



**SAMSUNG DISPLAY**



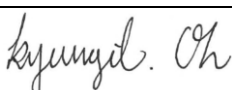
# Product Specification

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

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

|               |              |                |            |
|---------------|--------------|----------------|------------|
| CUSTOMER      | R/A Customer | MODEL NO.      | LTI460HF01 |
| DATE OF ISSUE | 2015/01/28   | EXTENSION CODE | -V(0)      |

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

|                                                                              |                                                                                                    |
|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Approved by                                                                  | <br>2015/01/28 |
| Prepared by                                                                  | <br>2015/01/28 |
| <b>Customer Support Engineering Group</b><br><b>Samsung Display Co., Ltd</b> |                                                                                                    |

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## REVISION HISTORY

| Date       | Rev.No. | Page  | Revision Description                                                                             |
|------------|---------|-------|--------------------------------------------------------------------------------------------------|
| 2014/11/17 | 000     | all   | Approval Specification Firstly issued                                                            |
| 2015/01/14 | 001     | 4     | Modify the comment regarding the Black Fog Mura                                                  |
| 2015/01/28 | 002     | 15~16 | - Modify the LVDS Signal pin map(10bit E Channel added)<br>- Add the additional comment(Note(2)) |

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## GENERAL DESCRIPTION

### DESCRIPTION

LTI460HF01-V(0) 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. This 46.0" model has a resolution of 1,920 x 1,080 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 Brightness Panel (2,500nit)**

RoHS compliance(Pb-free)

FHD(1,920X1,080) resolution(16:9)

SVA(Super Vertical Align) mode

High Tni(110°C) Liquid Crystal

High speed response

High contrast ratio, High aperture ratio with the wide color gamut

Wide viewing angle( $\pm 178^\circ$ )

Landscape / Portrait type compatible

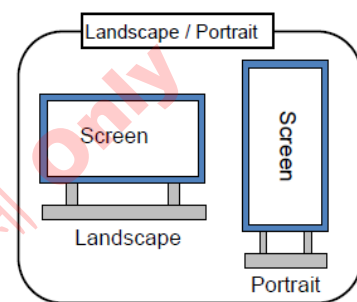
LVDS(Low Voltage Differential Signaling) Interface(2pixel/clock)

DE(Data Enable) mode

Direct LED(Light Emitting Diode) Backlight

Low power consumption

Black Fog Mura Improvement Technology



### APPLICATIONS

Public Information Display(PID)

(If the intent to use this product is for other purpose, please contact Samsung Display.)

### GENERAL INFORMATION

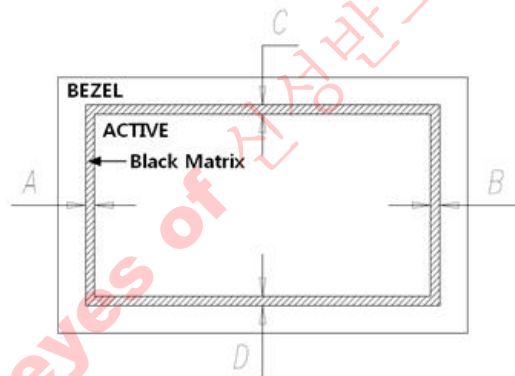
| Item               | Specification            | Unit              | Note      |
|--------------------|--------------------------|-------------------|-----------|
| Module Size        | 1,035.9(H) x 590.5(V)    | mm                | Typ       |
|                    | 84.1                     |                   | Max(Typ)  |
| Weight             | 12,000                   | g                 | Max       |
| Display area       | 1018.08 (H) x 572.67 (V) | mm                |           |
| Driver Element     | a-Si TFT active matrix   |                   |           |
| Display colors     | 16.7M (8bit)             |                   |           |
| Number of pixel    | 1,920 x 1,080            | Pixel             |           |
| Pixel Arrangement  | RGB Vertical stripe      |                   |           |
| Display Mode       | Normally Black           |                   |           |
| Surface treatment  | Haze 0%                  |                   | Clear POL |
| Luminance of White | 2,500(Typ)               | cd/m <sup>2</sup> |           |

## MECHANICAL INFORMATION

| Item               |                | Min.   | Typ.   | Max.   | Unit | Note  |
|--------------------|----------------|--------|--------|--------|------|-------|
| Module Size        | Horizontal (H) | 1034.9 | 1035.9 | 1036.9 | mm   |       |
|                    | Vertical (V)   | 589.5  | 590.5  | 591.5  | mm   |       |
|                    | Depth (D)      | -      | 84.1   | 87.1   | mm   | (2)-a |
|                    |                | -      | 55     | 56     |      | (2)-b |
| Bezel Open         | Horizontal (H) | -      | 1020.1 | -      | mm   |       |
|                    | Vertical (V)   | -      | 574.7  | -      | mm   |       |
| Black Matrix Shift | Horizontal (H) | -      | -      | 2      | mm   | (1)   |
|                    | Vertical (V)   | -      | -      | 2      | mm   |       |
| Weight             |                | -      | 11,000 | 12,000 | 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

|                        |                          |
|------------------------|--------------------------|
| <p>Converter cover</p> | <p>Outline~30mm Edge</p> |
| a. Max Depth           | b. Inspection Depth      |

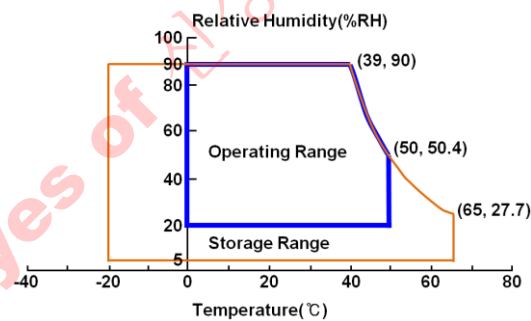
# 1. ABSOLUTE MAXIMUM RATINGS

## 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)      |
| Glass Surface temperature<br>(Operation) | T <sub>SUR</sub> | 0    | 65   | °C   | (1)      |
| Storage humidity                         | H <sub>STG</sub> | 5    | 90   | %RH  | -        |
| Operating humidity                       | H <sub>OPR</sub> | 20   | 90   | %RG  | -        |
| Endurance on static electricity          | -                | -    | 150  | V    | -        |
| Shock( non-operating )                   | Snop(X,Y)        | -    | 40   | G    | (2), (4) |
|                                          | Snop(Z)          | -    | 30   | G    |          |
| 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) 10~300Hz, Swap rate for X, Y, Z axis one time

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.

## 1.2 ELECTRICAL ABSOLUTE RATINGS

### (1) TFT LCD MODULE

| Item                 | Symbol | Max  | Unit | Note |
|----------------------|--------|------|------|------|
| Power Supply Voltage | VDD    | 13.2 | V    | (1)  |

### (2) BACKLIGHT UNIT(LED Unit)

| Item                 | Symbol          | Max | Unit. | Note |
|----------------------|-----------------|-----|-------|------|
| Input Supply Voltage | V <sub>CC</sub> | 26  | V     | (1)  |

Note(1) Ta= 25 ± 2 °C

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

## 1.3 THE OTHERS ABSOLUTE RATINGS

### Static Electricity Pressure Resistance

| Item              | Test Conditions                            | Remark    |
|-------------------|--------------------------------------------|-----------|
| Contact Discharge | 150pF, 330Ω, ±10kV, 210points, 1time/point | Operating |
| Air Discharge     | 150pF, 330Ω, ±20kV, 210points, 1time/point |           |

## 2. APPLICATION INFORMATION FOR PID (Public Information Display)

A PID'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:  $20 \pm 15^{\circ}\text{C}$
- b. Humidity:  $55 \pm 20\%$
- 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 PID 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 PID stated in this spec is guaranteed if the PID is used under the proper operating conditions.

### 2.5 Clean the system regularly for not accumulating the dust around the system considering user environment, otherwise, its reliability and function may not be satisfied.



### 3. OPTICAL CHARACTERISTICS

The optical characteristics should be measured in a dark room or equivalent.

Measuring equipment : TOPCON RD-80S, SR-3, ELDIM EZ-Contrast

$T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$ ,  $V_{DD} = 12\text{V}$ ,  $f_v = 120\text{Hz}$ ,  $f_{DCLK} = 297\text{MHz}$ ,  $I_F = 100\%$  duty

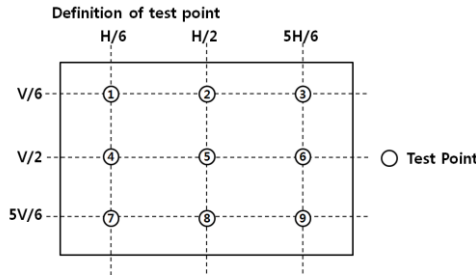
| Item                                            |              | Symbol           | Condition                                 | Min           | Typ   | Max          | Unit              | Note                       |
|-------------------------------------------------|--------------|------------------|-------------------------------------------|---------------|-------|--------------|-------------------|----------------------------|
| Contrast Ratio                                  |              | C/R              | -                                         | 3000          | 5000  | -            | -                 | (3) SR-3                   |
| Response time                                   | G-to-G (AVG) | T <sub>g</sub>   | -                                         | -             | 6     | 15           | msec              | (5) RD-80S                 |
| Luminance of White<br>(At the center of screen) |              | Y <sub>L</sub>   | -                                         | 2000          | 2500  | -            | cd/m <sup>2</sup> | (6) 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 | -                 | (7), (8) 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                                     |              | -                | -                                         | 69            | 72    | -            | %                 | (7) SR-3                   |
| Color temperature                               |              | -                | -                                         | 7000          | 10000 | 13000        | K                 |                            |
| Viewing Angle                                   | Hor.         | θ <sub>L</sub>   | CR ≥ 10                                   | 75            | 89    | -            | Degree            | (8)<br>SR-3<br>EZ-Contrast |
|                                                 |              | θ <sub>R</sub>   |                                           | 75            | 89    | -            |                   |                            |
|                                                 | Ver.         | θ <sub>U</sub>   |                                           | 75            | 89    | -            |                   |                            |
|                                                 |              | θ <sub>D</sub>   |                                           | 75            | 89    | -            |                   |                            |
| Brightness Uniformity<br>(9 Point)              |              | B <sub>Uni</sub> | -                                         | -             | -     | 25.0         | %                 | (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 backlight at the given temperature for stabilization of the backlight. This should be measured in the center of screen.

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

Note(2) Definition of test point



Note(3) Definition of Contrast ratio(C/R)

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

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

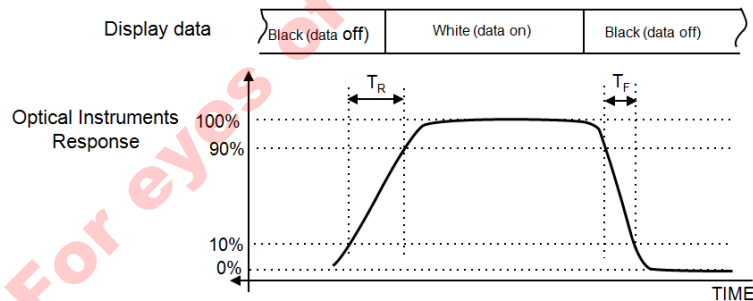
Gmax : Luminance in all white pixels  
Gmin : Luminance in all black pixels.

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(5) Definition of Response time : Average response time of all Gray to Gray except Tr, Tf



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

| Gray to Gray Response Time |      |           |            |            |            |             |             |             |             |             |                 |
|----------------------------|------|-----------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-----------------|
|                            | Gray | End       |            |            |            |             |             |             |             |             |                 |
|                            |      | 0         | 31         | 63         | 95         | 127         | 159         | 191         | 223         | 255         |                 |
| Start                      | 0    |           | Tr(0-31)   | Tr(0-63)   | Tr(0-95)   | Tr(0-127)   | Tr(0-159)   | Tr(0-191)   | Tr(0-223)   | Tr(0-255)   | T <sub>ON</sub> |
|                            | 31   | Tr(31-0)  |            | Tr(31-63)  | Tr(31-95)  | Tr(31-127)  | Tr(31-159)  | Tr(31-191)  | Tr(31-223)  | Tr(31-255)  |                 |
|                            | 63   | Tr(63-0)  | Tr(63-31)  |            | Tr(63-95)  | Tr(63-127)  | Tr(63-159)  | Tr(63-191)  | Tr(63-223)  | Tr(63-255)  |                 |
|                            | 95   | Tr(95-0)  | Tr(95-31)  | Tr(95-63)  |            | Tr(95-127)  | Tr(95-159)  | Tr(95-191)  | Tr(95-223)  | Tr(95-255)  |                 |
|                            | 127  | Tr(127-0) | Tr(127-31) | Tr(127-63) | Tr(127-95) |             | Tr(127-159) | Tr(127-191) | Tr(127-223) | Tr(127-255) |                 |
|                            | 159  | Tr(159-0) | Tr(159-31) | Tr(159-63) | Tr(159-95) | Tr(159-127) |             | Tr(159-191) | Tr(159-223) | Tr(159-255) |                 |
|                            | 191  | Tr(191-0) | Tr(191-31) | Tr(191-63) | Tr(191-95) | Tr(191-127) | Tr(191-159) |             | Tr(191-223) | Tr(191-255) |                 |
|                            | 223  | Tr(223-0) | Tr(223-31) | Tr(223-63) | Tr(223-95) | Tr(223-127) | Tr(223-159) | Tr(223-191) |             | Tr(223-255) |                 |
|                            | 255  | Tr(255-0) | Tr(255-31) | Tr(255-63) | Tr(255-95) | Tr(255-127) | Tr(255-159) | Tr(255-191) | Tr(255-223) |             |                 |
| T <sub>OFF</sub>           |      |           |            |            |            |             |             |             |             |             |                 |

T\*(X-Y) : Response time from level of gray at X to level of gray at Y

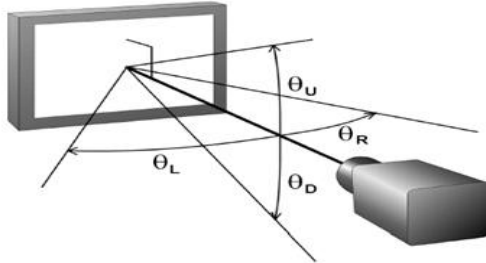
**The definition of response time** =  $\sum [T^*(X-Y)] / 72$

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( $C/R \geq 10$ )



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## 4. ELECTRICAL CHARACTERISTICS

### 4.1 TFT LCD MODULE

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

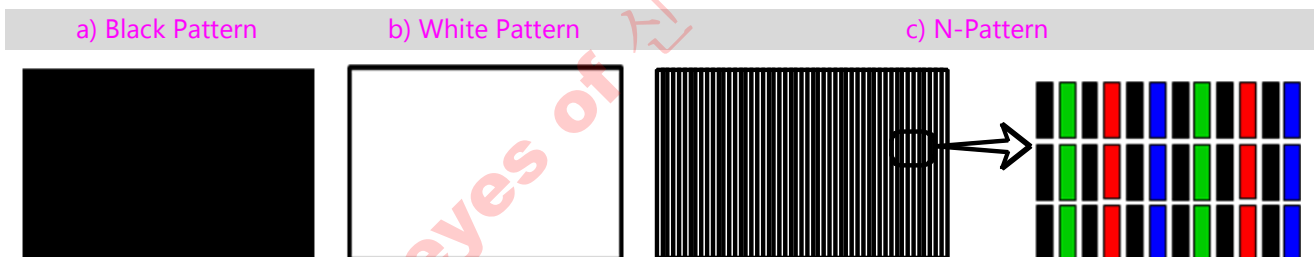
$T_a = 25 \pm 2^\circ\text{C}$

| Item                    | Symbol        | Min  | Typ  | Max   | Unit | Note     |
|-------------------------|---------------|------|------|-------|------|----------|
| Voltage of Power Supply | $V_{DD}$      | 10.8 | 12   | 13.2  | V    | (1)      |
| Current of Power Supply | (a) Black     | -    | 710  | 930   | mA   | (2), (3) |
|                         | (b) White     | -    | 690  | 910   |      |          |
|                         | (C) N-Pattern | -    | 1090 | 1450  |      |          |
| Vsync Frequency         | $f_V$         | 98   | 120  | 122   | Hz   | -        |
| Hsync Frequency         | $f_H$         | 108  | 135  | 139.5 | kHz  | -        |
| Main Frequency          | $F_{dclk}$    | 260  | 297  | 307   | MHz  | -        |
| Rush Current            | $I_{RUSH}$    | -    | -    | 1.9   | A    | (4)      |

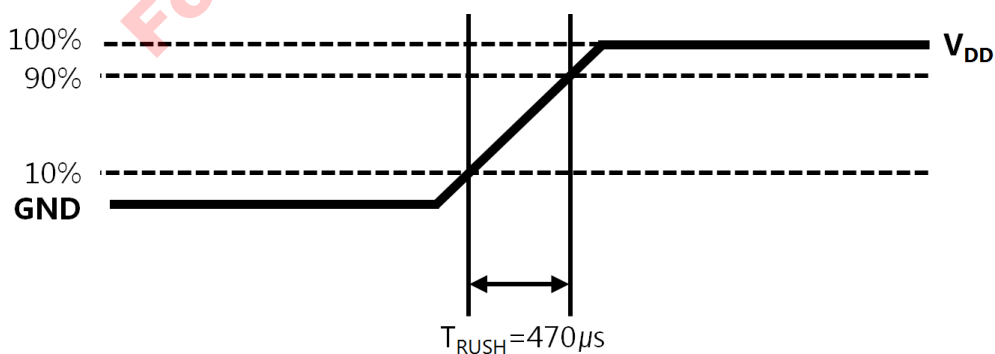
Note(1) The ripple voltage should be controlled under 10% of  $V_{DD}$ .

Note(2)  $f_V=120\text{Hz}$ ,  $f_{DCLK}=297\text{MHz}$ ,  $V_{DD}=12.0\text{V}$ , 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

The back light unit contains 128 LEDs(Light Emitting Diode).  
The characteristics of BLU are shown in the following tables.

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

| Item                | Symbol | Min | Typ    | Max | Unit | Note |
|---------------------|--------|-----|--------|-----|------|------|
| 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 :  $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$ ]

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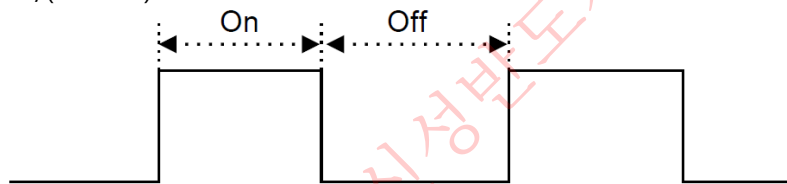
## 4.3 LED CONVERTER CHARACTERISTICS

| Items                    | Symbol       | Conditions                         | Specifications |     |       | Unit        | Note                         |
|--------------------------|--------------|------------------------------------|----------------|-----|-------|-------------|------------------------------|
|                          |              |                                    | Min            | Typ | Max   |             |                              |
| Input Voltage            | $V_{in}$     | -                                  | 22             | 24  | 26    | V           | $T_a=25\pm2^{\circ}\text{C}$ |
| Inrush Current           | $I_{inrush}$ | $V_{in} = 24\text{V}$<br>Dim = Max | -              | -   | 12.68 |             | (2)                          |
| Output Current           | $I_{LED}$    | $V_{in} = 24\text{V}$<br>Dim = Max | 85.5           | 90  | 94.5  | mA<br>(rms) | Per String                   |
| Backlight On/Off Control | ENA          | Enable                             | 2.4            | -   | 5.25  | V           | -                            |
|                          |              | Disable                            | -0.3           | -   | 0.4   |             |                              |
| Analog Dimming           | $V_{A\_Dim}$ | $V_{in} = 24\text{V}$              | 0              | -   | 3.3   | V           | (3)                          |
|                          | $D_{A\_Dim}$ |                                    | 10             | -   | 100   | %           |                              |

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

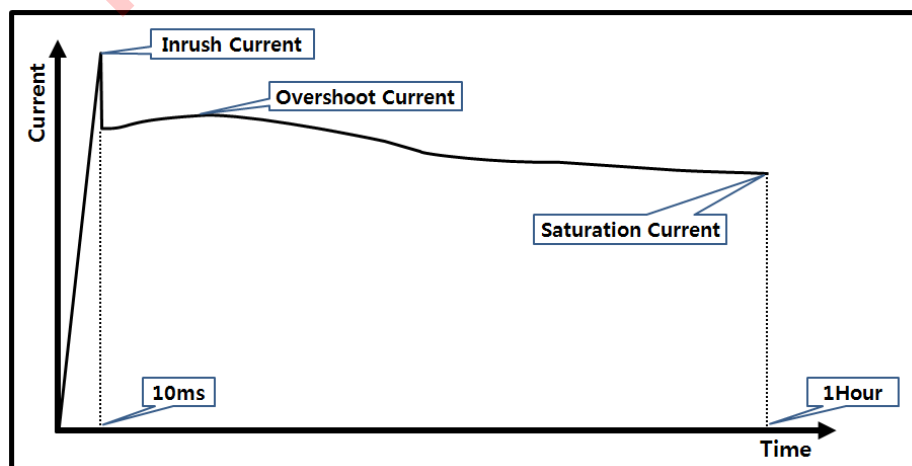
Note(2) Inrush is measured within BLU on 10ms after leaving the BLU as it is at least 1hr or more at room temperature(25°C).

Note(3) High-duty = On/(On+Off)\*100



※ Additional appendix for supply current(@ 25°C)

| Items         | Symbol               | Conditions                                          | Specification |       |       | Unit       |
|---------------|----------------------|-----------------------------------------------------|---------------|-------|-------|------------|
|               |                      |                                                     | Min           | Typ   | Max   |            |
| Input Current | $I_{in\_Overshoot}$  | $V_{in}=24\text{V}$ , Dim=3.3V<br>(After turn on)   | -             | 10.98 | 11.29 | $A_{mean}$ |
|               | $I_{in\_Saturation}$ | $V_{in}=24\text{V}$ , Dim=3.3V<br>(After 1hr aging) | -             | 10.78 | 11.09 |            |



## 5. INPUT TERMINAL PIN ASSIGNMENT

### 5.1 INPUT SIGNAL & POWER

Connector 1 (51Pin) : 05002HR-H51G5(G) (YEONHO) / PF050-O51B-C20-F (UJU)

| 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       | V <sub>DD</sub> (12V) |             | 31      | GND               |             |
| 7       | V <sub>DD</sub> (12V) |             | 32      | LVDS<br>Clock     | Rx2CLK_N    |
| 8       | No Connection (1)     |             | 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      |                   | Rx2[E]_N(2) |
| 13      |                       | Rx1[B]_P    | 38      |                   | Rx2[E]_P(2) |
| 14      |                       | Rx1[C]_N    | 39      | GND               |             |
| 15      |                       | Rx1[C]_P    | 40      | No Connection (1) |             |
| 16      | GND                   |             | 41      | No Connection (1) |             |
| 17      | LVDS<br>Clock         | Rx1CLK_N    | 42      | No Connection (1) |             |
| 18      |                       | Rx1CLK_P    | 43      | No Connection (1) |             |
| 19      | GND                   |             | 44      | No Connection (1) |             |
| 20      | LVDS<br>Signal        | Rx1[D]_N    | 45      | No Connection (1) |             |
| 21      |                       | Rx1[D]_P    | 46      | No Connection (1) |             |
| 22      |                       | Rx1[E]_N(2) | 47      | No Connection (1) |             |
| 23      |                       | Rx1[E]_P(2) | 48      | No Connection (1) |             |
| 24      | GND                   |             | 49      | No Connection (1) |             |
| 25      | LVDS Signal           | Rx2[A]_N    | 50      | No Connection (1) |             |
|         |                       |             | 51      | No Connection (1) |             |

Connector 2 (41Pin) : 05002HR-H41G5(G) (YEONHO) / PF050-O41B-C20-F (UJU)

| PIN No. |                   | Description | PIN No. | Description       |             |
|---------|-------------------|-------------|---------|-------------------|-------------|
| 1       | No Connection (1) |             | 26      | LVDS<br>Signal    | Rx4[A]_P    |
| 2       | No Connection (1) |             | 27      |                   | Rx4[B]_N    |
| 3       | No Connection (1) |             | 28      |                   | Rx4[B]_P    |
| 4       | No Connection (1) |             | 29      |                   | Rx4[C]_N    |
| 5       | No Connection (1) |             | 30      |                   | Rx4[C]_P    |
| 6       | No Connection (1) |             | 31      | GND               |             |
| 7       | GND               |             | 32      | LVDS<br>Clock     | Rx4CLK_N    |
| 8       | GND               |             | 33      |                   | Rx4CLk_P    |
| 9       | GND               |             | 34      | GND               |             |
| 10      | LVDS<br>Signal    | Rx3[A]_N    | 35      | LVDS<br>Signal    | Rx4[D]_N    |
| 11      |                   | Rx3[A]_P    | 36      |                   | Rx4[D]_P    |
| 12      |                   | Rx3[B]_N    | 37      |                   | Rx4[E]_N(2) |
| 13      |                   | Rx3[B]_P    | 38      |                   | Rx4[E]_P(2) |
| 14      |                   | Rx3[C]_N    | 39      | GND               |             |
| 15      |                   | Rx3[C]_P    | 40      | No Connection (1) |             |
| 16      | GND               |             | 41      | No Connection (1) |             |
| 17      | LVDS<br>Clock     | Rx3CLK_N    |         |                   |             |
| 18      |                   | Rx3CLK_P    |         |                   |             |
| 19      | GND               |             |         |                   |             |
| 20      | LVDS<br>Signal    | Rx3[D]_N    |         |                   |             |
| 21      |                   | Rx3[D]_P    |         |                   |             |
| 22      |                   | Rx4[E]_N(2) |         |                   |             |
| 23      |                   | Rx4[E]_P(2) |         |                   |             |
| 24      | GND               |             |         |                   |             |
| 25      | LVDS Signal       | Rx4[A]_N    |         |                   |             |

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

Note(2) 8bit & 10bit input mode available

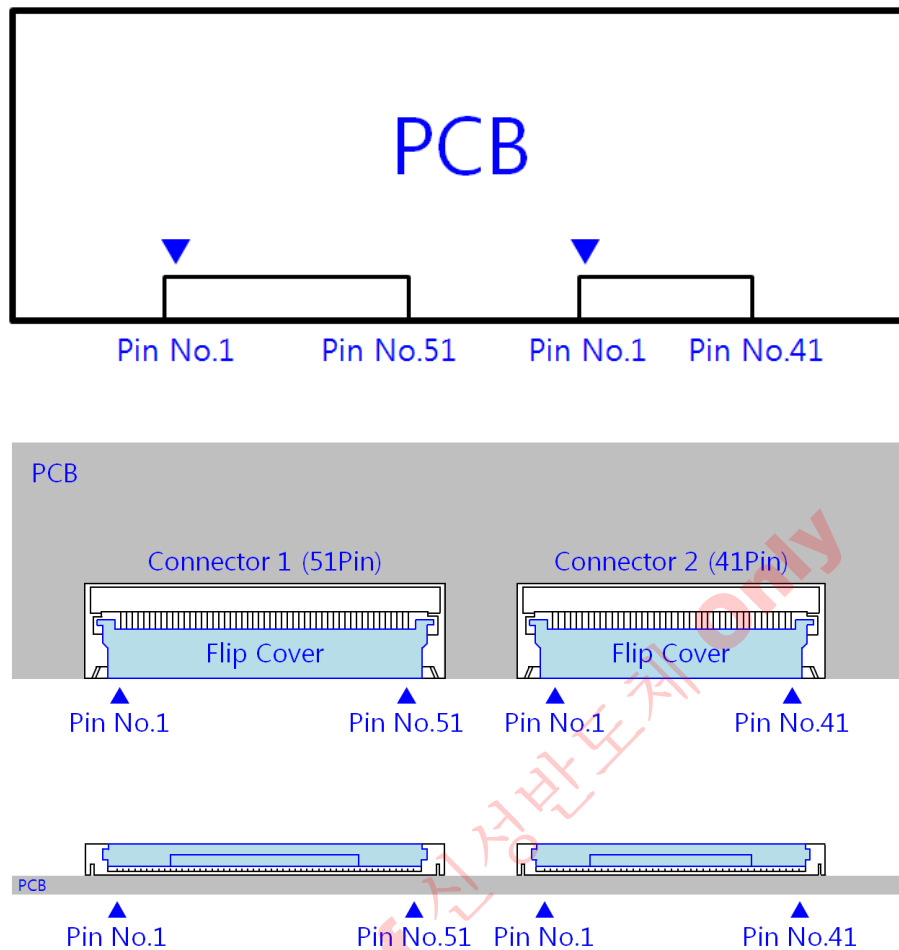
- If input mode is 8bit, → E\_Channel : Keep Level '0'

- E\_Channel N(Rxx(E)\_N) : Pull up (3.3V) with 1.5k ohm resistor
- E\_Channel P(Rxx(E)\_P) : Pull down(GND) with 1.5k ohm resistor

\* Level of LVDS signals are base on LVDS CHARACTERISTICS



## Note(3) LVDS Connector



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

## 5.2 LED CONVERTER INPUT PIN CONFIGURATION

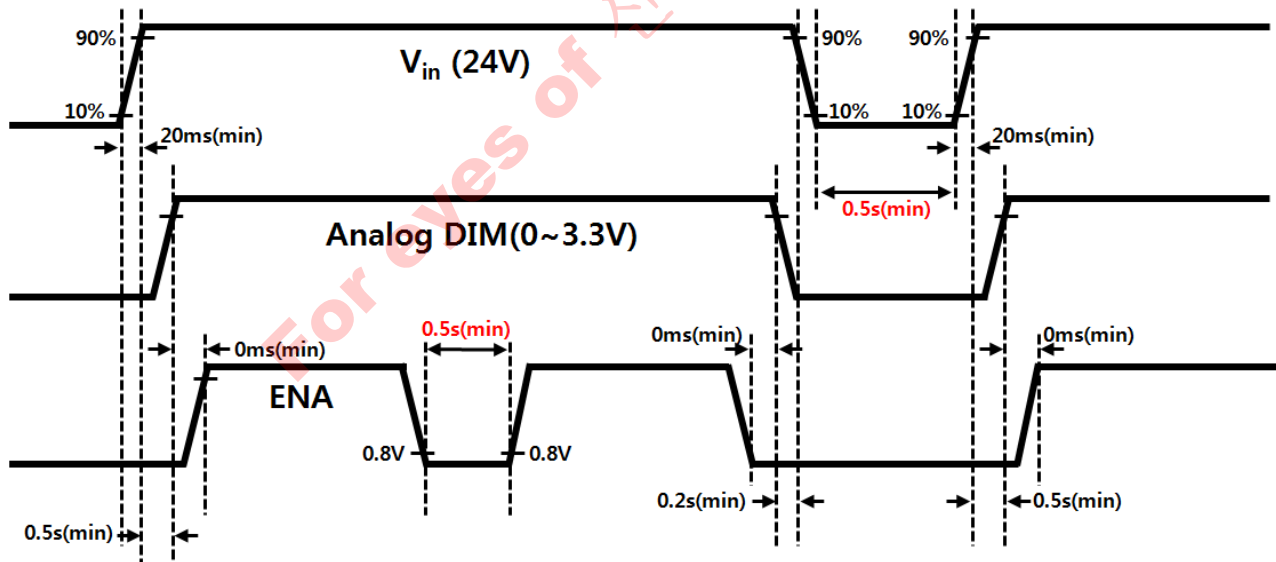
Master Connector : YEONHO, 22022WR-H14B2

| PIN NO     | Pin Configuration(FUNCTION)                                              |
|------------|--------------------------------------------------------------------------|
| 1,2,3,4,5  | V <sub>in</sub> (24V)                                                    |
| 6,7,8,9,10 | GND                                                                      |
| 11         | No Connection                                                            |
| 12         | ENA (Converter On/Off control signal)<br>Off : -0.3~0.4V / On : 2.4~5.5V |
| 13         | Analog Dimming control (0V : Min, 3.3V : Max)                            |
| 14         | No Connection                                                            |

Slave Connector : YEONHO, 22022WR-H14B2

| PIN NO      | Pin Configuration(FUNCTION) |
|-------------|-----------------------------|
| 1,2,3,4,5   | V <sub>in</sub> (24V)       |
| 6,7,8,9,10  | GND                         |
| 11,12,13,14 | No Connection               |

## 5.3 LED CONVERTER POWER SEQUENCE



## 5.4 LVDS INTERFACE

- LVDS Receiver : Tcon(Merged)
- Data Format (JEIDA Only)

|             | LVDS pin     | JEIDA -DATA |
|-------------|--------------|-------------|
| TxOUT/RxIN0 | TxIN/RxOUT0  | R2          |
|             | TxIN/RxOUT1  | R3          |
|             | TxIN/RxOUT2  | R4          |
|             | TxIN/RxOUT3  | R5          |
|             | TxIN/RxOUT4  | R6          |
|             | TxIN/RxOUT6  | R7          |
|             | TxIN/RxOUT7  | G2          |
| TxOUT/RxIN1 | TxIN/RxOUT8  | G3          |
|             | TxIN/RxOUT9  | G4          |
|             | TxIN/RxOUT12 | G5          |
|             | TxIN/RxOUT13 | G6          |
|             | TxIN/RxOUT14 | G7          |
|             | TxIN/RxOUT15 | B2          |
|             | TxIN/RxOUT18 | B3          |
| TxOUT/RxIN2 | TxIN/RxOUT19 | B4          |
|             | TxIN/RxOUT20 | B5          |
|             | TxIN/RxOUT21 | B6          |
|             | TxIN/RxOUT22 | B7          |
|             | TxIN/RxOUT24 | HSYNC       |
|             | TxIN/RxOUT25 | VSYNC       |
|             | TxIN/RxOUT26 | DEN         |
| TxOUT/RxIN3 | TxIN/RxOUT27 | R0          |
|             | TxIN/RxOUT5  | R1          |
|             | TxIN/RxOUT10 | G0          |
|             | TxIN/RxOUT11 | G1          |
|             | TxIN/RxOUT16 | B0          |
|             | TxIN/RxOUT17 | B1          |
|             | TxIN/RxOUT23 | 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    | -           |                        |
|                            | 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>↑<br><br>↓<br>LIGHT | 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 |                        |
|                            |                             | :           | :  | :  | :  | :  | :  |    |    | :  | :     | :  | :  | :  | :  |    |    | :  | :    | :  | :  | :  | :  |    |    |      |             |                        |
|                            |                             | 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 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  | 0    | G255        |                        |
| GRAY<br>SCALE 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  | 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             | $1/T_C$  | 260  | 297  | 305  | MHz    | -    |
| Hsync                           |                       | $F_H$    | 100  | 130  | 146  | KHz    | -    |
| Vsync                           |                       | $F_V$    | 90   | 120  | 130  | Hz     | -    |
| Term for the vertical display   | Active display period | $T_{VD}$ | -    | 1080 | -    | Lines  | -    |
|                                 | Total vertical        | $T_V$    | 1105 | 1125 | 1425 | Lines  | -    |
| Term for the horizontal display | Active display period | $T_{HD}$ | -    | 1920 | -    | Clocks | -    |
|                                 | Total Horizontal      | $T_H$    | 2180 | 2200 | 2350 | clocks | -    |

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

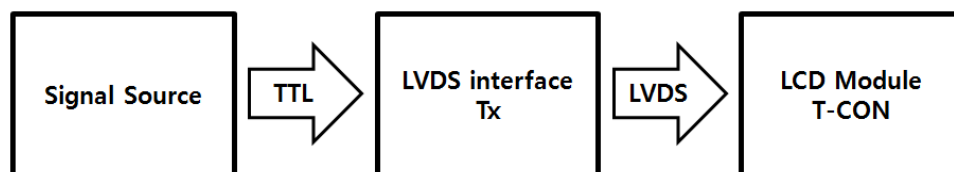
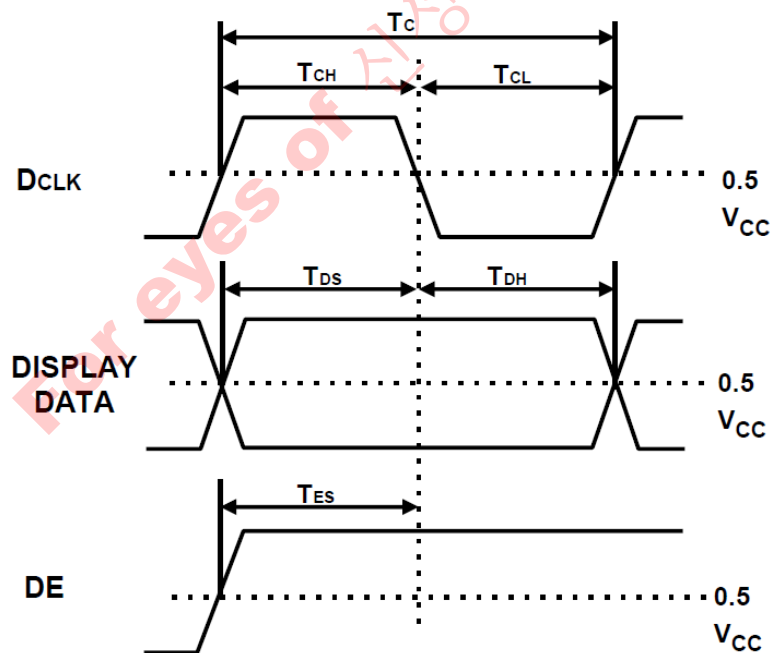
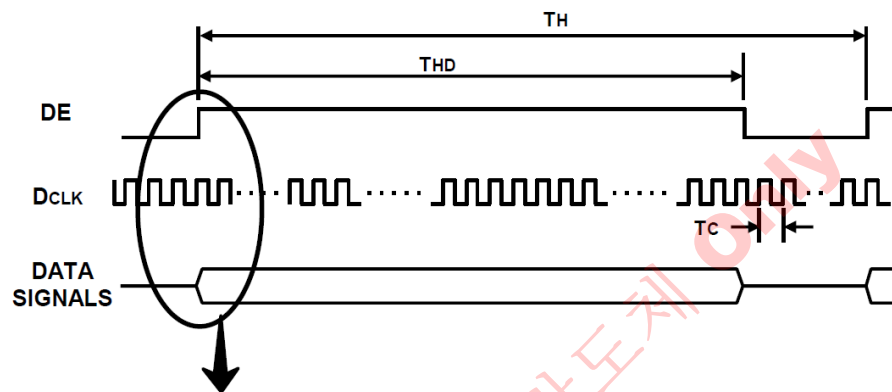
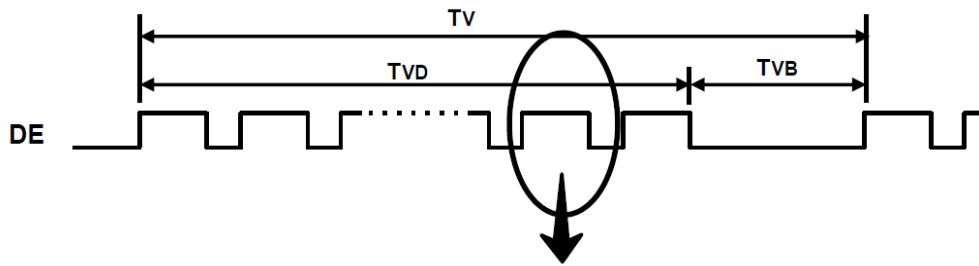
(1) Test Point: TTL controls signal and CLK at LVDS Tx at the input terminal of system.

(2) Internal VDD = 3.3V

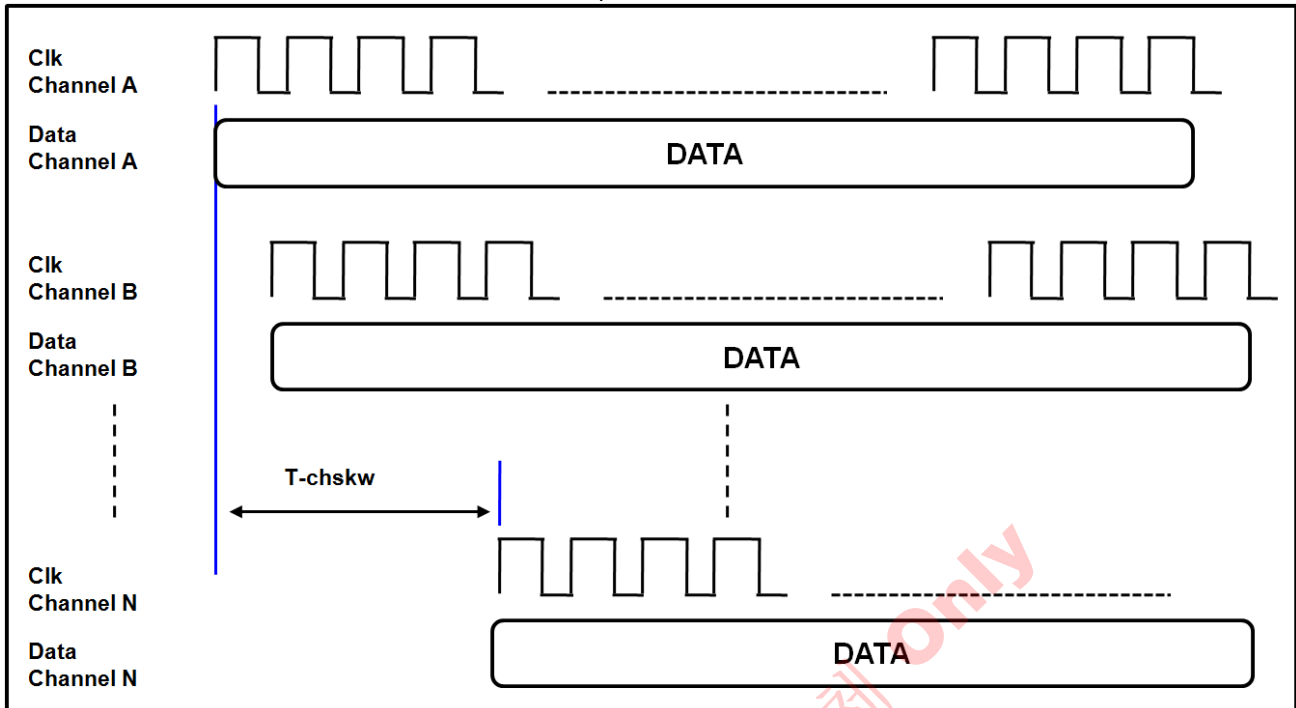
(3) The spread spectrum

- The limit of spread spectrum's range of SET in which the LCD module is assembled should be within  $\pm 0.3\%$
- Frequency for modulation : Max 30KHz

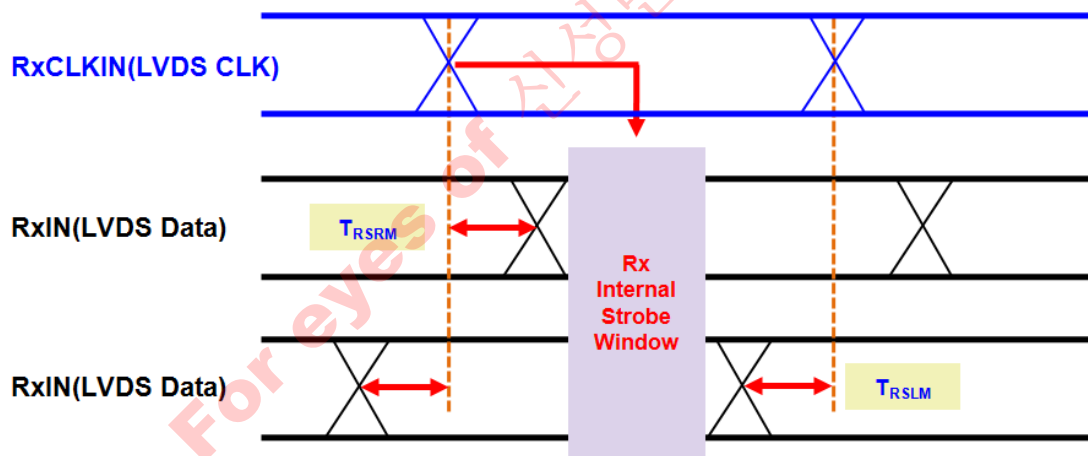
## 6.2 TIMING DIAGRAMS OF INTERFACE SIGNAL (DE ONLY MODE)



\* LVDS Channel to Channel Skew(T-chskw) in Multiple LVDS Channels



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

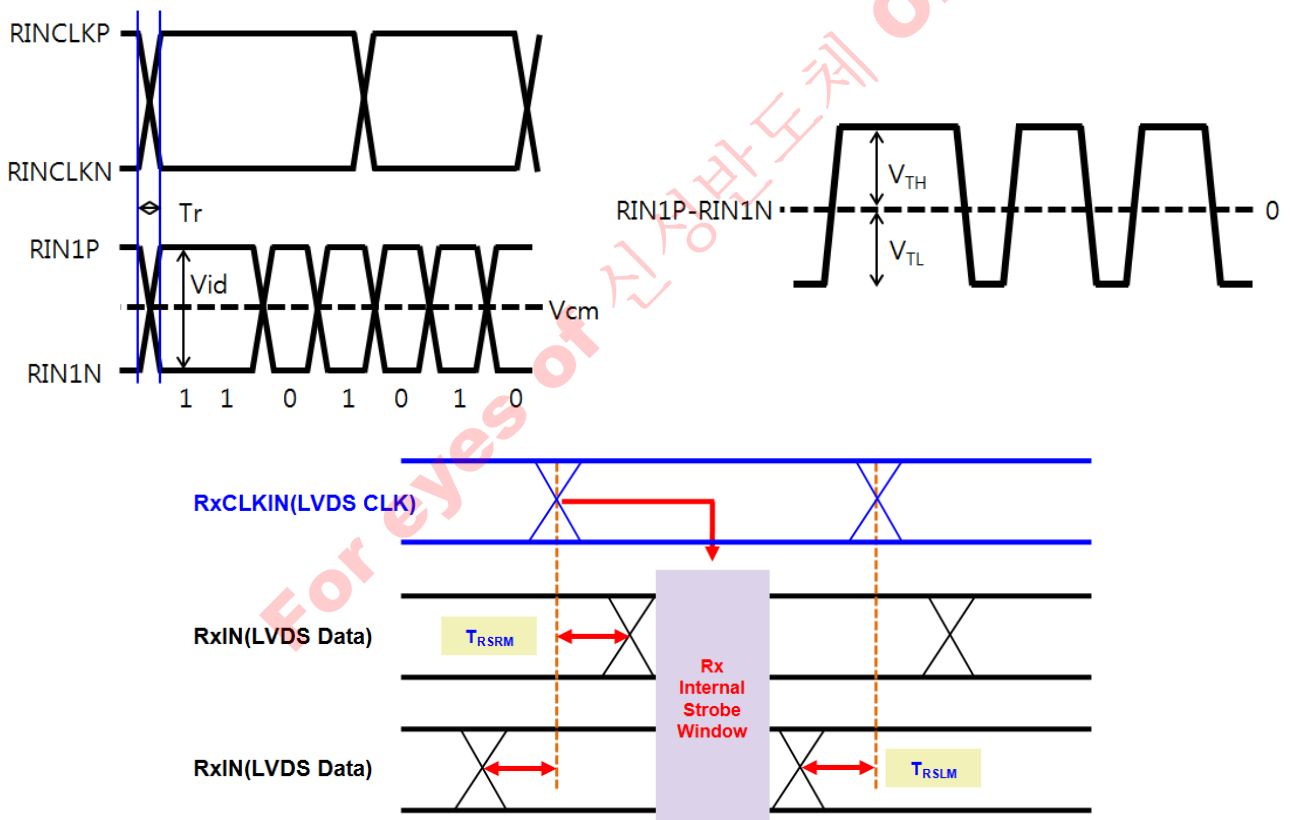


| SYMBOL            | ITEM                |                | Min | Typ | Max | UNIT |
|-------------------|---------------------|----------------|-----|-----|-----|------|
| t <sub>RSRM</sub> | Input data position | LVDS CLK=85MHz | -   | -   | 400 | ps   |
|                   |                     | LVDS CLK=78MHz | -   | -   | 450 | ps   |
|                   |                     | LVDS CLK=75MHz | -   | -   | 500 | ps   |
| t <sub>RSLM</sub> |                     | LVDS CLK=85MHz | 400 | -   | -   | ps   |
|                   |                     | LVDS CLK=78MHz | 450 | -   | -   | ps   |
|                   |                     | LVDS CLK=75MHz | 500 | -   | -   | ps   |

### 6.3 CHARACTERISTICS OF INPUT DATA OF LVDS

| ITEM                                      | SYMBOL         | Min        | Typ  | Max | UNIT | NOTE            |
|-------------------------------------------|----------------|------------|------|-----|------|-----------------|
| Differential input high threshold voltage | $V_{TH}$       | -          | -    | 120 | mV   | $V_{CM} = 1.2V$ |
| Differential input low threshold voltage  | $V_{TL}$       | -120       | -    | -   | mV   |                 |
| Input common mode voltage                 | $V_{CM}$       | 0.3        | -    | 1.8 | V    | -               |
| Differential Input Voltage                | $ V_{ID} $     | 120        | 200  | 600 | mV   | -               |
| Input data position                       | $F_{IN}=80MHz$ | $t_{RSRM}$ | -    | 400 | ps   | -               |
|                                           |                | $t_{RSLM}$ | -400 | -   | ps   | -               |

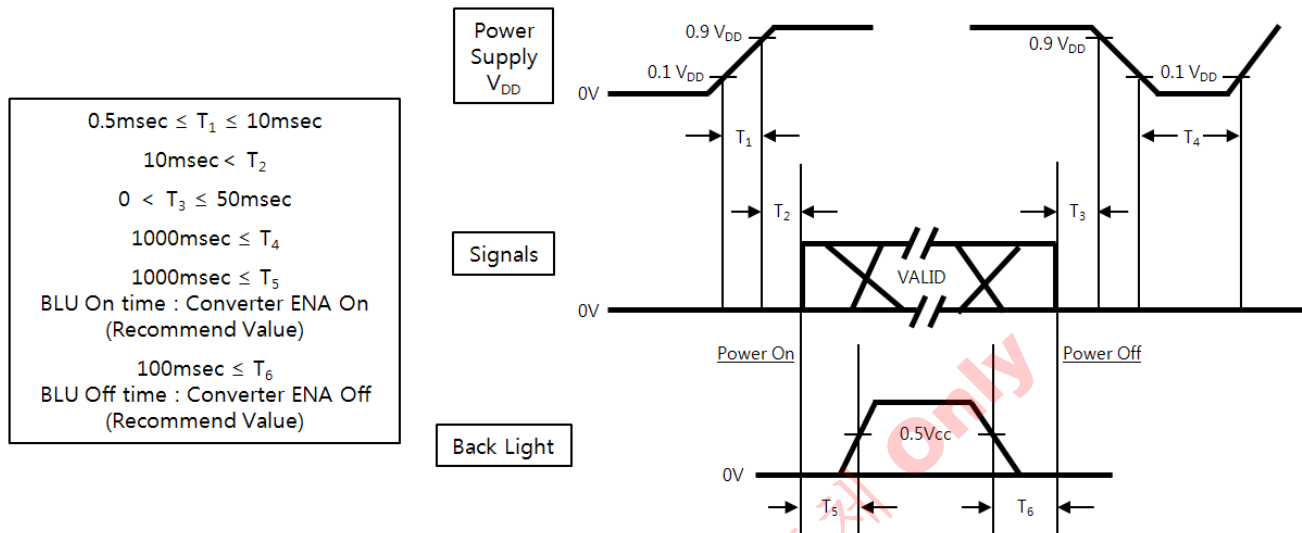
Note) The spread spectrum should be 0% when the skew is measured.  
Position of a measurement is T-CON LVDS input pin.





## 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 <sub>1</sub> | The time, during which the level of V <sub>DD</sub> is rising from 10% to 90%.                                                  |
| T <sub>2</sub> | The changing time, during which the V <sub>DD</sub> starts rising beyond 90% until the valid data of signal started coming in.  |
| T <sub>3</sub> | The changing time, during which the valid data of signal starts leaving out until the V <sub>DD</sub> starts falling below 90%. |
| T <sub>4</sub> | The changing time, during which the V <sub>DD</sub> starts falling below 10% to restart the Windows.                            |
| T <sub>5</sub> | The changing time, during which the signal of BLU starts rising beyond 50%.                                                     |
| T <sub>6</sub> | The changing time, during which the signal of BLU starts falling below 50%.                                                     |

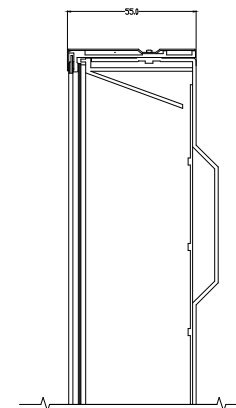
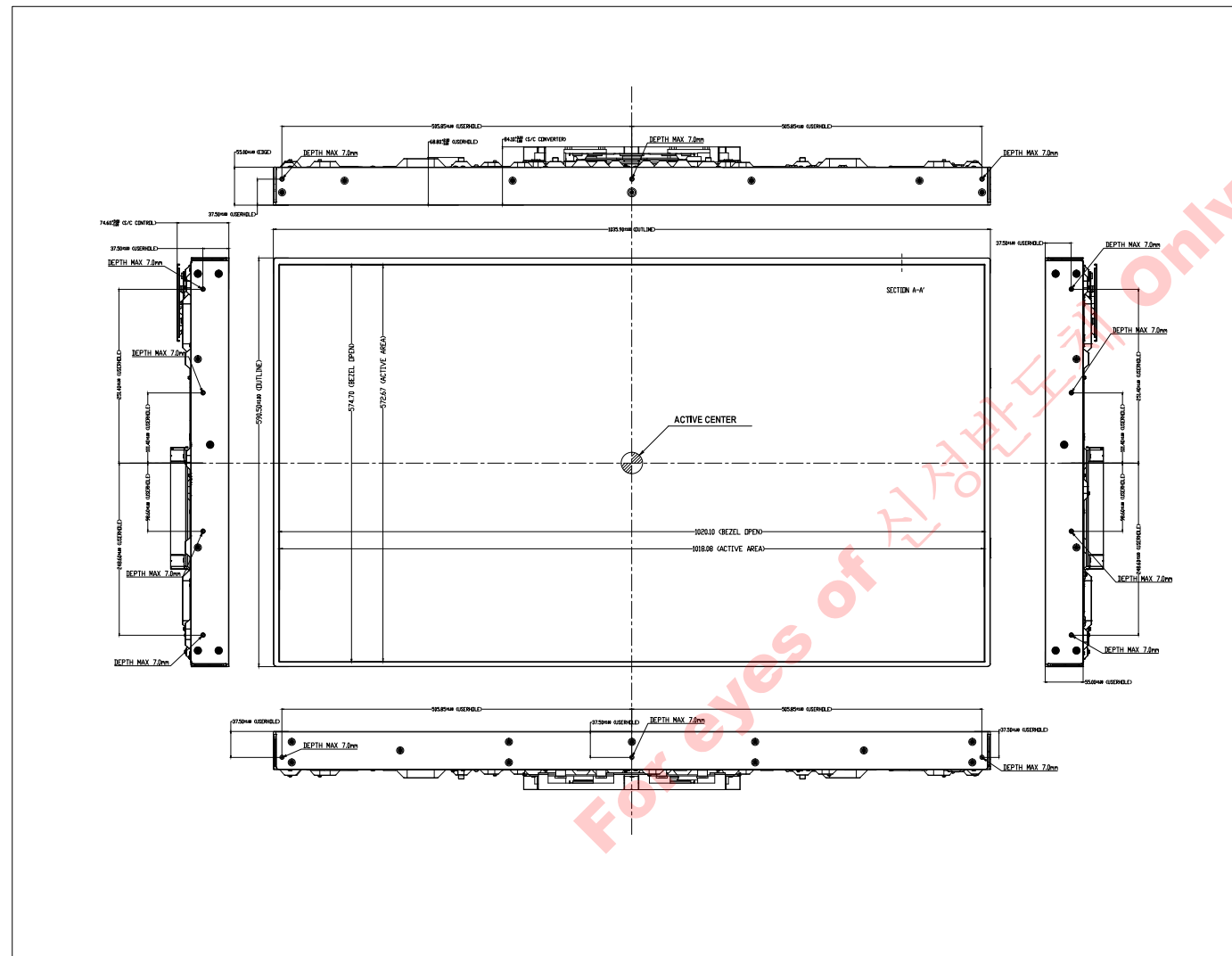
- The inputted V<sub>DD</sub> 's value for supply voltage, BLU, and signal to the external system of the module shall be computed with referring to the former mentioned value.
- The method to apply the voltage to the LED within the range, which the LCD operates. When the back-light is turned on before 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<sub>DD</sub> 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 T4 timing. The backlight may be flashed if the interface signal remains floated when the above-mentioned signal becomes invalid.

## 7. OUTLINE DIMENSION

Please refer next 2pages.

**SAMSUNG CONFIDENTIAL**

| NO | PART NAME         | CODE NO | SPECIFICATION | QTY | SPEC NO | REMARK |
|----|-------------------|---------|---------------|-----|---------|--------|
| 1  | OUTLINE DIMENSION | -       | LTJ460HFOI-V  | 1   |         |        |



SECTION A-A'

- \* NOTE
- 1. BACKLIGHT : WLED (Direct Type)
- 2. I/F CONNECTOR SPECIFICATION  
(SIPIN)
  - MAKER : UJUELE, YEDINHD
  - PART NO. : 3708-003216
  - (4PIN)
  - MAKER : UJUELE, YEDINHD
  - PART NO. : 3708-003215
- 3. CONVERTER CONNECTOR SPECIFICATION
  - MAKER : YEDINHD
  - PART NO. : 20022WR-14B2
- 4. USER HOLE
- 5. ALLOWED SCREW TORQUE
  - M3 TAP : 5.0Kgf.cm MAX
  - M4 TAP : 8.0Kgf.cm MAX
  - M5 TAP : 10.0Kgf.cm MAX
- 6. SCREW REPEATED INSERTION WARRANTY : 6 times
- 7. WEIGHT : 128Kgm (MAX)
- 8. TOLERANCE IN 2 AXIS
  - ZONE A : +3 / -1
  - ZONE B : +1 / -1



| GENERAL TOLERANCE |         |         |         |           |                         |            |          |            |                 |            |          |    | REASON |  | CHK'D BY |  |
|-------------------|---------|---------|---------|-----------|-------------------------|------------|----------|------------|-----------------|------------|----------|----|--------|--|----------|--|
| DISTANCE          | LEVEL 1 | LEVEL 2 | LEVEL 3 | REV DATE  | DESCRIPTION OF REVISION |            |          |            |                 |            |          |    |        |  |          |  |
|                   |         |         |         | UNIT      | WHEN DRAWN BY           | CHECKED BY | APP'D BY | MODEL NAME | PART/SHEET NAME | LINENUMBER | SPEC NO. |    |        |  |          |  |
| 0 < X ≤ 6         | + 0.05  | + 0.1   | + 0.3   | SCALE     | JWDDH                   | S.Y.TON    | I.P.RACH |            |                 |            |          |    |        |  |          |  |
| 6 < X ≤ 30        | + 0.1   | + 0.2   | + 0.5   | TOLERANCE |                         |            |          |            |                 |            |          |    |        |  |          |  |
| 30 < X ≤ 100      | + 0.15  | + 0.3   | + 0.8   | LEVEL 3   | 14083                   | 14083      |          |            |                 |            |          |    |        |  |          |  |
| 100 < X ≤ 400     | + 0.2   | + 0.5   | + 1.2   |           |                         |            |          |            |                 |            |          |    |        |  |          |  |
| 400 < X ≤ 1000    | + 0.25  | + 0.6   | + 1.6   |           |                         |            |          |            |                 |            |          |    |        |  |          |  |
| SAMSUNG DISPLAY   |         |         |         |           |                         |            |          |            |                 |            |          |    |        |  |          |  |
|                   |         |         |         |           |                         |            |          |            | CODE NAME       | -          | VER.     | 00 |        |  |          |  |

Userhole Distance from Datum Point :  $X < 400 : \pm 0.5$ ,  $400 \leq X : \pm 0.8$

$\square$  M3     $\diamond$  M4     $\triangleright$  M5

| NO | PART NAME         | CODE NO | SPECIFICATION | QTY | SPEC NO | REMARK |
|----|-------------------|---------|---------------|-----|---------|--------|
| 1  | OUTLINE DIMENSION | -       | LTJ460FDI-V   | 1   |         |        |

| GENERAL TOLERANCE |         |         |         | REV. DATE | DESCRIPTION OF REVISION |           |          |          | REASON          |                     | CHK'D BY |
|-------------------|---------|---------|---------|-----------|-------------------------|-----------|----------|----------|-----------------|---------------------|----------|
| DISTANCE          | LEVEL 1 | LEVEL 2 | LEVEL 3 | UNIT      | DRAWN BY                | DESIGN BY | CHK'D BY | APP'D BY | PART NAME       |                     |          |
| 0 < X ≤ 6         | ± 0.05  | ± 0.01  | ± 0.3   | SCALE     |                         |           |          |          |                 | LTI460H-01-V        |          |
| 6 < X ≤ 30        | ± 0.1   | ± 0.02  | ± 0.5   | TOLERANCE |                         |           |          |          |                 |                     |          |
| 30 < X ≤ 150      | ± 0.15  | ± 0.03  | ± 0.8   | LEVEL 3   |                         |           |          |          |                 | OUTLINE DRAW(SHOOT) | SHEET 2  |
| 150 < X ≤ 400     | ± 0.2   | ± 0.05  | ± 1.2   |           |                         |           |          |          |                 |                     |          |
| 400 < X ≤ 1000    | ± 0.3   | ± 0.08  | ± 1.8   |           |                         |           |          |          |                 |                     |          |
| SAMSUNG DISPLAY   |         |         |         |           |                         |           |          |          |                 |                     |          |
|                   |         |         |         |           |                         |           |          |          | PART/SHEET NAME |                     |          |
|                   |         |         |         |           |                         |           |          |          | CODE NO.        | -                   | VER.     |

## 8. 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 : 60Min, 200cycle                                                                           | 4EA      |
| TSS                               | -20 ~ 65℃, 220cycle                                                                                               | 4EA      |
| Image sticking                    | 50℃, Mosaic pattern (9X10), 168hrs                                                                                | 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 / 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  |
| Vibration                         | Frequency range 10hz~300hz for 10min at the sine wave at 1.5G<br>Direction of X, Y and Z axis for 30min           | 3EA      |
| Shock                             | 40G for ±X and Y axis / 30G for ±Z axis                                                                           | 3EA      |
| 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

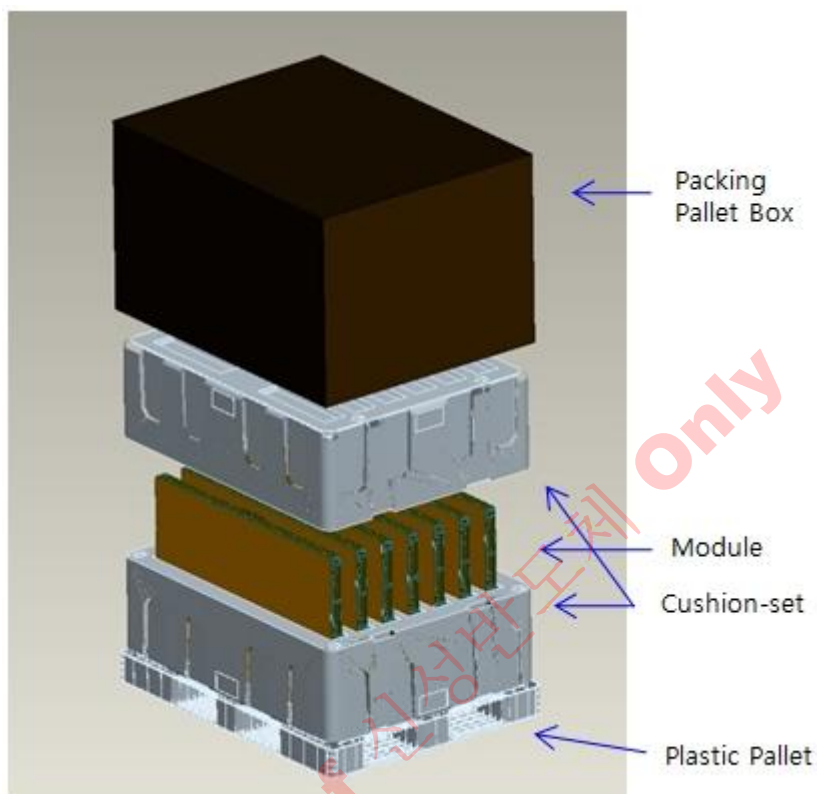
\* HTS / LTS : The storage at the high and low temperature

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

## 9. PACKING

(1) Packing Form : EPS Cushion / Paper Box

(2) Packing Method



Note(1) Total Weight : Approximately 117.4kg [With Pallet-Plastic]

Note(2) Acceptance number of piling : 2 Pallets

Note(3) Carton size : 1270mm(H) x 1150mm(V) x 712mm(Height) [Without Pallet Plastic]

1270mm(H) x 1150mm(V) x 847mm(Height) [With Pallet Plastic]

(3) Packing Material

| No | Part name                  | Quantity |
|----|----------------------------|----------|
| 1  | Packing-Pallet box         | 1 EA     |
| 2  | EPS cushion (Top / Bottom) | 2 EA     |
| 3  | Bag-Shielding              | 7 EA     |
| 4  | Protector-Panel            | 7 EA     |
| 5  | Pallet-Plastic             | 1 EA     |

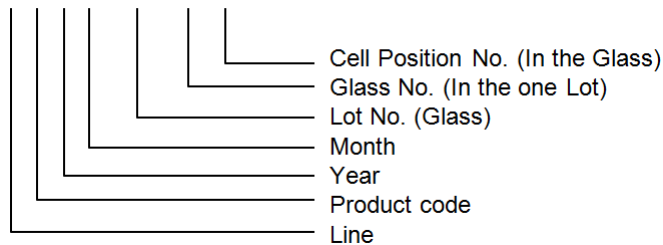
## 10. MARKINGS & OTHERS

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

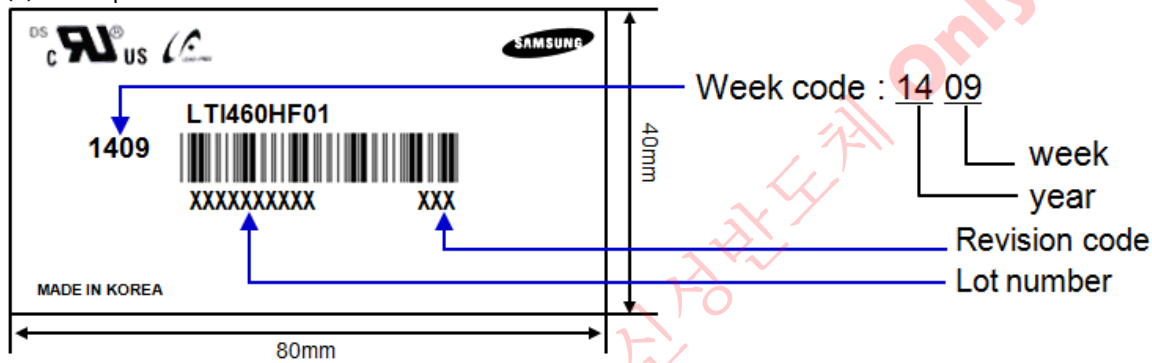
(1) Parts number : LTI460HF01

(2) Revision code : V(0)XX(Three letters)

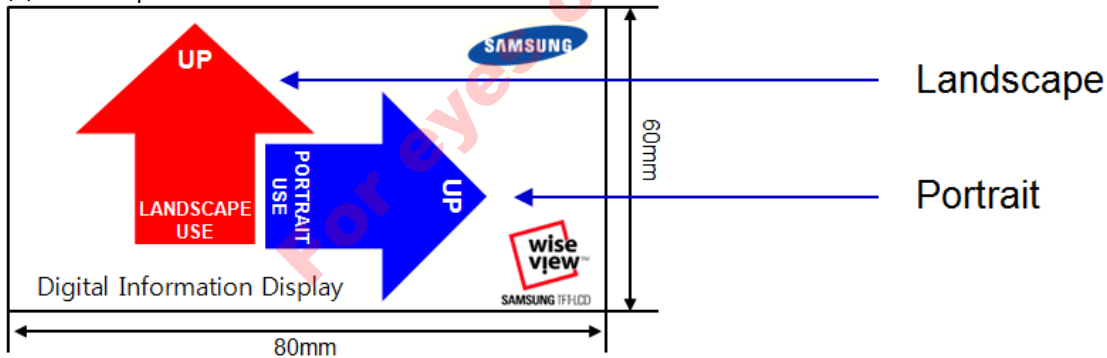
(3) Lot number : X X X X XXX XX X



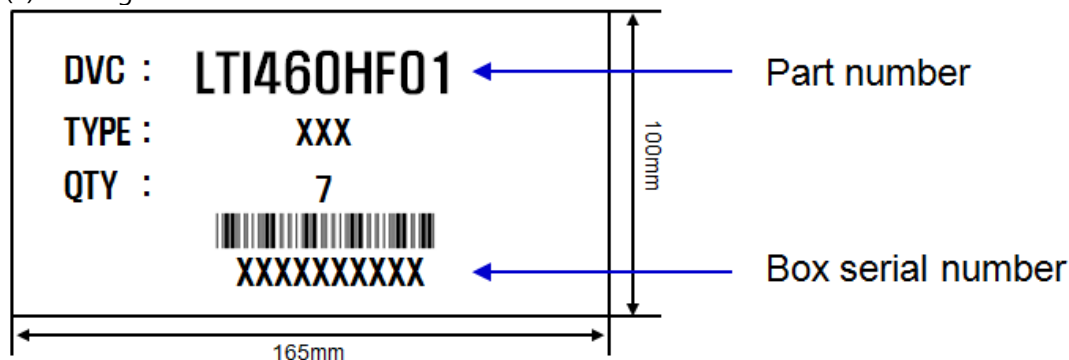
(4) Nameplate Indication



(5) Landscape / Portrait Direction Indication



(6) Packing small box attach



## **11. GENERAL PRECAUTIONS**

### **11.1 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 LED 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 LED 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.

## 11.2 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> |      |      |

## 11.3 OPERATION

- (a) Do not connect or disconnect the cable to/ from the module at the "Power On" condition.
- (b) The power shall be always turned on/off by the item 6.4. "Power on/off sequence"
- (c) 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.
- (d) Design the length of cable to connect between the connector for back-light and the converter as short as possible and the shorter cable shall be connected directly.  
The longer cable between that of back-light and that of converter may cause the luminance of LED to lower and need a higher startup voltage(Vs).

## 11.4 OPERATION CONDITION GUIDE

- (a) The LCD product should be operated under normal conditions.  
Normal condition is defined as below;  
Temperature : 20±15°C  
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 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.



## 11.5 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.

For eyes of 신정만도기 only