# TITLE: HT12X13-100
# Product Specification

## Rev. B

BOE HYDIS TECHNOLOGY CO., LTD.

# REVISION HISTORY

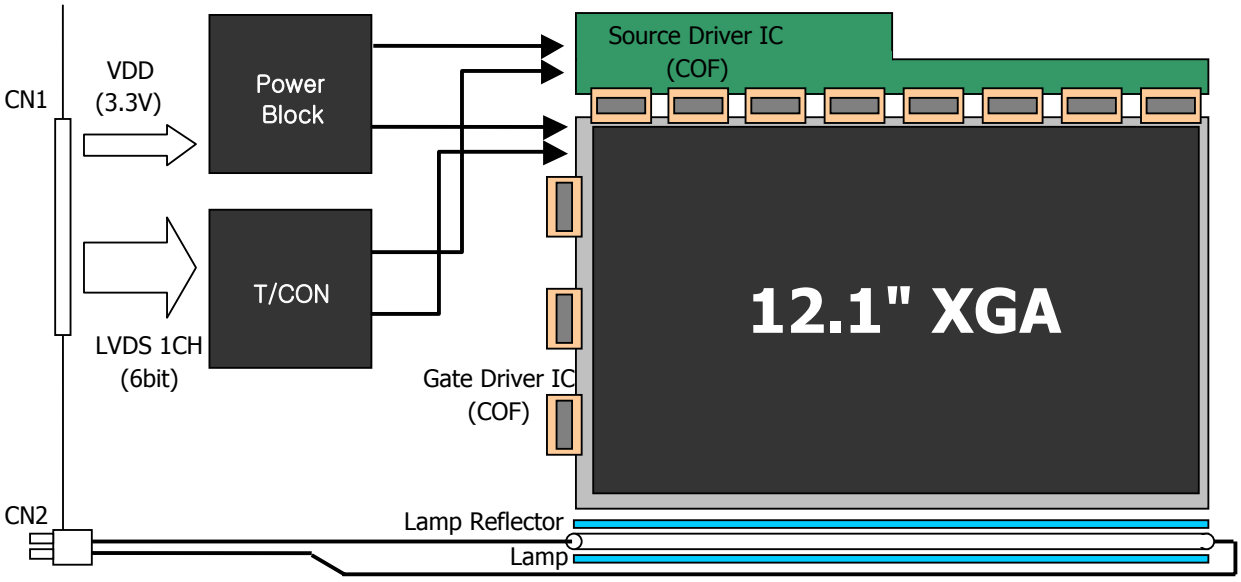
| REV. | ECN NO. | DESCRIPTION OF CHANGES | DATE | PREPARED |
|---|---|---|---|---|
| O | | Initial Release | 04.05.31 | S.M.Lee |
| A | E407-F009 | Lamp Start Voltage Change. (7 Page)<br>-. Typ. Data (860, 1080) Delete.<br>-. Max. Data -> Min. Data Change.<br>-. Note 4 Add. | 04.07.09 | H.R.Park |
| B | E408-F020 | Power Supply Current Change. (7 Page)<br>-. Typ. Current : 233 -> 255<br>-. Max. Current : 430 -> 455 | 04.08.31 | I.H.JUN |

# Contents

## 1.0 GENERAL DESCRIPTION

### 1.1 Introduction

HT12X13-100 is a color active matrix TFT LCD module using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This module has a 12.1 inch diagonally measured active area with XGA resolutions (1024 horizontal by 768 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 262,144 colors. The TFT-LCD panel used for this module is a low reflection and higher color type.




### 1.2 Features

- Thin and light weight
- 3.3 V power supply
- Low driving voltage and low power consumption
- 1 Channel LVDS Interface
- Single CCFL (Bottom side/Horizontal Direction)
- 262,144 colors
- Data enable signal mode
- Side Mounting Frame

1.3 Applications

- Notebook PC

1.4 General Specifications

| Parameter | Specification | Unit | Remarks |
|---|---|---|---|
| Active area | 245.76 (H) ×184.32 (V) | mm | |
| Number of pixels | 1024 (H) ×768 (V) | pixels | |
| Pixel pitch | 0.240 (H) ×0.240 (V) | mm | |
| Pixel arrangement | RGB Vertical stripe | | |
| Display colors | 262,144 | colors | |
| Display mode | Normally white | | |
| Dimensional outline | 261.0±0.5(W) ×199.0±0.5(V) ×4.7(D) Typ./5.0(D)Max | mm | |
| Weight | 290 (Typ.) / 300 (Max.) | g | |
| Back-light | CCFL, Horizontal-lamp type | | Note 1 |

Note 1: CCFL (Cold Cathode Fluorescent Lamp)

## 2.0 ABSOLUTE MAXIMUM RATINGS

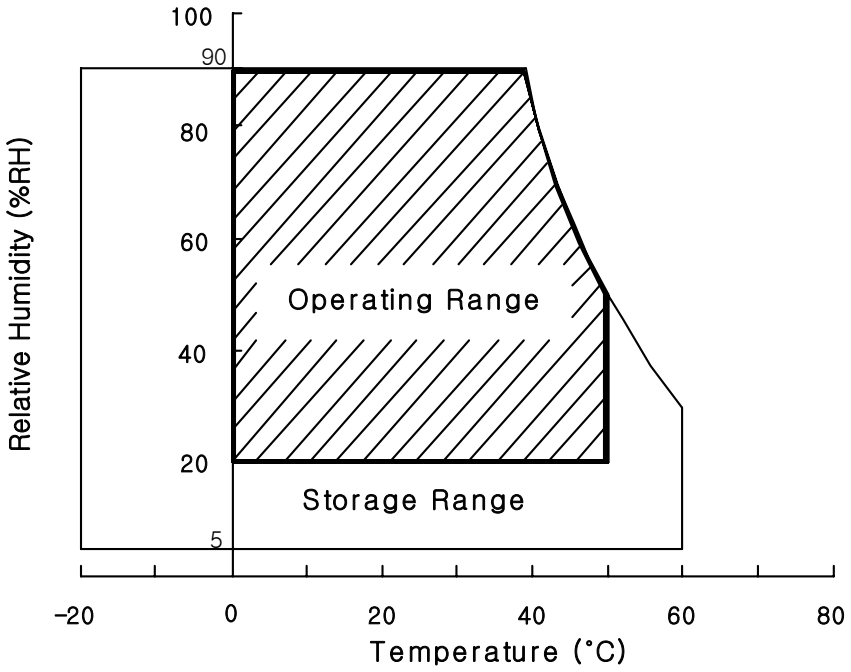
The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit.

< Table 2. Absolute Maximum Ratings>

| Parameter | Symbol | Min. | Max. | Unit | Remarks |
|---|---|---|---|---|---|
| Logic Power Supply | $V_{DD}$ | VSS-0.3 | 4.0 | V | Ta = 25 ±2 ℃ |
| Logic Input Voltage | $V_{IN}$ | VSS-0.3 | $V_{DD}$+0.3 | V | |
| Back-light Lamp Current | IBL | 2.0 | 6.0 | mA | |
| Back-light Frequency | FBL | 45 | 80 | KHz | |
| Operating Temperature | $T_{OP}$ | 0 | +50 | ℃ | Note 1 |
| Storage Temperature | $T_{SP}$ | -20 | +60 | ℃ | |

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

* 90 [%] RH Max. (40℃ ≥ Ta)
* Maximum wet-bulb temperature at 39 ℃ or less.(Ta > 40℃) No condensation



## 3.0 ELECTRICAL SPECIFICATIONS

[Ta = 25±2℃]

| Parameter | | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| Power Supply Voltage | $V_{DD}$ | 3.0 | 3.3 | 3.6 | V | Note1 |
| Power Supply Current | $I_{DD}$ | | 255 | 455 | mA | Note1 |
| High Level Differential Input Signal Voltage | $V_{IH}$ | | - | +100 | mV | |
| Low Level Differential Input Signal Voltage | $V_{IL}$ | -100 | - | | mV | |
| Back-light Lamp Voltage | $V_{BL}$ | 690 | 600 | 570 | $V_{rms}$ | Note2 |
| Back-light Lamp Current | $I_{BL}$ | 2.0 | 5.0 | 6.0 | mA | |
| Back-light Lamp operating Frequency | $F_L$ | 45 | | 80 | KHz | One Lamp, Note3 |
| Lamp Start Voltage | | 1,080 | | | $V_{rms}$ | At Ta=25℃, Note4 |
| | | 1,350 | | | $V_{rms}$ | At Ta=0℃, Note4 |
| Lamp Life | | 10,000 | 15,000 | | Hrs | $I_{BL}$= 6mA, Note5 |
| Power Consumption | $P_D$ | | 0.8 | 1.5 | W | Typ.@8color bar |
| | $P_{BL}$ | | 3.0 | 3.3 | W | $I_{BL}$=5mA, Note6 |
| | $P_{total}$ | | 3.8 | 4.8 | W | |

Notes : 1. The supply voltage is measured and specified at the interface connector of LCM.

The current draw and power consumption specified is for 3.3V at 25℃.

a) Typ: 8 color bar Pattern b) Max: V2 Skip Pattern

2. Reference value, which is measured with Samsung Electric SIC-180 Inverter.
(VBL Min is value at IBL Min and VBL Max is value at IBL Max)

3. The lamp frequency should be selected as different as possible from the horizontal synchronous frequency and its harmonics to avoid interference which may cause line flow on the display.

4. For starting the backlight unit, the output voltage of DC/AC's transformer should be larger than the minimum lamp starting voltage.(1,080 Vrms at 25 ℃ & 1,350 Vrms at 0 ℃)

If an inverter has shutdown function it should keep its output for more than 1 second even if the lamp connector open. Otherwise the lamps may not to be turned on.

5. End of Life shall be determined by the time when any of the following is satisfied under continuous lighting at 25℃ and $I_{BL}$ = 6.0[mA].
   • Intensity drops to 50% of the Initial Value.

6. Calculated value for reference (VBL × IBL)

## 4.0 OPTICAL SPECIFICATIONS

### 4.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance ≤ 1 lux and temperature = 25±2℃) with the equipment of Luminance meter system (Goniometer system and TOPCONE BM-5) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of Θ and Φ equal to 0°. We refer to $\Theta_{Ø=0}$ (=$\Theta_3$) as the 3 o'clock direction (the "right"), $\Theta_{Ø=90}$ (= $\Theta_{12}$) as the 12 o'clock direction ("upward"), $\Theta_{Ø=180}$ (= $\Theta_9$) as the 9 o'clock direction ("left") and $\Theta_{Ø=270}$(= $\Theta_6$) as the 6 o'clock direction ("bottom"). While scanning Θ and/or Ø, the center of the measuring spot on the Display surface shall stay fixed. The backlight should be operating for 30 minutes prior to measurement... VDD shall be 3.3+/- 0.3V at 25°C. Optimum viewing angle direction is 6 o'clock.

### 4.2 Optical Specifications

<Table 4. Optical Specifications>

| Parameter | | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Viewing Angle range | Horizontal | $\Theta_3$ | CR > 10 | 40 | 45 | | Deg. | Note 1 |
| | | $\Theta_9$ | | 40 | 45 | | Deg. | |
| | Vertical | $\Theta_{12}$ | | 15 | 20 | | Deg. | |
| | | $\Theta_6$ | | 45 | 50 | | Deg. | |
| Luminance Contrast ratio | | CR | Θ = 0° | | 300 | | | Note 2 |
| Luminance of White | 5 Points | $Y_w$ | Θ = 0° $I_{BL}$ = 5mA | 130 | 150 | | $cd/m^2$ | Note 3 |
| White Luminance uniformity | 5 Points | $\Delta Y_5$ | | 80 | 85 | | % | Note 4 |
| | 13 Points | $\Delta Y_{13}$ | | 65 | 75 | | | |
| White Chromaticity | | $x_w$ | Θ = 0° | 0.285 | 0.315 | 0.345 | | Note 5 |
| | | $y_w$ | | 0.302 | 0.332 | 0.362 | | |
| Reproduction of color | Red | $x_R$ | Θ = 0° | 0.551 | 0.581 | 0.611 | | |
| | | $y_R$ | | 0.307 | 0.337 | 0.367 | | |
| | Green | $x_G$ | | 0.279 | 0.309 | 0.339 | | |
| | | $y_G$ | | 0.514 | 0.544 | 0.574 | | |
| | Blue | $x_B$ | | 0.120 | 0.150 | 0.180 | | |
| | | $y_B$ | | 0.113 | 0.143 | 0.173 | | |
| Response Time | Rise | $T_r$ | Ta= 25° C Θ = 0° | | 10 | 20 | ms | Note 6 |
| | Decay | $T_d$ | | | 20 | 40 | ms | |
| Cross Talk | | CT | Θ = 0° | | | 2.0 | % | Note 7 |

Note:

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface (see FIGURE 1 shown in Appendix).

2. Contrast measurements shall be made at viewing angle of $\Theta = 0°$ and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See FIGURE 1 shown in Appendix) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Average Luminance of white is defined as arithmetic mean of five measurement points across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display.

4. The White luminance uniformity on LCD surface is then expressed as : $\Delta Y$ = Maximum Luminance of 5(or 13) points / Minimum Luminance of 5(or 13) points (see FIGURE 2 shown in Appendix).

5. The color chromaticity coordinates specified in Table 4 shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

6. The electro-optical response time measurements shall be made as FIGURE 3 shown in Appendix by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is Tr, and 90% to 10% is Td.

7. Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance ($Y_A$) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance ($Y_B$) of that same area when any adjacent area is driven dark. (See FIGURE 4 shown in Appendix).

## 5.0 INTERFACE CONNECTION

5.1 Electrical Interface

CN1 Interface connector : Hirose/DF19KR-20P-1H or equivalent

User side connector : Hirose/DF19G-20S-1C or equivalent

| Pin No | Symbol | Function | Remark |
|---|---|---|---|
| 1 | VDD1 | Power Supply: +3.3V | |
| 2 | VDD2 | Power Supply: +3.3V | |
| 3 | VSS | Ground | |
| 4 | VSS | Ground | |
| 5 | RIN0- | LVDS Negative data signal (-) | Tx pin # 48 |
| 6 | RIN0+ | LVDS Positive data signal (+) | Tx pin # 47 |
| 7 | VSS | Ground | |
| 8 | RIN1- | LVDS Negative data signal (-) | Tx pin # 46 |
| 9 | RIN1+ | LVDS Positive data signal (+) | Tx pin # 45 |
| 10 | VSS | Ground | |
| 11 | RIN2- | LVDS Negative data signal (-) | Tx pin # 42 |
| 12 | RIN2+ | LVDS Positive data signal (+) | Tx pin # 41 |
| 13 | VSS | Ground | |
| 14 | RCLKIN- | LVDS Negative clock signal (-) | Tx pin # 40 |
| 15 | RCLKIN+ | LVDS Positive clock signal (+) | Tx pin # 39 |
| 16 | VSS | Ground | |
| 17 | Vdd_EDID | No Connection | |
| 18 | NC | No Connection | |
| 19 | Clk_EDID | No Connection | |
| 20 | Clk_Data | No Connection | |

5.2 Back-light Interface

| CN2 | Interface Connector | : BHSR-02VS-1 (JST) or equivalent |
|---|---|---|

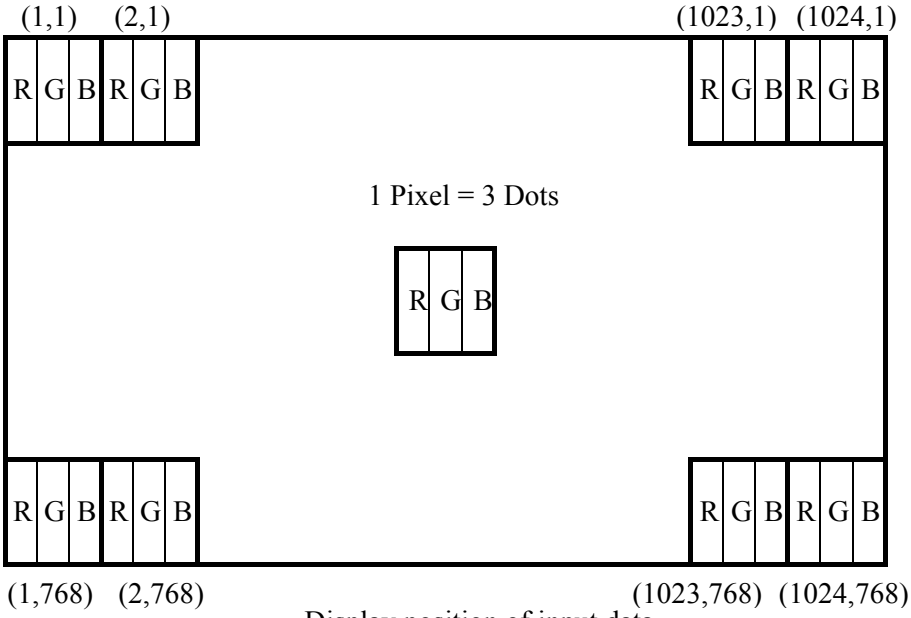
| Pin No | INPUT | Function | Remarks |
|---|---|---|---|
| 1 | HOT | High voltage | Pink |
| 2 | COLD | Ground | Black |

5.3 LVDS Interface

LVDS Transmitter: THC63LVDM83A or equivalent.

| Input signal | Transmitter | | Interface | | DF19KR-20P-1H | Remark |
|---|---|---|---|---|---|---|
| | Pin No | Pin No | System (Tx) | TFT-LCD (Rx) | Pin No. | |
| R0 | 51 | 48<br>47 | OUT0-<br>OUT0+ | IN0-<br>IN0+ | 5<br>6 | |
| R1 | 52 | | | | | |
| R2 | 54 | | | | | |
| R3 | 55 | | | | | |
| R4 | 56 | | | | | |
| R5 | 3 | | | | | |
| G0 | 4 | | | | | |
| G1 | 6 | 46<br>45 | OUT1-<br>OUT1+ | IN1-<br>IN1+ | 8<br>9 | |
| G2 | 7 | | | | | |
| G3 | 11 | | | | | |
| G4 | 12 | | | | | |
| G5 | 14 | | | | | |
| B0 | 15 | | | | | |
| B1 | 19 | | | | | |
| B2 | 20 | 42<br>41 | OUT2-<br>OUT2+ | IN2-<br>IN2+ | 11<br>12 | |
| B3 | 22 | | | | | |
| B4 | 23 | | | | | |
| B5 | 24 | | | | | |
| HSYNC | 27 | | | | | |
| VSYNC | 28 | | | | | |
| DE | 30 | | | | | |
| MCLK | 31 | 40<br>39 | CLKOUT-<br>CLKOUT+ | CLKIN-<br>CLKIN+ | 14<br>15 | |

5.4 Data Input Format




Display position of input data

## 6.0 SIGNAL TIMING SPECIFICATIONS

6.1 The 12.1"XGA LCM is operated by the only DE (Data enable) mode (LVDS Transmitter Input)

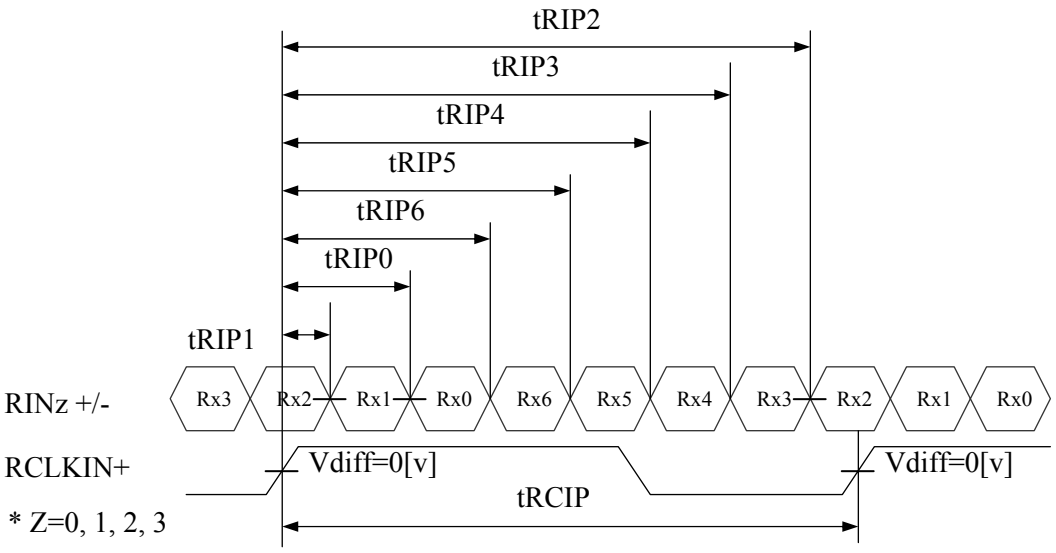
| Item | | Symbols | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Clock | Frequency | 1/Tc | - | 65 | 80 | MHz |
| | High Time | Tch | 4.5 | - | - | ns |
| | Low Time | Tcl | 4.5 | - | - | ns |
| Data | Setup Time | Tds | 2.7 | - | - | ns |
| | Hold Time | Tdh | 0 | - | - | ns |
| Data Enable Setup Time | | Tes | 2.7 | - | - | ns |
| Frame Period | | Tv | 772 | 806 | 1022 | lines |
| Vertical Display Period | | Tvd | 768 | 768 | 768 | lines |
| One Line Scanning Period | | Th | 1100 | 1344 | 2046 | clocks |
| Horizontal Display Period | | Thd | 1024 | 1024 | 1024 | clocks |

6.2 LVDS Rx interface timing parameter

The specification of the LVDS Rx interface timing parameter

<LVDS Rx Interface Timing Specification>

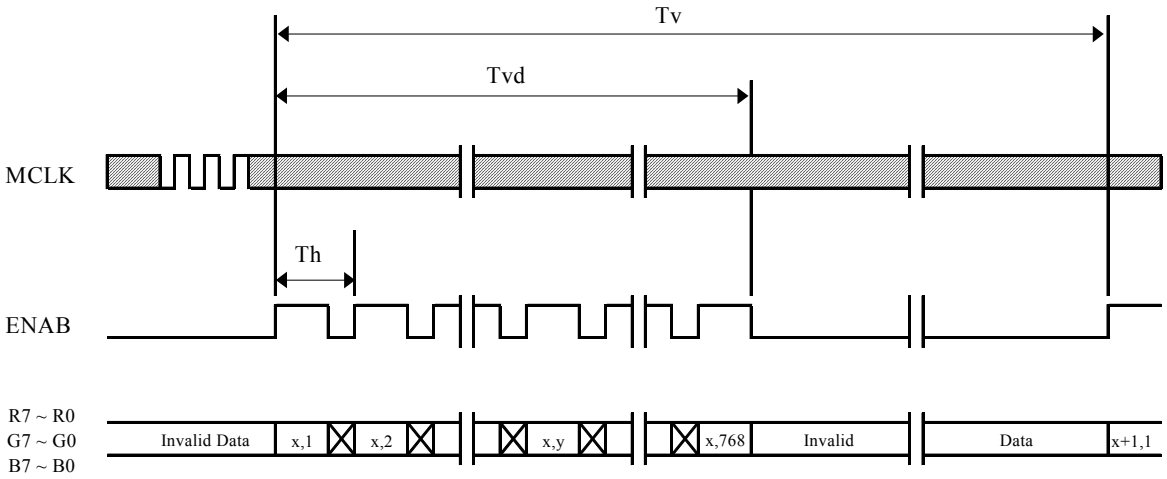
| Item | Symbol | Min | Typ | Max | Unit | Remark |
|---|---|---|---|---|---|---|
| CLKIN Period | tRCIP | 12.5 | 15.38 | - | nsec | |
| Input Data 0 | tRIP1 | -0.4 | 0.0 | +0.4 | nsec | |
| Input Data 1 | tRIP0 | 1*tRICP/7 -0.4 | 1*tRICP/7 | 1*tRICP/7 +0.4 | nsec | |
| Input Data 2 | tRIP6 | 2*tRICP/7 -0.4 | 2*tRICP/7 | 2*tRICP/7 +0.4 | nsec | |
| Input Data 3 | tRIP5 | 3*tRICP/7 -0.4 | 3*tRICP/7 | 3*tRICP/7 +0.4 | nsec | |
| Input Data 4 | tRIP4 | 4*tRICP/7 -0.4 | 4*tRICP/7 | 4*tRICP/7 +0.4 | nsec | |
| Input Data 5 | tRIP3 | 5*tRICP/7 -0.4 | 5*tRICP/7 | 5*tRICP/7 +0.4 | nsec | |
| Input Data 6 | tRIP2 | 6*tRICP/7 -0.4 | 6*tRICP/7 | 6*tRICP/7 +0.4 | nsec | |



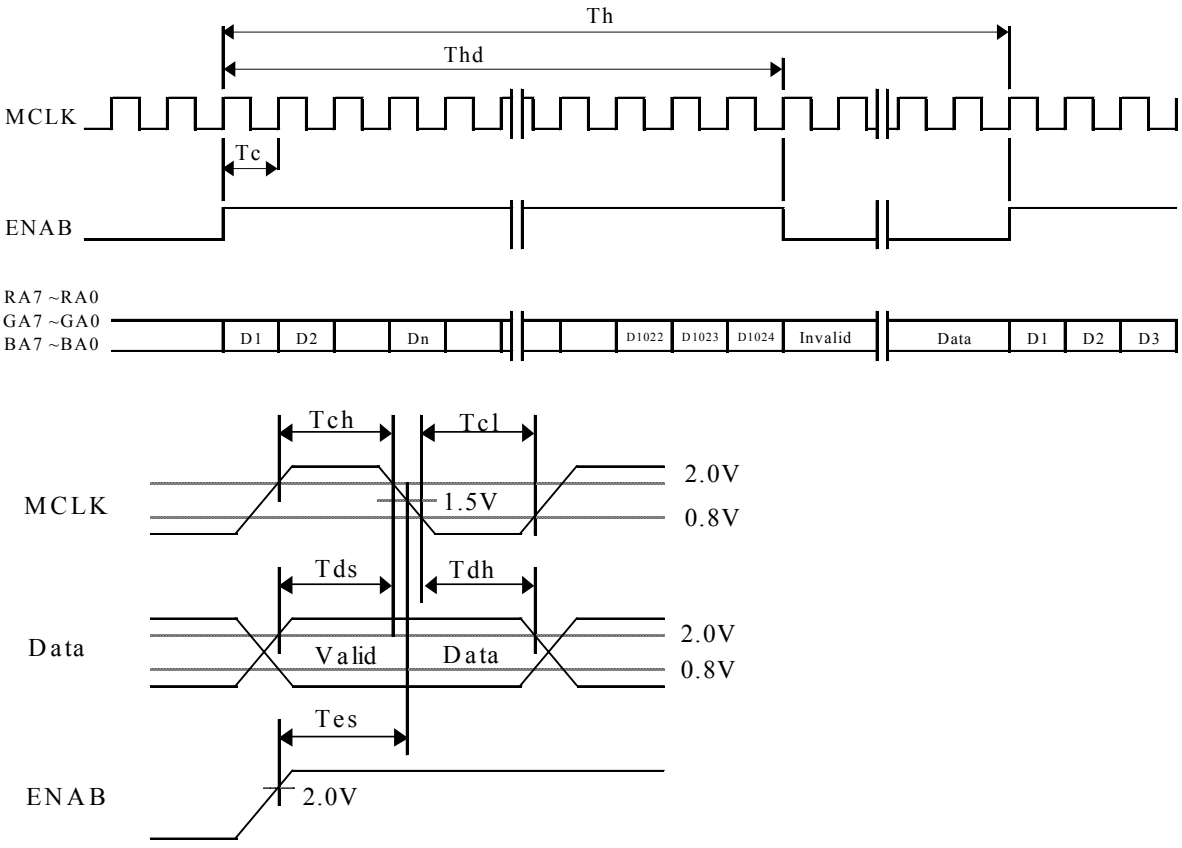

* Vdiff = (RINz+)-(RINz-), (RCLKIN+)-(RCLKIN-)

## 7.0 SIGNAL TIMING WAVEFORMS OF INTERFACE SIGNAL (DE MODE)

### 7.1 Vertical Timing Waveforms




### 7.2 Horizontal Timing Waveforms

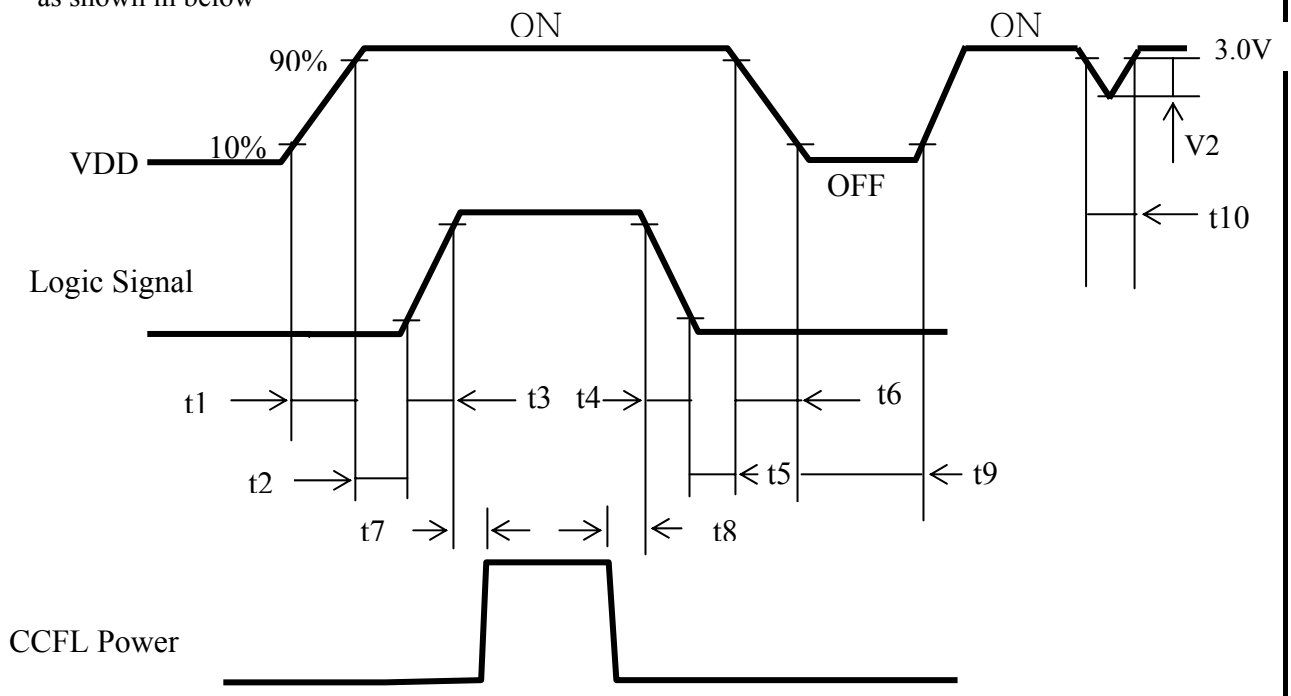


## 8.0 INPUT SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

| Colors & Gray Scale | | Red Data | | | | | | Green Data | | | | | | Blue Data | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale Of 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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | △ | | | ↓ | | | | | | ↓ | | | | | | ↓ | | | |
| | ▽ | | | ↓ | | | | | | ↓ | | | | | | ↓ | | | |
| | Brighter | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ▽ | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of 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 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | △ | | | ↓ | | | | | | ↓ | | | | | | ↓ | | | |
| | ▽ | | | ↓ | | | | | | ↓ | | | | | | ↓ | | | |
| | Brighter | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ▽ | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of 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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Darker | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | △ | | | ↓ | | | | | | ↓ | | | | | | ↓ | | | |
| | ▽ | | | ↓ | | | | | | ↓ | | | | | | ↓ | | | |
| | Brighter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| | ▽ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale Of White & Black | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | △ | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Darker | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | △ | | | ↓ | | | | | | ↓ | | | | | | ↓ | | | |
| | ▽ | | | ↓ | | | | | | ↓ | | | | | | ↓ | | | |
| | Brighter | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | ▽ | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

## 9.0 POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as shown in below




| | |
|---|---|
| $0 < t1 \leq 10$ ms | $0 \leq t4 \leq 50$ ms |
| $0 < t2 \leq 50$ ms | $0 < t5 \leq 50$ ms |
| $0 \leq t3 \leq 50$ ms | $t6 \leq 10$ ms |
| $t7 \geq 100$ ms | $t8 \geq 100$ ms |
| $t9 \geq 200$ ms | $t10 \leq 10$ ms |

$2.8\ V \leq V2 \leq 3.0V$

Notes :

1. When the power supply VDD is 0V, Keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on.
3. Back Light must be turn on after power for logic and interface signal are valid.

## 10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

FIGURE 5, 6 shown in appendix shows mechanical outlines for the model.

| Parameter | Specification | Unit |
|---|---|---|
| Active area | 245.76 (H) ×184.32 (V) | mm |
| Number of pixels | 1024(H) ×768(V) | pixels |
| | (1 pixel = R + G + B dots) | |
| Pixel pitch | 0.240(H) ×0.240(V) | mm |
| Pixel arrangement | RGB Vertical stripe | |
| Display colors | 262,144 | colors |
| Display mode | Normally white | |
| Dimensional outline | 261.0±0.5(W) ×199.0±0.5(V) ×4.7(D) Typ./5.0(D)Max. | mm |
| Weight | 290 (Typ.) / 300 (Max.) | gram |
| Back-light | CCFL, Horizontal-lamp type | |

10.2 Mounting

See FIGURE 5 shown in appendix

10.3 Anti-Glare and Polarizer Hardness.

The surface of the LCD has an anti-glare coating to minimize reflection and a coating to reduce scratching.

10.4 Light Leakage

There shall not be visible light from the back-lighting system around the edges of the screen as seen from a distance 50 cm from the screen with an overhead light level of 150lux. The manufacture shall furnish limit samples of the panel showing the light leakage acceptable.

## 11.0 RELIABILITY TEST

| No | Test Items | Conditions |
|---|---|---|
| 1 | High temperature storage test | Ta = 60 °C, 240 hrs |
| 2 | Low temperature storage test | Ta = -20 °C, 240 hrs |
| 3 | High temperature operation Test | Ta = 50 °C, 240 hrs |
| 4 | High temperature & high humidity operation test | Ta = 50 °C, 80 %RH, 240 hrs |
| 5 | Low temperature operation test | Ta = 0 °C, 240 hrs |
| 6 | Thermal shock | Ta = -20 °C ↔ 60 °C (30 min), 100 cycle |
| 7 | Vibration test (non-operating) | Frequency : 10 ~ 500 Hz<br>Gravity/AMP : 1.5G<br>Period : X, Y, Z 30 min |
| 8 | Shock test (non-operating) | Gravity : 220G<br>Pulse width : 2ms, half sine wave<br>±X, ±Y, ±Z Once for each direction |
| 9 | Electrostatic discharge test | Air : 150 pF, 330Ω , 15KV<br>Contact : 150 pF, 330Ω , 8KV |

## 12.0 HANDLING & CAUTIONS

12.1 Cautions when taking out the module

- Pick the pouch only, when taking out module from a shipping package.

12.2 Cautions for handling the module

- As the electrostatic discharges may break the LCD module, handle the LCD module with care. Peel a protection sheet off from the LCD panel surface as slowly as possible.
- As the LCD panel and backlight element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.
- As the surface of the polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.
- Do not pull the interface connector in or out while the LCD module is operating.
- Put the module display side down on a flat horizontal plane.
- Handle connectors and cables with care.

12.3 Cautions for the operation

- When the module is operating, do not lose MCLK, DE signals. If any one of these signals were lost, the LCD panel would be damaged.
- Obey the supply voltage sequence. If wrong sequence were applied, the module would be damaged.

12.4 Cautions for the atmosphere

- Dewdrop atmosphere should be avoided.
- Do not store and/or operate the LCD module in a high temperature and/or humidity atmosphere. Storage in an electro-conductive polymer-packing pouch and under relatively low temperature atmosphere is recommended.

12.5 Cautions for the module characteristics

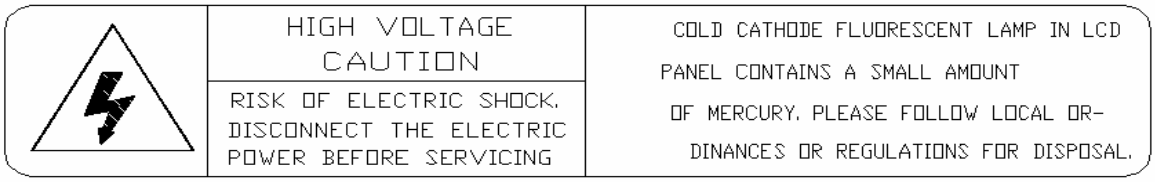
- Do not apply fixed pattern data signal to the LCD module at product aging.
- Applying fixed pattern for a long time may cause image sticking.

12.6 Other cautions

- Do not disassemble and/or re-assemble LCD module.
- Do not re-adjust variable resistor or switch etc.
- When returning the module for repair or etc, please pack the module not to be broken. We recommend using the original shipping packages.

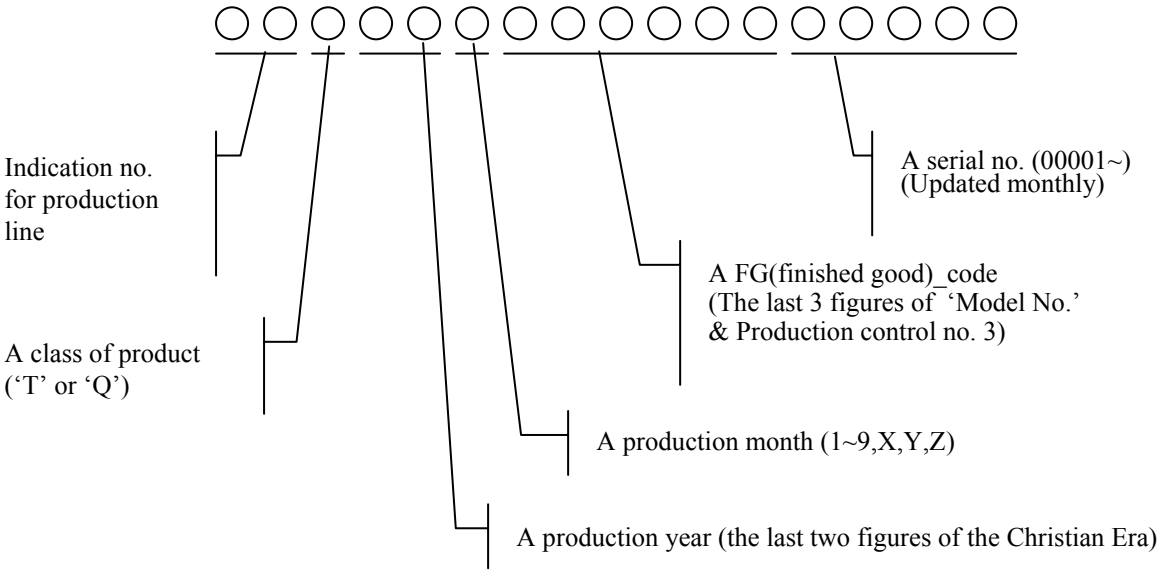
**13.0 Environment & Safety**

13.1 Mercury disposal & High voltage caution




13.2 Product Label


How to express 'Lot No.'



## 14.0 APPENDIX

**Figure 1. Measurement Set Up**

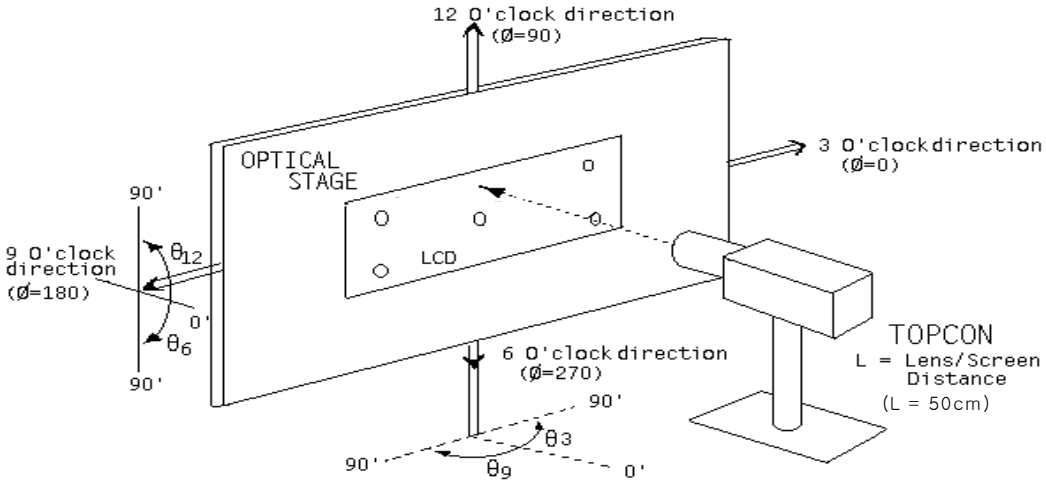
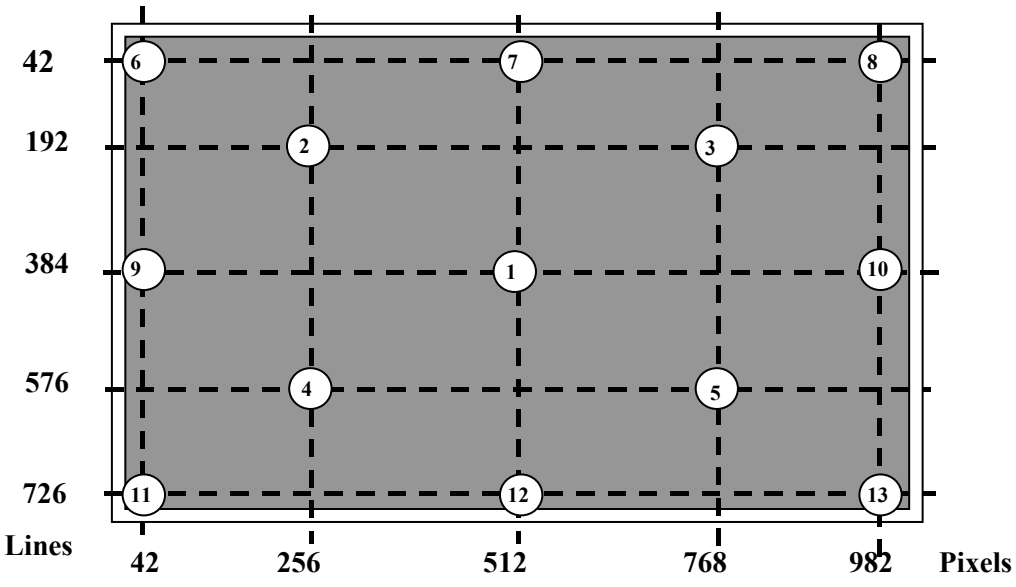



**Figure 2. Average Luminance Measurement Locations & Uniformity Measurement Locations**




(X) : **Test Point**

**Figure 3. Response Time Testing**

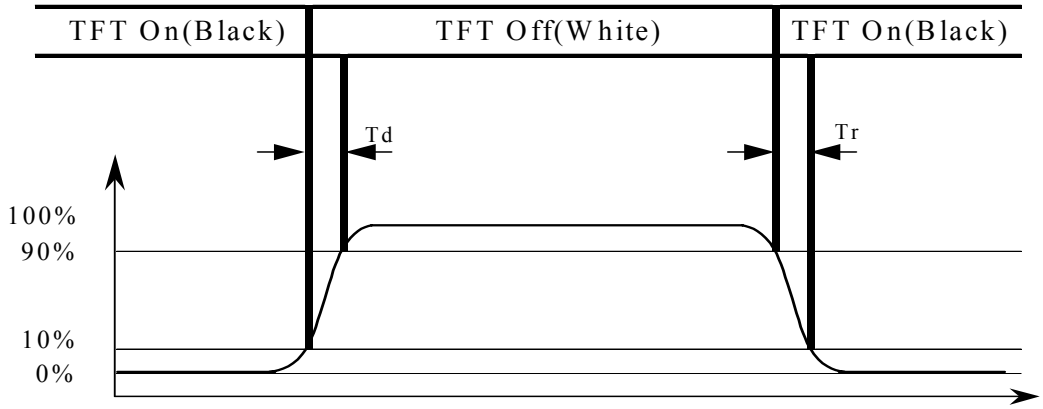
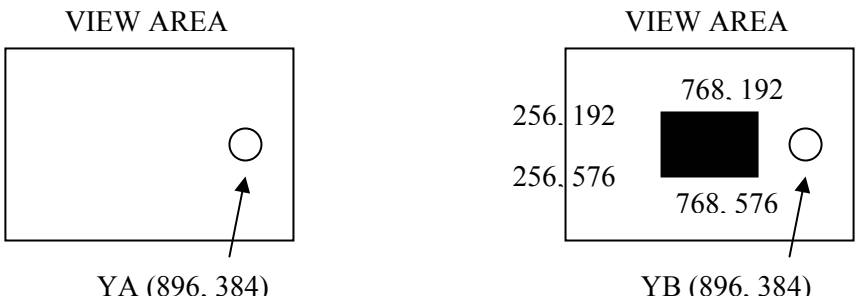



**Figure 4. Cross Modulation Test Description**




$$\text{Cross-Talk} = \left| \frac{YB - YA}{YA} \right| \times 100$$

Where:

$Y_A$ = Initial luminance of measured area ($cd/m^2$)

$Y_B$ = Subsequent luminance of measured area ($cd/m^2$)

The location measured will be exactly the same in both patterns.

**Figure 5. TFT-LCD Module Outline Dimensions (Front view)**

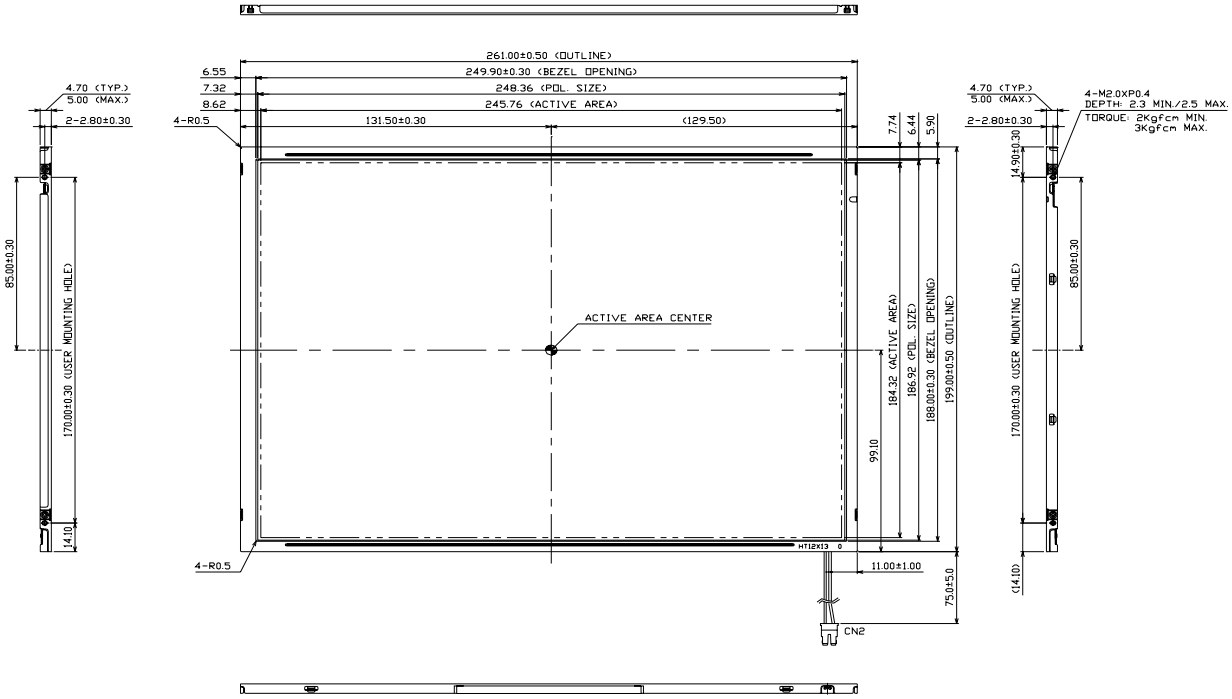



**Figure 6. TFT-LCD Module Outline Dimensions (Rearview)**