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**TITLE : HT12X21-240**  
**Product Specification**  
**(Rev. B)**

**BOE HYDIS TECHNOLOGY CO., LTD.**


**SPEC. NUMBER**  
S864-1203

**PRODUCT GROUP**  
TFT-LCD PRODUCT

**REV.**  
B

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**PAGE**  
1 OF 23

|  |           | PRODUCT GROUP                                      | REV.     | ISSUE DATE   |
|---|-----------|--|----------|--------------|
|   |           | TFT-LCD PRODUCT                                    | B        | 2004. 12. 31 |
| REVISION HISTORY  |           |  |          |              |
| REV.  | ECN NO.   | DESCRIPTION OF CHANGES                             | DATE     | PREPARED     |
| 0   |           | Initial Release                                    | 04.10.22 | C.Y.CHO      |
| A   | E411-F006 | Change Bezel Marking (HT12X21-240 → HT12X21)       | 04.11.15 | W.KIM        |
| B   | E412-F018 | PRODUCT LABEL POSITION CHANGED<br>from 14.8 to 4.0 | 04.12.31 | E.S.PARK     |
| SPEC. NUMBER  |           | SPEC. TITLE  |          | PAGE         |
| S864-1203   |           | HT12X21-240 Product Specification                  |          | 2 OF 23      |

**PRODUCT GROUP****REV.****ISSUE DATE**

TFT-LCD PRODUCT

B

2004.12.31

**Contents**

| No   | Item  | Page |
|------|---|------|
| 1.0  | General Description                                   | 4    |
| 2.0  | Absolute Maximum Ratings                              | 5    |
| 3.0  | Electrical Specifications                             | 6    |
| 4.0  | Optical Specifications                                | 7    |
| 5.0  | Interface Connection                                  | 9    |
| 6.0  | Signal Timing Specifications                          | 11   |
| 7.0  | Signal Timing Waveforms of interface signal (DE mode) | 13   |
| 8.0  | Input Signals, Display Colors & Gray Scale of Colors  | 14   |
| 9.0  | Power Sequence  | 15   |
| 10.0 | Mechanical Characteristics                            | 16   |
| 11.0 | Reliability Test                                      | 17   |
| 12.0 | Handling & Cautions                                   | 18   |
| 13.0 | Appendix  | 19   |

**SPEC. NUMBER**

S864-1203

**SPEC. TITLE**

HT12X21-240 Product Specification

**PAGE**

3 OF 23



## PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

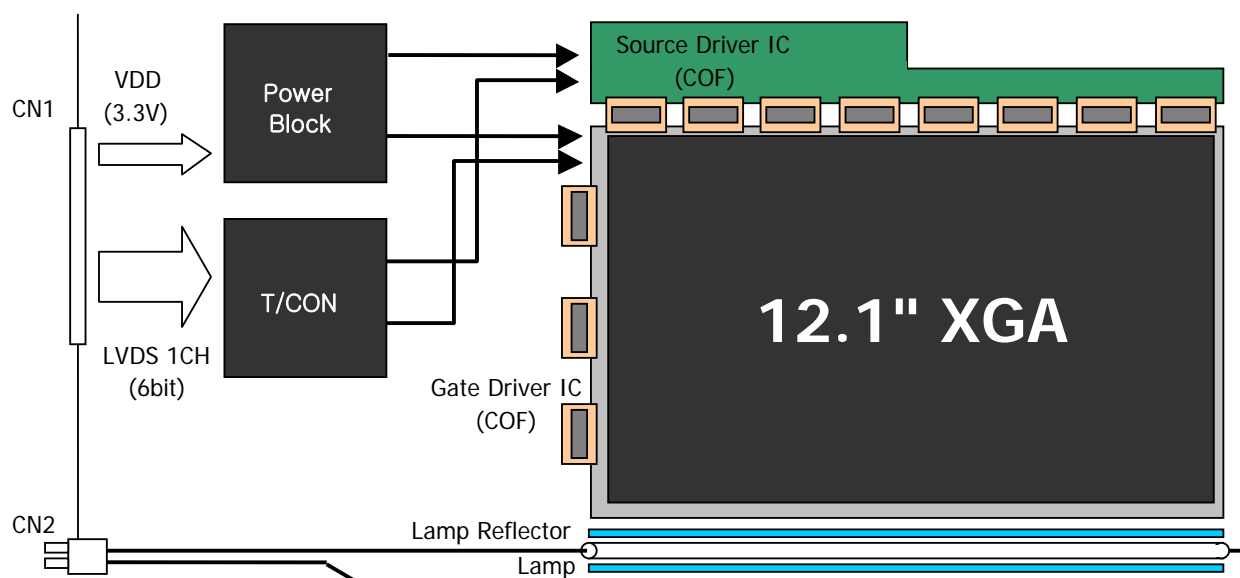
B

2004.12.31

## 1.0 GENERAL DESCRIPTION

### 1.1 Introduction

12.1"XGA is a color active matrix TFT LCD module using AFFS(Advanced Fringe Field Switching: Wide viewing technology) mode and 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

- LVDS Interface with 1pixel / clock
- High-speed response
- 6-bit color depth, Display 262,144 colors
- Incorporated edge type back-light (1 lamp)
- High luminance and contrast ratio, Glare and wide viewing angle
- DE (Data Enable) mode only

### 1.3 Applications

- Pen-type & Tablet PC

SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

4 OF 23

**PRODUCT GROUP****REV.****ISSUE DATE**

TFT-LCD PRODUCT

B

2004.12.31

## 1.4 General Specifications

| Parameter           | Specification                 | Unit   | Remark |
|---------------------|-------------------------------|--------|--------|
| Active area         | 245.76 X 184.32               | 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 Black                |        |        |
| Dimensional outline | 270.0(H)X199.0(V)X 4.8 @ Lamp | mm     | Note 2 |
| Weight              | 305 typ.                      | gram   |        |
| Back-light          | Bottom edge side 1-CCFL type  |        | Note 1 |
| Surface treatment   | Glare & hard-coating (2H)     |        |        |

Note: 1. CCFL (Cold Cathode Fluorescent Lamp)

2. LCM Height: 4.8[mm]Typ.(Lamp) , 6.7[mm] Typ(Pouch)

**SPEC. NUMBER**

S864-1203

**SPEC. TITLE**

HT12X21-240 Product Specification

**PAGE**

5 OF 23



## PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

## 2.0 ABSOLUTE MAXIMUM RATINGS

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

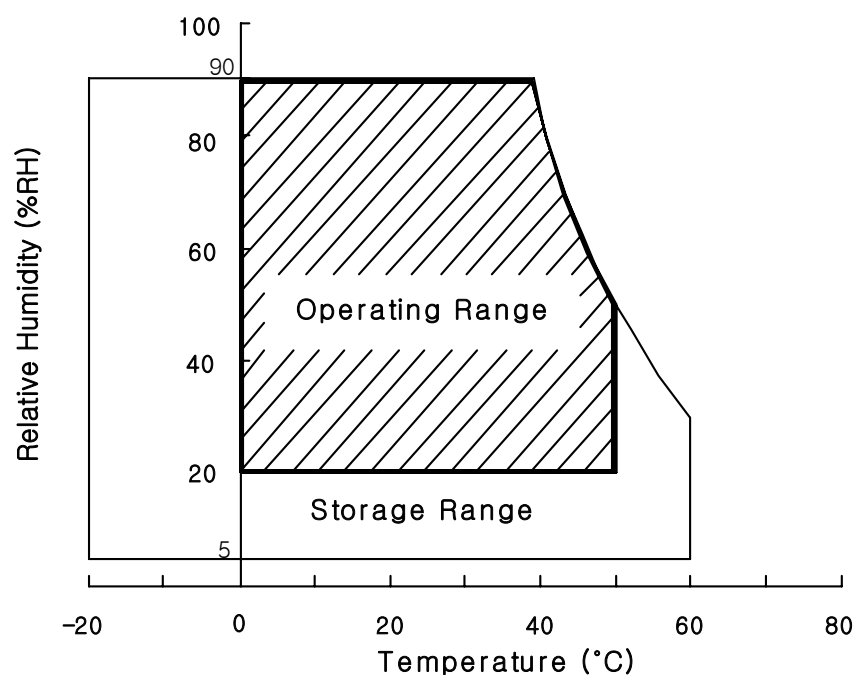
[VSS = GND = 0V]

| Parameter                 | Symbol   | Min     | Max          | Unit | Remark     |
|---------------------------|----------|---------|--------------|------|------------|
| Power Input Voltage       | $V_{DD}$ | VSS-0.3 | 4.0          | V    | Ta = 25 °C |
| Logic Input Voltage       | $V_{IN}$ | VSS-0.3 | $V_{DD}+0.3$ | V    |            |
| Back-light Lamp Current   | $I_{BL}$ | 2       | 6            | mA   |            |
| Back-light lamp Frequency | $F_L$    | 30      | 80           | KHz  |            |
| Operating Temperature     | $T_{OP}$ | 0       | +50          | °C   |            |
| Storage Temperature       | $T_{ST}$ | -20     | +60          | °C   |            |

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

\* 90 [%] RH Max. (40 °C ≥ Ta)

\* Maximum wet-bulb temperature at 39 °C or less.(Ta > 40 °C) No condensation



SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

6 OF 23



## PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

### 3.0 ELECTRICAL SPECIFICATIONS

[Ta = 25±2 °C]

| Parameter                                       |                    | Min    | Typ    | Max  | Unit             | Remark                             |
|---|--------------------|--------|--------|------|------------------|------------------------------------|
| Power Supply Voltage                            | V <sub>DD</sub>    | 3.0    | 3.3    | 3.6  | V                |                                    |
| Power Supply Current                            | I <sub>DD</sub>    | -      | 240    |      | mA               | Note1                              |
| Permissible Input Ripple Voltage                | V <sub>RF</sub>    | -      | -      | 100  | mV               | V <sub>DD</sub> = 3.3V             |
| High Level Differential Input Threshold Voltage | V <sub>IH</sub>    | -      | -      | +100 | mV               | V <sub>cm</sub><br>= 1.2V typ.     |
| Low Level Differential Input Threshold Voltage  | V <sub>IL</sub>    | -100   | -      | -    | mV               |                                    |
| Back-light Lamp Voltage                         | V <sub>BL</sub>    | -      | 595    | -    | V <sub>rms</sub> |                                    |
| Back-light Lamp Current                         | I <sub>BL</sub>    | 2.0    | 5.0    | 6.0  | mA <sub>rm</sub> |                                    |
| Back-light Lamp Frequency                       | F <sub>L</sub>     | 30     | 60     | 80   | KHz              | Note 2                             |
| Lamp Start Voltage                              |                    | 1080   |        |      | V <sub>rms</sub> | 25 °C, Note 3                      |
|   |                    | 1350   |        |      | V <sub>rms</sub> | 0 °C, Note 3                       |
| Lamp Life                                       |                    | 10,000 | 15,000 |      | hrs              | I <sub>BL</sub> = 2.0~6.0mA        |
| Power Consumption                               | P <sub>D</sub>     |        | 0.7    |      | W                |                                    |
|   | P <sub>BL</sub>    |        | 3.0    |      | W                | I <sub>BL</sub> = 5.0mA,<br>Note 4 |
|   | P <sub>total</sub> |        | 3.7    |      | 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 VDD = 3.3V, Frame rate = 60 Hz and Clock frequency = 65MHz.

Test Pattern of power supply current

- a) Typ : Vertical color bar pattern
- b) Max : Gray 28 @ Vertical 2 Skip line pattern

2. 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

3. 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 °C & 1,350 Vrms at 0 °C)

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.

4. Calculated value for reference (V<sub>BL</sub> × I<sub>BL</sub>) excluding inverter loss.

SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

7 OF 23



## PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

### 4.0 OPTICAL SPECIFICATIONS

The measurement shall be executed after 30 minutes warm-up period.

Measuring equipment: TOPCON-BM5.

[VDD=3.3V, Frame rate=60Hz, Clock=65MHz,  $I_{BL} = 5.0\text{mA}$ ,  $T_a = 25 \pm 2^\circ\text{C}$ ]

| Parameter                  |                     | Symbol               | Condition  | Min   | Typ   | Max   | Unit              | Remark |
|----------------------------|---------------------|----------------------|--|-------|-------|-------|-------------------|--------|
| Viewing Angle              | Horizontal          | $\Theta_{\text{3}}$  | CR > 10  |       | 80    |       | Deg               | Note 1 |
|                            |                     | $\Theta_{\text{9}}$  |  |       | 80    |       | Deg               |        |
|                            | Vertical            | $\Theta_{\text{12}}$ |  |       | 80    | -     | Deg               |        |
|                            |                     | $\Theta_{\text{6}}$  |  |       | 80    | -     | Deg               |        |
| Luminance contrast ratio   |                     | CR                   | $\Theta = 0^{\circ}$<br>(Center)<br>Normal<br>Viewing<br>Angle | -     | 450   | -     |                   | Note 2 |
| Luminance of white         |                     | $Y_{\text{L}}$       |  |       | 180   | -     | cd/m <sup>2</sup> | Note 3 |
| White luminance uniformity |                     | $\Delta Y$           |  | -     | -     | 1.25  |                   | Note 4 |
| Color Cord.                | White               | $x_{\text{W}}$       |  | 0.275 | 0.305 | 0.335 |                   | Note 5 |
|                            |                     | $y_{\text{W}}$       |  | 0.305 | 0.335 | 0.365 |                   |        |
|                            | Red                 | $x_{\text{R}}$       |  | 0.547 | 0.577 | 0.607 |                   |        |
|                            |                     | $y_{\text{R}}$       |  | 0.314 | 0.344 | 0.374 |                   |        |
|                            | Green               | $x_{\text{G}}$       |  | 0.278 | 0.308 | 0.338 |                   |        |
|                            |                     | $y_{\text{G}}$       |  | 0.511 | 0.541 | 0.571 |                   |        |
|                            | Blue                | $x_{\text{B}}$       |  | 0.120 | 0.150 | 0.180 |                   |        |
|                            |                     | $y_{\text{B}}$       |  | 0.114 | 0.144 | 0.174 |                   |        |
| Color Reproduction         |                     |                      |  |       | 40    |       | %                 |        |
| Response time              | Ttotal<br>(Tr + Td) | Ttotal               |  | -     | 40    | 45    | msec              | Note 6 |
| Cross talk                 |                     | CT                   |  | -     | -     | 2.0   | %                 | Note 7 |

SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

8 OF 23





# PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

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  $\Theta = 0^\circ$  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. Luminance of white is defined as a center point(#1) on 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 :  $\Delta Y = \text{Maximum Luminance of 5 points} / \text{Minimum Luminance of 5 points}$  (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  $T_r$ , and 90% to 10% is  $T_d$ .

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).

SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

9 OF 23



## PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

### 5.0 INTERFACE CONNECTION

#### 5.1 Electrical Interface

CN1 Interface connector : DF19L-20P-1H (HIROSE) or equivalent

User side connector : DF19G-20S-1C (HIROSE) 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     | NC      | No Connection                  |             |
| 18     | NC      | No Connection                  |             |
| 19     | VSS     | Ground                         |             |
| 10     | VSS     | Ground                         |             |

SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

10 OF 23



## PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

### 5.2 Back-light Interface

CN2 Connector : BHSR-02VS-1 (JST) or equivalent  
User side connector : MS02B-BHSS-1 (JST) or equivalent

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

### 5.3 LVDS Interface

LVDS Transmitter: THC63LVDM83A or equivalent.

| Input signal | Transmitter |          | Interface          |                  | DF19L-14P-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           | 46<br>45 | OUT1-<br>OUT1+     | IN1-<br>IN1+     | 7<br>8       |        |
| G1           | 6           |          |                    |                  |              |        |
| G2           | 7           |          |                    |                  |              |        |
| G3           | 11          |          |                    |                  |              |        |
| G4           | 12          |          |                    |                  |              |        |
| G5           | 14          |          |                    |                  |              |        |
| B0           | 15          | 42<br>41 | OUT2-<br>OUT2+     | IN2-<br>IN2+     | 9<br>10      |        |
| B1           | 19          |          |                    |                  |              |        |
| B2           | 20          |          |                    |                  |              |        |
| B3           | 22          |          |                    |                  |              |        |
| B4           | 23          |          |                    |                  |              |        |
| B5           | 24          |          |                    |                  |              |        |
| HSYNC        | 27          | 40<br>39 | CLKOUT-<br>CLKOUT+ | CLKIN-<br>CLKIN+ | 11<br>12     |        |
| VSYNC        | 28          |          |                    |                  |              |        |
| DE           | 30          |          |                    |                  |              |        |
| MCLK         | 31          |          |                    |                  |              |        |

SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

11 OF 23



## PRODUCT GROUP

REV.

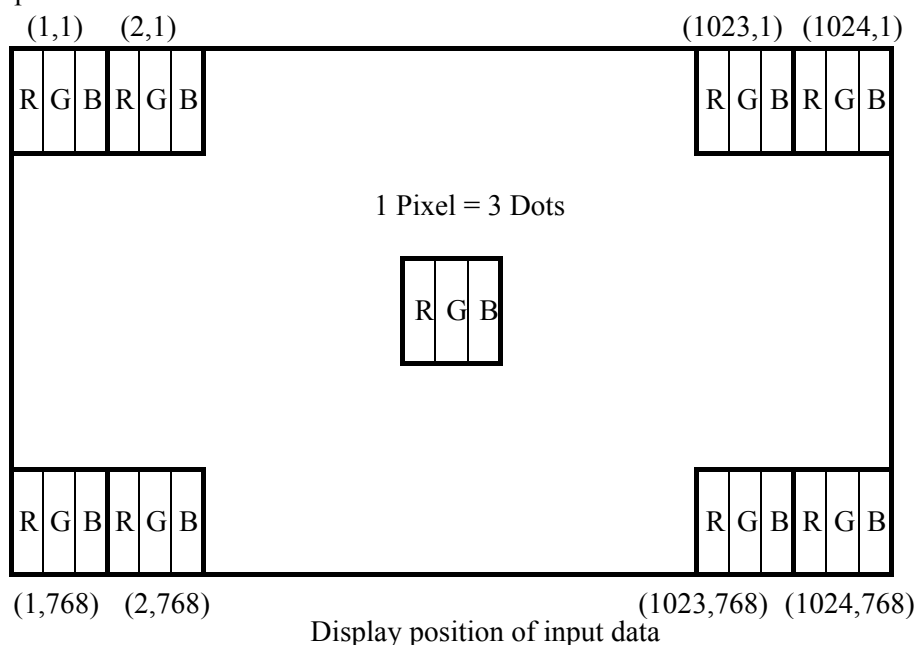
ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

### 5.4 Data Input Format



## 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 |

SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

12 OF 23





## PRODUCT GROUP

REV.

ISSUE DATE

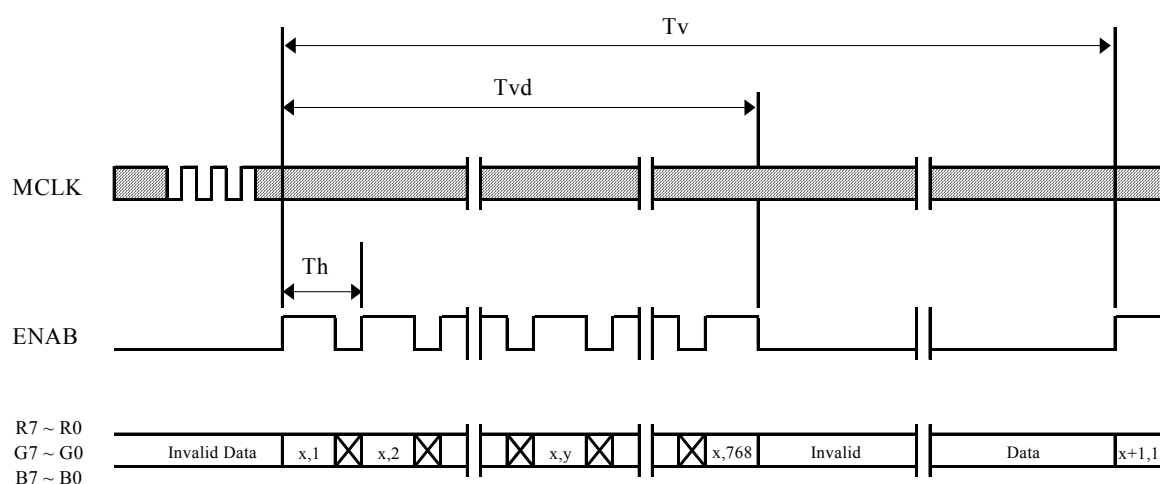
TFT-LCD PRODUCT

B

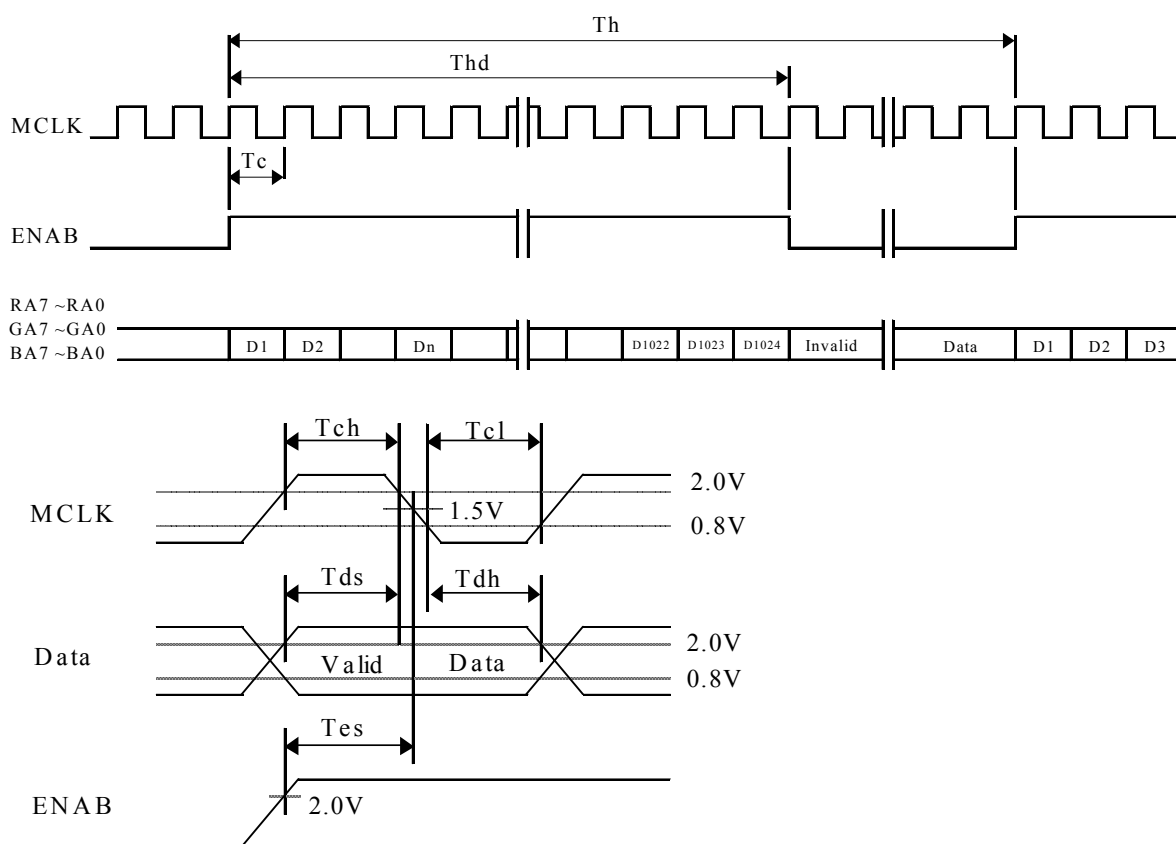
2004.12.31

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

### 7.1 Vertical Timing Waveforms



### 7.2 Horizontal Timing Waveforms



SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

14 OF 23



# PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

## 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  |

SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

15 OF 23



## PRODUCT GROUP

REV.

ISSUE DATE

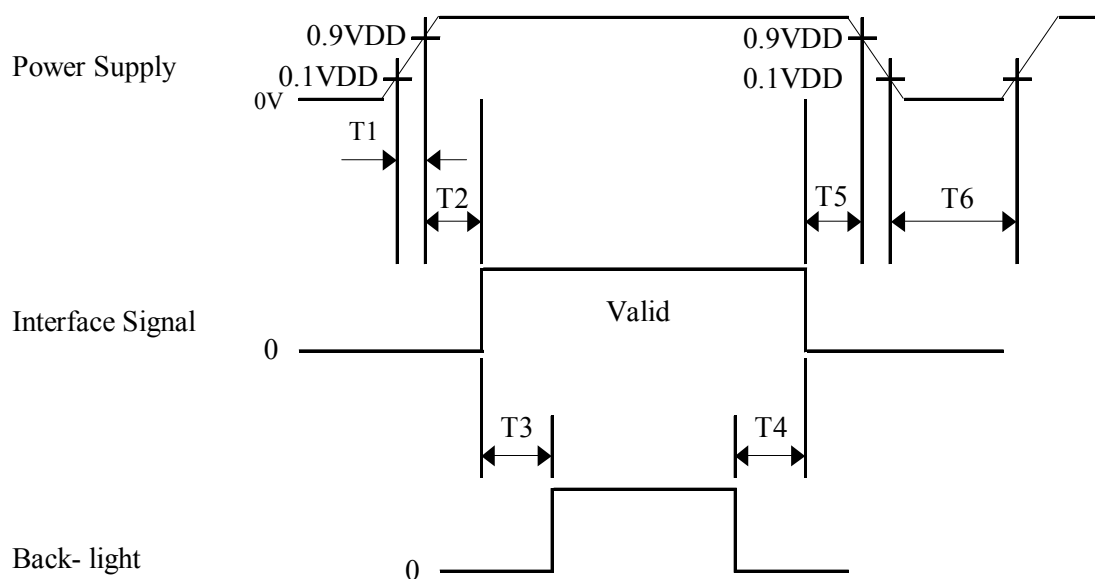
TFT-LCD PRODUCT

B

2004.12.31

### 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



- $0 < T1 \leq 10 \text{ ms}$
- $0 < T2 \leq 50 \text{ ms}$
- $100 \text{ ms} \leq T3, T4$
- $0 < T5 \leq 50 \text{ ms}$
- $1 \text{ sec} < T6$

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.

SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

16 OF 23





## PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

### 10.0 MECHANICAL CHARACTERISTICS

#### 10.1 Dimensional Requirements

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

| Parameter           | Specification                   | Unit   |
|---------------------|---------------------------------|--------|
| Dimensional outline |                                 |        |
| Horizontal          | 270.0±0.5                       | mm     |
| Vertical            | 199.0±0.5                       |        |
| Thickness           | 4.8 Typ @ Lamp, 6.7 Typ @ Pouch |        |
| Weight              | 305 typ.                        | gram   |
| Active area         | 245.76 (H) × 184.32(V)          | mm     |
| Pixel pitch         | 0.240(H) × 0.240(V)             | mm     |
| Number of pixels    | 1024(H) × 768(V)                | pixels |

#### 10.2 Mounting

See FIGURE 5 shown in appendix

#### 10.3 Glare and Polarizer Hardness.

The surface of the LCD has an glare coating 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.

SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

17 OF 23



## PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

### 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<br>(non-operating)               | Frequency : 10 ~ 500 Hz<br>Gravity/AMP : 1.5G<br>Period : X, Y, Z 30 min                  |
| 8  | Shock test<br>(non-operating)                   | Gravity : 150G<br>Pulse width : 6ms, 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                                   |

SPEC. NUMBER


S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

18 OF 23

|   |   |             |                         |
|---|---|-------------|-------------------------|
|    | <b>PRODUCT GROUP</b>                                    | <b>REV.</b> | <b>ISSUE DATE</b>       |
|   | TFT-LCD PRODUCT   | B           | 2004.12.31              |
| <p><b>12.0 HANDLING &amp; CAUTIONS</b></p> <p>12.1 Cautions when taking out the module</p> <ul style="list-style-type: none"> <li>• Pick the pouch only, when taking out module from a shipping package.</li> </ul> <p>12.2 Cautions for handling the module</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• As the LCD panel and backlight element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.</li> <li>• As the surface of the polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.</li> <li>• Do not pull the interface connector in or out while the LCD module is operating.</li> <li>• Put the module display side down on a flat horizontal plane.</li> <li>• Handle connectors and cables with care.</li> </ul> <p>12.3 Cautions for the operation</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Obey the supply voltage sequence. If wrong sequence were applied, the module would be damaged.</li> </ul> <p>12.4 Cautions for the atmosphere</p> <ul style="list-style-type: none"> <li>• Dewdrop atmosphere should be avoided.</li> <li>• 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.</li> </ul> <p>12.5 Cautions for the module characteristics</p> <ul style="list-style-type: none"> <li>• Do not apply fixed pattern data signal to the LCD module at product aging.</li> <li>• Applying fixed pattern for a long time may cause image sticking.</li> </ul> <p>12.6 Other cautions</p> <ul style="list-style-type: none"> <li>• Do not disassemble and/or re-assemble LCD module.</li> <li>• Do not re-adjust variable resistor or switch etc.</li> <li>• When returning the module for repair or etc, please pack the module not to be broken. We recommend using the original shipping packages.</li> </ul> |   |             |                         |
| <b>SPEC. NUMBER</b><br>S864-1203  | <b>SPEC. TITLE</b><br>HT12X21-240 Product Specification |             | <b>PAGE</b><br>19 OF 23 |



## PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

### 13.0 APPENDIX

Figure 1. Measurement Set Up

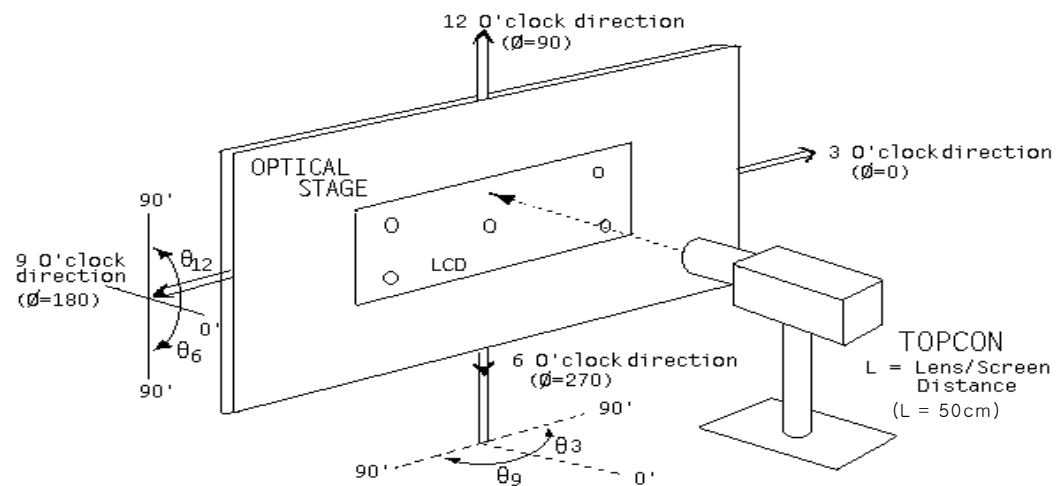
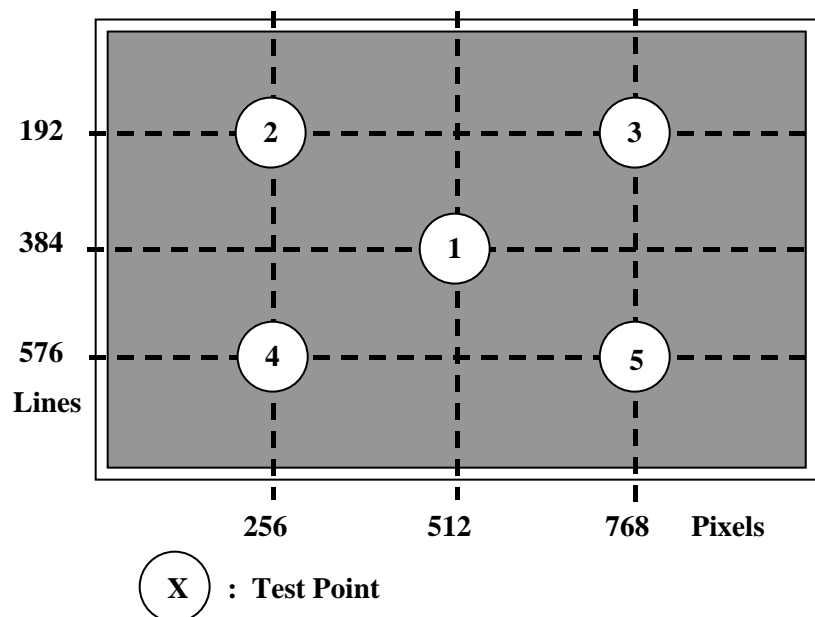


Figure 2. Average Luminance Measurement Locations & Uniformity Measurement Locations



SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

20 OF 23



# PRODUCT GROUP

REV.

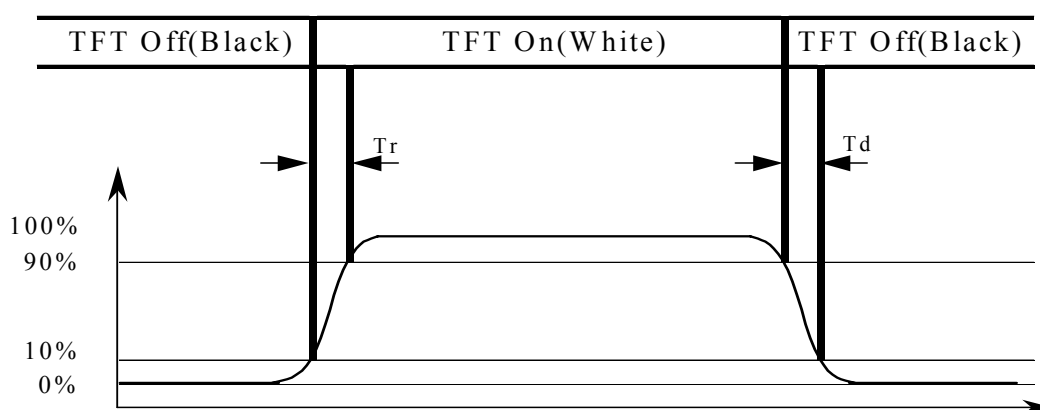
ISSUE DATE

TFT-LCD PRODUCT

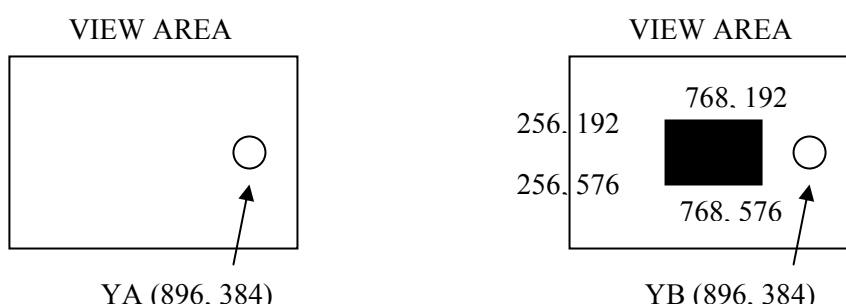
B

2004.12.31

**Figure 3. Response Time Testing**



**Figure 4. Cross Modulation Test Description**



$$\text{Cross-Talk} = \left| \frac{Y_B - Y_A}{Y_A} \right| \times 100$$

Where:

$Y_A$  = Initial luminance of measured area ( $\text{cd/m}^2$ )

$Y_B$  = Subsequent luminance of measured area ( $\text{cd/m}^2$ )

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

**SPEC. NUMBER**

S864-1203

**SPEC. TITLE**

HT12X21-240 Product Specification

**PAGE**

21 OF 23



# PRODUCT GROUP

REV.

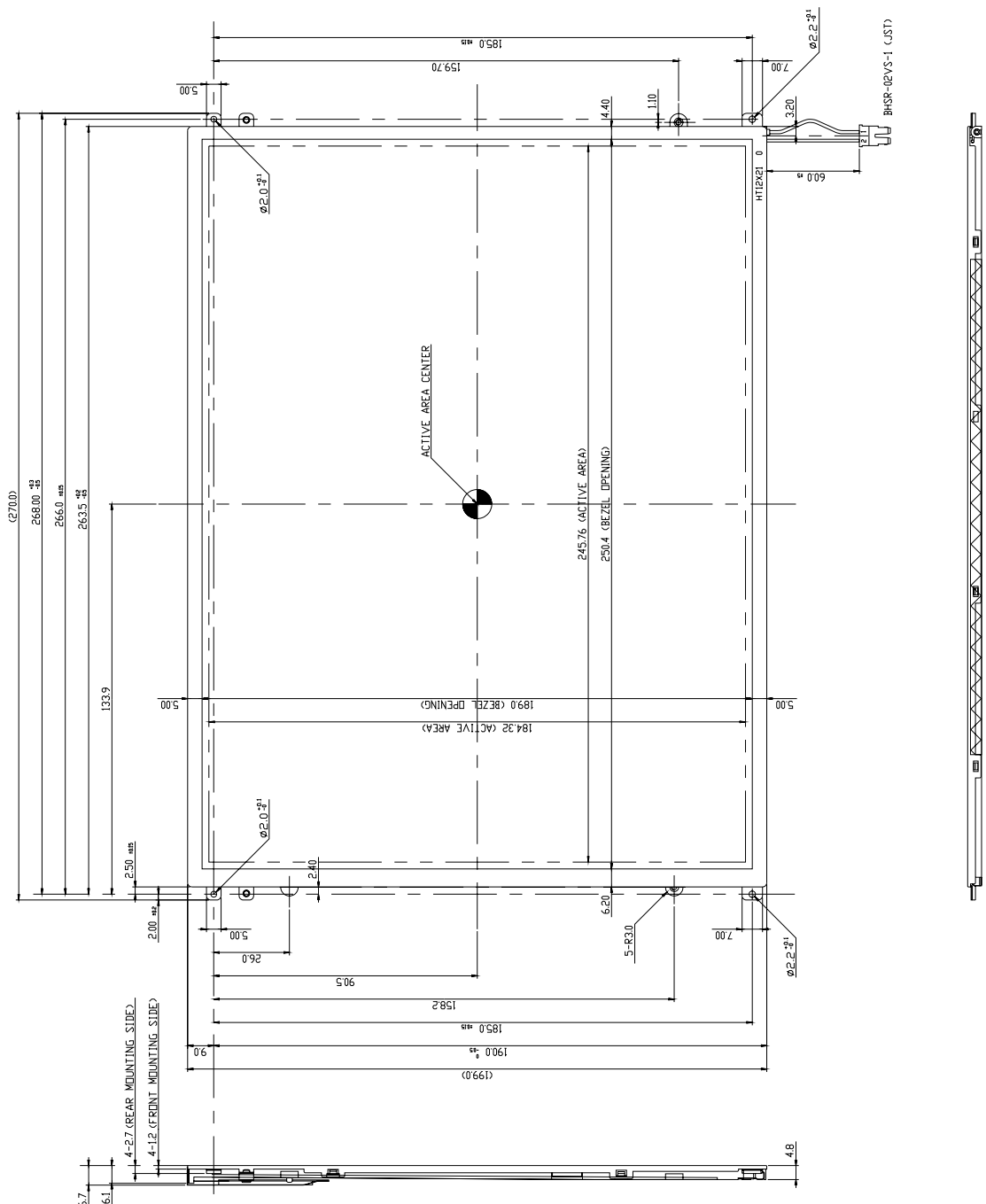
ISSUE DATE

TFT-LCD PRODUCT

B

2004.12.31

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



SPEC. NUMBER

S864-1203

SPEC. TITLE

HT12X21-240 Product Specification

PAGE

22 OF 23

