**DATE : 20.Dec.2006**

*SAMSUNG TFT-LCD*

# MODEL : LTI320AA01-001

*The Information Described in this Specification is Preliminary and can be changed without prior notice*

| APPROVED BY | DATE | PREPARED BY | DATE |
|---|---|---|---|
| *Kyunghwan Ko* | 20.Dec.2006 | **Yu Geun Lee** | 20.Dec.2006 |

Product Planning Group 3, Marketing Team

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# Contents

## * Revision History

| Date | Rev. No | Page | Summary |
|------|---------|------|---------|
| Dec 20, 2006 | 000 | all | First issued |

## General Description

### Description

LTI320AA01-001 is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT(Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit. The resolution of a 32.0" is 1366 x 768 and this model can display up to 16.7 million colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide a excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV, Display terminals for AV application products, and Digital Information Display (DID).

### Features

- RoHS compliance (Pb-free)
- High contrast ratio, High aperture ratio
- SPVA(Super Patterned Vertical Align) mode
- Wide viewing angle ($\pm$178°)
- High speed response
- WXGA (1366 x 768 pixels) resolution (16:9)
- Low Power consumption
- Direct Type 16 CCFTs(Cold Cathode Fluorescent Tube)
- DE(Data Enable) mode
- LVDS (Low Voltage Differential Signaling) interface (1pixel/clock)

## General Information

| Items | Specification | Unit | Note |
|---|---|---|---|
| Module Size | 760.0($W_{TYP}$) x 450.0($H_{TYP}$) | mm | $\pm$1.0mm |
| | 51.0($D_{MAX}$) | | |
| Weight | 7,500(Max.) | g | |
| Pixel Pitch | 0.51075(H) x 0.51075(V) | mm | |
| Active Display Area | 697.6845(H) x 392.256(V) | mm | |
| Surface Treatment | Haze 41% , Hard-coating (3H) | | |
| Display Colors | 8 bit - 16.7M | colors | |
| Number of Pixels | 1366 x 768 | pixel | |
| Pixel Arrangement | RGB vertical stripe | | |
| Display Mode | Normally Black | | |
| Luminance of White | 500 (Typ.) | cd/m$^2$ | |

# 1. Absolute Maximum Ratings

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

| Item | | Symbol | Min. | Max. | Unit | Note |
|------|------|--------|------|------|------|------|
| Power Supply Voltage | | $V_{DD}$ | GND-0.5 | 5.5 | V | (1) |
| Storage temperature | | $T_{STG}$ | -20 | 60 | ℃ | (2) |
| Glass surface temperature (Operation) | Center | $T_{OPR}$ | 0 | 50 | ℃ | (2),(5) |
| | T. Uniformity | $\triangle T$ | - | 10 | ℃ | |
| Shock ( non - operating ) | | $S_{nop}$ | - | 50 | G | (3) |
| Vibration ( non - operating ) | | $V_{nop}$ | - | 1.5 | G | (4) |

Note (1) Ta= 25 ± 2 °C
(2) Temperature and relative humidity range are shown in the figure below.
    a. 90 % RH Max. (Ta ≤ 39 °C)
    b. Relative Humidity is 90% or less. (Ta > 39 °C)
    c. No condensation
(3) 11ms, sine wave, one time for ±X, ±Y, ±Z axis
(4) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis



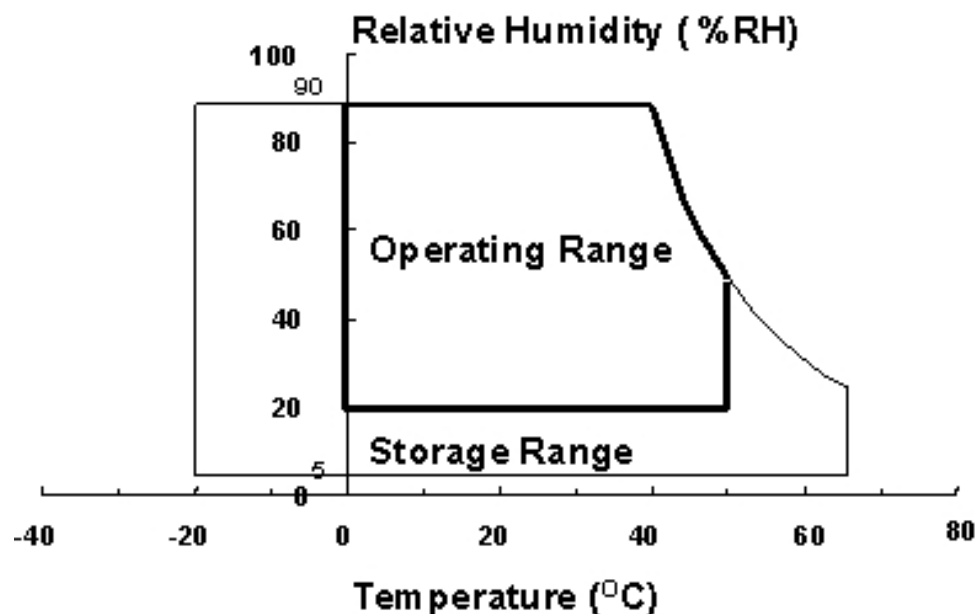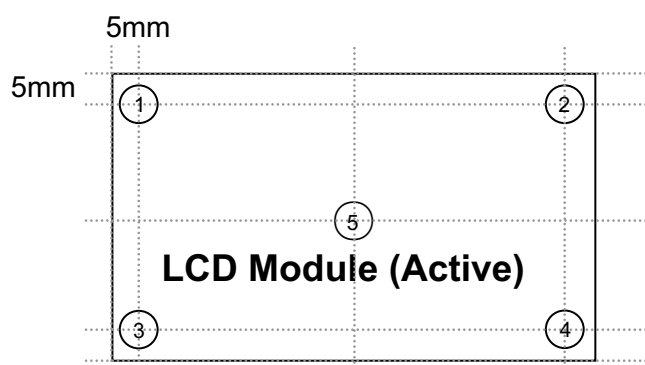**Fig. Temperature and Relative humidity range**

(5) Definition of test point

5mm

5mm



**LCD Module (Active)**

$T_{OPR}$ : Temperature of the center of the glass surface (Test point 5)
T1 ~ T4 : Temperature of each edge of the glass surface
$T_{MAX}$ : The highest temperature of the glass surface

## 2. Application information for I.D. (Information Display)

Generally large-sized LCD modules are designed for TV applications. A long-term display like DID application can cause uneven display including image retention. To optimize module's lifetime and function, several operating usages are required.

1. Normal operating condition
   - Temperature: 20 ± 15℃
   - Humidity: 65 ± 20 %
   - Display pattern: moving picture
  Note) Long-term static information image can cause uneven display.

2. Operating usages under abnormal operating condition. Note (1)
   a. Ambient condition
    - Well-ventilated place is recommended to set up I.D. system.
   b. Power off and screen saver
    - Periodical power-off or screen saver is needed after long-term static display. Note (2)

3. Operating usages to protect uneven display due to long-term static information display
   a. Suitable operating time: under 18 hours a day.
   b. Static information display is recommended to use moving picture periodically.
    - Change display to moving picture for 10 seconds after 5 minutes static information display.
   c. Background and character (image) color change
    - Use different colors for background and character (image), respectively.
    - Change colors periodically.
   d. Avoid combination of background and character with large different luminance.

Note (1) Abnormal condition means every operating condition except normal operating condition.
Note (2) Moving picture or black pattern is strongly recommended for screen saver.

4. Lifetime in this spec is guaranteed only when I.D. is used under operating usages.

# 3. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.
Measuring equipment : TOPCON BM-7,SPECTRORADIOMETER SR-3

(Ta = 25 $\pm$ 2°C, VDD = 5V, fv = 60Hz, $f_{DCLK}$ = 75MHz, $I_L$ = 7.0mArms)

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio (Center of screen) | | C/R | | 1000 | 1200 | - | | (3) SR-3 |
| Response Time | Rising | Tr | | - | 10 | 13 | msec | (5) BM-7 |
| | Falling | Tf | | - | 6 | 10 | | |
| | G-to-G | Tg | | - | 8 | - | | |
| Luminance of White (Center of screen) | | $Y_L$ | Normal $\theta$**L,R**=0 | 450 | 500 | - | cd/m² | (6) SR-3 |
| Color Chromaticity (CIE 1931) | Red | Rx | $\theta$**U,D**=0 | | 0.643 | | | (7),(8) SR-3 |
| | | Ry | | | 0.332 | | | |
| | Green | Gx | Viewing Angle | | 0.281 | | | |
| | | Gy | | TYP. -0.03 | 0.598 | TYP. +0.03 | | |
| | Blue | Bx | | | 0.143 | | | |
| | | By | | | 0.065 | | | |
| | White | Wx | | | 0.280 | | | |
| | | Wy | | | 0.290 | | | |
| Color Gamut | | - | | - | 72 | - | % | (7) SR-3 |
| Color Temperature | | - | | - | 10,000 | - | K | (7) SR-3 |
| Viewing Angle | Hor. | $\theta_L$ | C/R$\geq$10 | 75 | 89 | - | Degree | (8) SR-3 |
| | | $\theta_R$ | | 75 | 89 | - | | |
| | Ver. | $\theta_U$ | | 75 | 89 | - | | |
| | | $\theta_D$ | | 75 | 89 | - | | |
| Brightness Uniformity (9 Points) | | $B_{uni}$ | | - | - | 25 | % | (4) SR-3 |

Note (1) Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

Single lamp current : 7.0mA
Environment condition : Ta  = 25 $\pm$ 2 °C

| Photo detector | Field |
|---|---|
| SR-3 | 1° |
| BM-7 | 2° |

Photo detector

Field

SR-3 : 50㎝
BM-7 : 50㎝

TFT - LCD Module

LCD Panel

The center of the screen

Note (2) Definition of test point

|  | 228 | 683 | 1138 |
|---|---|---|---|
| 128 | ⑨ | ⑧ | ⑦ |
| 384 | ⑥ | ⑤ | ④ |
| 640 | ③ | ② | ① |

Active Area
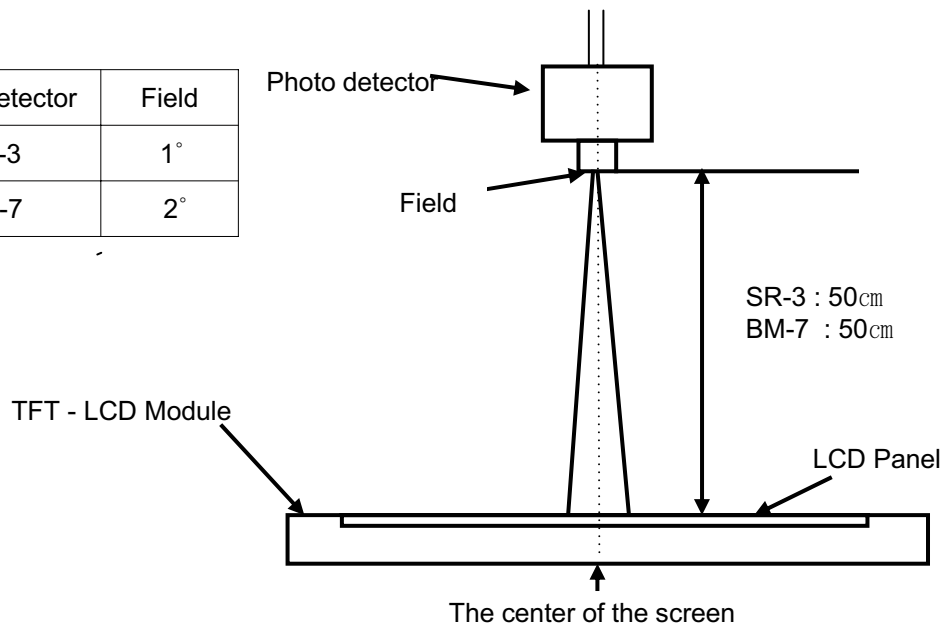
○ Test Point
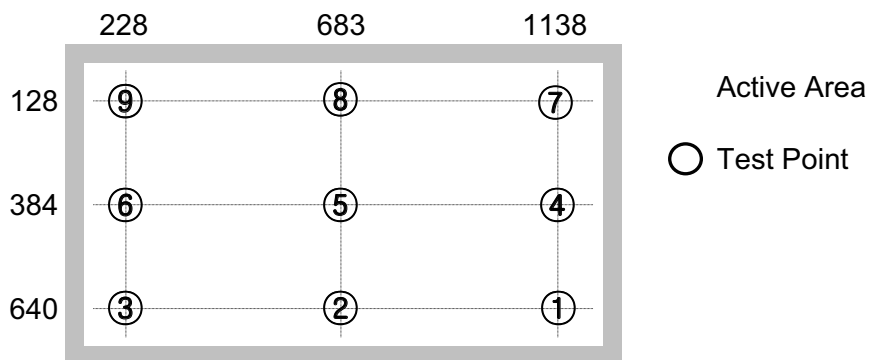
Note (3) Definition of Contrast Ratio (C/R)
: Ratio of gray max (Gmax) & gray min (Gmin) at the center point ⑤ of the panel

$$C/R = \frac{G\max}{G\min}$$

Gmax : Luminance with all pixels white
Gmin : Luminance with all pixels black

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|---|---|---|---|---|---|

Note (4) Definition of 9 points brightness uniformity

$$Buni = 100 * \frac{(B\max - B\min)}{B\max}$$

Bmax : Maximum brightness
Bmin : Minimum brightness

Note (5) Definition of Response time : Sum of Tr, Tf

| Display data | Black (data off) | White (data on) | White (data off) |

Optical Instruments Response

100%
90%

10%
0%

$T_R$     $T_F$

TIME
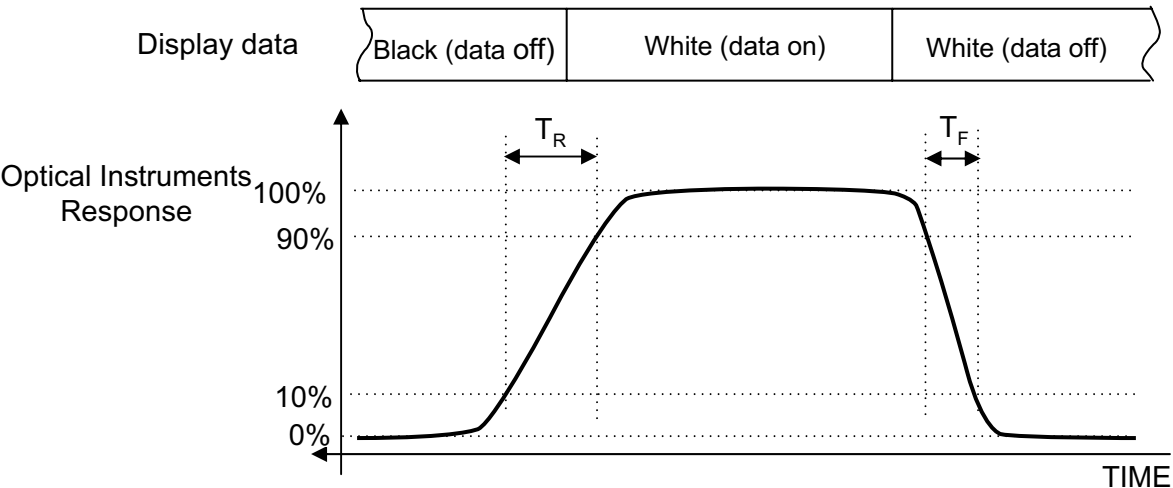
Note (6) Definition of Luminance of White : Luminance of white at center point ⑤

Note (7) Definition of Color Chromaticity (CIE 1931)
Color coordinate of Red, Green, Blue & White at center point ⑤

Note (8) Definition of Viewing Angle
: Viewing angle range (C/R ≥ 10)

$\Theta_U$
$\Theta_R$
$\Theta_L$
$\Theta_D$

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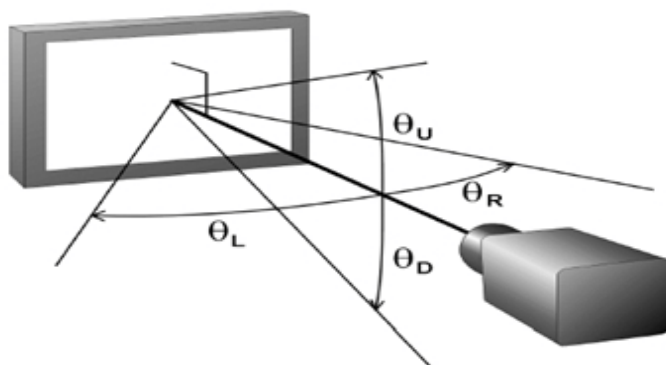
# 4. Electrical Characteristics

## 4.1 TFT LCD Module

The connector for display data & timing signal should be connected.

Ta = 25°C $\pm$ 2 °C

| Item | | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Voltage of Power Supply | | $V_{DD}$ | 4.5 | 5.0 | 5.5 | V | (1) |
| Current of Power Supply | (a) Black | $I_{DD}$ | - | 1000 | - | mA | (2),(3) |
| | (b) White | | - | 1100 | - | mA | |
| | (c) N-Pattern | | - | 1500 | 2200 | mA | |
| Vsync Frequency | | $f_V$ | 48 | 60 | 66 | Hz | |
| Hsync Frequency | | $f_H$ | 44 | 48 | 53 | kHz | |
| Main Frequency | | $f_{DCLK}$ | 65 | 75 | 82 | MHz | |
| Rush Current | | $I_{RUSH}$ | - | - | 4 | A | (4) |

Note (1) The ripple voltage should be controlled under 10% of $V_{DD}$.
(2) $f_V$ = 60Hz, $f_{DCLK}$ = 75MHz, $V_{DD}$ = 5.0V, DC Current.
(3) Power dissipation check pattern (LCD Module only)

a) Black Pattern      b) White Pattern      c) N-Pattern
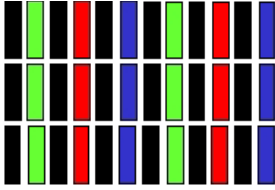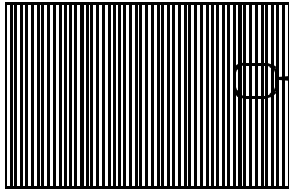
(4) Measurement Conditions

100% ........................................................ $V_{DD}$
90% .........................................................

10% .........................................................
GND

$T_{RUSH}$=470μs
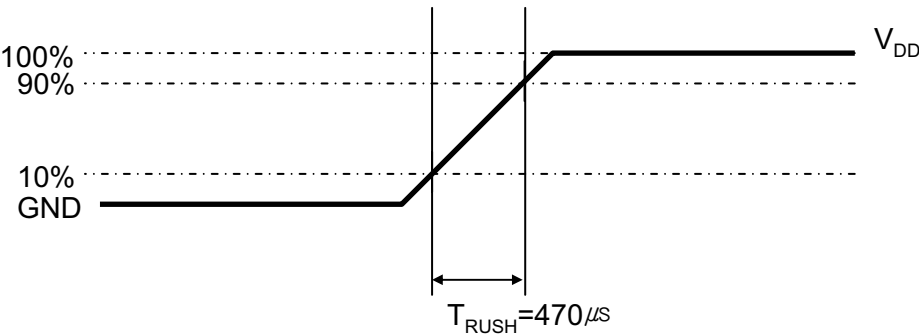
Rush Current $I_{RUSH}$ can be measured when $T_{RUSH}$. is 470μs.

## 4.2 Back Light Unit

The back light unit contains 16 direct-lighting type CCFTs (Cold Cathode Fluorescent Tube). The characteristics of lamps are shown in the following tables.

Ta=25 ± 2°C

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|------|--------|------|------|------|------|------|
| Lamp Current | $I_L$ | 3.0 | 7.0 | 7.3 | mArms | |
| Lamp Voltage | $V_L$ | - | 1200 | - | Vrms | |
| Operating Life Time | Hr | 50,000 | - | - | Hour | (1) |

Note (1) It is defined as the time to take until the brightness reduces to 50% of its original value.

[Operating condition : Ta = 25±2°C, IL = 7.0mArms, For single lamp only]
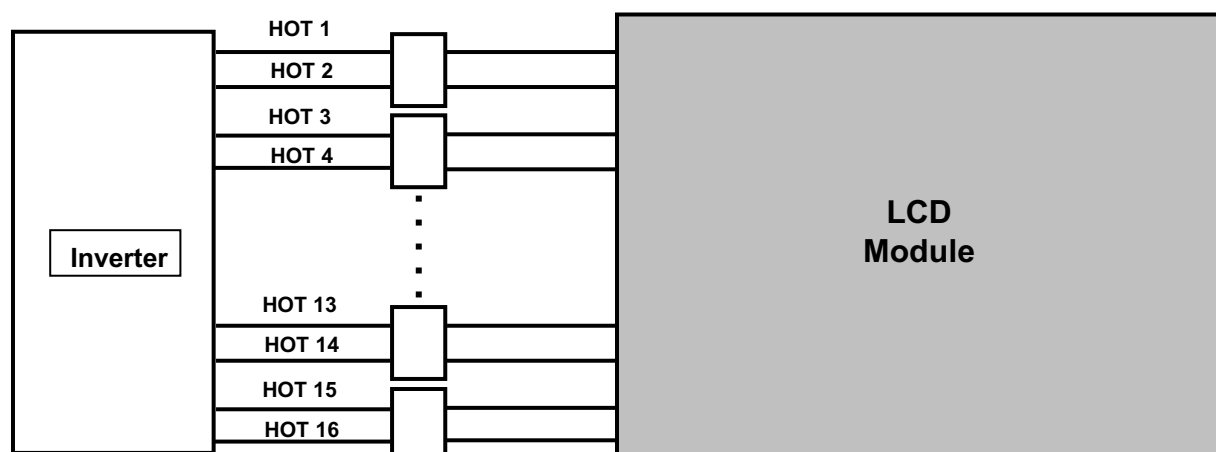
## 4.3 Inverter Input Condition & Specification

| Items | Symbol | Conditions | Specifications | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Input Voltage | Vin | - | 22 | 24 | 26 | V | Ta=25±2 °C |
| Input Current | Iin | Vin=24.0V Vdim=3.3V | - | - | 5.5 | A | After 1 hour Warm-up @Vin=24V |
| Lamp Current | $I_{O,MAX}$ | Vdim=3.3V | 6.8 | 7.3 | 7.8 | mArms | |
| Frequency | $F_{LAMP}$ | Vin=24.0V Vdim=3.3V | 60.0 | 62.5 | 65.0 | kHz | |
| Backlight On/Off | ON | Vin=24.0V | 2.4 | - | 5.25 | V | - |
| | OFF | | 0 | - | 0.8 | | |
| PWM Frequency | Fpwm | Vin = 24.0V | 135 | 150 | 165 | Hz | - |
| External PWM Dimming | - | Vin = 24.0V | 30 | - | 100 | % | (2) |
| Internal PWM Dimming | - | Vin = 24.0V | 0 | - | 3.3 | V | (3) |

Note (1) Power Consumption is measured at 500[cd/m2] of luminance condition which is the typical luminance value. Max Value of the Power Consumption is measured at initial turn-on of the backlight. Lamp Current is measured at the point before Lamp.

Note (2) High-duty = On/(On+Off) * 100
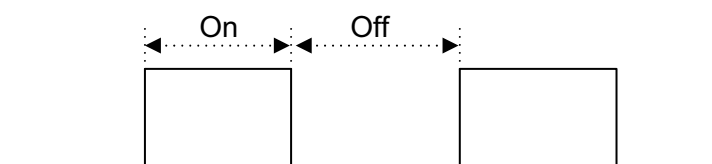


(3) Internal PWM Dimming
- Analog DC Voltage 0 V    : Minimum Duty (20%)
- Analog DC Voltage 3.3 V : Maximum Duty (100%)

## 5. Input Terminal Pin Assignment

### 5.1 Input Signal & Power                                    Connector : FI-E30S (JAE)

| PIN No. | Description | PIN No. | Description |
|---------|-------------|---------|-------------|
| 1 | No Connection (Note 1) | 16 | GND |
| 2 | No Connection (Note 1) | 17 | RxIN3- |
| 3 | No Connection (Note 1) | 18 | RxIN3+ |
| 4 | GND | 19 | GND |
| 5 | RxIN0- | 20 | GND |
| 6 | RxIN0+ | 21 | LVDS Option (Note 2) |
| 7 | GND | 22 | No Connection (Note 1) |
| 8 | RxIN1- | 23 | GND |
| 9 | RxIN1+ | 24 | GND |
| 10 | GND | 25 | GND |
| 11 | RxIN2- | 26 | Vdd (5V) |
| 12 | RxIN2+ | 27 | Vdd (5V) |
| 13 | GND | 28 | Vdd (5V) |
| 14 | RxCLK- | 29 | Vdd (5V) |
| 15 | RxCLK+ | 30 | Vdd (5V) |

Note (1) No Connection :These pins are only used for SAMSUNG internal purpose.
   (2)  LVDS Option : High (3.3 V) or Open (N.C) → Normal LVDS format
                  : Low (GND)  →  JEIDA LVDS format
   Sequence :On  = $V_{DD}$(T1) ≥ LVDS Option ≥ Interface Signal(T2)
                  OFF =  Interface Signal(T3) ≥ LVDS Option ≥ $V_{DD}$

Note (3) Pin number starts from Right side
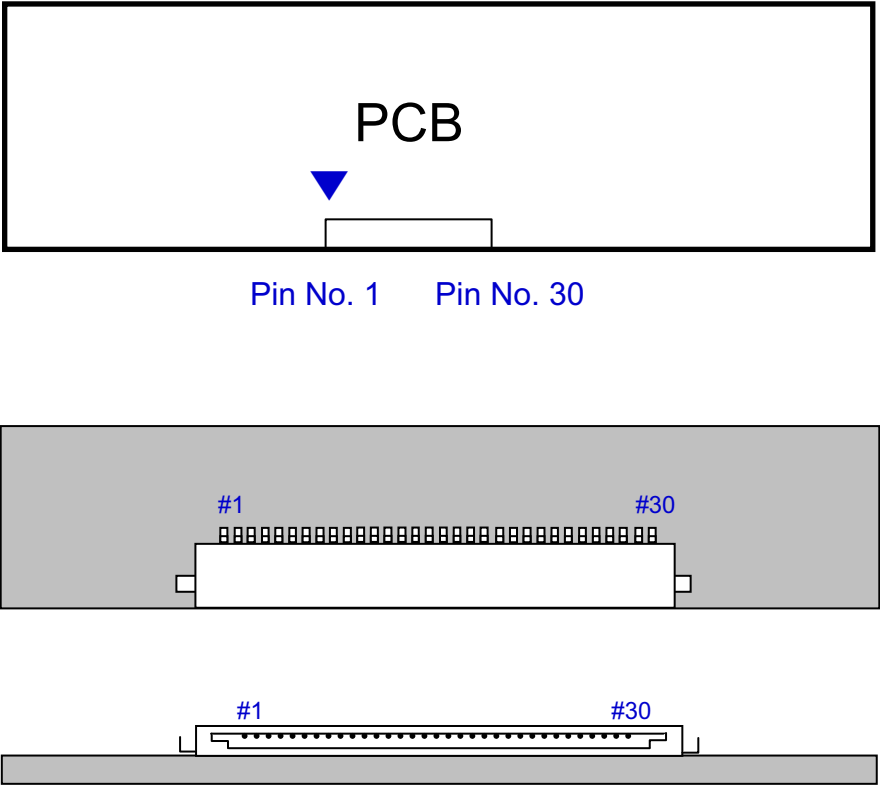


**Fig. Connector diagram**

    a. All GND pins should be connected together and  also be connected to the LCD's
       metal chassis.
    b. All power input pins should be connected together.
    c. All N.C pins should be separated from other signal or power.

## 5.2 Inverter Input Pin Configuration

Connector : JST, S14B-PHA-SM-TB(LF)

| Pin No. | Pin Configuration(FUNCTION) |
|---------|------------------------------|
| 1 | Vin (24V) |
| 2 | Vin (24V) |
| 3 | Vin (24V) |
| 4 | Vin (24V) |
| 5 | Vin (24V) |
| 6 | GND |
| 7 | GND |
| 8 | GND |
| 9 | GND |
| 10 | GND |
| 11 | No Connection |
| 12 | Backlight On /Off [ON:2.4 ~ 5.25 V, OFF: -0.3 ~ 0.8 V] |
| 13 | Internal PWM Dimming [0V:Min, 3.3V:Max] |
| 14 | External PWM Dimming [30%:Min, 100%:Max] |

Note) External PWM Dimming → Pin 13 : 3.3V or Open, Pin 14 : External PWM Pulse
      Internal PWM Dimming → Pin 13 : DC Voltage, Pin 14 :Open

## 5.3 Inverter Input Power Sequence
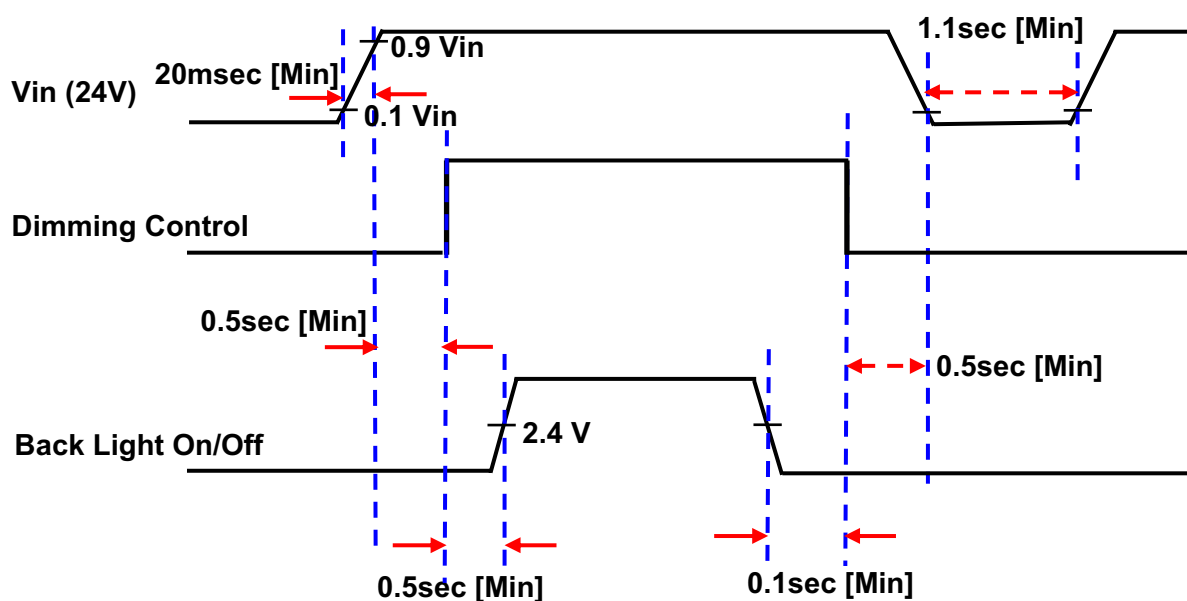
### 5.4 LVDS Interface
- LVDS Receiver : Tcon (merged)
- Data Format (JEIDA & Normal)          Default LVDS Option : VESA

|  | LVDS pin | JEIDA -DATA | VESA -DATA |
|---|---|---|---|
| TxOUT/RxIN0 | TxIN/RxOUT0 | R2 | R0 |
|  | TxIN/RxOUT1 | R3 | R1 |
|  | TxIN/RxOUT2 | R4 | R2 |
|  | TxIN/RxOUT3 | R5 | R3 |
|  | TxIN/RxOUT4 | R6 | R4 |
|  | TxIN/RxOUT6 | R7 | R5 |
|  | TxIN/RxOUT7 | G2 | G0 |
| TxOUT/RxIN1 | TxIN/RxOUT8 | G3 | G1 |
|  | TxIN/RxOUT9 | G4 | G2 |
|  | TxIN/RxOUT12 | G5 | G3 |
|  | TxIN/RxOUT13 | G6 | G4 |
|  | TxIN/RxOUT14 | G7 | G5 |
|  | TxIN/RxOUT15 | B2 | B0 |
|  | TxIN/RxOUT18 | B3 | B1 |
| TxOUT/RxIN2 | TxIN/RxOUT19 | B4 | B2 |
|  | TxIN/RxOUT20 | B5 | B3 |
|  | TxIN/RxOUT21 | B6 | B4 |
|  | TxIN/RxOUT22 | B7 | B5 |
|  | TxIN/RxOUT24 | HSYNC | HSYNC |
|  | TxIN/RxOUT25 | VSYNC | VSYNC |
|  | TxIN/RxOUT26 | DEN | DEN |
| TxOUT/RxIN3 | TxIN/RxOUT27 | R0 | R6 |
|  | TxIN/RxOUT5 | R1 | R7 |
|  | TxIN/RxOUT10 | G0 | G6 |
|  | TxIN/RxOUT11 | G1 | G7 |
|  | TxIN/RxOUT16 | B0 | B6 |
|  | TxIN/RxOUT17 | B1 | B7 |
|  | TxIN/RxOUT23 | RESERVED | RESERVED |

## 5.5 Input Signals, Basic Display Colors and Gray Scale of Each Color

| COLOR | DISPLAY (8bit) | RED | | | | | | | | GREEN | | | | | | | | BLUE | | | | | | | | GRAY SCALE LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R0 | R1 | R2 | R3 | R4 | R5 | R6 | R7 | G0 | G1 | G2 | G3 | G4 | G5 | G6 | G7 | B0 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | |
| 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 | - |
| | BLUE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | GREEN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | 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 | - |
| | RED | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | 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 | - |
| 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 | 0 | R0 |
| | DARK ↑ | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R1 |
| | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R2 |
| | | : | : | : | : | : | : | | | : | : | : | : | : | : | | | : | : | : | : | : | : | | | R3~ |
| | ↓ | : | : | : | : | : | : | | | : | : | : | : | : | : | | | : | : | : | : | : | : | | | R252 |
| | LIGHT | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R253 |
| | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R254 |
| | RED | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R255 |
| 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 | G0 |
| | DARK ↑ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G1 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G2 |
| | | : | : | : | : | : | : | | | : | : | : | : | : | : | | | : | : | : | : | : | : | | | G3~ |
| | ↓ | : | : | : | : | : | : | | | : | : | : | : | : | : | | | : | : | : | : | : | : | | | G252 |
| | LIGHT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G253 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G254 |
| | GREEN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G255 |
| 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 | B0 |
| | DARK ↑ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | B1 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | B2 |
| | | : | : | : | : | : | : | | | : | : | : | : | : | : | | | : | : | : | : | : | : | | | B3~ |
| | ↓ | : | : | : | : | : | : | | | : | : | : | : | : | : | | | : | : | : | : | : | : | | | B252 |
| | LIGHT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | B253 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | B254 |
| | BLUE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | B255 |

Note) Definition of Gray :
   Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)
   Input Signal : 0 = Low level voltage, 1 = High level voltage

## 6. Interface Timing

### 6.1 Timing Parameters (DE only mode)

| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Clock | Frequency | $1/T_C$ | 65 | 75 | 82 | MHz | - |
| Hsync | | $F_H$ | 44 | 48 | 53 | KHz | - |
| Vsync | | $F_V$ | 48 | 60 | 66 | Hz | - |
| Vertical Display Term | Active Display Period | $T_{VD}$ | - | 768 | - | Lines | - |
| | Vertical Total | $T_{VB}$ | 773 | 838 | 1200 | Lines | - |
| Horizontal Display Term | Active Display Period | $T_{HD}$ | - | 1366 | - | Clocks | - |
| | Horizontal Total | $T_H$ | 1460 | 1600 | 2000 | clocks | - |

Note) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.
Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

## 6.2 Timing diagrams of interface signal (DE only mode)
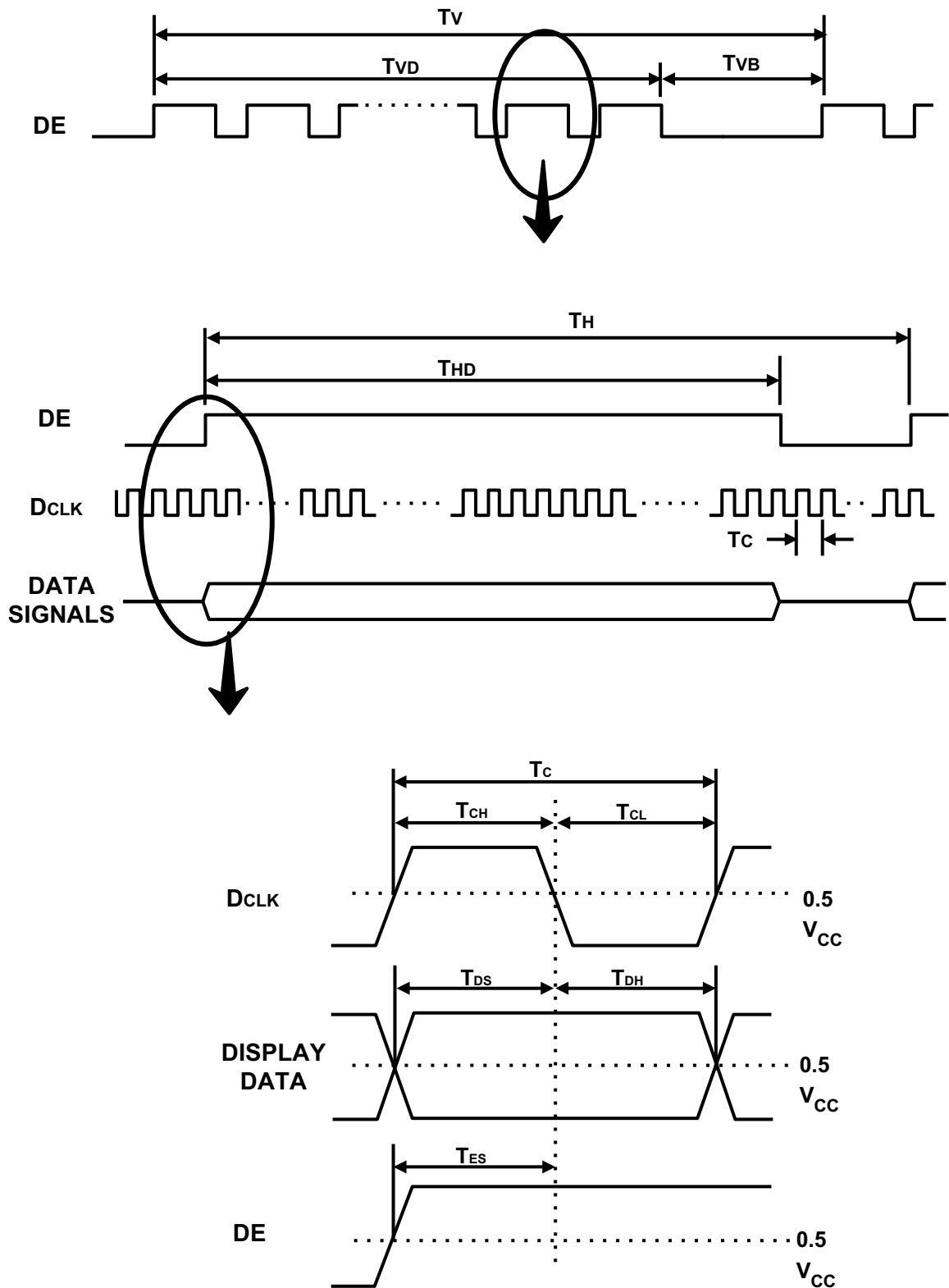
## 6.3 Power ON/OFF Sequence

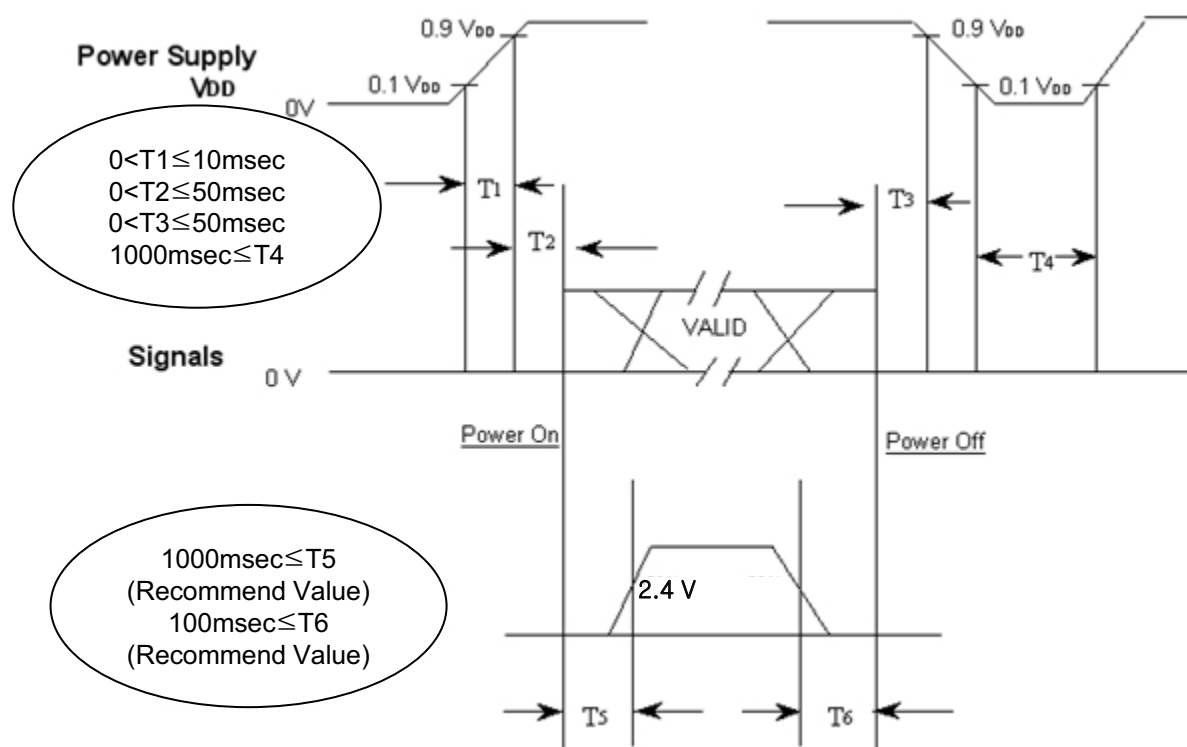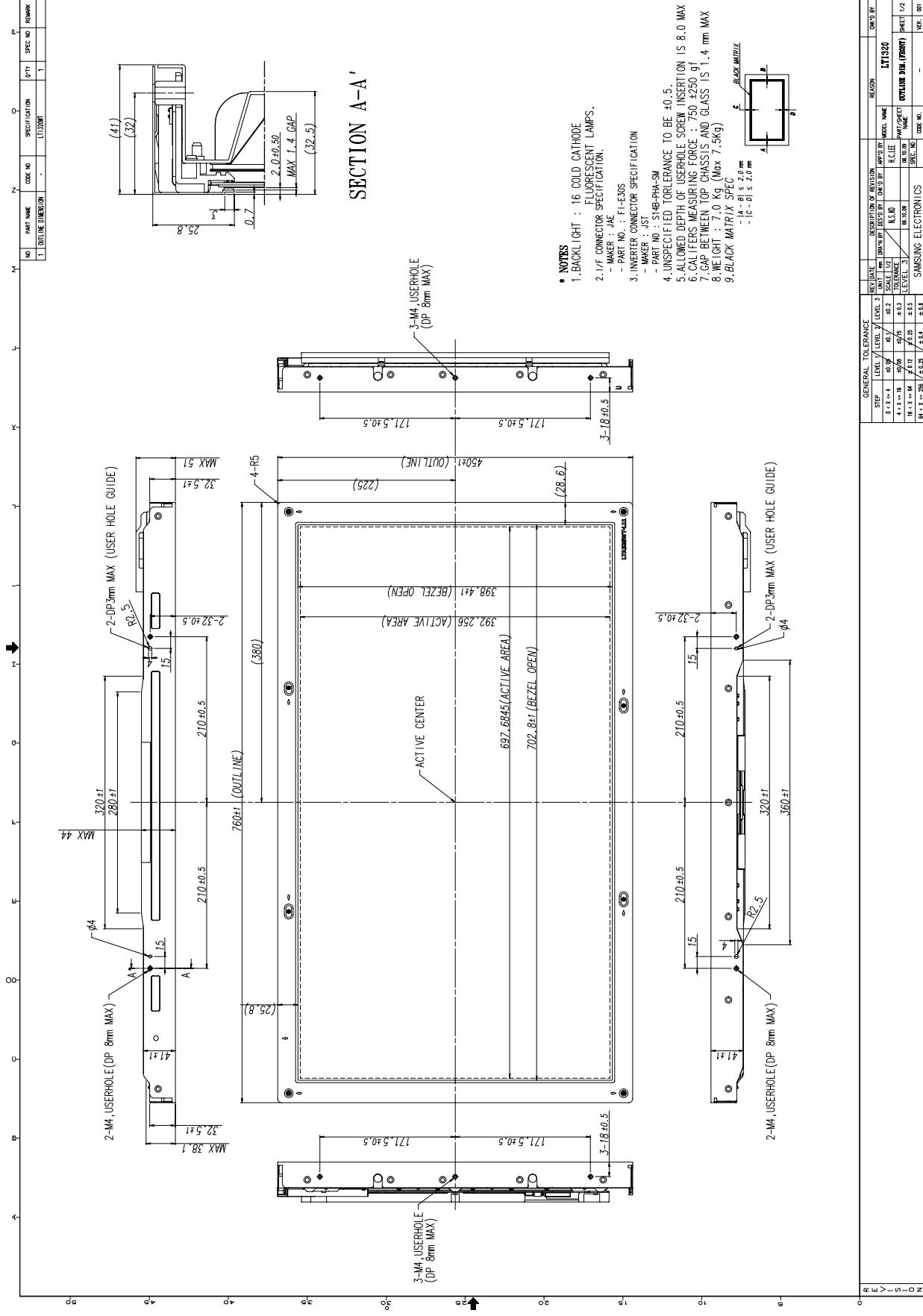To prevent a latch-up or DC operation of the LCD Module, the power on/off sequence should be as the diagram below.

**Power Supply $V_{DD}$**

$0.9 V_{DD}$
$0.1 V_{DD}$
$0V$

0<T1≤10msec
0<T2≤50msec
0<T3≤50msec
1000msec≤T4

T1
T2
T3
T4

VALID

**Signals** 0 V

Power On

Power Off

1000msec≤T5
(Recommend Value)
100msec≤T6
(Recommend Value)

2.4 V

T5
T6

T1 : $V_{DD}$ rising time from 10% to 90%
T2 : The time from $V_{DD}$ to valid data at power ON.
T3 : The time from valid data off to $V_{DD}$ off at power Off.
T4 : $V_{DD}$ off time for Windows restart
T5 : The time from valid data to B/L enable at power ON.
T6 : The time from valid data off to B/L disable at power Off.

- The supply voltage of the external system for the Module input should be the same as the definition of $V_{DD}$.
- Apply the lamp voltage within the LCD operation range. When the back light turns on before the LCD operation or the LCD turns off before the back light turns off, the display may momentarily show abnormal screen.
- In case of $V_{DD}$ = off level, please keep the level of input signals low or keep a high impedance.
- T4 should be measured after the Module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.

# 7. Outline Dimension (Front View)

SECTION A-A'

* NOTES
1. BACKLIGHT : 16 COLD CATHODE FLUORESCENT LAMPS.
2. I/F CONNECTOR SPECIFICATION.
   - MAKER : JAE
   - PART NO. : FI-E30S
3. INVERTER CONNECTOR SPECIFICATION
   - MAKER : JST
   - PART NO : S14B-PHA-SM
4. UNSPECIFIED TOLERANCE TO BE ±0.5.
5. ALLOWED DEPTH OF USERHOLE SCREW INSERTION IS 8.0 MAX
6. CALIFERS MEASURING FORCE : 750 ±250 gf
7. GAP BETWEEN TOP CHASSIS AND GLASS IS 1.4 mm MAX
8. WEIGHT : 7.0 Kg (Max 7.5Kg)
9. BLACK MATRIX SPEC
   - IA - BI ≤ 2.0 mm
   - IC - DI ≤ 2.0 mm

BLACK MATRIX

| GENERAL TOLERANCE | | | |
|---|---|---|---|
| UNIT : mm | LEVEL 1/ | LEVEL 2/ | LEVEL 3 |
| STEP | | | |
| 0 < X < 4 | ±0.0 | ±0.1 | ±0.2 |
| 4 < X < 16 | ±0/08 | ±0/15 | ±0.3 |
| 16 < X < 64 | ±0.12 | ±0.25 | ±0.5 |
| 64 < X < 256 | ±0.25 | ±0.4 | ±0.6 |

| REV DATE | DESCRIPTION OF REVISION | DRW'N BY | DES'D BY | CHK'D BY | APPD BY |
|---|---|---|---|---|---|
| | | N.S.KU | | | W.C.LEE |
| | 06.10.09 | | | | 06.10.09 |

MODEL NAME : LTI320
PART/SHEET NAME : OUTLINE DIM.(FRONT)
SPEC. NO / CODE. NO : -

SAMSUNG ELECTRONICS

SCALE : 1/2
TOLERANCE
LEVEL 3
SHEET 1/2
VER. 001

| NO | PART NAME | CODE NO | SPECIFICATION | Q'TY | SPEC NO | REMARK |
|---|---|---|---|---|---|---|
| 1 | OUTLINE DIMENSION | - | LTI320WT | 1 | | |

ACTIVE CENTER

3-M4,USERHOLE (DP 8mm MAX)
2-M4,USERHOLE(DP 8mm MAX)
2-DP3mm MAX (USER HOLE GUIDE)

# 7. Outline Dimension (Rear View)



DETAIL "A" (4PARTS)

REAR MOUNT 4x2-M4 (DP= 4mm)
4-LOCATION PIN BOSS Ø5.0(HT=1.5)
4-EMBOSS(HT=4mm)

LAMP SUPPORT AREA
HT MAX 3.5mm

2-BEAD(HT=0.5mm)

| NO | PART NAME | CODE NO | SPECIFICATION | Q'TY | SPEC NO | REMARK |
|---|---|---|---|---|---|---|
| | OUTLINE DIMENSION | - | LTI320WT | 1 | | |

SAMSUNG ELECTRONICS

| GENERAL TOLERANCE | | | | |
|---|---|---|---|---|
| STEP | LEVEL 1 | LEVEL 2 | LEVEL 3 | UNIT mm |
| 0 < X ≤ 4 | ±0.05 | ±0.1 | ±0.2 | SCALE 1/2 |
| 4 < X ≤ 16 | ±0.08 | ±0.15 | ±0.3 | TOLERANCE |
| 16 < X ≤ 64 | ±0.12 | ±0.25 | ±0.5 | |
| 64 < X ≤ 256 | ±0.25 | ±0.4 | ±0.8 | |

| | | DESCRIPTION OF REVISION | | | CHG'D BY |
|---|---|---|---|---|---|
| REV | DATE | DRA'N BY | DES'D BY | CHK'D BY | APP'D BY | |
| | | N.S.KO | | | | |
| | 06.10.09 | | | | H.C.LEE | |

REASON
MODEL NAME | LTI320
PART/SHEET NAME | OUTLINE DIM.(REAR) | SHEET 2/2
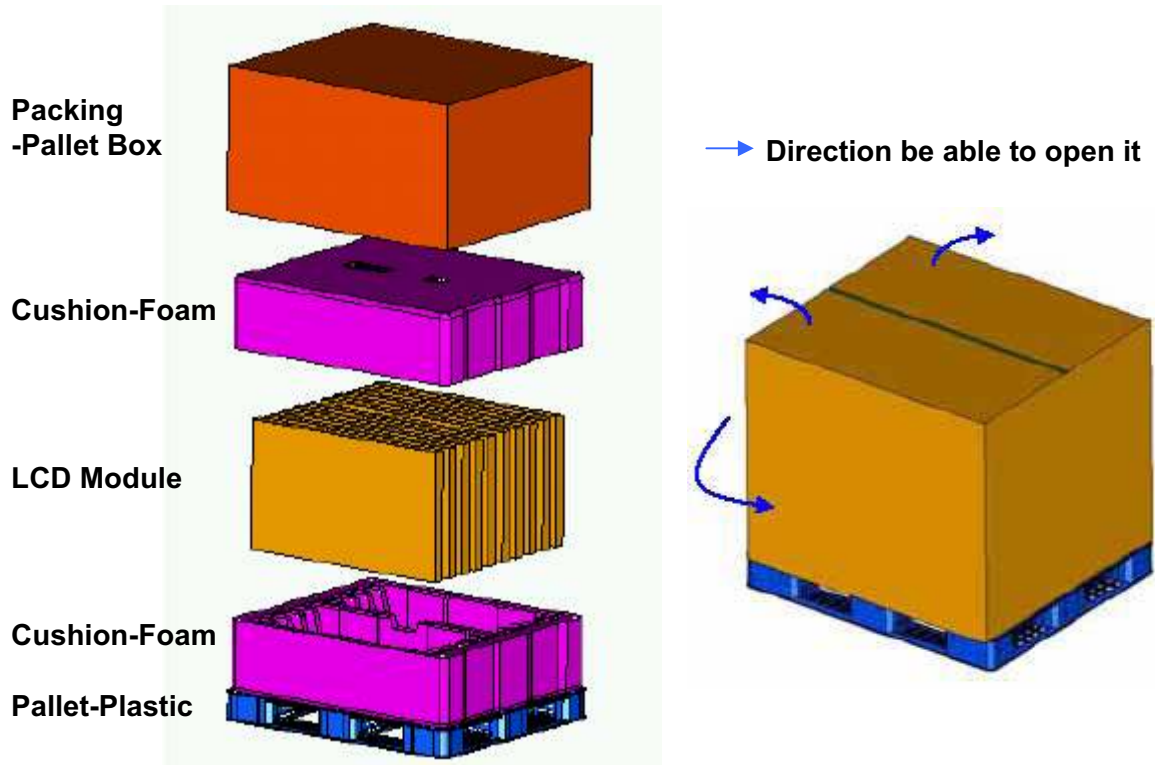CODE NO. | - | VER. 001
SPEC. NO

## 8. PACKING

### 8.1 CARTON (Internal Package)
 (1) Packing Form
    Corrugated fiberboard box and corrugated cardboard as shock absorber
 (2) Packing Method



**Packing
-Pallet Box**

**Cushion-Foam**

**LCD Module**

**Cushion-Foam**

**Pallet-Plastic**

→ **Direction be able to open it**

### 8.2 Packing Specification

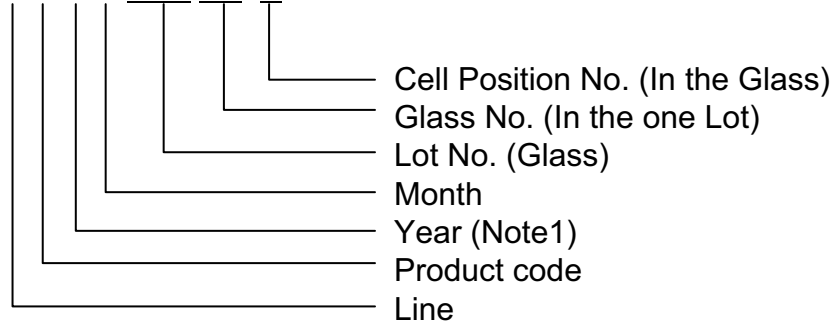| Item | Specification | Remark |
|---|---|---|
| LCD Packing | 12ea / (Packing-Pallet Box) | 1. 84Kg / LCD (12ea)<br>2. 7 Kg / Cushion-pallet (2ea)<br>3. 8.8 Kg / Packing-Pallet Box (1ea)<br>4. Cushion-pallet Material : EPS<br>5. Packing-Pallet Box Material : DW4 |
| Pallet | 1Box / Pallet | 1. Pallet weight = 8.0kg |
| Packing Direction | Vertical | |
| Total Pallet Size | H x V x height | 1150mm(H) x 985mm(V) x 125mm(height) |
| Total Pallet Weight | 107.8 kg | Pallet(8kg) + Module (7.0*12=84kg) + Cushion (up + bottom=7kg) + Pallet-BOX(8.8kg) |

## 9. MARKING & OTHERS

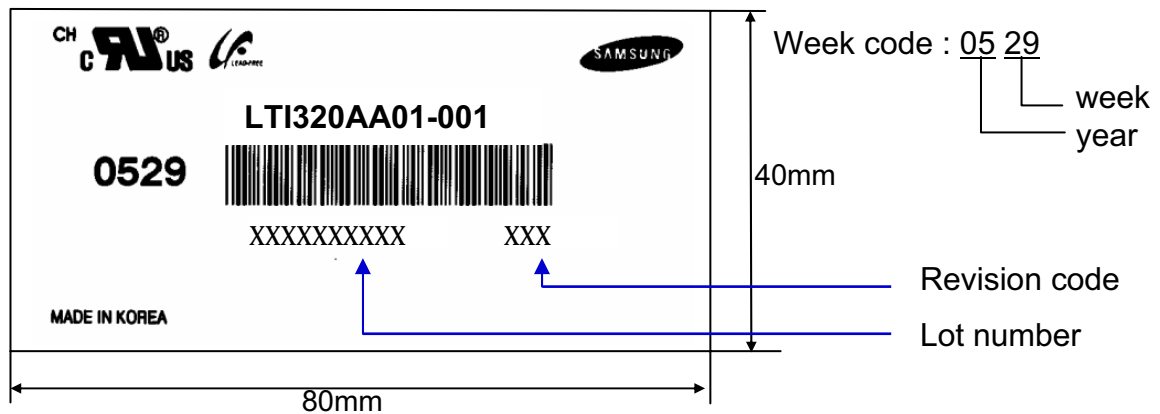A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

(1) Part number : LTI320AA01-001
(2) Revision: Three letters
(3) Lot number : X X X X XXX XX  X

- Cell Position No. (In the Glass)
- Glass No. (In the one Lot)
- Lot No. (Glass)
- Month
- Year (Note1)
- Product code
- Line

(4) Nameplate Indication

LTI320AA01-001

0529

XXXXXXXXXX    XXX

MADE IN KOREA

80mm

40mm

Week code : 05 29

- week
- year

Revision code

Lot number

(5) Packing box attach

DVC : LTI320AA01-001
TYPE:    XXXX
QTY :    12

ZAT53K0003    G1

100mm

165mm

Part number

Box serial number

(6) Others
1. After service part
   Lamps cannot be replaced because of the narrow bezel structure.

| MODEL | LTI320AA01-001 | Doc. No | 05-000-G-061220 | Page | 24 / 27 |
|-------|----------------|---------|-----------------|------|---------|

## 10. General Precautions

10.1 Handling

(a) When the Module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist and bend the Module.

(b) Because the inverter use high voltage, it should be disconnected from power before it is assembled or disassembled.

(c) Refrain from strong mechanical shock and / or any force to the Module. In addition to damage, this may cause improper operation or damage to the Module and CCFT back light.

(d) Note that polarizers are very fragile and could be damage easily. Do not press or scratch the surface harder than a HB pencil lead.

(e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.

(f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.

(g) Desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away with soap thoroughly.

(i) Protect the Module from static, or the CMOS Gate Array IC would be damaged.

(j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(k) Do not disassemble the Module.

(l) Do not pull or fold the lamp wire.

(m) Do not adjust the variable resistor located on the Module.

(n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized.

(o) Pins of I/F connector should not be touched directly with bare hands.

## 10.2 Storage

(a) Do not leave the Module in high temperature, and high humidity for a long time.
   It is highly recommended to store the Module with temperature from 0 to 35℃
   and relative humidity of less than 70%.

(b) Do not store the TFT-LCD Module in direct sunlight.

(c) The Module should be stored in a dark place. It is prohibited to apply sunlight or
   fluorescent light in storing.


## 10.3 Operation

(a) Do not connect or disconnect the Module in the "Power On" condition.

(b) Power supply should always be turned on/off  by the "Power on/off sequence"

(c) Module has high frequency circuits. Sufficient suppression to the electromagnetic
   interference should be done by system manufacturers.
   Grounding and shielding methods may be important to minimize the interference.

(d) The cable between the back light connector and its inverter power supply should
   be connected directly with a minimized length. A longer cable between
   the back light and the inverter may cause lower luminance of lamp(CCFT) and
   may require higher startup voltage(Vs).

## 10.4 Operation Condition Guide

(a) The LCD product should be operated under normal conditions.
    Normal condition is defined as below;
        - Temperature : 20±15℃
        - Humidity : 55±20%
        - Display pattern : continually changing pattern (Not stationary)

(b) If the product will be used in extreme conditions such as high temperature,
   humidity, display patterns or operation time etc.., It is strongly recommended
   to contact SEC for Application engineering advice. Otherwise, its reliability and
   function may not be guaranteed. Extreme conditions are commonly found at
   Airports, Transit Stations, Banks, Stock market, and Controlling systems.

10.5 Others

   (a) Ultra-violet ray filter is necessary for outdoor operation.

   (b) Avoid condensation of water. It may result in improper operation or disconnection
        of electrode.

   (c) Do not exceed the absolute maximum rating value. ( supply voltage variation,
        input voltage variation, variation in part contents and environmental temperature,
        and so on)
        Otherwise the Module may be damaged.

   (d) If the Module keeps displaying the same pattern for a long period of time,
        the image may be "sticked" to the screen.
        To avoid image sticking, it is recommended to use a screen saver.

   (e) This Module has its circuitry PCB's on the rear side and should be handled
        carefully in order not to be stressed.

   (f)  Please contact SEC in advance when you display the same pattern for a long time.