagram

## Product Specification

### 3-3. Signal Timing Specifications

This is signal timing required at the input of the TMDS transmitter. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

**Table 6. TIMING TABLE**

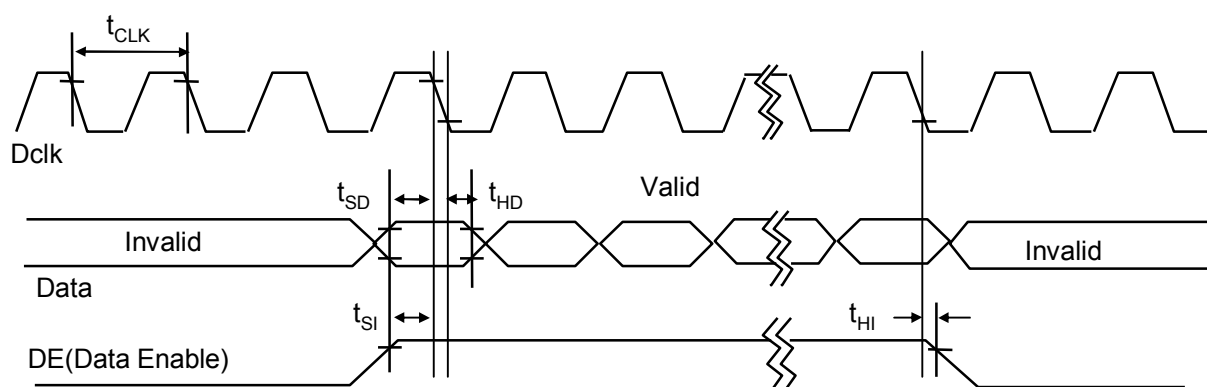
| Parameter           |                  | Symbol    | Min. | Typ. | Max. | Unit      | Notes                             |
|---------------------|------------------|-----------|------|------|------|-----------|-----------------------------------|
| $D_{CLK}$           | Period           | $t_{CLK}$ | 14.6 | 18.5 | 23.1 | ns        | Pixel frequency<br>: Typ.108.0MHz |
|                     | Frequency        | $f_{CLK}$ | 43.2 | 54.0 | 68.4 | MHz       |                                   |
| Horizontal          | Horizontal Valid | $t_{HV}$  | 800  | 800  | 800  | $t_{CLK}$ |                                   |
|                     | H Period Total   | $t_{HP}$  | 840  | 900  | 1200 |           |                                   |
|                     | Hsync Frequency  | $f_H$     | 48.0 | 60.0 | 76.0 | kHz       |                                   |
| Vertical            | Vertical Valid   | $t_{VV}$  | 900  | 900  | 900  | $t_{HP}$  |                                   |
|                     | V Period Total   | $t_{VP}$  | 908  | 1000 | 1300 |           |                                   |
|                     | Vsync Frequency  | $f_V$     | 48   | 60   | 76   | Hz        |                                   |
| DE<br>(Data Enable) | DE Setup Time    | $t_{SI}$  | 4    | -    | -    | ns        | For $D_{CLK}$                     |
|                     | DE Hold Time     | $t_{HI}$  | 4    | -    | -    |           |                                   |
| Data                | Data Setup Time  | $t_{SD}$  | 4    | -    | -    | ns        | For $D_{CLK}$                     |
|                     | Data Hold Time   | $t_{HD}$  | 4    | -    | -    |           |                                   |

Note:

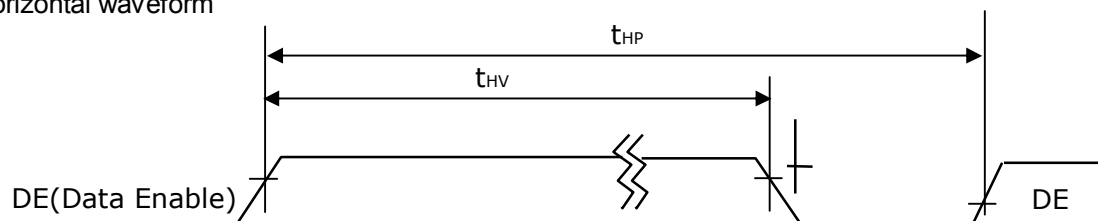
1. DE Only mode operation. The input of Hsync & Vsync signal does not have an effect on LCD normal operation.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
3. Horizontal period should be even.

### 3-4. Signal Timing Waveforms

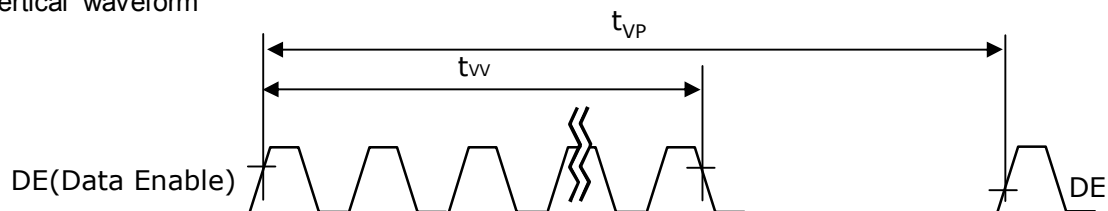
#### 1. DCLK, DE, DATA waveforms



#### 2. Horizontal waveform



#### 3. Vertical waveform



## Product Specification

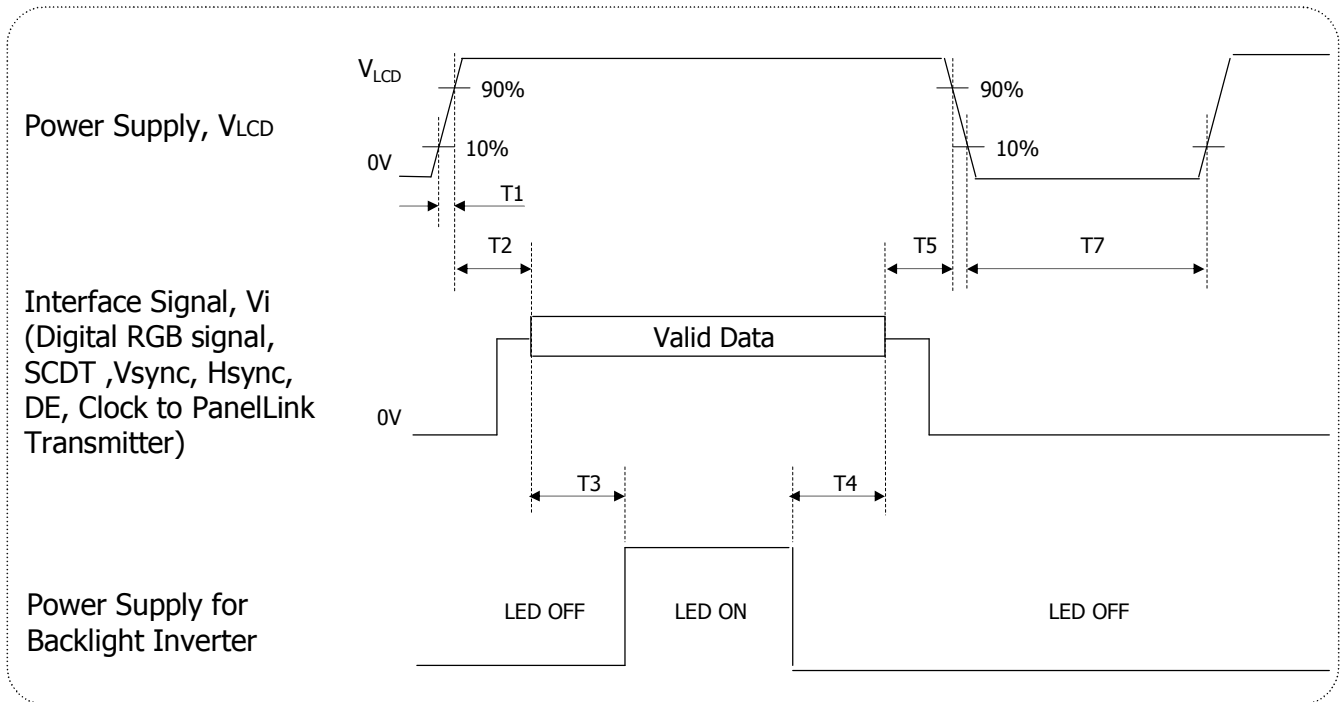
### 3-5. Color Input Data Reference

The Brightness of each primary color(red,green,blue) is based on the 8-bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

**Table 7. COLOR DATA REFERENCE**

| Color       |             |      | Input Color Data |    |    |    |     |    |    |    |       |    |    |    |     |    |    |    |      |    |    |    |     |    |    |    |
|-------------|-------------|------|------------------|----|----|----|-----|----|----|----|-------|----|----|----|-----|----|----|----|------|----|----|----|-----|----|----|----|
|             |             |      | RED              |    |    |    |     |    |    |    | GREEN |    |    |    |     |    |    |    | BLUE |    |    |    |     |    |    |    |
|             |             |      | MSB              |    |    |    | LSB |    |    |    | MSB   |    |    |    | LSB |    |    |    | MSB  |    |    |    | LSB |    |    |    |
|             |             |      | 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 (255)   |      | 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 (255) |      | 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 (255)  |      | 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         | RED (000)   | Dark | 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 (001)   |      | 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 (254)   |      | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | RED (255)   |      | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
| GREEN       | GREEN (000) | Dark | 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 (001) |      | 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 (254) |      | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | GREEN (255) |      | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
| BLUE        | BLUE (000)  | Dark | 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 (001)  |      | 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 (254)  |      | 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 (255)  |      | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |

### 3-6. Power Sequence



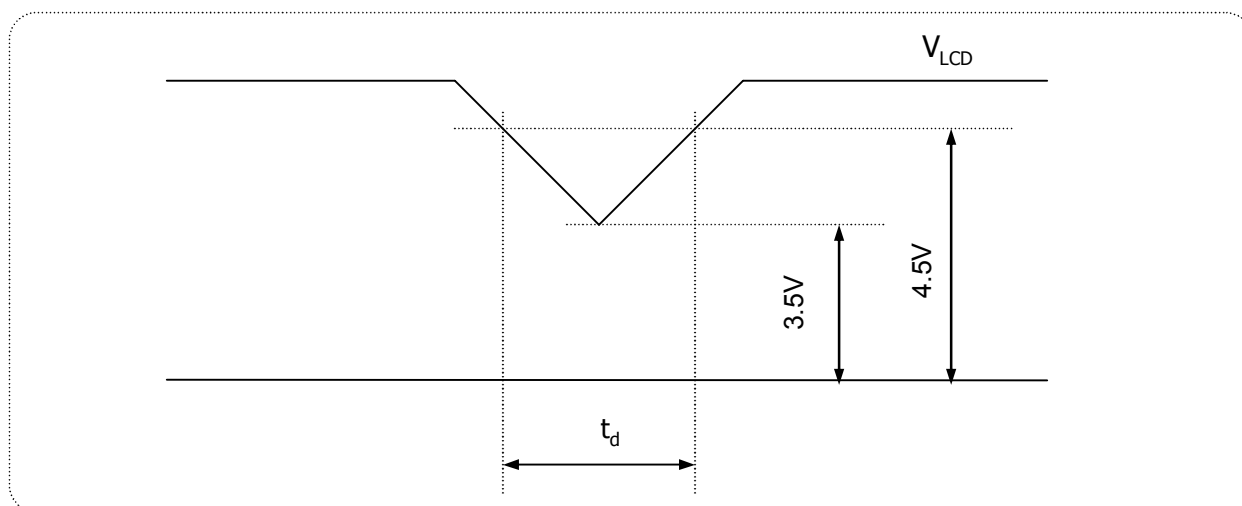
[ Figure 6 ] Power sequence

**Table 8. POWER SEQUENCE**

| Parameter | Values |     |     | Units |
|-----------|--------|-----|-----|-------|
|           | Min    | Typ | Max |       |
| T1        | 0.5    | -   | 10  | ms    |
| T2        | 0.01   | -   | 50  | ms    |
| T3        | 500    | -   | -   | ms    |
| T4        | 200    | -   | -   | ms    |
| T5        | 0.01   | -   | 50  | ms    |
| T7        | 1000   | -   | -   | ms    |

- Notes :
1. Please avoid floating state of interface signal at invalid period.
  2. When the interface signal is invalid, be sure to pull down the power supply for LCD  $V_{LCD}$  to 0V.
  3. LED power must be turn on after power supply for LCD and interface signal are valid.

### 3-7. $V_{LCD}$ Power Dip Condition



[ Figure 7 ] Power dip condition

1) Dip condition

$$3.5V \leq V_{LCD} < 4.5V, t_d \leq 20ms$$

2)  $V_{LCD} < 3.5V$

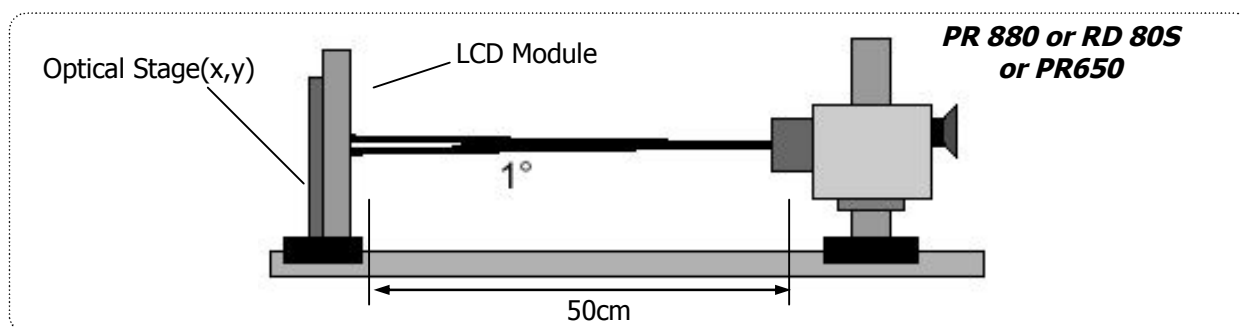
$V_{LCD}$ -dip conditions should also follow the Power On/Off conditions for supply voltage.

## Product Specification

### 4. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' for approximately 30 minutes in a dark environment at  $25 \pm 2^\circ\text{C}$ . The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of  $\Phi$  and  $\theta$  equal to  $0^\circ$  and aperture 1 degree.

FIG. 1 presents additional information concerning the measurement equipment and method.



[ Figure 8 ] Optical Characteristic Measurement Equipment and Method

**Table 9. OPTICAL CHARACTERISTICS**

( $T_a = 25^\circ\text{C}$ ,  $V_{\text{LCD}} = 5.0\text{V}$ ,  $f_v = 60\text{Hz}$  Dclk=108MHz,  $I_s = 110\text{mA}$ )

| Parameter                                           |              | Symbol                     | Values       |       |              | Units             | Notes |
|-----------------------------------------------------|--------------|----------------------------|--------------|-------|--------------|-------------------|-------|
|                                                     |              |                            | Min          | Typ   | Max          |                   |       |
| Contrast Ratio                                      |              | CR                         | 600          | 1000  | -            |                   | 1     |
| Surface Luminance, white                            |              | $L_{\text{WH}}$            | 200          | 250   | -            | cd/m <sup>2</sup> | 2     |
| Luminance Variation                                 |              | $\delta_{\text{WHITE}}$    | 75           | -     | -            | %                 | 3     |
| Response Time                                       | Gray To Gray | $T_{\text{GTG\_AVR}}$      | -            | 14    | 25           | ms                | 4     |
| Color Coordinates<br>[CIE1931]<br><b>(By PR650)</b> | RED          | Rx                         | Typ<br>-0.03 | 0.638 | Typ<br>+0.03 |                   |       |
|                                                     |              | Ry                         |              | 0.332 |              |                   |       |
|                                                     | GREEN        | Gx                         |              | 0.302 |              |                   |       |
|                                                     |              | Gy                         |              | 0.627 |              |                   |       |
|                                                     | BLUE         | Bx                         |              | 0.153 |              |                   |       |
|                                                     |              | By                         |              | 0.073 |              |                   |       |
|                                                     | WHITE        | Wx                         |              | 0.313 |              |                   |       |
|                                                     |              | Wy                         |              | 0.329 |              |                   |       |
| Color Shift<br>(Avg. $\Delta u'v' < 0.02$ )         | Horizontal   | $\theta_{\text{CST\_H}}$   | -            | 100   | -            | Degree            | 5     |
|                                                     | Vertical     | $\theta_{\text{CST\_V}}$   | -            | 140   | -            |                   |       |
| Viewing Angle (CR>10)                               |              |                            |              |       |              |                   |       |
| General                                             | Horizontal   | $\theta_{\text{H}}$        | 170          | 178   | -            | Degree            | 6     |
|                                                     | Vertical     | $\theta_{\text{V}}$        | 170          | 178   | -            |                   |       |
| GSR @ 60degree<br>(Gamma shift rate)                | Horizontal   | $\delta_{\text{Gamma\_H}}$ | -            | -     | 20           | %                 | 7     |
|                                                     | Vertical     | $\delta_{\text{Gamma\_V}}$ | -            | -     | 20           |                   |       |
| Gray Scale                                          |              | -                          |              | 2.2   |              |                   | 8     |

## Product Specification

Notes 1. Contrast Ratio(CR) is defined mathematically as : **(By PR880)**

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

It is measured at center point(Location P1)

2. Surface luminance( $L_{WH}$ ) is luminance value at Center 1 point(P1) across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG.8 (By PR880)

3. The variation in surface luminance ,  $\delta_{WHITE}$  is defined as : **(By PR880)**

$$\delta_{WHITE} = \frac{\text{Minimum}(L_{P1}, L_{P2}, \dots, L_{P9})}{\text{Maximum}(L_{P1}, L_{P2}, \dots, L_{P9})} \times 100$$

Where L1 to L9 are the luminance with all pixels displaying white at 9 locations.  
 For more information see FIG.9

4. Gray to gray response time is the time required for the display to transition from gray to gray.  
 For additional information see Table 10. **(By RD80S)**

5. Color shift is the angle at which the average color difference for all Macbeth is lower than 0.02.  
 For more information see FIG.10 **(By EZ Contrast)**  
 - Color difference ( $\Delta u'v'$ )

$$u' = \frac{4x}{-2x + 12y + 3} \quad v' = \frac{9y}{-2x + 12y + 3} \quad \Delta u'v' = \sqrt{(u'_1 - u'_2)^2 + (v'_1 - v'_2)^2}$$

$$Avg(\Delta u'v') = \frac{\sum_{i=1}^{24} (\Delta u'v')_i}{24}$$

$u'_1, v'_1$  :  $u'v'$  value at viewing angle direction  
 $u'_2, v'_2$  :  $u'v'$  value at front ( $\theta=0$ )  
 $i$  : Macbeth chart number (Define 22 page)

- Pattern size : 25% Box size
- Viewing angle direction of color shift : Horizontal, Vertical

6. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG.11 **(By PR880)**

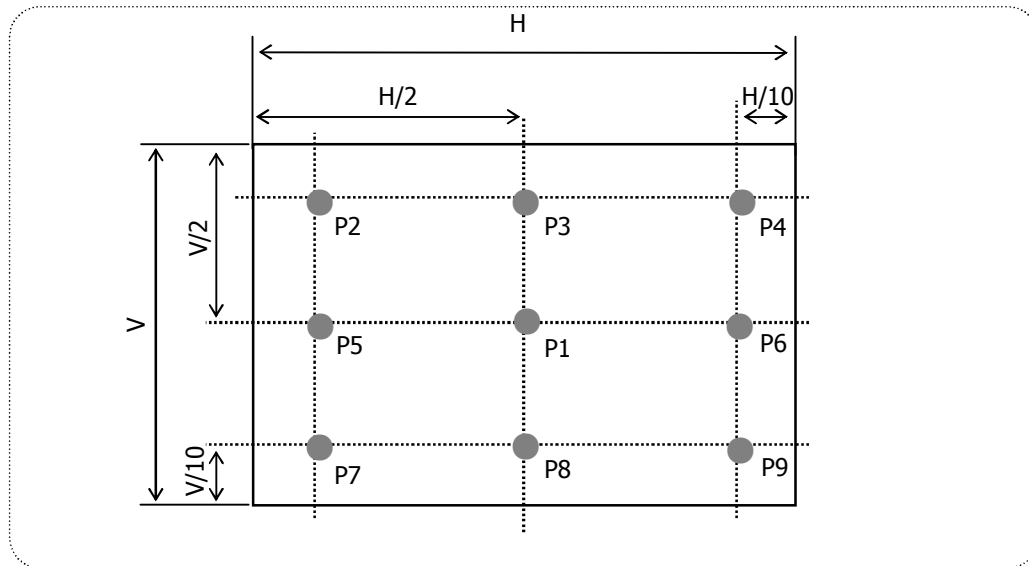
7. GSR is the rate of gamma shift at up, down, left and right 60 degree viewing angle compare with center gamma. For more information see FIG.11 and FIG.12 **(By EZ Contrast)**  
 - GSR ( $\delta_{Gamma}$ ) is defined as :

$$GSR = \left( 1 - \frac{\text{View angle Gamma Value (Up, Down, Reft, Light 60 Degree)}}{\text{Center Gamma Value (0 Degree)}} \right) \times 100$$

### Product Specification

Notes 8. Gamma Value is approximately 2.2. For more information see Table 11.

Measuring point for surface luminance & measuring point for luminance variation.



**[ Figure 9 ] \_Measure Point for Luminance**

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

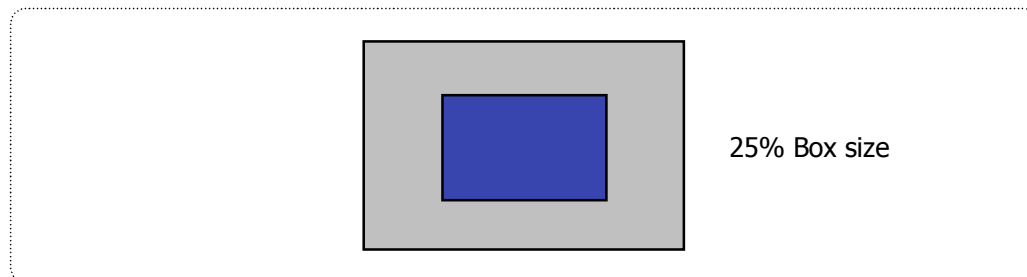
- Gray step : 5 Step
- TGTG\_AVR is the total average time at rising time and falling time for "Gray To Gray".
- if system use ODC ( Over Driving Circuit) function, Gray to Gary response time may be 5ms~8ms GtG
- \* it depends on Overshoot rate.

**Table. 10 GTG Gray Table**

| Gray to Gray |      | Rising Time |      |      |     |    |
|--------------|------|-------------|------|------|-----|----|
|              |      | G255        | G191 | G127 | G63 | G0 |
| Falling Time | G255 |             |      |      |     |    |
|              | G191 |             |      |      |     |    |
|              | G127 |             |      |      |     |    |
|              | G63  |             |      |      |     |    |
|              | G0   |             |      |      |     |    |

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Color shift is defined as the following test pattern and color.



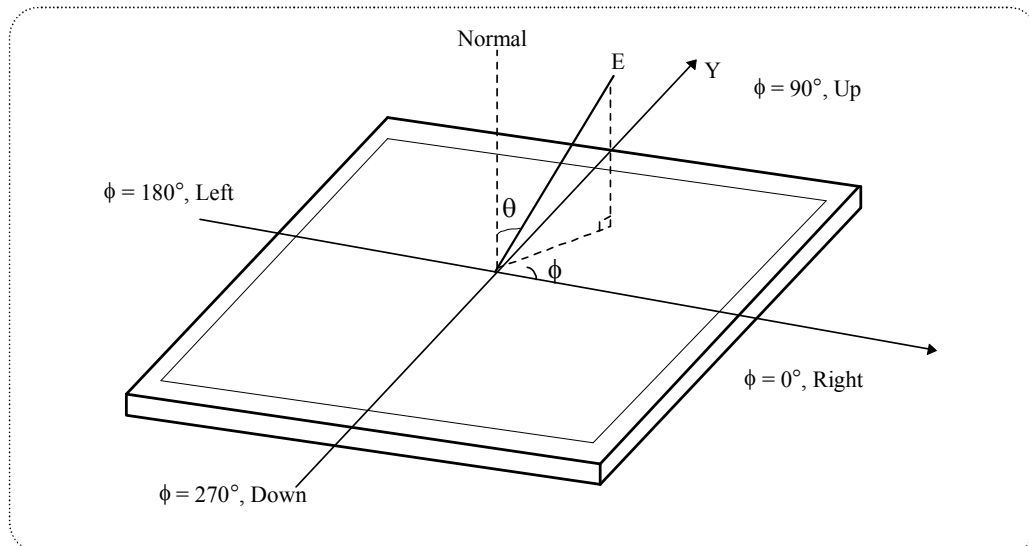
**[ Figure 10 ] Color Shift Test Pattern**

Average RGB values in Bruce RGB for Macbeth Chart

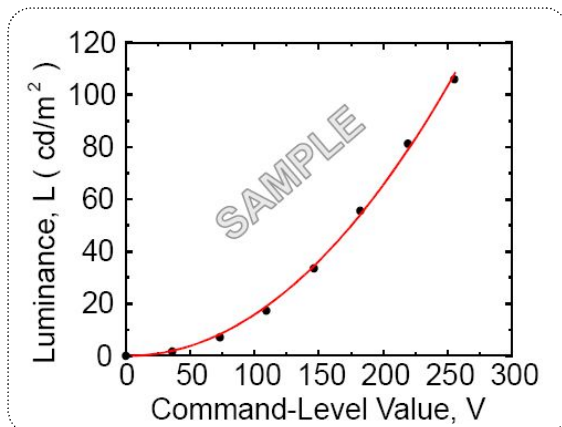
|   | Dark skin (i=1) | Light skin    | Blue sky     | Foliage   | Blue flower  | Bluish green  |
|---|-----------------|---------------|--------------|-----------|--------------|---------------|
| R | 98              | 206           | 85           | 77        | 129          | 114           |
| G | 56              | 142           | 112          | 102       | 118          | 199           |
| B | 45              | 123           | 161          | 46        | 185          | 178           |
|   | Orange          | Purplish blue | Moderate red | Purple    | Yellow green | Orange yellow |
| R | 219             | 56            | 211          | 76        | 160          | 230           |
| G | 104             | 69            | 67           | 39        | 193          | 162           |
| B | 24              | 174           | 87           | 86        | 58           | 29            |
|   | Blue            | Green         | Red          | Yellow    | Magenta      | Cyan          |
| R | 26              | 72            | 197          | 241       | 207          | 35            |
| G | 32              | 148           | 27           | 212       | 62           | 126           |
| B | 145             | 65            | 37           | 36        | 151          | 172           |
|   | White           | Neutral 8     | Neutral 6.5  | Neutral 5 | Neutral 3.5  | Black         |
| R | 240             | 206           | 155          | 110       | 63           | 22            |
| G | 240             | 206           | 155          | 110       | 63           | 22            |
| B | 240             | 206           | 155          | 110       | 63           | 22            |

**Product Specification**

Dimension of viewing angle range.

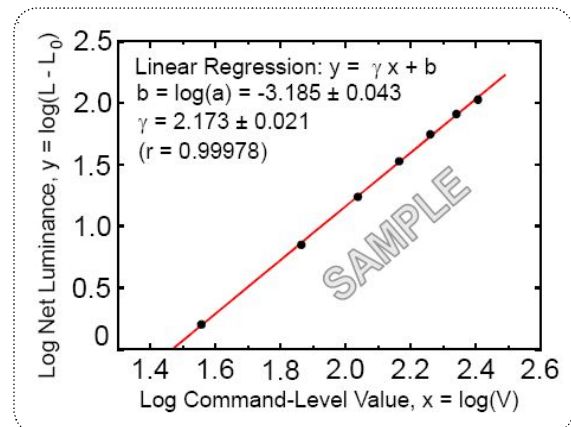


**[ Figure 11 ] Viewing angle**



**[Figure .12] Sample Luminance vs. gray scale (using a 256 bit gray scale)**

$$L = aV^r + L_b$$



**[Figure .13] Sample Log-log plot of luminance vs. gray scale**

$$\log(L - L_b) = r \log(V) + \log(a)$$

Here the Parameter  $\alpha$  and  $\gamma$  relate the signal level  $V$  to the luminance  $L$ .  
The GAMMA we calculate from the log-log representation (FIG.12)

**Product Specification**
**Table 11. Gray Scale Specification**

| Gray Level | Relative Luminance [%] (Typ.) |
|------------|-------------------------------|
| 0          | 0.11                          |
| 31         | 1.08                          |
| 63         | 4.72                          |
| 95         | 11.49                         |
| 127        | 21.66                         |
| 159        | 35.45                         |
| 191        | 53.00                         |
| 223        | 74.48                         |
| 255        | 100                           |

## Product Specification

### 5. Mechanical Characteristics

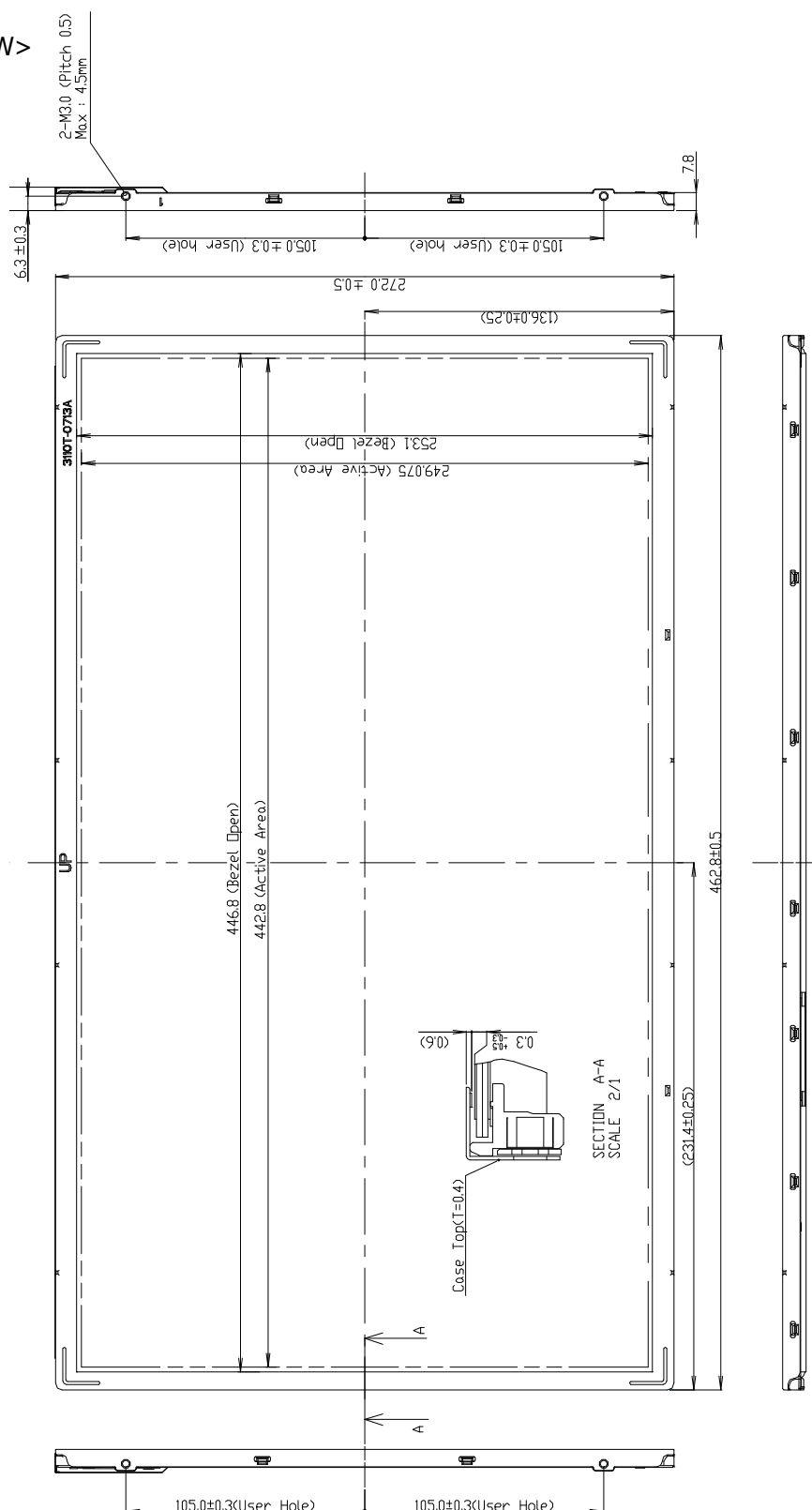
The contents provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD.

|                     |                                                                 |          |
|---------------------|-----------------------------------------------------------------|----------|
| Outline Dimension   | Horizontal                                                      | 462.8 mm |
|                     | Vertical                                                        | 272.0 mm |
|                     | Depth                                                           | 10.2 mm  |
| Bezel Area          | Horizontal                                                      | 446.8 mm |
|                     | Vertical                                                        | 253.1 mm |
| Active Display Area | Horizontal                                                      | 442.8 mm |
|                     | Vertical                                                        | 249.1 mm |
| Weight              | Typ : 1120 g , Max : 1180 g                                     |          |
| Surface Treatment   | Hard coating(3H)<br>Anti-glare treatment of the front polarizer |          |

Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.

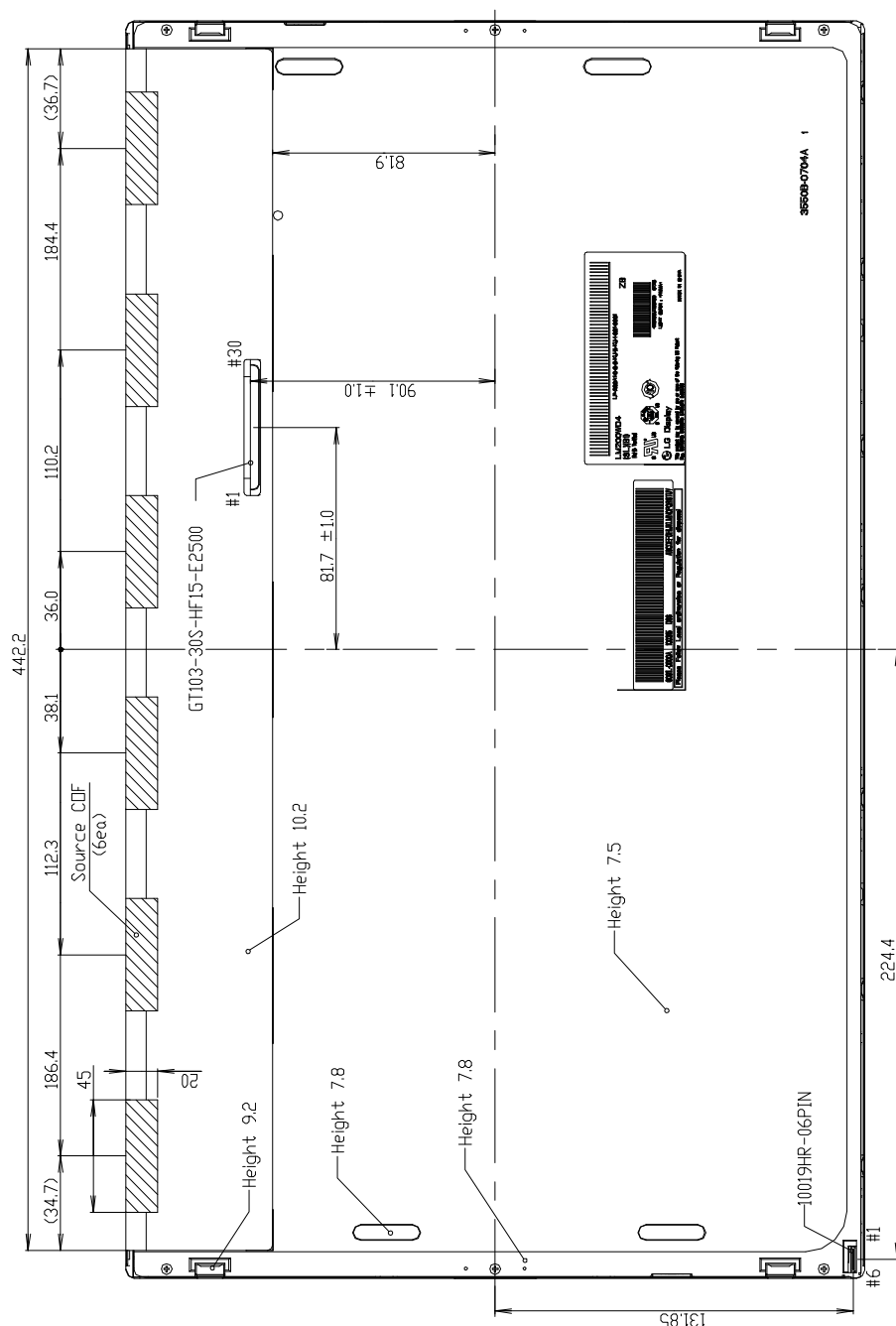
**Product Specification**

<FRONT VIEW>



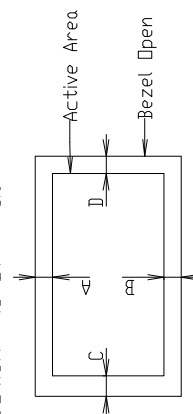
## Product Specification

<REAR VIEW>



## Notes

1. I/F Connector Specification : GT103-30S-HF15-E2500  
 2. LED Connector Specification : 10019HR-06PIN  
 3. Torque of user hole : 2.5~3.5 kgf-cm
4. Tilt and partial disposition tolerance of display area as following
- (1) Y-Direction :  $LA-BL \leq 1.0$   
 (2) X-Direction :  $LC-DL \leq 1.0$



5. Unspecified tolerances to be  $\pm 0.5\text{mm}$
6. The COF area is weak & sensitive, So, please don't press the COF area.

LGD Highly recommendation :

As The IPS panel is sensitive & slim, please recommend the metal frame of the system supports the panel by the double side-mount.

## Product Specification

### 6. Reliability

Environment test condition

| No | Test Item                                                    | Condition                                                                                                                          |
|----|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| 1  | High temperature storage test                                | Ta= 60°C 240h                                                                                                                      |
| 2  | Low temperature storage test                                 | Ta= -20°C 240h                                                                                                                     |
| 3  | High temperature operation test                              | Ta= 50°C 50%RH 240h                                                                                                                |
| 4  | Low temperature operation test                               | Ta= 0°C 240h                                                                                                                       |
| 5  | Vibration test<br>(non-operating)                            | Wave form : random<br>Vibration level : 1.00G RMS<br>Bandwidth : 10-300Hz<br>Duration : X, Y, Z, 10 min<br>One time each direction |
| 6  | Shock test<br>(non-operating)                                | Shock level : 120G<br>Waveform : half sine wave, 2ms<br>Direction : $\pm X$ , $\pm Y$ , $\pm Z$<br>One time each direction         |
| 7  | Humidity condition Operation                                 | Ta= 40 °C ,90%RH                                                                                                                   |
| 8  | Altitude<br>operating<br>storage / shipment                  | 0 - 10,000 feet(3,048m)<br>0 - 40,000 feet(12,192m)                                                                                |
| 9  | Maximum Storage Humidity for<br>4 corner light leakage Mura. | Max 70%RH , Ta=40°C                                                                                                                |

**Product Specification****7. International Standards****7-1. Safety**

- a) UL 60950-1, Second Edition, Underwriters Laboratories Inc.  
Information Technology Equipment - Safety - Part 1 : General Requirements.
- b) CAN/CSA C22.2 No.60950-1-07, Second Edition, Canadian Standards Association.  
Information Technology Equipment - Safety - Part 1 : General Requirements.
- c) EN 60950-1:2006 + A11:2009, European Committee for Electrotechnical Standardization (CENELEC).  
Information Technology Equipment - Safety - Part 1 : General Requirements.
- d) IEC 60950-1:2005, Second Edition, The International Electrotechnical Commission (IEC).  
Information Technology Equipment - Safety - Part 1 : General Requirements.  
(Including report of IEC60825-1:2001 clause 8 and clause 9)

**Notes****1. Laser (LED Backlight) Information**

|                                                                           |
|---------------------------------------------------------------------------|
| Class 1M LED Product<br>IEC60825-1 : 2001<br>Embedded LED Power (Class1M) |
|---------------------------------------------------------------------------|

**2. Caution**

- : LED inside.
- Class 1M laser (LEDs) radiation when open.
- Do not open while operating.

**7-2. EMC**

- a) ANSI C63.4 "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz." American National Standards Institute (ANSI), 2003.
- b) CISPR 22 "Information technology equipment – Radio disturbance characteristics – Limit and methods of measurement." International Special Committee on Radio Interference (CISPR), 2005.
- c) CISPR 13 "Sound and television broadcast receivers and associated equipment – Radio disturbance characteristics – Limits and method of measurement." International Special Committee on Radio Interference (CISPR), 2006.

**7-3. Environment**

- a) RoHS. Directive 2002/95/EC of the European Parliament and of the Council on the reduction of the use of certain hazardous substances in electrical and electronic equipment. January 2003

## Product Specification

### 8. Packing

#### 8-1. Designation of Lot Mark

a) Lot Mark

|   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

A,B,C : SIZE(INCH)

E : MONTH

D : YEAR

F ~ M : SERIAL NO.

Note

1. YEAR

|      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|
| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| Mark | A    | B    | C    | D    | E    | F    | G    | H    | J    | K    |

2. MONTH

|       |     |     |     |     |     |     |     |     |     |     |     |     |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Mark  | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | A   | B   | C   |

b) Location of Lot Mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.

This is subject to change without prior notice.

#### 8-2. Packing Form

a) Package quantity in one box : 12 pcs

b) Box Size : 355mm X 305mm X 560mm

**Product Specification****9. PRECAUTIONS**

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

**9-1. MOUNTING PRECAUTIONS**

- (1) You must mount a module using holes arranged in four corners or four sides.
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface 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.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.
- (10) As The IPS panel is sensitive & slim, please recommend the metal frame of the system supports the panel by the double side-mount.

**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.
- (7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
- (8) A screw which is fastened up the steels should be a machine screw.  
(if not, it causes metallic foreign material and deal LCM a fatal blow)
- (9) Please do not set LCD on its edge.
- (10) When LCMs are used for public display defects such as Yogure, image sticking can not be guarantee.

**Product Specification****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) The protection film is attached to the bezel with a small masking tape.  
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) 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 bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.