# SPECIFICATION
# FOR
# APPROVAL

**( ◆ ) Preliminary Specification**
**( ) Final Specification**

| Title | **23" WXGA TFT LCD** |
|---|---|

| BUYER | **General** |
|---|---|
| MODEL | |

| SUPPLIER | **LG.Philips LCD CO., Ltd.** |
|---|---|
| *MODEL | **LC230W02** |
| SUFFIX | **A5K1** |

*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.

| | **SIGNATURE DATE** |
|---|---|
| **APPROVED BY**<br>**Jay Yoon / G.Manager** | |
| **REVIEWED BY**<br>**K.N Kim / Manager** | |
| **PREPARED BY**<br>**B.J Choi / Engineer** | |

**TV Products Engineering Dept.**
**LG. Philips LCD Co., Ltd**

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# RECORD OF REVISIONS

| Revision No. | Date | Page | Description |
|---|---|---|---|
| Ver 0.0 | AUG.11, 2004 | | First draft, Preliminary specifications |
| Ver 0.1 | SEP.08, 2004 | 4,6<br>22~23 | Preliminary update<br>- Updated the current consumption<br>- Updated the Mechanical Drawing |

## 1. General Description

The LC230W02 is a Color Active Matrix Liquid Crystal Display with an integral External Electrode Fluorescent Lamp(EEFL) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally black mode. This TFT-LCD has a 23.0 inch diagonally measured active display area with WXGA resolution (768 vertical by 1366 horizontal 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 luminance 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(True) colors. The LC230W02 has been designed to apply the LVDS interface. It is intended to support LCD TV, PCTV where high brightness, super wide viewing angle, high color gamut, high color depth, and fast response time are important.

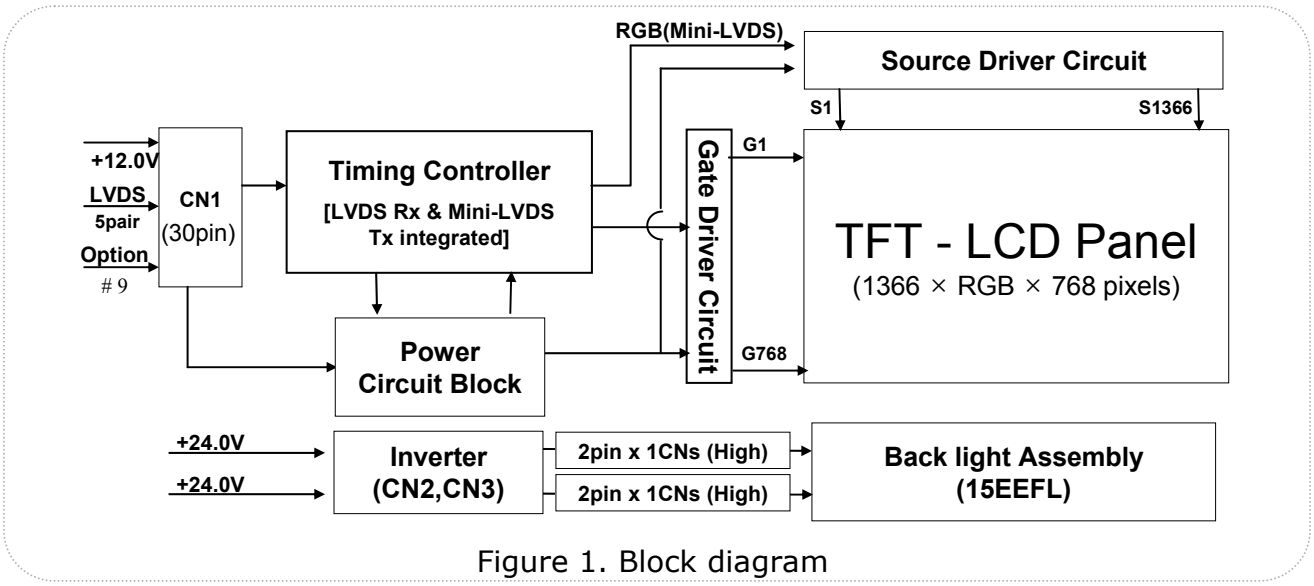



Figure 1. Block diagram

## General Features

| | |
|---|---|
| Active screen size | 22.95 inches(582.96mm) diagonal |
| Outline Dimension | 559.8(H) x 333.8(V) x 45.7(D) mm(Typ.) |
| Pixel Pitch | 0.372 mm x 0.124 mm x RGB |
| Pixel Format | 1366 horizontal by 768 vertical pixels. RGB stripe arrangement |
| Interface | LVDS 1port |
| Color depth | 8-bit, 16,777,216 colors |
| Luminance, white | 500 cd/m$^2$ ( Center 1 point, Typ. ) |
| Viewing Angle (CR>10) | Viewing Angle Free(R/L 176(Typ.), U/D 176(Typ.)) |
| Power Consumption | Total 59.0 Watt(Typ.), (3.8 Watt @$V_{LCD}$, 55.2 Watt @$V_{BL}$) |
| Weight | 4200 g (Typ.) |
| Display operating mode | Transmissive mode, normally black |
| Surface treatments | Hard coating (3H), Anti-glare treatment of the front polarizer |

## 2. Absolute Maximum Ratings

Table 1. Absolute Maximum Ratings

| Parameter | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min | Max | | |
| Power Supply Input Voltage | VLCD | -0.3 | +14 | Vdc | At 25℃ |
| | VBL | -0.3 | +27 | Vdc | |
| On/Off Control Voltage | ON/OFF | -0.3 | +5.25 | Vdc | |
| Brightness Control Voltage | VBR | 0 | +3.3 | Vdc | |
| Operating Temperature | TOP | 0 | +40 | °C | 1 |
| Storage Temperature | TST | -20 | +50 | °C | 1 |
| Operating Ambient Humidity | HOP | 10 | 90 | %RH | 1 |
| Storage Humidity | HST | 10 | 90 | %RH | 1 |

Note :

1. Temperature and relative humidity range are shown in the figure below.
   Wet bulb temperature should be 39 °C Max, and no condensation.

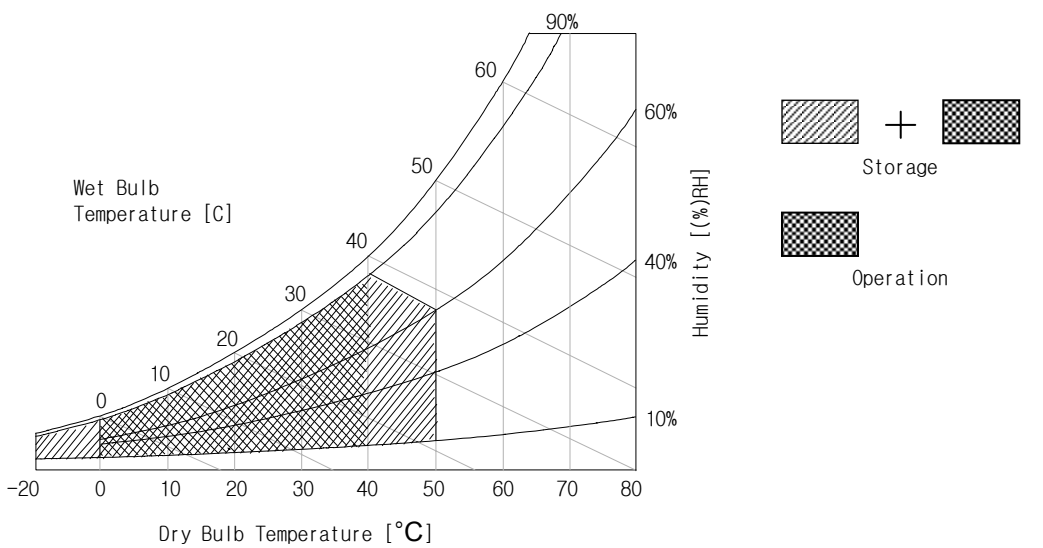



Figure 2. Temperature and relative humidity

## 3. Electrical Specifications

The LC230W02 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 EEFL/Backlight, is to power the inverter.

### 3-1. Electrical Characteristics

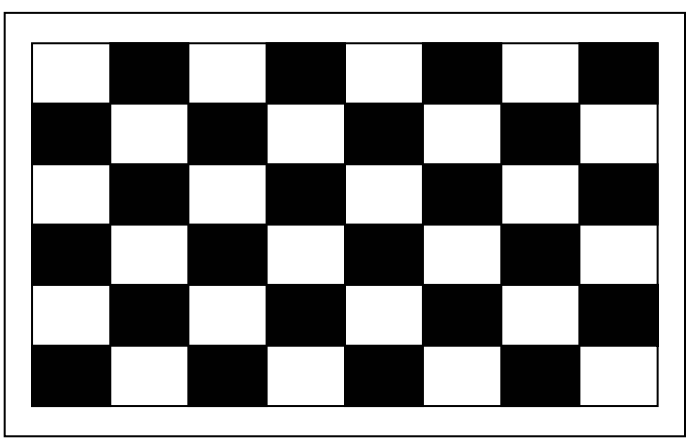
Table 2. Electrical Characteristics

| Parameter | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| 1. Power for Panel: | | | | | | |
| Power Supply Input Voltage | $V_{LCD}$ | 11.4 | 12.0 | 12.6 | Vdc | |
| Power Supply Input Current | $I_{LCD}$ | - | 317 | 412 | mA | 1 |
| | | - | 373 | 485 | mA | 2 |
| Power Consumption | $P_{LCD}$ | - | 3.80 | 4.94 | Watt | 1 |
| Inrush Current ($V_{LCD}$ Input) | $I_{RUSH}$ | - | - | 3 | A | 3 |

Notes:

1. The specified current and power consumption are under the $V_{LCD}$=12V, 25°C, fV(frame frequency)=60Hz condition.
   Typical supply current is measured at the condition of 8 X 6 Mosaic pattern(white & black) shown in the [ Figure 3 ] is displayed.

2. The current is specified at te maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power input is 1ms(min).



[ Figure 3 ]
Mosaic pattern : for power consumption measurement

Table 3. Inverter Electrical Characteristics

| Parameter | Symbol | Condition | Value | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| 2. Power for Inverter | | | | | | | |
| Power supply Input Voltage | $V_{BL}$ | | 22.8 | 24.0 | 25.2 | Vdc | 1 |
| Power supply Input Current | $I_{BL}$ | $V_{BR}$-B = 3.3V | - | 2.3 | 2.7 | A | 1 |
| Power Consumption | $P_{BL}$ | $V_{BR}$-B =3.3V | - | 55.2 | 64.8 | Watt | 1 |
| Back-Light ON/OFF Control voltage | ON/OFF | H (Lamp ON) | 2.4 | - | 5.0 | Vdc | |
| | | L (Lamp OFF) | 0.0 | - | 0.6 | Vdc | |
| Brightness Adj. | VBR | | 0 | - | 3.3 | Vdc | |
| Lamp Lifetime | | | 50,000 | | - | Hrs | 2 |

Note :

1. The specified current and power consumption are under the typical supply input voltage, 24.0V. The ripple voltage of the power supply input voltage is under 0.5 Vp-p. Inrush current of the power supply input current is under +10% of the typical current. Electrical characteristics are determined after the unit has been "ON" for 30Min. in a dark environment at 25 ± 2°C

2. The life is determined as the time at which luminance of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at 25 ± 2°C.

## 3-2. Interface Connections

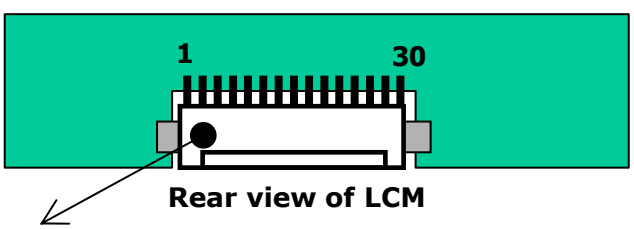
This LCD employs two kinds of interface connections. A 30 pin connector is used for LCD electronics and a 12pin connector is used for the integral backlight system.

### 3-2-1. Signal Interface

The LCD connector(CN1) : FI-X30SSL-HF (Manufactured by JAE) or Equivalent.
The pin configuration for the 30 pin connector is shown in the table below.

Table 4. 20Pin Connector pin configuration (For LCD Panel)

| Pin | Signal assignment | Pin | Signal assignment |
|---|---|---|---|
| 1 | $V_{LCD}$ (12V) | 16 | LVDS SIGNAL CHANNEL 1+ |
| 2 | $V_{LCD}$ (12V) | 17 | GND |
| 3 | $V_{LCD}$ (12V) | 18 | LVDS SIGNAL CHANNEL 2- |
| 4 | $V_{LCD}$ (12V) | 19 | LVDS SIGNAL CHANNEL 2+ |
| 5 | GND | 20 | GND |
| 6 | GND | 21 | LVDS CLOCK C- |
| 7 | GND | 22 | LVDS CLOCK C+ |
| 8 | GND | 23 | GND |
| 9 | DISM (Note 1) | 24 | LVDS SIGNAL CHANNEL 3- |
| 10 | NC | 25 | LVDS SIGNAL CHANNEL 3+ |
| 11 | GND | 26 | GND |
| 12 | LVDS SIGNAL CHANNEL 0- | 27 | NC |
| 13 | LVDS SIGNAL CHANNEL 0+ | 28 | NC |
| 14 | GND | 29 | GND |
| 15 | LVDS SIGNAL CHANNEL 1- | 30 | GND |

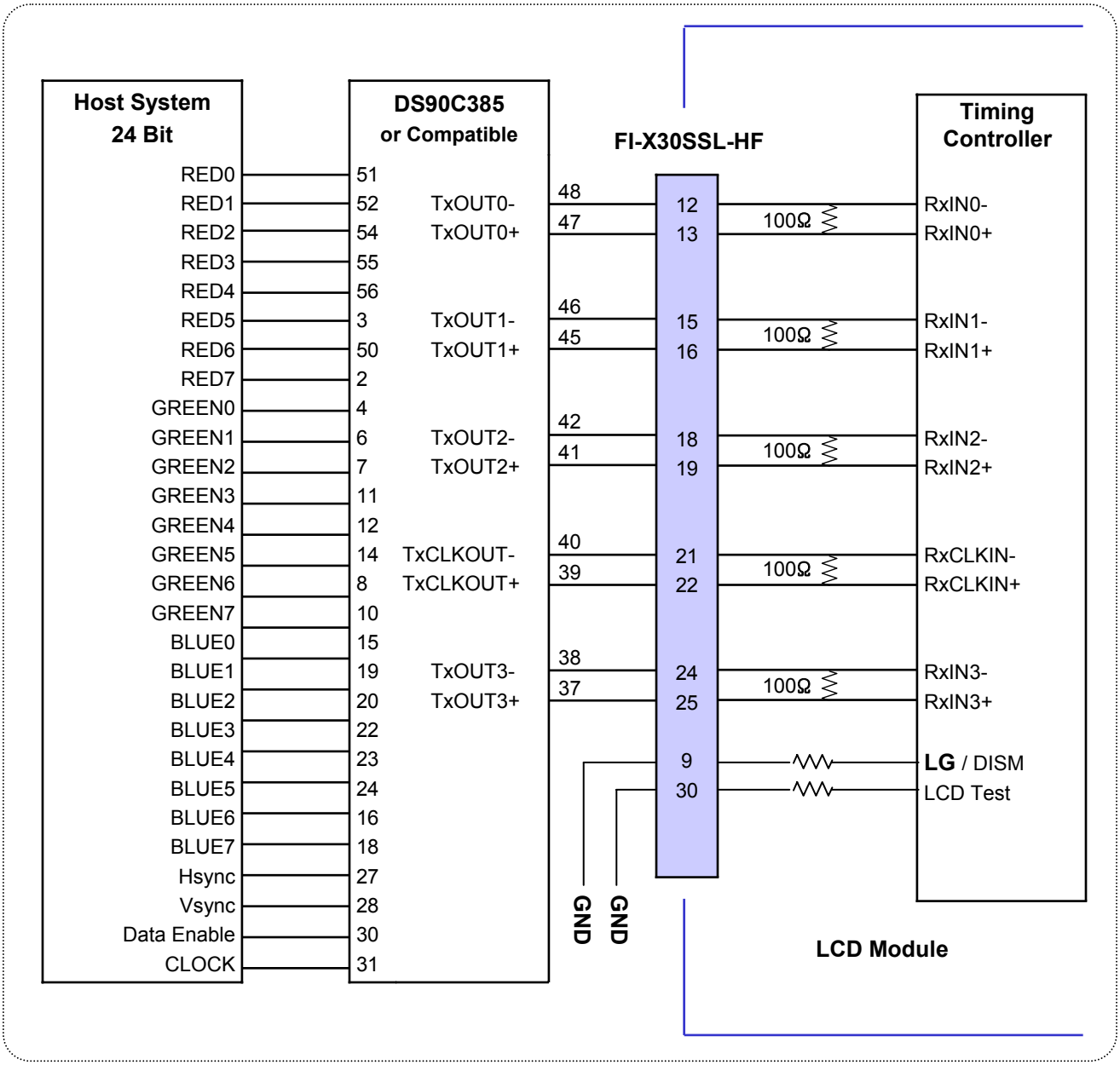



- Part/No. : FI-X30SSL-HF(JAE)
- Mating connector : FI-30C2L
  (Manufactured by JAE) or cpmpatible

Notes:

1. If pin9 is ground, interface format is "LG", and if pin9 is 3.3V, interface format is "DISM. (See page 9~10)
2. All GND(ground) pins should be connected together and should also be connected to the LCD'smetal frame.
3. All power input pins should be connected together.
4. Input level of LVDS signal is based on the IEA664 standard.
5. The pin30 should be ground, this pin is necessary for LPL's test

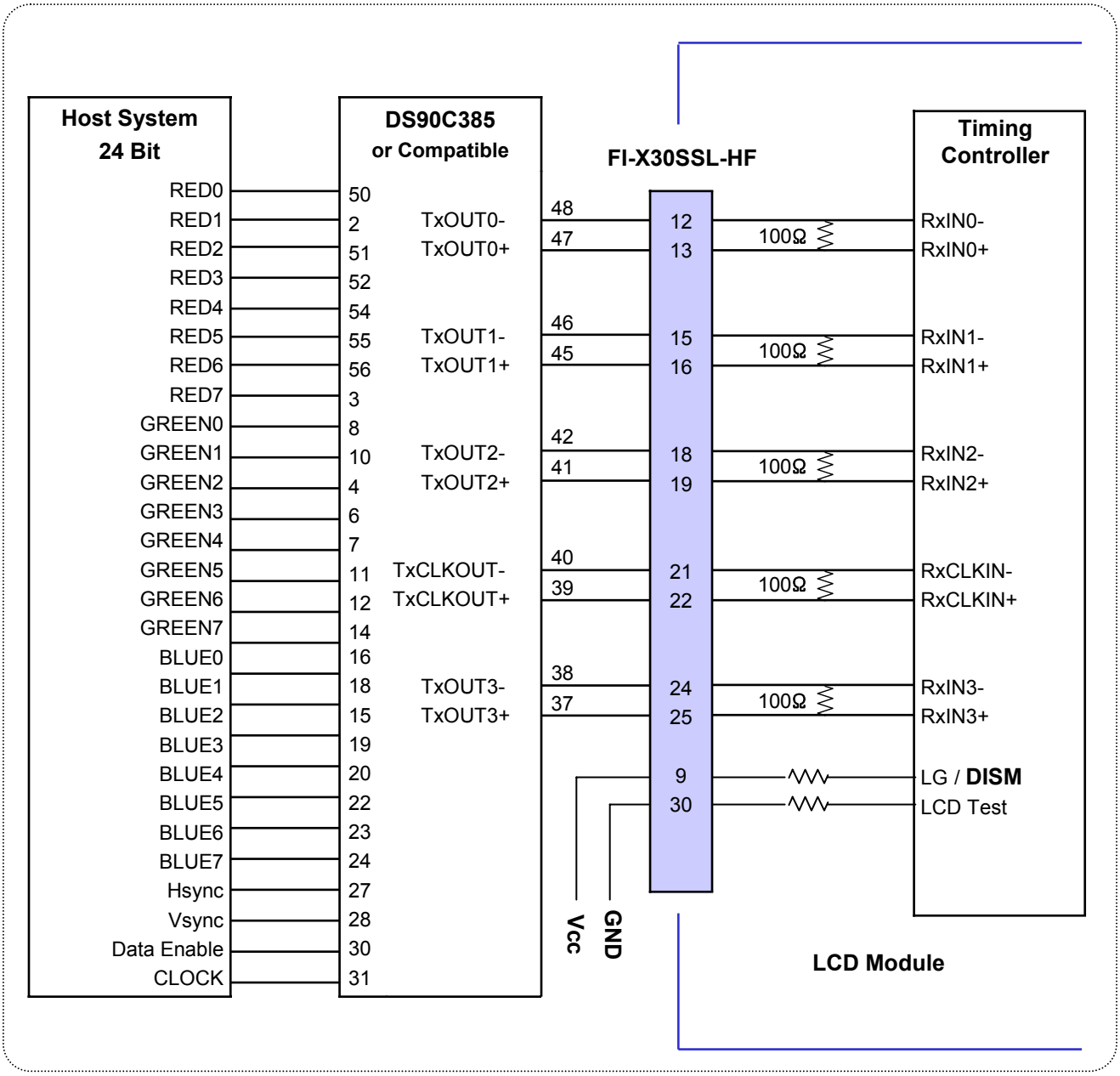
Table 5.
Required signal assignment for LVDS transmitter (Pin9 = "L" or open)




Note:

1. The LCD module uses a 100 Ohm(Ω) resistor between positive and negative lines of each receiver input.
2. Refer to LVDS transmitter data sheet for detail descriptions. (DS90C385 or Compatible)
3. '7' means MSB and '0' means LSB at R,G,B pixel data.

Table 6.
Required signal assignment for LVDS transmitter (Pin9 = "H" )




Note:

1. The LCD module uses a 100 Ohm(Ω) resistor between positive and negative lines of each receiver input.
2. Refer to LVDS transmitter data sheet for detail descriptions. (DS90C385 or Compatible)
3. '7' means MSB and '0' means LSB at R,G,B pixel data.

### 3-2-2. Inverter Connector for Backlight

The inverter connector is S12B-PH-SM3 (manufactured by JST) or equivalent
The pin configuration for the 12 pin connector is shown in the table below.

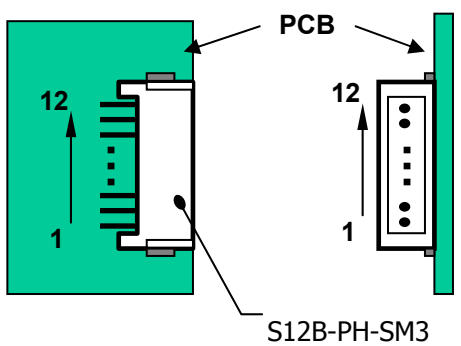
Table 7. 12Pin Connector Pin Configuration (For Inverter Connector)

| Pin | Symbol | Signal assignment | | | Note |
|---|---|---|---|---|---|
| | | | Master(CN2) | Slave(CN3) | |
| 1 | $V_{BL}$ | 24V Power Input | $V_{BL}$ | $V_{BL}$ | |
| 2 | $V_{BL}$ | 24V Power Input | $V_{BL}$ | $V_{BL}$ | |
| 3 | $V_{BL}$ | 24V Power Input | $V_{BL}$ | $V_{BL}$ | |
| 4 | $V_{BL}$ | 24V Power Input | $V_{BL}$ | $V_{BL}$ | |
| 5 | $V_{BL}$ | 24V Power Input | $V_{BL}$ | $V_{BL}$ | |
| 6 | GND | GROUND | GND | GND | |
| 7 | GND | GROUND | GND | GND | |
| 8 | GND | GROUND | GND | GND | 1 |
| 9 | GND | GROUND | GND | GND | |
| 10 | GND | GROUND | GND | GND | |
| 11 | $V_{BR}$-B | Burst dimming | $V_{BR}$-B | Don't care | 0V ~ 3.3V |
| 12 | ON/OFF | Backlight ON/OFF control | ON/OFF | Don't care | ON : 2.4 ~ 5.0V<br>OFF : 0.0 ~ 0.6V |

1. Connector
   1) Connector(Receptacle)
      : S12B-PH-SM3 (JST) or its equivalent
   2) Mating Connector(Plug)
      : PHR12 (JST) or its equivalent

* JST : Japan solderless Terminal Co.,Ltd.

**Rear view of LCM**




Notes : Pin 1~10 should connect to master and slave conncetor.
1. GROUND is connected to the LCD's metal frame.

## 3-3. Signal Timing Specifications

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

Table 8. Timing Table

| ITEM | | SYMBOL | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Clock | Period | $t_{CLK}$ | 12.5 | 13.8 | 14.7 | ns | |
| | Frequency | $f_{CLK}$ | 68 | 72.3 | 80 | MHz | |
| Hsync | Horizontal total | $t_{HT}$ | 1416 | 1528 | 1776 | Pixel | |
| | Hsync frequency | $f_{H}$ | 45.0 | 47.4 | 50 | KHz | |
| | Hsync width | $t_{WH}$ | 8 | 32 | - | Pixel | |
| Vsync | Vertical total | $t_{VT}$ | 775 | 790 | 1063 | Line | PAL : 47~53Hz, NTSC : 57~63Hz |
| | Vsync frequency | $f_{V}$ | 47 | 60 | 63 | Hz | |
| | Vsync width | $t_{WV}$ | 2 | 5 | - | Line | |
| DE | Horizontal valid | $t_{HV}$ | 1366 | 1366 | 1366 | Pixel | |
| | Horizontal back porch | $t_{HBP}$ | 24 | 80 | - | | |
| | Horizontal front porch | $t_{HFP}$ | 16 | 48 | - | | |
| | Horizontal blank | - | 48 | 160 | $t_{HP}$- $t_{HV}$ | | |
| | Vertical valid | $t_{VV}$ | 768 | 768 | 768 | Line | |
| | Vertical back porch | $t_{VBP}$ | 4 | 15 | - | | |
| | Vertical front porch | $t_{VFP}$ | 1 | 2 | - | | |
| | Vertical blank | - | 7 | 22 | $t_{VP}$- $t_{VV}$ | | |

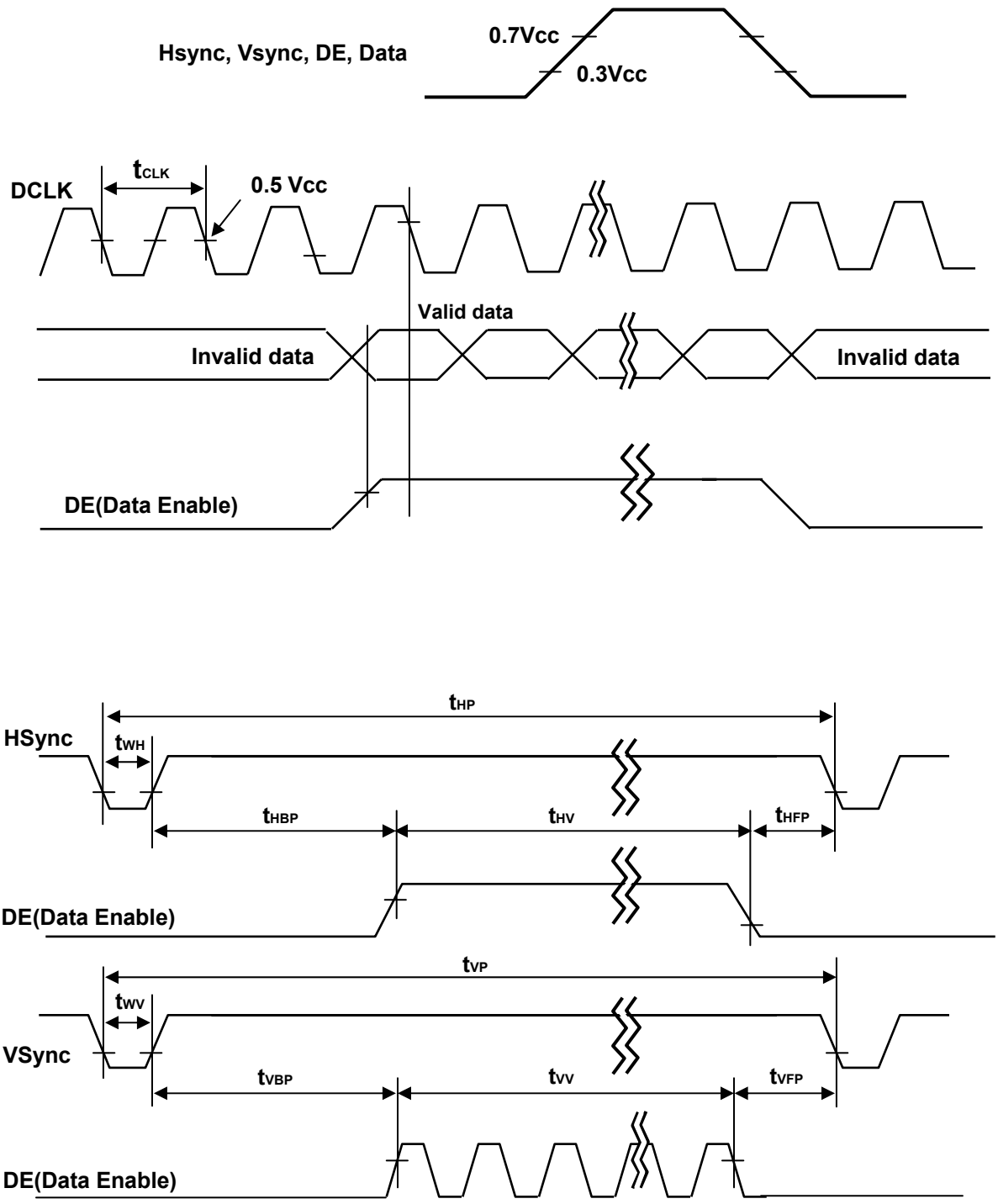
Note:

Hsync period and Hsync width-active should be even number times of $t_{CLK}$. If the value is odd number times of $t_{CLK}$, display control signal can be asynchronous.

In order to operate this LCM a Hsync.,Vsync and DE(data enable) signals should be used.

1. The performance of the electro-optical characteristics are may be influenced by variance of the vertical refresh rates.
2. Vsync, Hsync should be keep the above specification.

## 3-4. Signal Timing Waveforms



## 3-5. Color Input Data Reference

The brightness of each primary color (red,green and 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 9. 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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(002) | 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(253) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(255) Bright | 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 | 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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(002) | 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(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(255) Bright | 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 | 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(002) | 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(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 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) Bright | 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

### 3-6-1. Sequence for LCD Module

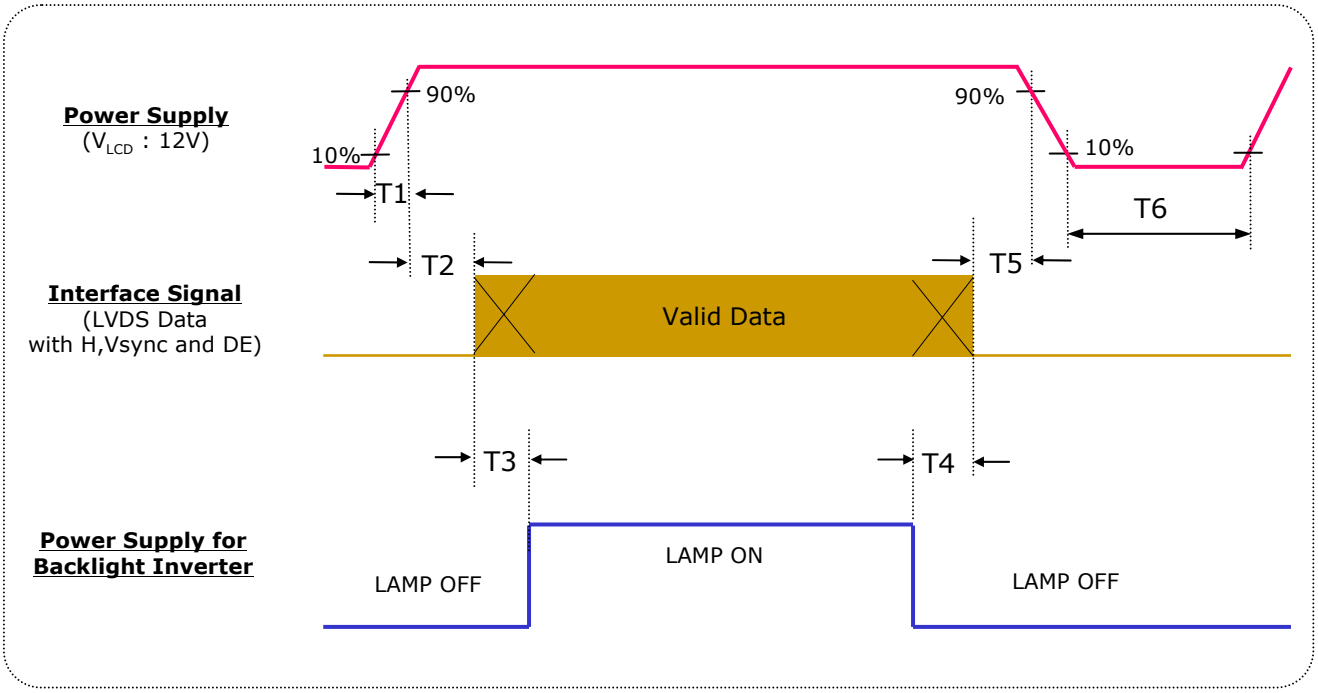


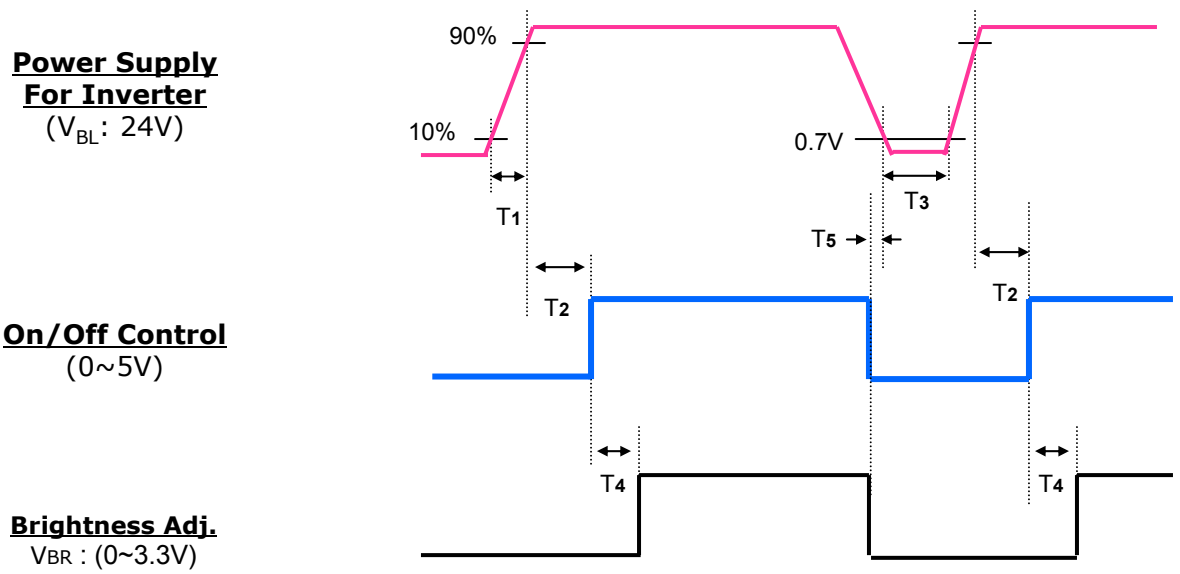

Table 10. Power Sequence for LCM

| Parameter | Value | | | Unit |
|---|---|---|---|---|
| | Min | Typ | Max | |
| T1 | 0.01 | - | 10 | ms |
| T2 | 0.01 | - | 50 | ms |
| T3 | 200 | - | - | ms |
| T4 | 200 | - | - | ms |
| T5 | 0.01 | - | 50 | ms |
| T6 | 2000 | - | - | 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. Lamp power must be turn on after power supply for a LCD interface signal are valid.
4. T6 should be measured after the module has been fully discharged between power off and on period.

### 3-6-2. Sequence for Inverter




### 3-6-3. Deep condition for Inverter

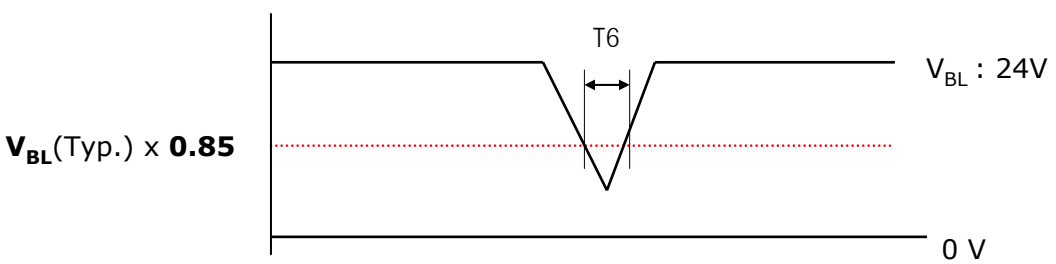
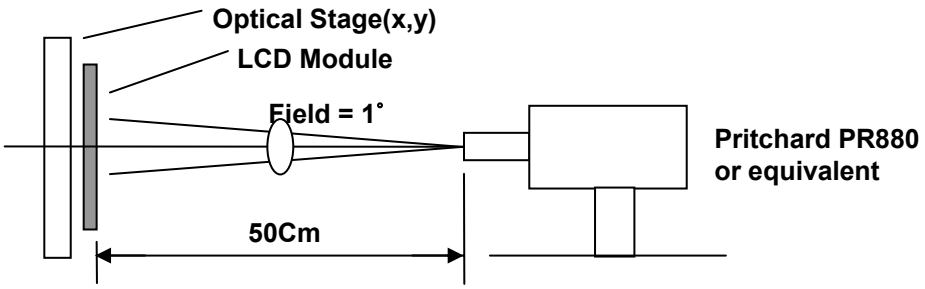



Table 11. Power Sequence for Inverter

| Parameter | Value | | | Unit | Note |
|---|---|---|---|---|---|
| | Min | Typ | Max | | |
| T1 | 20 | - | - | ms | |
| T2 | 100 | - | - | ms | |
| T3 | 200 | - | - | ms | 1 |
| T4 | 0 | - | - | ms | |
| T5 | 10 | - | - | ms | |
| T6 | - | - | 10 | ms | |

## 4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' for 30Min in a dark environment at 25±2°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.
FIG. 4 presents additional information concerning the measurement equipment and method.




[Figure 4] Optical characteristic measurement equipment and method

Table 12. Optical characteristics (Ta=25±2°C, $V_{LCD}$=12V, $f_V$=60Hz, CLK=72.3MHz, $V_{BR}$=3.3V)

| Parameter | | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Contrast Ratio | | CR | 400 | 550 | | | 1 |
| Surface Luminance, white | | $L_{WH}$ | 400 | 500 | | cd/m² | 2 |
| Luminance Variation | | $\delta_{WHITE}$ | | - | 1.3 | | 3 |
| Response Time | Rise Time | TrR | | 7 | 15 | ms | 4 |
| | Decay Time | TrD | | 9 | 15 | | |
| Color Coordinates | | | | | | | |
| | RED | RX | Typ – 0.03 | 0.640 | Typ +0.03 | | |
| | | RY | | 0.343 | | | |
| | GREEN | GX | | 0.292 | | | |
| | | GY | | 0.607 | | | |
| | BLUE | BX | | 0.147 | | | |
| | | BY | | 0.067 | | | |
| | WHITE | WX | | 0.285 | | | |
| | | WY | | 0.293 | | | |
| Viewing Angle (CR>10) | | | | | | | |
| x axis, right(ϕ=0°) | | θr | 85 | 88 | - | degree | 5 |
| x axis, left (ϕ=180°) | | θl | 85 | 88 | - | | |
| y axis, up (ϕ=90°) | | θu | 85 | 88 | - | | |
| y axis, down (ϕ=270°) | | θd | 85 | 88 | - | | |
| Gray scale | | | | | | | 6 |

Note :

1. Contrast ratio(CR) is defined mathematically as :

$$\text{Contrast ratio} = \frac{\text{Surface luminance with all white pixels}}{\text{Surface luminance with all black pixels}}$$

It is measured at center point(1)

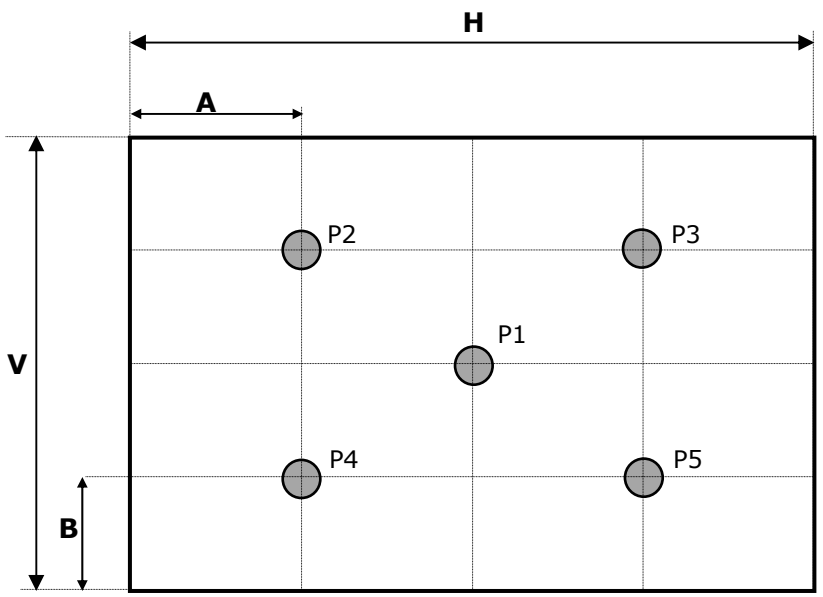
2. Surface luminance($L_{WH)}$ is luminance value at center point (P1) across the LCD surface 50cm from the surface with all pixels displaying white.
For more information see FIG 5.

3. The variation in surface luminance , $\delta_{WHITE}$ is defined as

$$\delta \text{ WHITE} = \text{Maximum (P1,P2, .....,P5)} / \text{ Minimum (P1,P2, .....,P5)}$$

For more information see [ Figure 5 ].

<Measuring point for surface luminance and luminance variation>




A : H / 4 mm
B : V / 4 mm
H : 508.152 mm
V : 285.696 mm
@ H,V : Active Area

Figure 5. Luminance measuring point

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

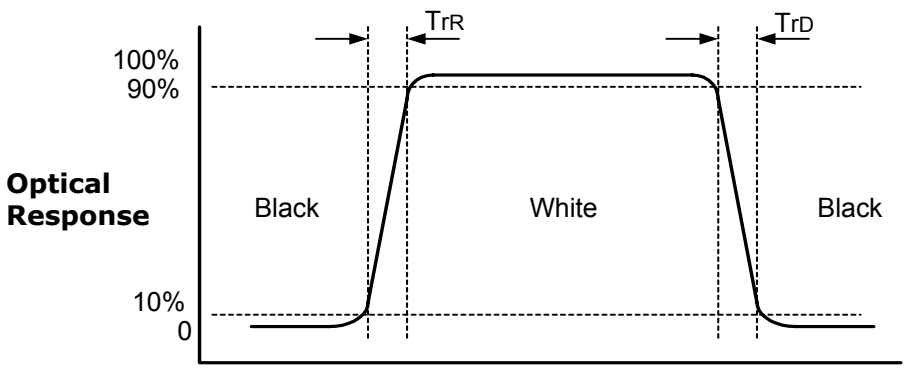



Figure 6. Response time

5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see Figure 7 .

<Dimension of viewing angle range>

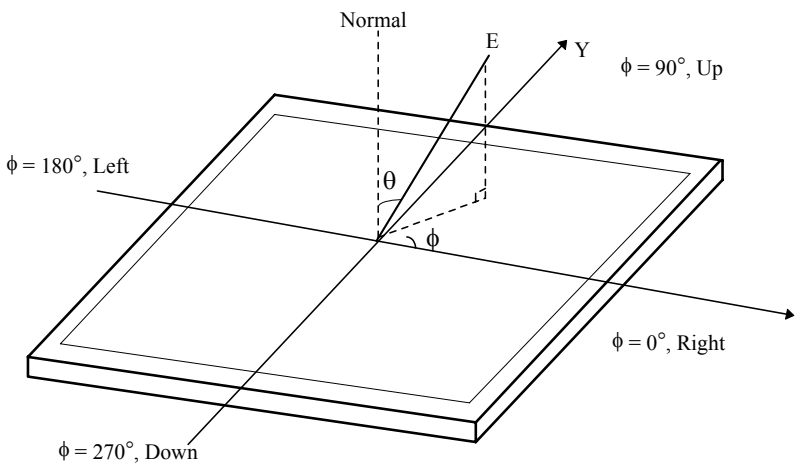



Figure 7. Viewing angle

6. Gray scale specification

Table 13. Gray scale

| Gray Level | Luminance [%] (Typ) |
|---|---|
| L0 | 0.15 |
| L15 | 0.23 |
| L31 | 0.74 |
| L47 | 1.91 |
| L63 | 3.95 |
| L79 | 6.91 |
| L95 | 10.9 |
| L111 | 15.6 |
| L127 | 20.7 |
| L143 | 27.0 |
| L159 | 34.7 |
| L175 | 43.6 |
| L191 | 53.1 |
| L207 | 63.9 |
| L223 | 75.6 |
| L239 | 90.9 |
| L255 | 100 |

## 5. Mechanical Characteristics

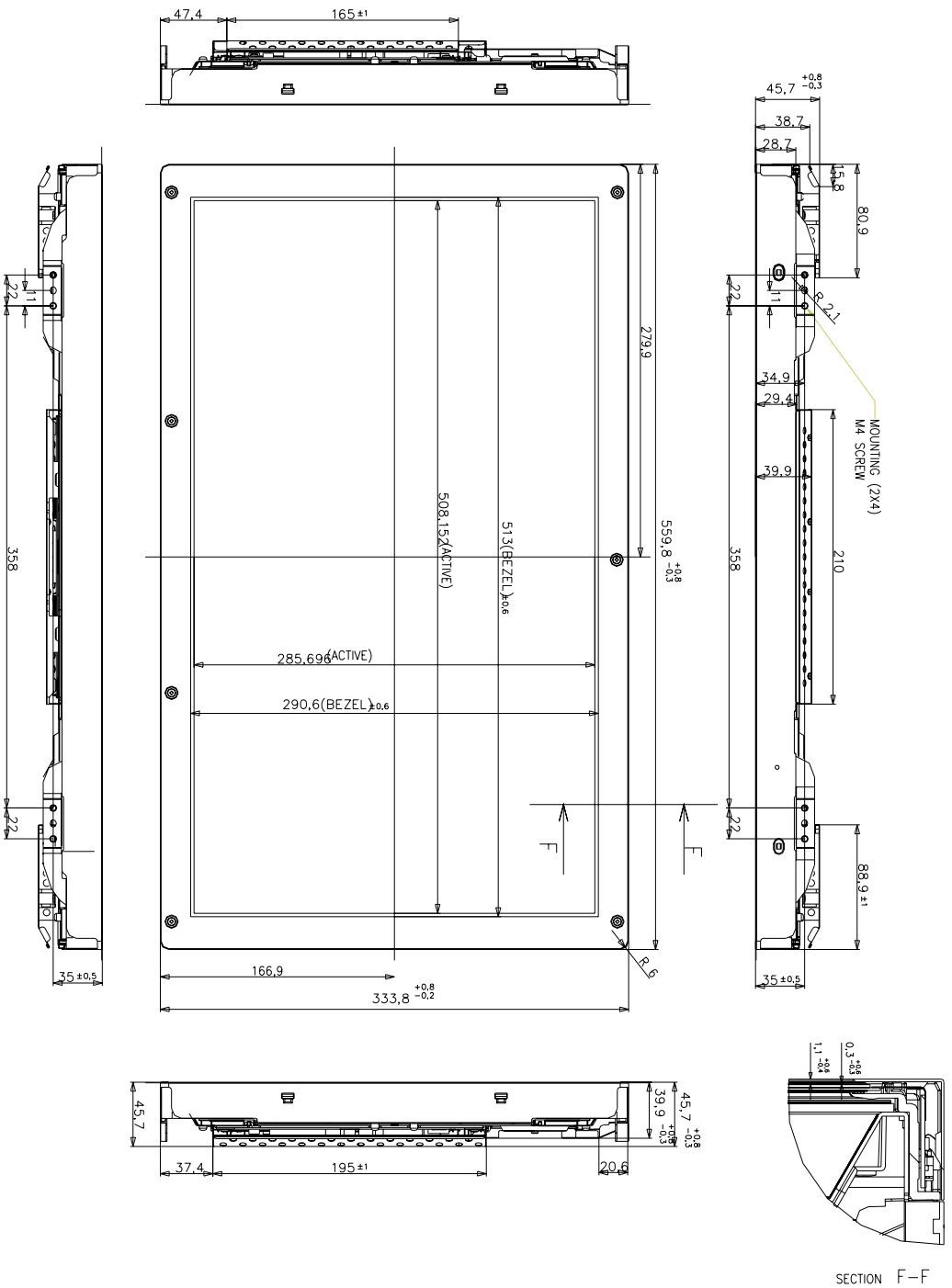
Table 11. provides general mechanical characteristics for the model LC230W02. In addition, the figures in the next page are detailed mechanical drawing of the LCD.

Table 14. Mechanical characteristics

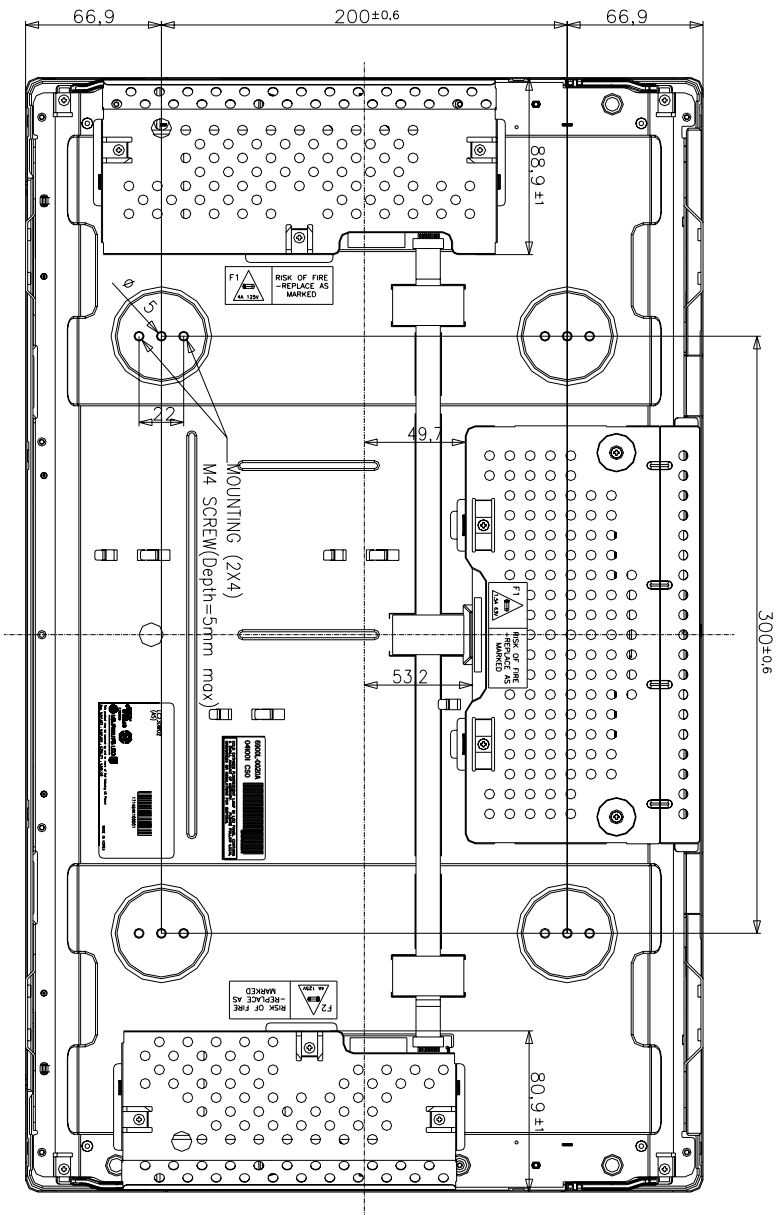
| | | |
|---|---|---|
| Outline Dimension | Horizontal | 559.8 mm |
| | Vertical | 333.8 mm |
| | Depth | 45.7 mm |
| Bezel Area | Horizontal | 513.0 mm |
| | Vertical | 290.6 mm |
| Active Display Area | Horizontal | 508.152 mm |
| | Vertical | 285.696 mm |
| Weight | 4200 g (Typ.), 4450 g (Max.) | |
| 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.

<FRONT VIEW>

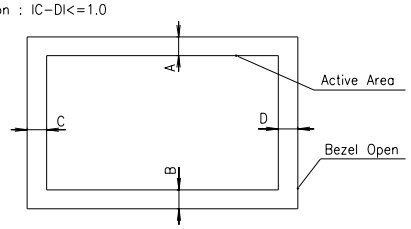

47.4
165±1
45.7 +0.8 -0.3
38.7
28.7
15.8
80.9
22
11
R 2.1
34.9
29.4
39.9
MOUNTING (2X4)
M4 SCREW
279.9
508.152(ACTIVE)
513(BEZEL)±0.6
559.8 +0.8 -0.3
358
210
285.696(ACTIVE)
290.6(BEZEL)±0.6
F
F
88.9±1
R 6
166.9
333.8 +0.8 -0.2
35±0.5
45.7
39.9 +0.8 -0.3
45.7 +0.8 -0.3
37.4
195±1
20.6
1.1 +0.6
0.3 +0.5
SECTION F-F

<REAR VIEW>




NOTES

1.Unspecified tolerances to be ±0.5.
2.This drawing is only preliminary data and can be changed without previous notice.
3.Tilt and partial disposition tolerance of display area as follow.
1)Y-Direction : IA-BI<=1.0
2)X-Direction : IC-DI<=1.0




4.The same shape is same demension.

## 6. Reliability

Environment test condition

| No | Test Item | Condition |
|---|---|---|
| 1 | High temperature storage test | 50°C, 240hrs |
| 2 | Low temperature storage test | -20°C, 240hrs |
| 3 | High temperature operation test | 40°C, 50%RH, 240hrs |
| 4 | Low temperature operation test | 0°C, 240hrs |
| 5 | Vibration test<br>(non-operating) | Wave form : random<br>Vibration level : 1.0Grms<br>Bandwidth : 10-500Hz<br>Duration : X,Y,Z, 10 min<br>One time each direction |
| 6 | Shock test<br>(non-operating) | Shock level : 100Grms<br>Waveform : half sine wave, 2ms<br>Direction : ±X, ±Y, ±Z<br>One time each direction |
| 7 | Humidity condition Operation | Ta= 40 °C ,90%RH |
| 8 | Altitude operating<br>storage / shipment | 0 - 14,000 feet(4267.2m)<br>0 - 40,000 feet(12192m) |

# 7. International Standards

## 7-1. Safety

a) UL 60950, Third Edition, Underwriters Laboratories, Inc., Dated Dec. 11, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.

b) CAN/CSA C22.2, No. 60950, Third Edition, Canadian Standards Association, Dec. 1, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.

c) EN 60950 : 2000, Third Edition
IEC 60950 : 1999, Third Edition
European Committee for Electrotechnical Standardization(CENELEC)
EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical Business Equipment.

## 7-2. EMC

a) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHZ to 40GHz. "American National Standards Institute(ANSI),1992

b) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special Committee on Radio Interference.

c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electrotechnical Standardization.(CENELEC), 1998( Including A1: 2000 )

# 8. Packing

## 8-1. Designation of Lot Mark

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

A,B,C : Inch
D : Year
E : Month
F : Panel Code
G : Factory Code
H : Assembly Code
I,J,K,L,M : Serial No

Note

1. Year

| Year | 97 | 98 | 99 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mark | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

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 |

3. Panel Code

| Panel Code | P1 Factory | P2 Factory | P3 Factory | P4 Factory | P5 Factory | Hydis Panel |
|---|---|---|---|---|---|---|
| Mark | 1 | 2 | 3 | 4 | 5 | H |

4. Factory Code

| Factory Code | LPL Gumi | LPL Nanjing |
|---|---|---|
| Mark | K | C |

5. Serial No

| Serial No. | 1 ~ 99,999 | 100,000 ~ |
|---|---|---|
| Mark | 00001 ~ 99999 | A0001 ~ A9999, - - - - , Z9999 |

## 8-2. Packing Form

a) Package quantity in one box : 4 pcs

b) Box size : 439mm X 350mm X 665mm.

# 9. Precautions

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

## 9-1. Mounting Precautions

(1) You must mount a module using holes arranged in side and rear.
(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 a transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the 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 describe 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 with bare hand or greasy cloth. (Some cosmetics are determined to the polarizer.)
(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
(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.

## 9-2. Operating Precautions

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage : V=±200mV(Over and under shoot voltage)
(2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
(3) Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on)becomes longer.
(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(6) 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 minimized the interference.
(7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can not be operated its full characteristics perfectly.
(8) A screw which is fastened up the steels should be a machine screw (if not, it causes metal foreign material and deals LCM a fatal blow)
(9) Please do not set LCD on its edge.

## 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 or its vestige is recognized,
please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.