

**SAMSUNG DISPLAY**

# Product Specification

- ( ) Product Information  
( ) Preliminary Specification  
( ☒ ) Approval Specification

*Any modification of Spec is not allowed without SDC's permission.*

|               |               |
|---------------|---------------|
| CUSTOMER      | G/A Customers |
| DATE OF ISSUE | 12/26/2012    |

|                |            |
|----------------|------------|
| MODEL NO.      | LTI460HN08 |
| EXTENSION CODE | -0         |

| Customer Approval & Feedback |
|------------------------------|
|                              |

|                                                                          |                                       |
|--------------------------------------------------------------------------|---------------------------------------|
| Approved by                                                              | <i>Kang Sang Rae</i><br>12/26/2012    |
| Prepared by                                                              | <i>Hyun Chang, KANG</i><br>12/26/2012 |
| <b>LCD Sales &amp; Marketing Team</b><br><b>Samsung Display Co., Ltd</b> |                                       |

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**REVISION HISTORY**

| Date.      | Rev.No. | Page | Revision Description |
|------------|---------|------|----------------------|
| 12/26/2012 | 000     | all  | First issued         |

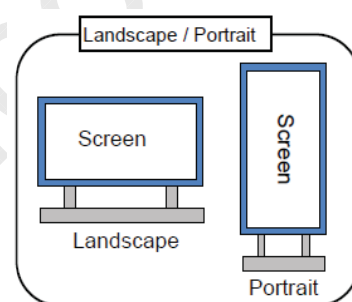
## GENERAL DESCRIPTION

### DESCRIPTION

This model uses a 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 ass'y KIT of source PBA and BLU(Back light Unit) Ass'y. This 46.0" model has a resolution of 1920 x 1080 pixels (16:9) can display up to 16.7 Million colors with the wide viewing angle of 89° or higher in all directions.

### FEATURES

High contrast ratio & aperture ratio with the wide color gamut  
SVA(Super Vertical Align) mode  
Wide viewing angle ( $\pm 178^\circ$ )  
High speed response  
FHD(1920X1080) resolution (16:9)  
Edge LED(Light Emitted Diode) BLU  
RoHS compliance (Pb-free)  
Low power consumption  
DE(Data Enable) mode  
2 Channel LVDS (Low Voltage Differential Signaling) interface  
The interface (2pixel/clock) of LVDS serial interface  
Landscape / Portrait type compatible  
High Tni Liquid Crystal (85°C)



### APPLICATIONS

Digital Information Display (DID)  
High Definition Public Monitor

### GENERAL INFORMATION

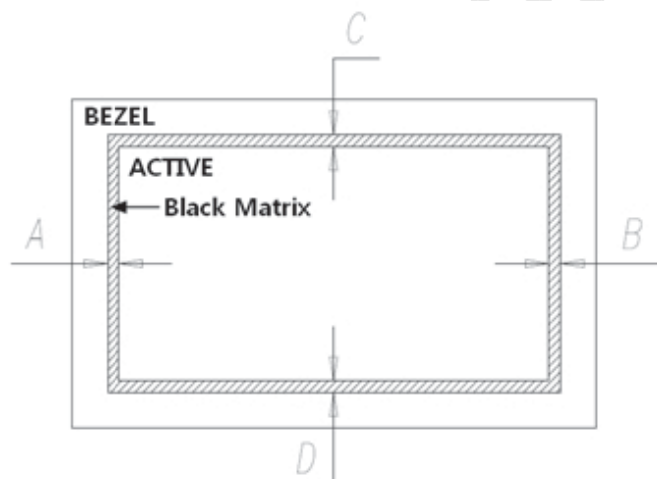
| Items                | Specification          | Unit              | Note       |
|----------------------|------------------------|-------------------|------------|
| Active Display area  | 1018.08(H) X 572.67(V) | mm                |            |
| Switching Components | a-Si TFT active matrix |                   |            |
| Module Size          | 1047.4(H) x 600.6 (V)  | mm                | Typ        |
|                      | 10.8(D)                | mm                | Typ        |
| Weight               | 12400                  | g                 | Typ        |
| Display colors       | 16.7M (8bits-True)     | Color             |            |
| Number of pixels     | 1,920 x 1,080          | Pixel             | 16:9       |
| Pixel Arrangement    | RGB Vertical stripe    |                   |            |
| Display Mode         | Normally Black         |                   | Anti-Glare |
| Surface Treatment    | Haze 44% / 3H          |                   |            |
| Luminance of White   | 700(Typ)               | cd/m <sup>2</sup> |            |

## MECHANICAL INFORMATION

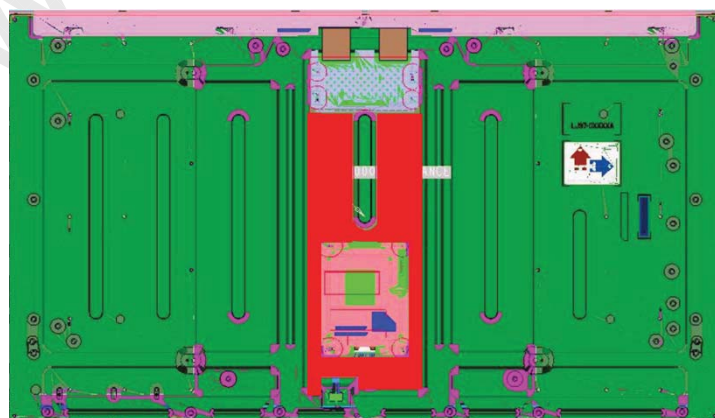
| Item               |                | Min.   | Typ.   | Max.   | Unit | Note              |
|--------------------|----------------|--------|--------|--------|------|-------------------|
| Module Size        | Horizontal (H) | 1046.4 | 1047.4 | 1048.4 | mm   |                   |
|                    | Vertical (V)   | 599.6  | 600.6  | 601.6  | mm   |                   |
|                    | Depth (D)      | 9.8    | 10.8   | 12.8   | mm   | Minimum Depth (2) |
| Bezel Open         | Horizontal (H) | -      | 1025.4 | -      | mm   |                   |
|                    | Vertical (V)   | -      | 578.6  | -      | mm   |                   |
| Black Matrix Shift | Horizontal (H) | -      | -      | 2.0    | mm   | (1)               |
|                    | Vertical (V)   | -      | -      | 2.0    | mm   |                   |
| Weight             |                | -      | 12,400 | 13,400 | g    |                   |

Note (1) Measure the figure for **Black Matrix shift** to be recorded on the spec. with referring to the drawings.

- $|A - B| \leq \text{Horizontal Spec}$
- $|C - D| \leq \text{Vertical Spec}$



Note (2) Measure point of Depth



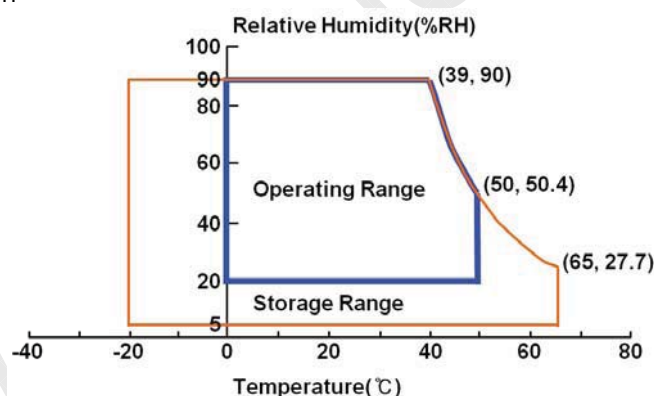
## 1. ABSOLUTE MAXIMUM RATINGS

### 1.1 ENVIRONMENTAL ABSOLUTE RATINGS

| Item                                  |              | Symbol              | Min. | Max. | Unit | Note     |
|---------------------------------------|--------------|---------------------|------|------|------|----------|
| Storage temperature                   |              | T <sub>STG</sub>    | -20  | 65   | °C   | (1)      |
| Operation Temperature                 |              | T <sub>OPR</sub>    | 0    | 50   | °C   | (1)      |
| Humidity of storage                   |              | H <sub>SUR</sub>    | 5    | 90   | %RH  |          |
| Operating humidity                    |              | H <sub>OPR</sub>    | 20   | 90   | %RH  |          |
| Glass surface Temperature (Operation) | Center       | T <sub>CENTER</sub> | 0    | 50   | °C   |          |
|                                       | T Uniformity | ΔT                  | -    | 10   | °C   |          |
| Shock ( non-operating )               |              | Snop(X,Y)           | -    | 40   | G    | (2), (4) |
|                                       |              | Snop(Z)             | -    | 40   |      |          |
| Vibration (non-operating)             |              | V <sub>nop</sub>    | -    | 1.5  | G    | (3), (4) |

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

- 90 % RH Max. (Ta ≤ 39 °C)
- Relative Humidity is 90% or less. (Ta > 39 °C)
- No condensation

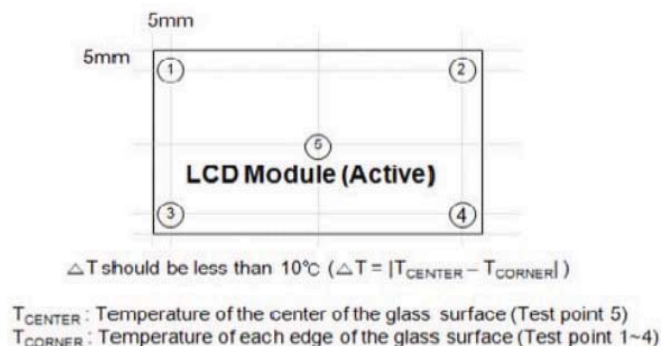


Note (2) 11ms half sine wave, one time for ±X, ±Y, ±Z axis.

Note (3) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis.

Note (4) The fixture for the test of the vibration and shock, which holds the module to be tested shall be hard and rigid in order for the module not to be twisted or bent by the fixture.

Note (5) Definition of Test point



## 1.2 ELECTRICAL ABSOLUTE RATINGS

### (1) TFT LCD MODULE

| Item                 | Symbol           | Min. | Typ. | Max. | Unit | Note    |
|----------------------|------------------|------|------|------|------|---------|
| Power Supply Voltage | V <sub>DD</sub>  | 10.8 | -    | 13.2 | V    | (1),(2) |
| Dimming Control      | V <sub>dim</sub> | 0    | -    | 5.25 | V    |         |

Note (1) Within Ta (25 ± 2 °C )

(2) The permanent damage or defect to the device may occur if the panel is operated at the figure set, which exceeds a limit of maximum value stated in the former spec. The functional operation should be limited to the conditions described above under normal operating conditions.

### (2) BACKLIGHT UNIT

| Item                             | Symbol          | Min. | Typ. | Max. | Unit | Note |
|----------------------------------|-----------------|------|------|------|------|------|
| Input Supply Voltage / Converter | V <sub>CC</sub> | 22   | 24   | 26   | V    |      |

## 1.3 The Others Absolute Ratings

### STATIC ELECTRICITY PRESSURE RSISTANCE

| Item              | Symbol                                       | Min.      |
|-------------------|----------------------------------------------|-----------|
| CONTACT DISCHARGE | 150pF, 330Ω, ± 10kV, 200points, 1 time/point | Operating |
| AIR DISCHARGE     | 150pF, 330Ω, ± 20kV, 200points, 1 time/point | Operating |

## **2. APPLICATION INFORMATION FOR DID (Digital Information Display)**

A DID's screen may display the sudden image such as an image retention.

To extend the lifetime and optimize a function of module, the below-mentioned operating conditions are required.

### **2.1 Normal operating condition**

- a. Temperature: 20 ±15℃
- b. Humidity: 55 ±20 %
- c. Display pattern: Moving image or image, which switches regularly.  
Note) The sudden image on the screen can be displayed after the static image is shown in the long-term.

### **2.2 The operating conditions when the module is operated under the abnormal condition.**

- a. Ambient condition
  - It is recommended to set the DID up in the well-ventilated place.
- b. The function of power off and screen saver
  - The function of periodical power-off or a screen saver is needed when the static image is displayed in the long-term.

### **2.3 Operating conditions to prevent the sudden display resulted from displaying the static image in the long-term.**

- a. The proper operating time: Under 20 hours a day.
- b. The moving image shall be inserted between the static displays periodically.
  - The refresh time for liquid crystal is needed.
- c. The periodic changing of background color and character's color(image)
  - Use the different color for background and character (image) respectively.
  - Change colors periodically.
- d. Avoid combining the color for background with the color for character, which has a largely different luminance.

Note (1) Abnormal condition means all operating condition except normal operating condition.

Note (2) The moving image or black pattern is strongly recommended as a screen saver.

### **2.4 Only the lifetime of DID stated in this spec is guaranteed if the DID is used under the proper operating conditions.**



### 3. OPTICAL CHARACTERISTICS

The optical characteristics should be measured in a dark room or the space surrounded by the similar ambient setting.

Measuring equipment : TOPCON RD-80S, SR-3, ELDIM EZ-Contrast Ta(25± 2 °C)

| Item                                            |              | Symbol           | Condition                                 | Min.          | Typ.  | Max.         | Unit              | Note                       |
|-------------------------------------------------|--------------|------------------|-------------------------------------------|---------------|-------|--------------|-------------------|----------------------------|
| Contrast Ratio                                  |              | C/R              | -                                         | 3000          | 4000  | -            | -                 | (1) SR-3                   |
| Response time                                   | G-to-G (AVG) | T <sub>g</sub>   | -                                         | -             | 8     | 16           | msec              | (3) RD-80S                 |
| Luminance of White<br>(At the center of screen) |              | Y <sub>L</sub>   | -                                         | 600           | 700   | -            | cd/m <sup>2</sup> | (4) SR-3                   |
| Color Chromaticity<br>(CIE 1931)                | Red          | R <sub>X</sub>   | Normal<br>ϕ = 0<br>θ = 0<br>Viewing Angle | TYP.<br>-0.03 | 0.640 | TYP<br>+0.03 | -                 | (5), (6)<br>SR-3           |
|                                                 |              | R <sub>Y</sub>   |                                           |               | 0.330 |              |                   |                            |
|                                                 | Green        | G <sub>X</sub>   |                                           |               | 0.300 |              |                   |                            |
|                                                 |              | G <sub>Y</sub>   |                                           |               | 0.600 |              |                   |                            |
|                                                 | Blue         | B <sub>X</sub>   |                                           |               | 0.150 |              |                   |                            |
|                                                 |              | B <sub>Y</sub>   |                                           |               | 0.060 |              |                   |                            |
|                                                 | White        | W <sub>X</sub>   |                                           |               | 0.280 |              |                   |                            |
|                                                 |              | W <sub>Y</sub>   |                                           |               | 0.290 |              |                   |                            |
| Color Gamut                                     |              | -                | -                                         | 67            | 70    | -            | %                 | (5)<br>SR-3                |
| Color temperature                               |              | -                | -                                         | -             | 10000 | -            | K                 |                            |
| Viewing Angle                                   | Hor.         | θ <sub>L</sub>   | CR ≥ 10                                   | 79            | 89    | -            | Degree            | (6)<br>SR-3<br>EZ-Contrast |
|                                                 |              | θ <sub>R</sub>   |                                           | 79            | 89    | -            |                   |                            |
|                                                 | Ver.         | θ <sub>U</sub>   |                                           | 79            | 89    | -            |                   |                            |
|                                                 |              | θ <sub>D</sub>   |                                           | 79            | 89    | -            |                   |                            |
| Brightness Uniformity<br>(9 Point)              |              | B <sub>uni</sub> | -                                         | -             | -     | 25.0         | %                 | (2)<br>SR-3                |

\* Ta = 25 ± 2 °C, VDD = 3.3V, fv=60Hz, fDCLK = 148.5MHz, IF =100% duty

\* If =560mA (each String 140mA), VF=100.8 (4 LED String)

## Notice (a) Setup for test equipment

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

The environment condition :  $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$

## Note (1) Definition of contrast ratio (C/R)

: The Ratio of max. gray (Gmax) & min. gray (Gmin) at the center point ⑤ of the panel.

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

Gmax : Luminance in all white pixels

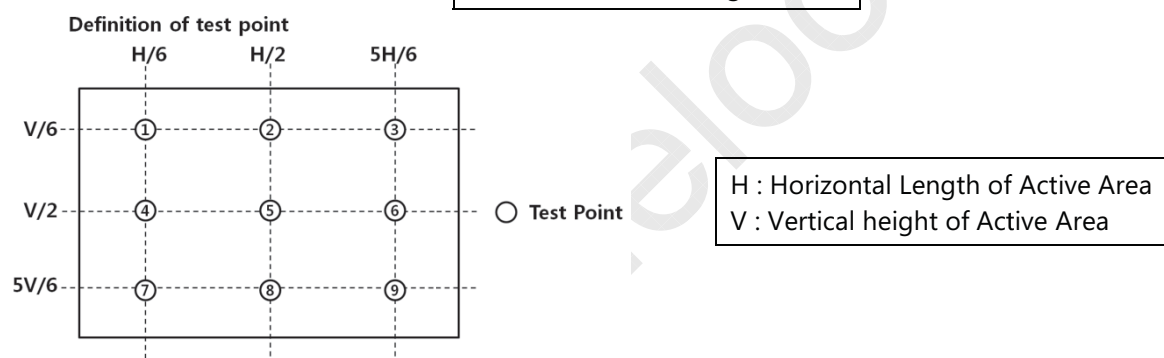
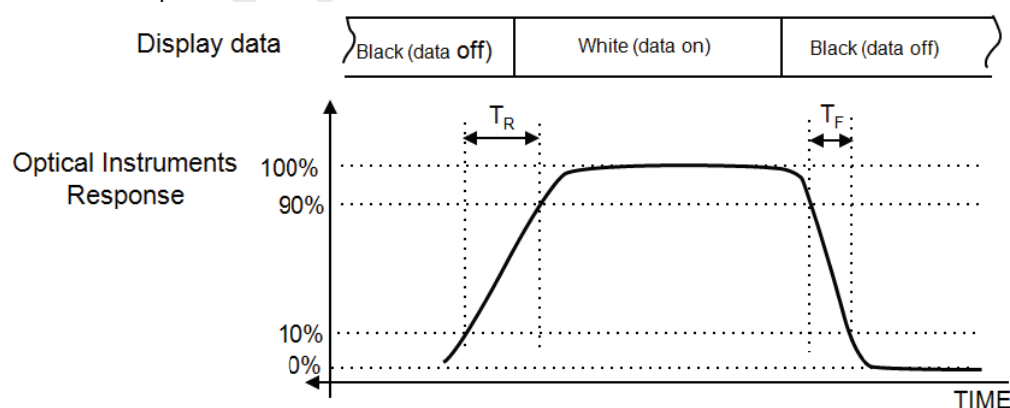
Gmin : Luminance in all black pixels.

## Note (4) Definition of brightness uniformity at 9 points ( Test pattern : Full white )

$$B_{uni} = 100 * \frac{(B_{\max} - B_{\min})}{B_{\max}}$$

Bmax : Maximum brightness

Bmin : Minimum brightness

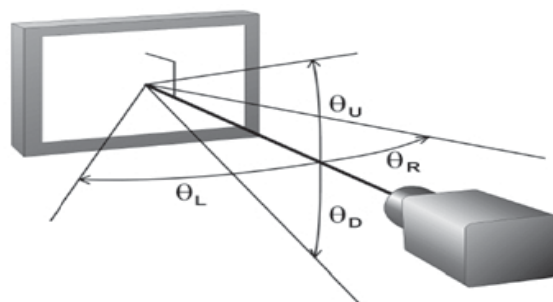
Note (3) Definition of Response time : Sum of  $T_r$ ,  $T_f$ 

※ G-to-G : Average response time between the whole gray scale to the whole gray scale.

Note (4) Definition of Luminance of White : Luminance of white at center point ⑤

Note (5) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red, Green, Blue & White at center point ⑤



Note (6) Definition of Viewing Angle : Viewing angle range ( $C/R \geq 10$ )

## 4. ELECTRICAL CHARACTERISTICS

### 4.1 TFT LCD MODULE

The connector to transmit a display data and a timing signal should be connected.

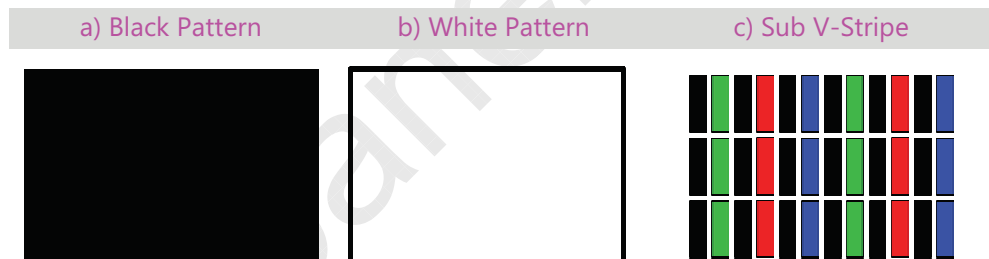
$T_a = 25 \pm 2^\circ\text{C}$

| Item                    | Symbol           | Min. | Typ.  | Max.  | Unit | Note     |
|-------------------------|------------------|------|-------|-------|------|----------|
| Voltage of Power Supply | $V_{DD}$         | 10.8 | 12.0  | 13.2  | V    | (1)      |
| Current of Power Supply | (a) Black        | 450  | 600   | 750   | mA   | (2), (3) |
|                         | (b) White        | 1000 | 1250  | 1500  |      |          |
|                         | (c) Sub V-Stripe | 1000 | 1250  | 1500  |      |          |
| Vsync Frequency         | $f_V$            | 48   | 60    | 62    | Hz   | -        |
| Hsync Frequency         | $f_H$            | 54   | 67.5  | 69.75 | kHz  | -        |
| Main Frequency          | $F_{dclk}$       | 100  | 148.5 | 150   | MHz  | -        |
| Rush Current            | $I_{RUSH}$       | -    | -     | 5.0   | A    | (4)      |

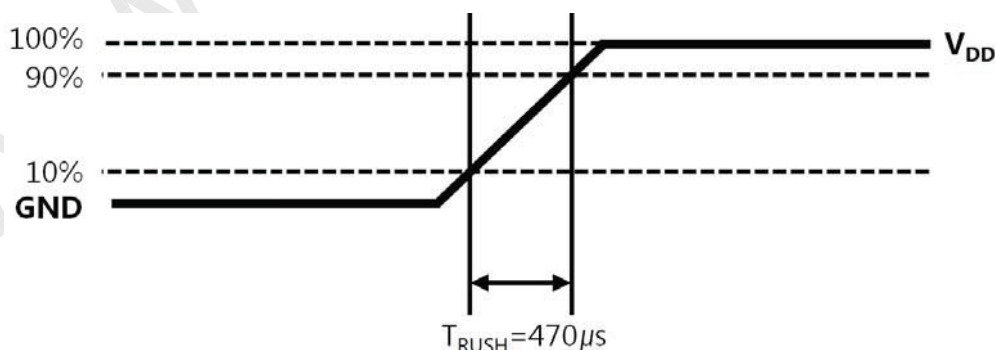
Note (1) The ripple voltage should be controlled under 10% of  $V_{DD}$ .

Note (2)  $f_V=60\text{Hz}$ ,  $f_{DCLK}=148.5\text{MHz}$ ,  $V_{DD}=12.0\text{V}$ , DC Current.

Note (3) The pattern for checking the power dissipation (LCD module only).



Note (4) Conditions for measurement



The rush current,  $I_{RUSH}$  can be measured when  $T_{RUSH}$  is  $470\mu\text{s}$ .

## 4.2 BACK LIGHT UNIT

| Item                | Min. | Typ.   | Max. | Unit | Note |
|---------------------|------|--------|------|------|------|
| Operating Life Time | -    | 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℃]

## 4.3 CONDITION & SPECIFICATION OF CONVERTER'S INPUT

| Items                    | Symbol                       | Conditions                                         | Specifications |      |      | Unit               | Note                                 |
|--------------------------|------------------------------|----------------------------------------------------|----------------|------|------|--------------------|--------------------------------------|
|                          |                              |                                                    | Min.           | Typ. | Max. |                    |                                      |
| Input Voltage            | V <sub>in</sub>              | -                                                  | 22             | 24   | 26   | V                  | Ta=25±2 °C                           |
| Inrush Current (*2)      | Inrush                       | V <sub>in</sub> = 24.0V<br>dim =Max                | -              | -    | 6.7  | A                  | Normal Mode<br>Note (2),(3)          |
| Output Current (*1)      | I <sub>LED</sub>             | V <sub>in</sub> = 22.0~26.0V<br>dim =Max           | 133            | 140  | 147  | mA <sub>mean</sub> | After 1 hour<br>Warm-up,<br>@1string |
| Converter On/Off Control | ENA                          | Enable                                             | 2.4            | -    | 5.25 | V                  | -                                    |
|                          |                              | Disable                                            | -0.3           | -    | 0.8  |                    |                                      |
| A <sub>DIM</sub>         | V <sub>A_DIM</sub>           | V <sub>IN</sub> = 24V                              | 0              | -    | 3.3  | V                  | -                                    |
|                          | D <sub>A_DIM</sub><br>(Duty) | V <sub>IN</sub> = 24V<br>V <sub>A_DIM</sub> = 3.3V | -              | -    | 100  | %                  |                                      |
|                          |                              | V <sub>IN</sub> = 24V<br>V <sub>A_DIM</sub> = 0V   | 20             | -    | -    | %                  |                                      |

Note (1) All data was approved after running 120 minutes.

(2) Inrush is measured within BLU on 10ms after leaving the BLU as it is at least 1hr or more at room temperature(25℃)

(3) Additional Appendix for Input current at room temperature (25℃)

| Items                       | Symbol      | Conditions            | Specifications |      |      | Unit              | Note                               |
|-----------------------------|-------------|-----------------------|----------------|------|------|-------------------|------------------------------------|
|                             |             |                       | Min.           | Typ  | Max. |                   |                                    |
| Input Current (Normal Mode) | Iovershoot  | V <sub>in</sub> =24V, | -              | 5.35 | 5.51 | A <sub>mean</sub> | Overshoot Current After Turn-on    |
|                             | Isaturation | Dim=Max               | -              | 5.18 | 5.32 | A <sub>mean</sub> | Saturation current after 1hr aging |

## 5. INPUT TERMINAL PIN ASSIGNMENT

### 5.1 INPUT SIGNAL & POWER

Connector : FI-RE51S-HF-J (JAE)

| PIN No. |                       | Description | PIN No. | Description    |          |
|---------|-----------------------|-------------|---------|----------------|----------|
| 1       | V <sub>DD</sub> (12V) |             | 26      | LVDS<br>Signal | Rx2[A]P  |
| 2       | V <sub>DD</sub> (12V) |             | 27      |                | Rx2[B]N  |
| 3       | V <sub>DD</sub> (12V) |             | 28      |                | Rx2[B]P  |
| 4       | V <sub>DD</sub> (12V) |             | 29      |                | Rx2[C]N  |
| 5       | V <sub>DD</sub> (12V) |             | 30      |                | Rx2[C]P  |
| 6       | No Connection         |             | 31      | GND            |          |
| 7       | GND                   |             | 32      | LVDS<br>Clock  | Rx2CLK_N |
| 8       | GND                   |             | 33      |                | Rx2CLK_P |
| 9       | GND                   |             | 34      | GND            |          |
| 10      | LVDS<br>Signal        | Rx1[A]N     | 35      | LVDS<br>Signal | Rx2[D]N  |
| 11      |                       | Rx1[A]P     | 36      |                | Rx2[D]P  |
| 12      |                       | Rx1[B]N     | 37      | No Connection  |          |
| 13      |                       | Rx1[B]P     | 38      | No Connection  |          |
| 14      |                       | Rx1[C]N     | 39      | GND            |          |
| 15      |                       | Rx1[C]P     | 40      | No Connection  |          |
| 16      | GND                   |             | 41      | No Connection  |          |
| 17      | LVDS<br>Clock         | Rx1CLK_N    | 42      | No Connection  |          |
| 18      |                       | Rx1CLK_P    | 43      | No Connection  |          |
| 19      | GND                   |             | 44      | No Connection  |          |
| 20      |                       | Rx1[D]N     | 45      | LVDS_SEL       |          |
| 21      |                       | Rx1[D]P     | 46      | No Connection  |          |
| 22      | No Connection         |             | 47      | No Connection  |          |
| 23      | No Connection         |             | 48      | No Connection  |          |
| 24      | GND                   |             | 49      | No Connection  |          |
| 25      | LVDS Signal           | Rx2[A]N     | 50      | No Connection  |          |
|         |                       |             | 51      | No Connection  |          |

Note (1) No Connection : These pins are only used for SAMSUNG internal purpose.

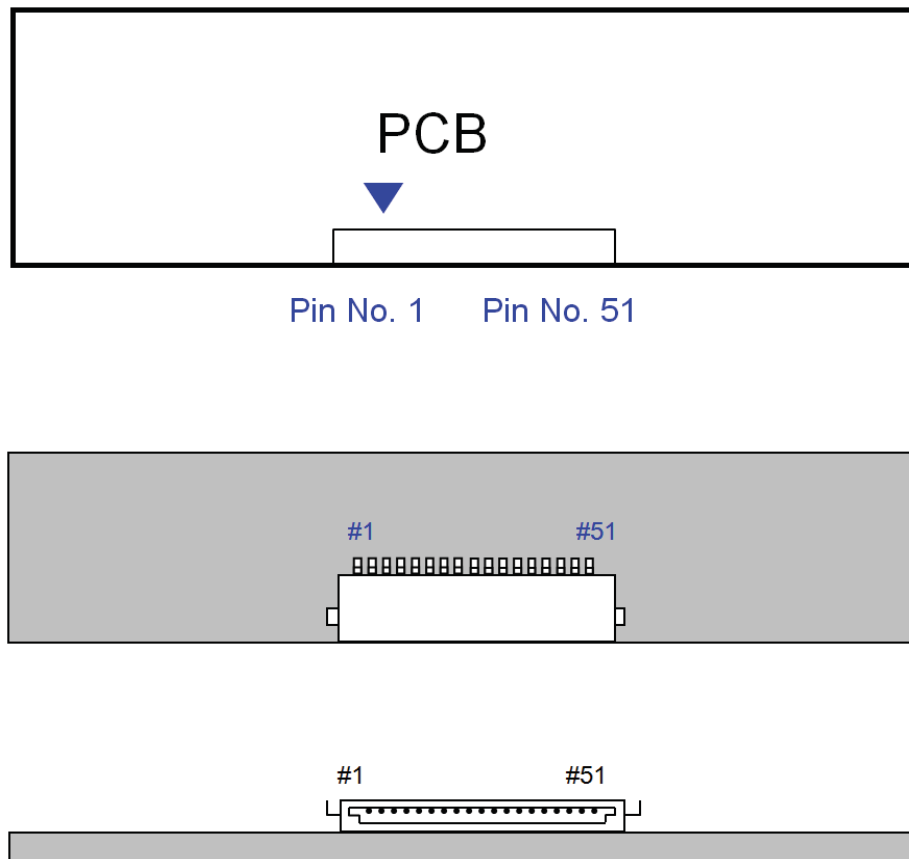
Note (2) LVDS Option : High(3.3V) → Normal NS LVDS format

Low(GND or N.C) → JEIDA LVDS format

Sequence : On = V<sub>DD</sub>(T1) ≥ LVDS Option ≥ Interface Signal(T2)

Off = Interface Signal(T3) ≥ LVDS Option ≥ V<sub>DD</sub>

## Note (3) LVDS Connector



- 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.

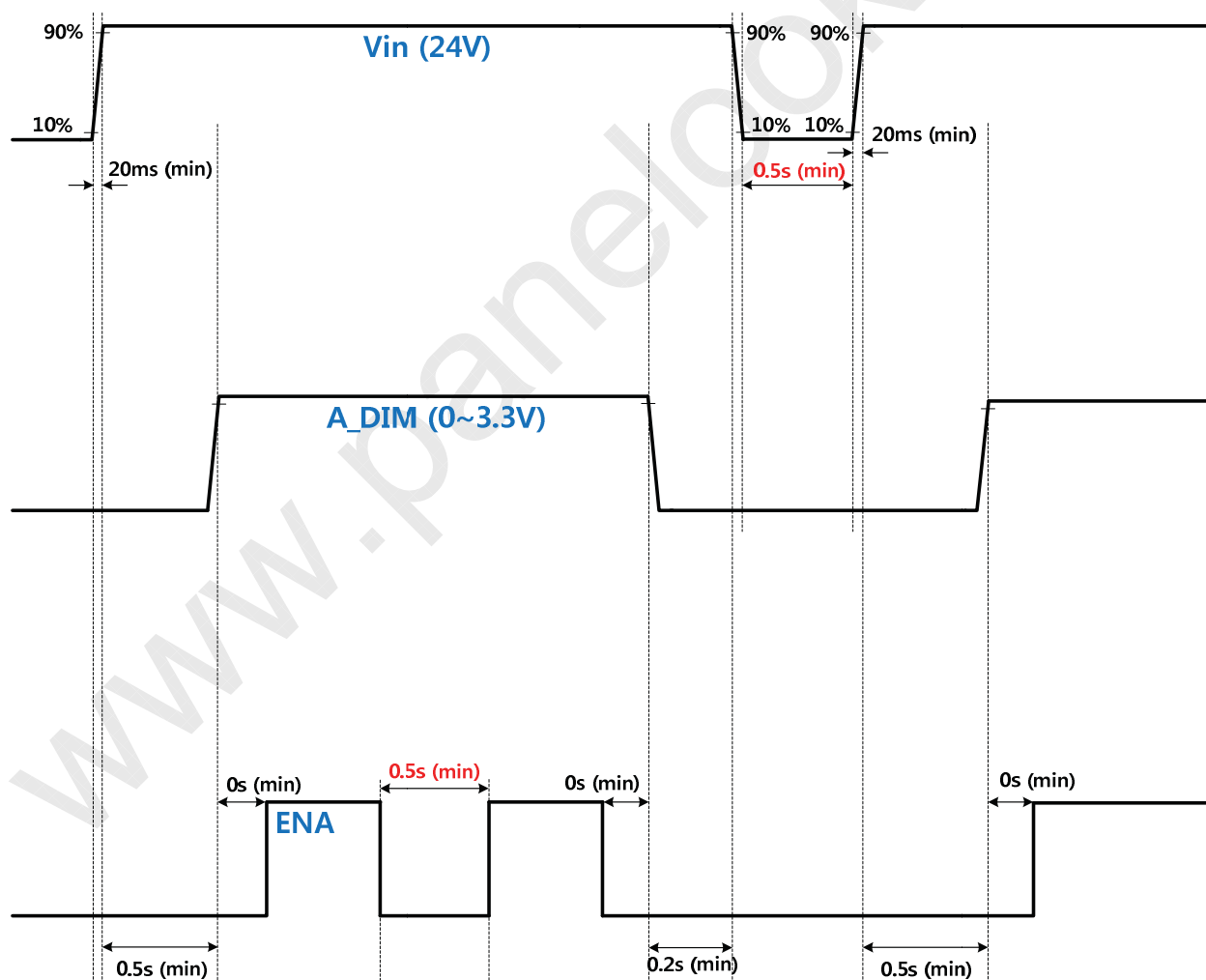
## 5.2 CONFIGURATION OF INPUT PIN OF CONVERTER

Input Connector Model No. : 22022WR-H14B2 (YEONHO)

| Pin No.        | SYMBOL | Pin Configuration(FUNCTION)     |
|----------------|--------|---------------------------------|
| 1, 2, 3, 4, 5  | Vin    | Power Supply DC 24V             |
| 6, 7, 8, 9, 10 | GND    | Ground                          |
| 11             | NC     | No connection                   |
| 12             | ENA    | Converter on/off Control signal |
| 13             | A_DIM  | Analog Dimming Control Signal   |
| 14             | -      | No Connection                   |

**Note) Pin 14 must be disconnected from signal**

## 5.3 THE POWER SEQUENCE FOR INPUTTING TO THE CONVERTER





## 5.4 LVDS INTERFACE

- LVDS Receiver : Tcon(Merged)
- Data Format (JEIDA & Normal)

Default LVDS Option : JEIDA

LVDS OPTION( input : pin9 ) : IF THIS PIN : LOW (GND or N/C) → JEIDA LVDS FORMAT  
OTHERWISE : HIGH (3.3V) → NORMAL NS LVDS FORMAT

|             | 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 | VSNC        | VSNC       |
|             | 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

| COLOR                        | DISPLAY<br>(8bit)           | DATA SIGNAL |    |    |    |    |    |    |    |    |       |    |    |    |    |    |    |    |    |      |    |    |    |    |    |      |             |   |  | GRAY<br>SCALE<br>LEVEL |
|------------------------------|-----------------------------|-------------|----|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|----|------|----|----|----|----|----|------|-------------|---|--|------------------------|
|                              |                             | RED         |    |    |    |    |    |    |    |    | GREEN |    |    |    |    |    |    |    |    | BLUE |    |    |    |    |    |      |             |   |  |                        |
|                              |                             | 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<br>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  | 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  | 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  | 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  | 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  | 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  | 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  | 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  | 1    | -           |   |  |                        |
| GRAY<br>SCALE<br>OF<br>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  | 0    | R0          |   |  |                        |
|                              | DARK<br>↑                   | 1           | 0  | 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  | 0    | R2          |   |  |                        |
|                              |                             | :           | :  | :  | :  | :  | :  |    |    | :  | :     | :  | :  | :  | :  |    |    | :  | :  | :    | :  | :  | :  |    |    |      | R3~<br>R252 |   |  |                        |
|                              |                             | :           | :  | :  | :  | :  | :  |    |    | :  | :     | :  | :  | :  | :  |    |    | :  | :  | :    | :  | :  | :  |    |    |      |             |   |  |                        |
|                              | ↓<br>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  | 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  | 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  | 0    | R255        |   |  |                        |
| GRAY<br>SCALE<br>OF<br>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    | G0          |   |  |                        |
|                              | DARK<br>↑<br><br>↓<br>LIGHT | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0     | 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  | 0    | G2          |   |  |                        |
|                              |                             | :           | :  | :  | :  | :  | :  |    |    | :  | :     | :  | :  | :  | :  |    |    | :  | :  | :    | :  | :  | :  |    |    |      | G3~<br>G252 |   |  |                        |
|                              |                             | :           | :  | :  | :  | :  | :  |    |    | :  | :     | :  | :  | :  | :  |    |    | :  | :  | :    | :  | :  | :  |    |    |      |             |   |  |                        |
|                              |                             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0     | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 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  | 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<br>SCALE<br>OF<br>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<br>↑<br><br>↓<br>LIGHT | 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    | 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  | 0    | B2          |   |  |                        |
|                              |                             | :           | :  | :  | :  | :  | :  |    |    | :  | :     | :  | :  | :  | :  |    |    | :  | :  | :    | :  | :  | :  |    |    |      | B3~<br>B252 |   |  |                        |
|                              |                             | :           | :  | :  | :  | :  | :  |    |    | :  | :     | :  | :  | :  | :  |    |    | :  | :  | :    | :  | :  | :  |    |    |      |             |   |  |                        |
|                              |                             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1    | 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  | 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  | 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             | $1/T_C$  | 100  | 148.5 | 150   | MHz    | -    |
| Hsync                           |                       | $F_H$    | 54   | 67.5  | 69.75 | KHz    | -    |
| Vsync                           |                       | $F_V$    | 48   | 60    | 62    | Hz     | -    |
| Term for the vertical display   | Active display period | $T_{VD}$ | -    | 1080  | -     | Lines  | -    |
|                                 | Total vertical        | $T_V$    | 1090 | 1125  | 2047  | Lines  | -    |
| Term for the horizontal display | Active display period | $T_{HD}$ | -    | 1920  | -     | Clocks | -    |
|                                 | Total Horizontal      | $T_H$    | 2010 | 2200  | 2890  | clocks | -    |

Note) The signals of Hsync and Vsync must be inputted even though this T-con is operated at DE mode.

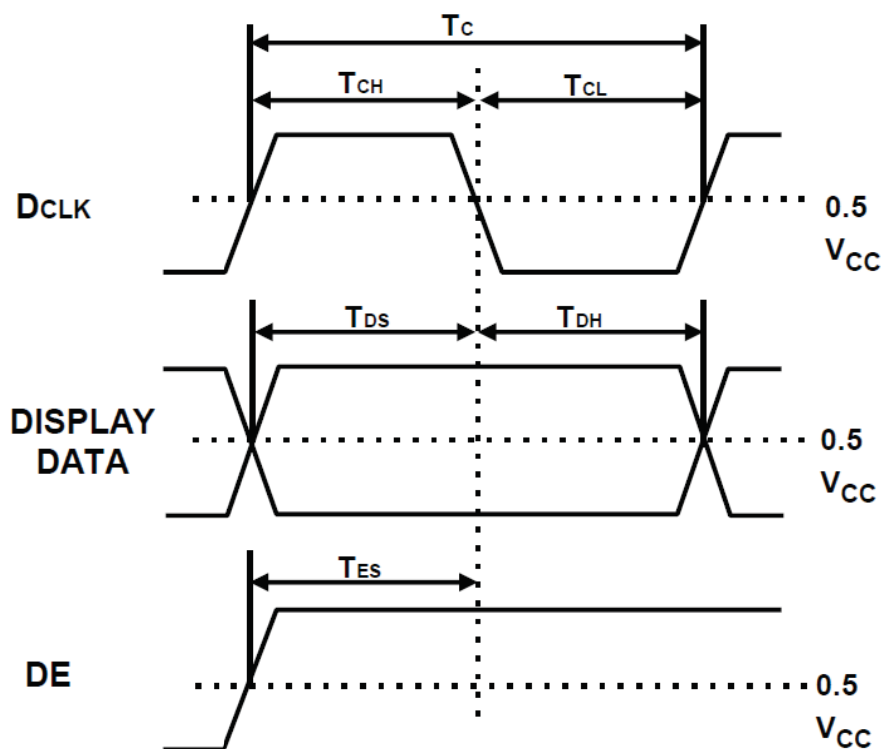
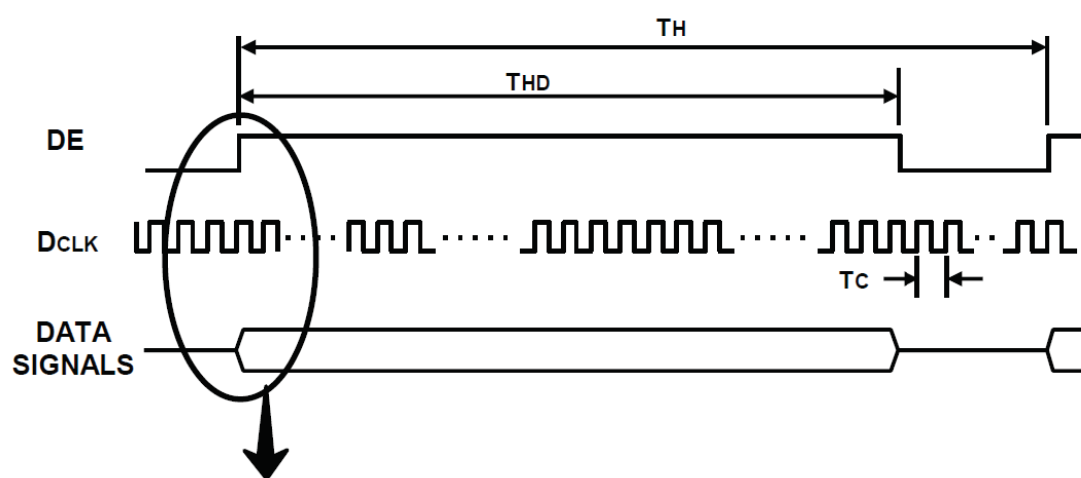
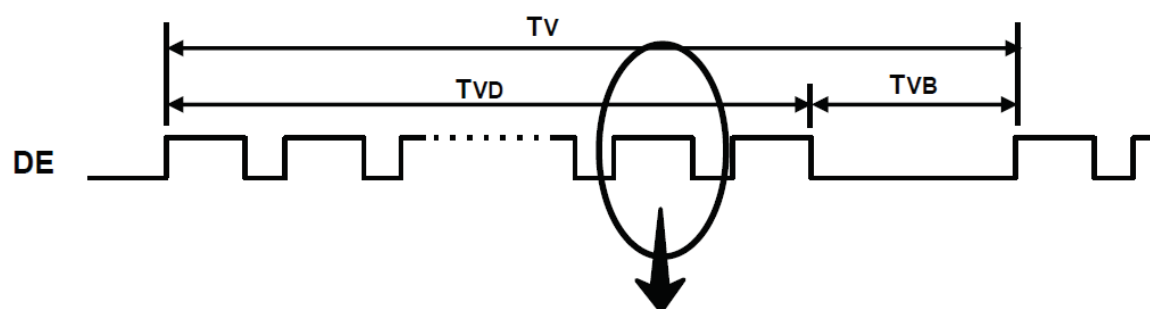
(1) Test Point: TTL controls signal and CLK at LVDS Tx at the input terminal of system.

(2) Internal VDD = 3.3V

(3) The spread spectrum

- The limit of spread spectrum's range of SET in which the LCD module is assembled should be within  $\pm 3\%$
- Frequency for modulation : 30~ 300KHz

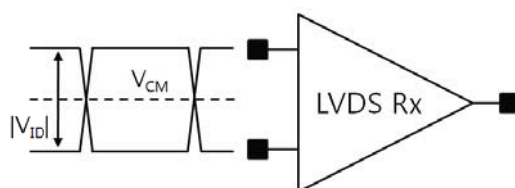
## 6.2 TIMING DIAGRAMS OF INTERFACE SIGNAL (DE ONLY MODE)



## 6.3 CHARACTERISTICS OF INPUT DATA OF LVDS

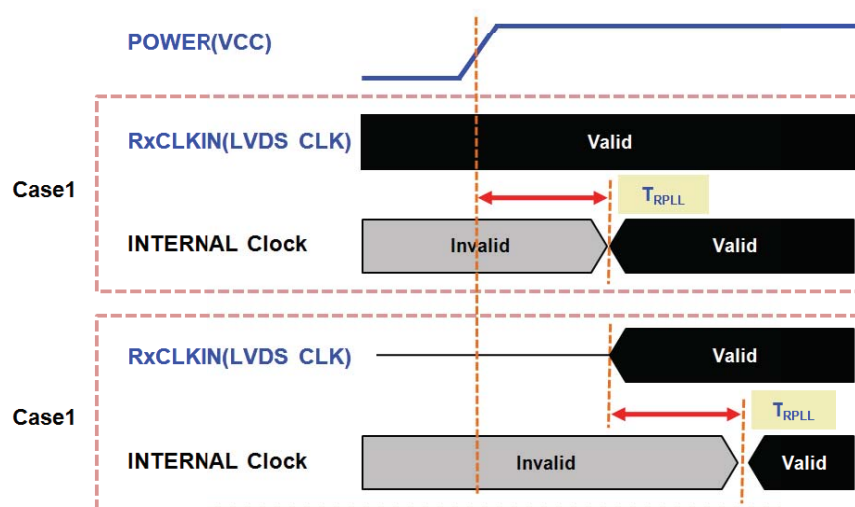
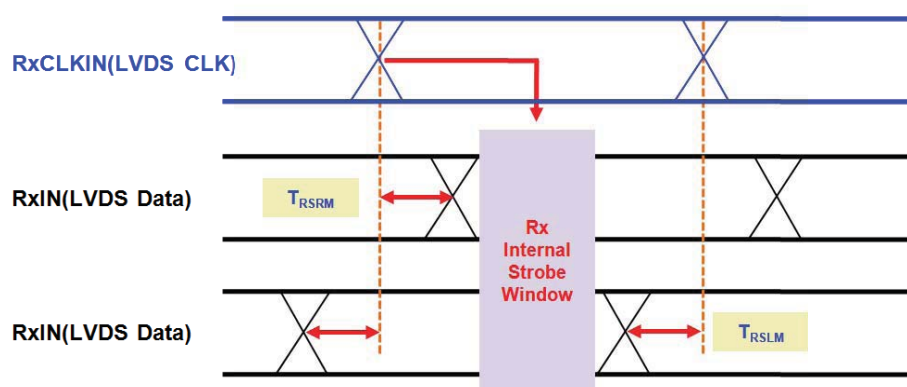
### (1) Specification for DC

| ITEM                             | SYMBOL     | Min. | Typ. | Max. | UNIT |
|----------------------------------|------------|------|------|------|------|
| Supply voltage for IO            | VDD33_LVDS | 3.0  | 3.3  | 3.6  | V    |
| Supply voltage in the core       | VDD12_LVDS | 1.1  | 1.2  | 1.3  | V    |
| Color depth                      |            |      | 8    |      | Bit  |
| Input voltage at the common mode | $V_{CM}$   | 0.3  |      | 1.8  | V    |
| Input voltage for differential   | $ V_{ID} $ | 100  | 350  | 600  | mV   |

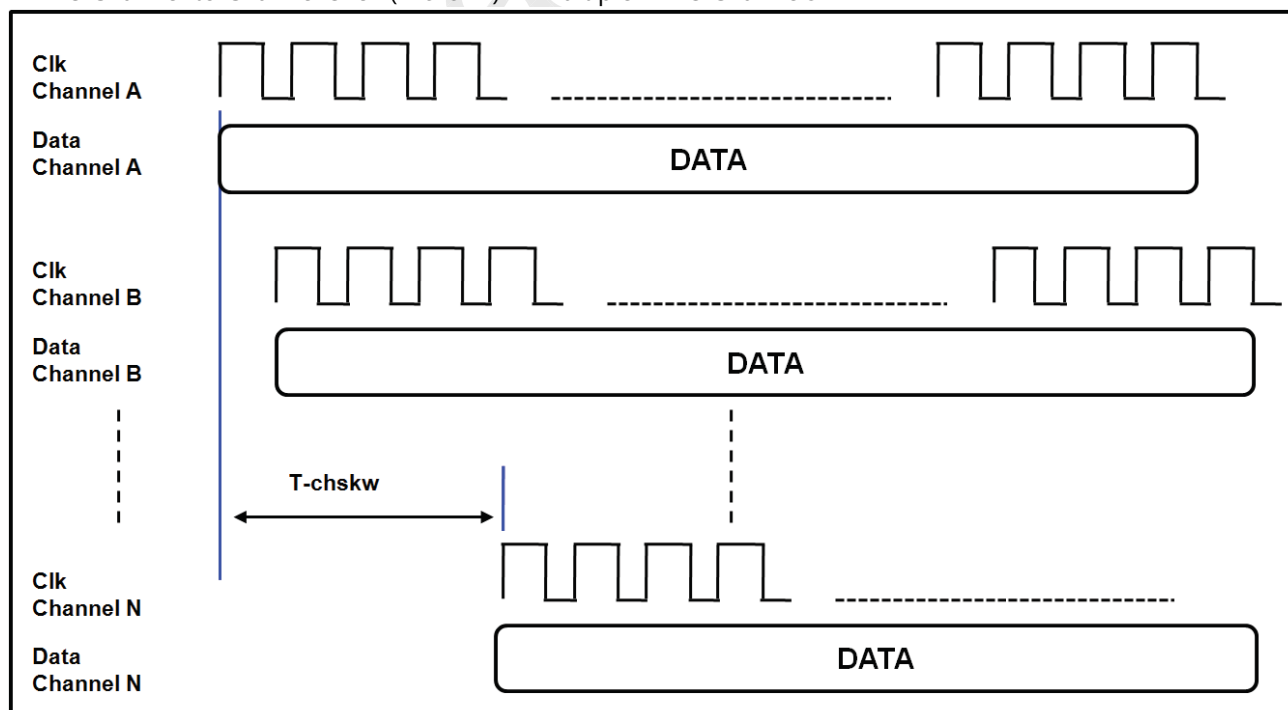


### (2) Specification for AC

| ITEM                                |           | SYMBOL            | Min.  | Typ. | Max. | UNIT |
|-------------------------------------|-----------|-------------------|-------|------|------|------|
| Frequency for input clock (=1/T)    |           | FIN               | 25    | -    | 90   | MHz  |
| Period of output clock              |           | t <sub>RCP</sub>  | 11.11 | -    | 40   | ns   |
| Position of input data              | FIN=85MHZ | t <sub>RSRM</sub> | -     | -    | +400 | ps   |
|                                     | FIN=78MHZ |                   | -     | -    | +450 |      |
|                                     | FIN=75MHZ |                   | -     | -    | +500 |      |
| Position of input data              | FIN=85MHZ | t <sub>RSLM</sub> | -400  | -    | -    | ps   |
|                                     | FIN=78MHZ |                   | -450  | -    | -    |      |
|                                     | FIN=75MHZ |                   | -500  | -    | -    |      |
| Lock time                           |           | t <sub>RPLL</sub> | -     | -    | 100  | usec |
| Duty ratio of Rx's clock for output |           | T <sub>duty</sub> | 45    | 50   | 55   | %    |



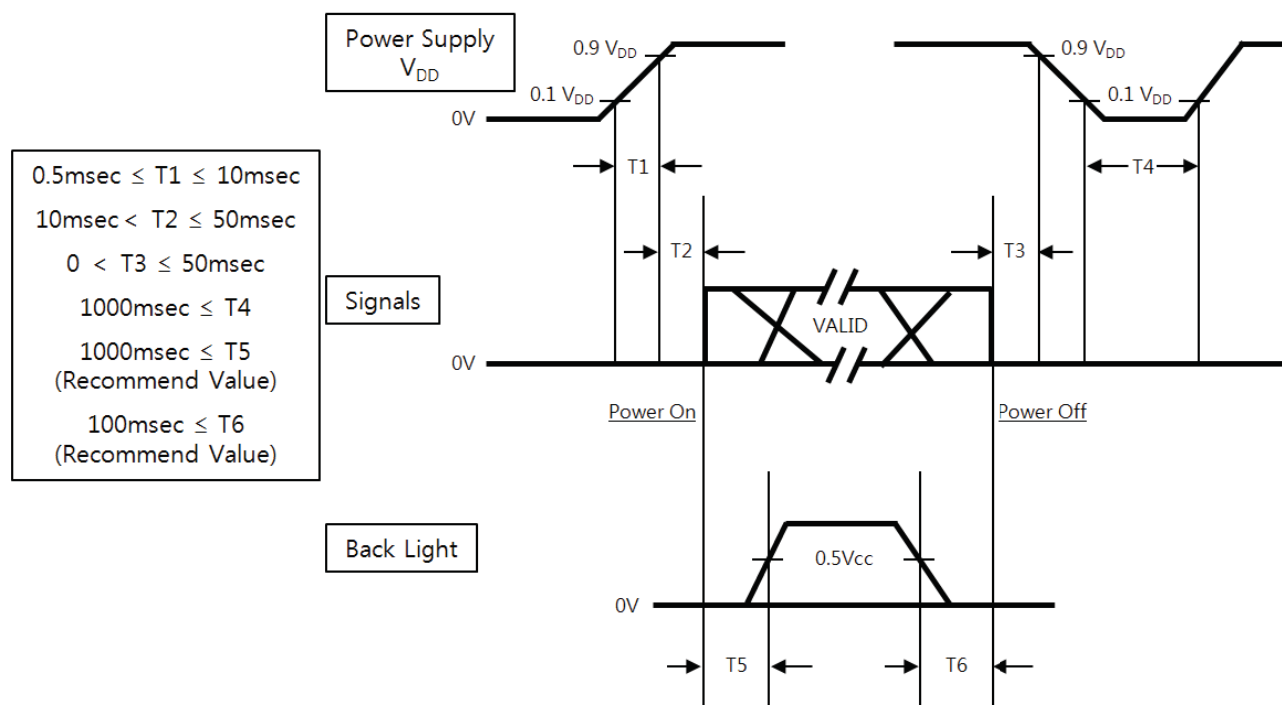
\* LVDS Channel to Channel Skew( $T_{chskw}$ ) in Multiple LVDS Channels



Note : DE should be synchronized with DE per each LVDS Channel and  $T_{chskw} < 16 \times \text{LVDS Clock Period}$

## 6.4 THE SEQUENCE OF POWER ON AND OFF

To prevent the product from being latched up or the DC in the LCD module from starting an operation, the order to turn the power on and off should be changed to the order as shown in the diagram below.



| Timing | Remarks                                                                                                                    |
|--------|----------------------------------------------------------------------------------------------------------------------------|
| $T_1$  | The time, during which the level of $V_{DD}$ is rising from 10% to 90%.                                                    |
| $T_2$  | The change for time, during which the $V_{DD}$ starts rising beyond 90% until the valid data of signal started coming in.  |
| $T_3$  | The change for time, during which the valid data of signal starts leaving out until the $V_{DD}$ starts falling below 90%. |
| $T_4$  | The time, during which the $V_{DD}$ starts falling below 10% to restart the Windows.                                       |
| $T_5$  | The time, during which the signal of BLU starts rising beyond 50%.                                                         |
| $T_6$  | The time, during which the signal of BLU starts falling below 50%.                                                         |

- The inputted  $V_{DD}$ 's value for supply voltage, BLU, and signal to the external system of the module shall be computed with referring to the former mentioned value.
- The method to apply the voltage to the lamp within the range, which the LCD operates. When the back-light is turned on before the LCD is operated or the power of LCD is turned off before the back-light is turned off, the abnormal display on the screen may be shown momentarily.
- Please keep the level of input signal low or keep the level of impedance high when the value of  $V_{DD}$  is below 10%.
- The value shall be measured after the module has been fully discharged between the period, which the power is turned on and the period, which the power is turned off like the  $T_4$  timing. The backlight may be flashed if the interface signal remains floated when the above-mentioned signal becomes invalid.

[illegible]





## 7. RELIABILITY TEST

| Item                              | Test condition                                                                                                    | Quantity |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------|----------|
| HTOL                              | 50℃, 500hr determination                                                                                          | 8EA      |
| LTOL                              | 0℃, 500hr determination                                                                                           | 4EA      |
| HTS                               | 70℃, 500hr determination                                                                                          | 4EA      |
| LTS                               | -25℃, 500hr determination                                                                                         | 4EA      |
| THB                               | 50℃ / 90%RH, 500hr determination                                                                                  | 10EA     |
| WHTS                              | 60℃ / 75%RH, 500hr determination                                                                                  | 4EA      |
| T/S                               | -20 ~ 60℃, Dwell time : 30Min, 200cycle                                                                           | 4EA      |
| TSS                               | -20 ~ 65℃, 220cycle                                                                                               | 4EA      |
| Image sticking                    | 50℃, Mosaic pattern (9X10), 12hrs                                                                                 | 8EA      |
| Contact ESD                       | ±10 kV, 210Point, 1 time/Point                                                                                    | 3EA      |
| Air ESD                           | ±20 kV, 210Point, 1 time/Point                                                                                    | 3EA      |
| Input Con. ESD                    | ±15kV, Input Con. Pin, 3 times/Pin                                                                                | 3EA      |
| Dust                              | 5sec spray, 5min sedimentation / 5hr(Portrait 10hr),<br>Power 10min on, 10min off                                 | 2EA      |
| Pallet Vibration →<br>Pallet Drop | Pallet vibration : 1.05Grms, 5 ~ 200Hz, 2hr/stack side<br>Pallet Drop : 20cm, bottom side 2 angles, 1side(Bottom) | 2Pallet  |
| Altitude                          | -40~50℃, 0m(0ft) ~ 13,700m(45,000ft), 72.5Hr                                                                      | 4EA      |

### [ Criteria on evaluation]

The components of product, which may affect to the function of display shall not be changed when the display quality test is executed under the normal operating condition.

\* HTOL / LTOL : The operating at the high and low temperature\*

\* THB : The slant of temperature and humidity

\* HTS / LTS : The storage at the high and low temperature

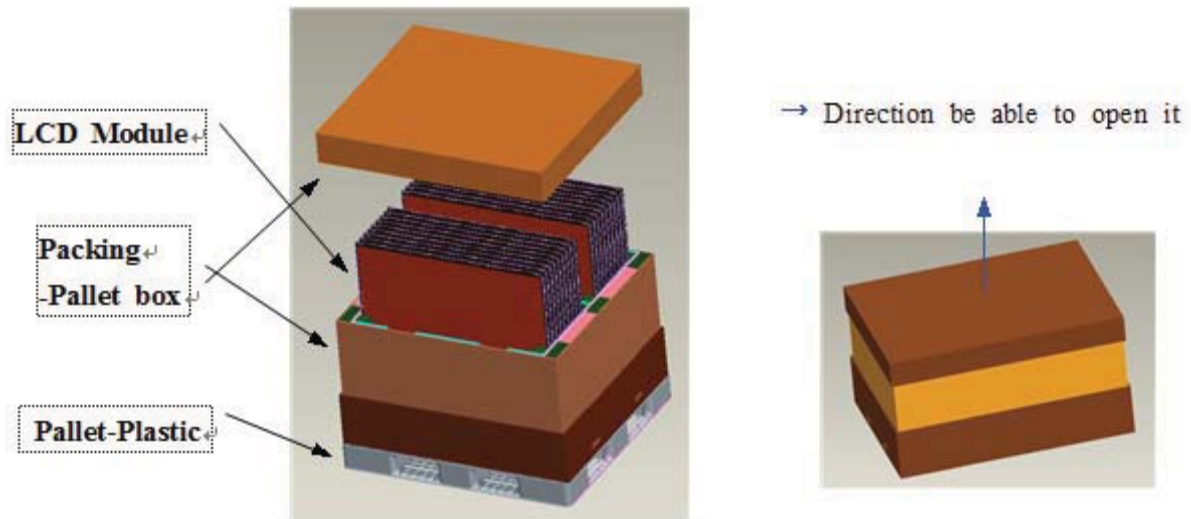
\* WHTS : The storage condition at the high temperature with the high humidity

## 8. PACKING

### 8.1 CARTON (INTERNAL PACKAGE)

(1) Packing Form : Paper

(2) Packing Method



Note(1) Total Weight : Approximately 287.08kg [With Pallet Plastic]

Note(2) Acceptance number of piling : 3 Pallets

Note(3) Carton size : 1255mm(H) x 1097mm(V) x 657mm(Height) [Without Pallet Plastic]

1270mm(H) x 1150mm(V) x 782mm(Height) [With Pallet Plastic]

(3) Packing Material

| No | Part name          | Quantity |
|----|--------------------|----------|
| 1  | Packing-Pallet BOX | 1 EA     |
| 2  | Bag-Shielding      | 18 EA    |
| 3  | Protector-Panel    | 18 EA    |
| 4  | Pallet-Plastic     | 1 EA     |

## 9. MARKINGS & OTHERS

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

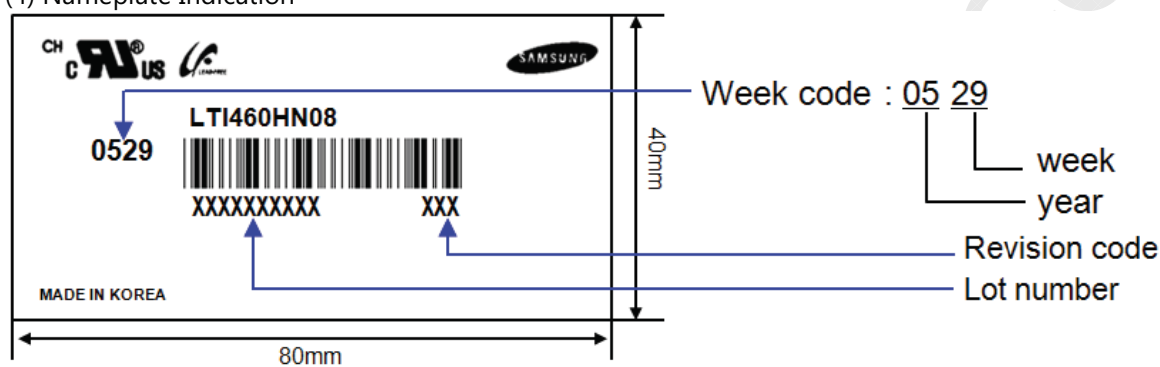
(1) Parts number : LTI460HN08

(2) Revision code : Three letters

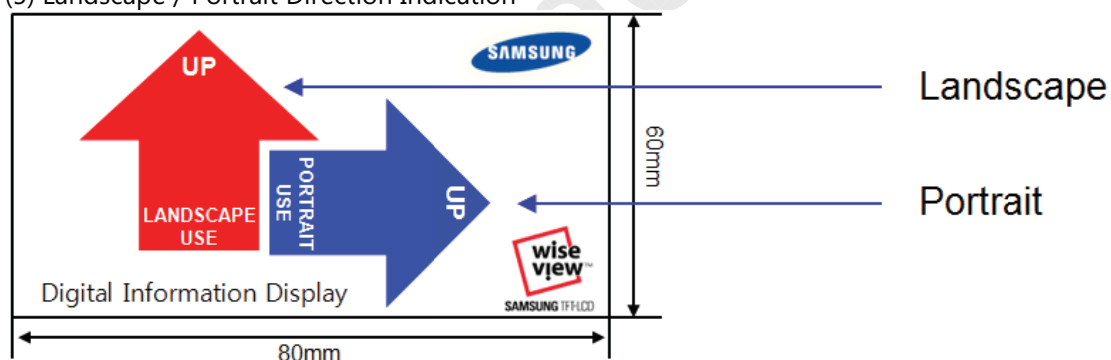
(3) Lot number : X X X X X X X X X

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

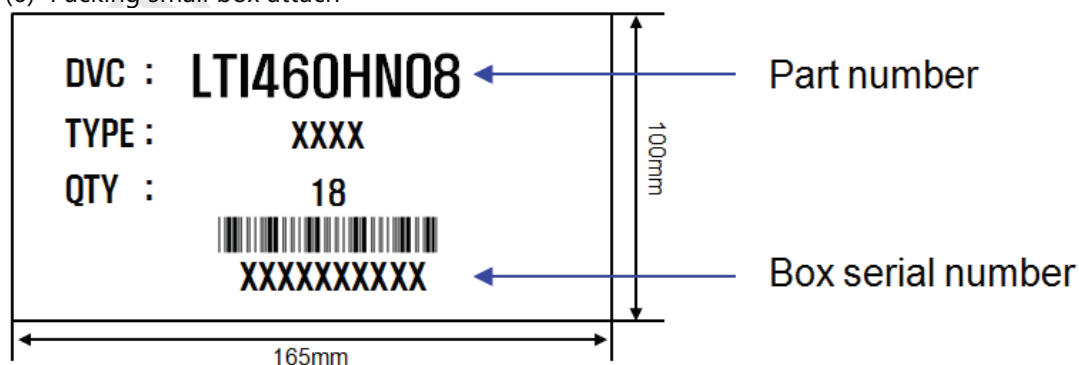
(4) Nameplate Indication



(5) Landscape / Portrait Direction Indication



(6) Packing small box attach



## 10. GENERAL PRECAUTIONS

### 10.1 HANDLING

- (a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.
- (b) 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.
- (c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.
- (d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.
- (e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (f) The desirable cleaners are water, IPA (Isoprophyl 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.
- (g) 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 thoroughly with soap.
- (h) Protect the module from static. it may cause damage to the C-MOS Gate Array IC.
- (i) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Do not pull or fold the Lamp wire.
- (l) Do not touch any component which is located on the back side.
- (m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (n) Pins of I/F connector shall not be touched directly with bare hands.

## 10.2 STORAGE

We highly recommend to comply with the criteria in the table below.

| ITEM                | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Min. | Max. |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|
| Storage Temperature | (°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 5    | 40   |
| Storage Humidity    | (%rH)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 35   | 75   |
| Storage Life        | 12 months                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |      |
| Storage Condition   | <ul style="list-style-type: none"> <li>- The storage room should be equipped with a good ventilation facility, which has a temperature controlling system.</li> <li>- Products should be placed on the pallet, which is away from the wall not on the floor.</li> <li>- Prevent products from being exposed to the direct sunlight, moisture, and water. Be cautious not to pile the products up.</li> <li>- Avoid storing products in the environment, which other hazardous material is placed.</li> <li>- If products are delivered or kept in the storage facility more than 3 months, we recommend you to leave products under the condition including a 20°C temperature and a humidity of 50% for 24 hours.</li> <li>- If you store semi-manufactured products for more than 3 months, bake the products under the condition including the 50°C temp. and the 10% humidity for 24hrs after being used.</li> </ul> |      |      |

## 10.3 OPERATION

- Do not connect or disconnect the cable to/ from the module at the "Power On" condition.
- The power shall be always turned on/off by the item 6.5. "Power on/off sequence"
- The module has a circuit with a high frequency. The system manufacturers shall suppress the electromagnetic interference sufficiently. The methods to ground and shield are important to minimize the interference.
- Design the length of cable to connect between the connector for back-light and the inverter as short as possible and the shorter cable shall be connected directly.  
The longer cable between that of back-light and that of inverter may cause the luminance of lamp(CCFL) to lower and need a higher startup voltage(Vs).

## 10.4 OPERATION CONDITION GUIDE

- The LCD product should be operated under normal conditions.  
Normal condition is defined as below;
  - Temperature : 0~65°C
  - Humidity : 20~90%
  - Display pattern : continually changing pattern (Not stationary)
- 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 SDC 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) Module should be turned clockwise (regular front view perspective) when used in portrait mode.
- (c) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (d) 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.
- (e) 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.
- (f) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.
- (g) Please contact SDC in advance when you display the same pattern for a long time.