



ELECTRONICS

TO :

DATE : 11. Oct. 2006

***SAMSUNG TFT-LCD***  
**MODEL NO. : LTV250QV-F0B**

Customer Approval

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Any Modification of Spec is not allowed without SEC's permission.

Approved by : ***S. K. HUR***

**AMLCD BUSINESS**

**Samsung Electronics Co . , LTD.**





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## Revision History

| Date          | Rev.<br>No. | Page | Summary                         |
|---------------|-------------|------|---------------------------------|
| Oct. 10. 2006 | 000         |      | Preliminary Rev.000 was issued. |

## General Description

### \* Description

LTV250QV-F0B is a TMR(Transmissive with Micro Reflective) type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching devices. This model is composed of a TFT-LCD module, a driver circuit and a back-light unit. The resolution of a 2.5" contains 320RGBx240 dots and can display up to 16.7M colors.

### \* Features

- Transmissive with Micro Reflective type and back-light with 4 LEDs are available.
- Visible in outdoor & back-light off condition with reflectivity.
- TN(Twisted Nematic) mode.
- Line inversion mode with stripe type.
- 8bit RGB Interface + Serial Peripheral Interface(SPI)
- SYNC(Vsync, Hsync, Dotclk) mode
- Gate Driver IC embeded on Panel(Double ASG)

### \* Applications

- Display terminals for DSC(Digital Still Camera), PMP(Portable Multimedia Player) application products.

### \* General information

| Items             | Specification          | Unit    | Note |
|-------------------|------------------------|---------|------|
| Display area      | 50.88(H) x 38.04(V)    | mm      | -    |
| Driver element    | a-Si TFT active matrix | -       | -    |
| Display colors    | 16.7M                  | colors  | -    |
| Number of pixels  | 320RGB(H) x 240(V)     | dot     | -    |
| Pixel arrangement | stripe type            | -       | -    |
| Pixel pitch       | 0.159 (H) x 0.1585 (V) | mm      | -    |
| Display mode      | Normally White         | -       | -    |
| Viewing direction | 6                      | o'clock | -    |

### \* Mechanical information

| Item        |               | Min.  | Typ.  | Max.  | Unit | Note |
|-------------|---------------|-------|-------|-------|------|------|
| Module size | Horizontal(H) | 56.78 | 56.98 | 57.18 | mm   | -    |
|             | Vertical(V)   | 47.74 | 47.94 | 48.14 | mm   | (1)  |
|             | Depth(D)      | 2.46  | 2.66  | 2.86  | mm   | (1)  |
| Weight      |               | -     | 16.0  |       | g    | -    |

Note (1) Not include FPC

Refer to the Outline Dimension in the "12.Outline Dimension" for further information.

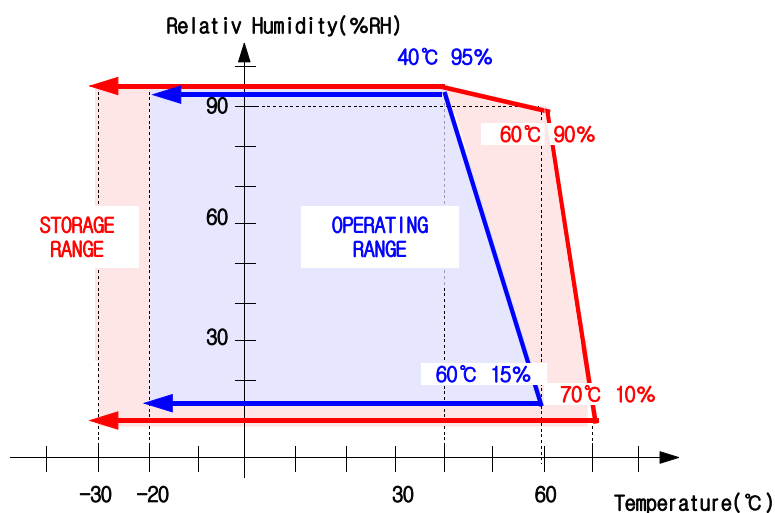
# 1. Absolute Maximum Ratings

## 1.1 Absolute Ratings of Environment

| Item                                           | Symbol           | Min. | Max. | Unit | Note    |
|------------------------------------------------|------------------|------|------|------|---------|
| Storage temperature                            | T <sub>STG</sub> | -30  | 70   | °C   | (1)     |
| Operating temperature<br>(Ambient temperature) | T <sub>OPR</sub> | -20  | 60   | °C   | (1),(2) |

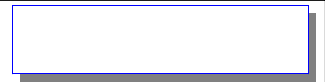
Note (1) 95 % RH Max. ( 40 °C Ta )

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



(2) In case of below 0°, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one.

Level of retardation depends on temperature, because of LC's characteristics.



## 1.2 Electrical Absolute Ratings

### (1) TFT-LCD Module

(Ta = 25 ± 2°C, V<sub>SS</sub>=GND=0)

| Characteristics        | Symbol          | Min. | Max. | Unit | Note |
|------------------------|-----------------|------|------|------|------|
| Digital supply voltage | V <sub>CC</sub> | -0.3 | +5.0 | V    | -    |
| Analog supply voltage  | DDVDH           | -0.3 | +7.0 | V    | -    |

### (2) Back-Light Unit

(Ta = 25 ± 2°C)

| Item    | Symbol         | Min. | Max. | Unit. | Note |
|---------|----------------|------|------|-------|------|
| Current | I <sub>B</sub> |      | 25   | mA    | (1)  |

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded.

Functional operation should be restricted to the conditions described under normal operating conditions.

## . Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be

measured in a dark room or equivalent state with the methods shown in Note (1).

Measuring equipment: LCD-5000, BM-5A, BM-7, PR-650, EZ-Contrast

(Ta = 25 ± 2°C, V<sub>CC</sub> = V<sub>CL</sub> = 3.3V, I<sub>B</sub> = 15mA)

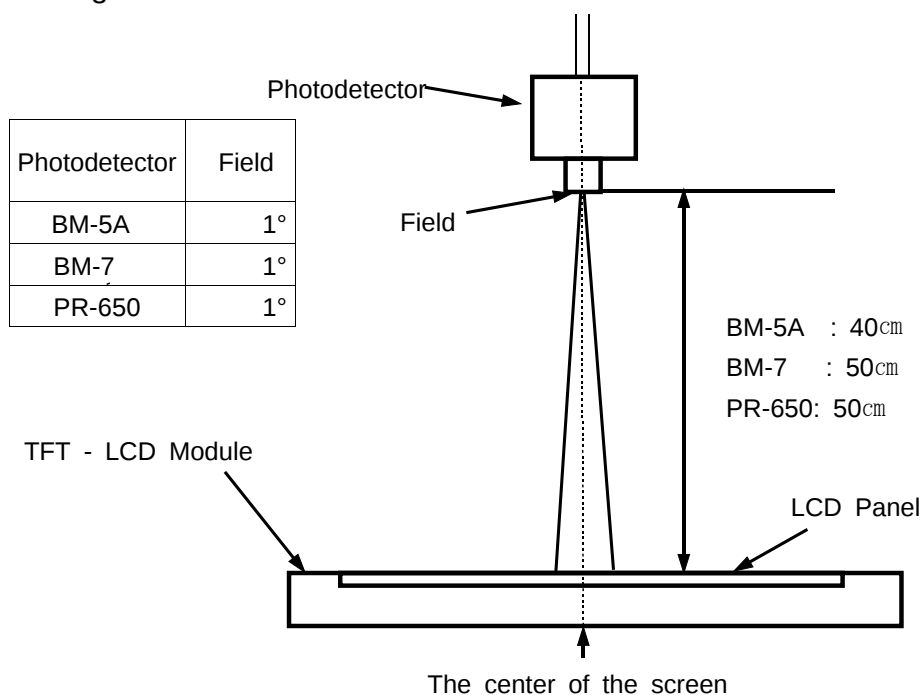
| Item                                 |            | Symbol         | Condition                                                                     | Min.  | Typ.  | Max.        | Unit                   | Note          |
|--------------------------------------|------------|----------------|-------------------------------------------------------------------------------|-------|-------|-------------|------------------------|---------------|
| Contrast ratio<br>(Center point)     |            | C/R            | NOTE<br>(1)<br><br>f = 0<br>q = 0<br>Normal<br>Viewing<br>Angle<br><br>B/L On | T.B.D | T.B.D |             | -                      | (2)<br>BM-5A  |
| Luminance of white<br>(Center point) |            | Y <sub>L</sub> |                                                                               |       | T.B.D |             | cd/m <sup>2</sup>      | (3)<br>BM-5A  |
| Response<br>time                     | Rising:Tr  | Tr+Tf          |                                                                               |       | 25    | 30          | msec                   | (4)<br>BM-7   |
|                                      | Falling:Tf |                |                                                                               |       |       |             |                        |               |
| Color<br>chromaticity<br>(CIE 1931)  | White      | W <sub>x</sub> | Viewing<br>Angle                                                              | 0.24  | 0.29  | 0.34        | -                      | (5)<br>PR-650 |
|                                      |            | W <sub>y</sub> |                                                                               | 0.28  | 0.33  | 0.38        |                        |               |
|                                      | Red        | R <sub>x</sub> |                                                                               | 0.58  | 0.63  | 0.68        |                        |               |
|                                      |            | R <sub>y</sub> |                                                                               | 0.28  | 0.33  | 0.38        |                        |               |
|                                      | Green      | G <sub>x</sub> | B/L On                                                                        | 0.28  | 0.33  | 0.38        |                        |               |
|                                      |            | G <sub>y</sub> |                                                                               | 0.51  | 0.56  | 0.61        |                        |               |
|                                      | Blue       | B <sub>x</sub> |                                                                               | 0.09  | 0.14  | 0.19        |                        |               |
|                                      |            | B <sub>y</sub> |                                                                               | 0.08  | 0.13  | 0.18        |                        |               |
| Viewing<br>angle                     | Hor.       | q <sub>L</sub> | C/R <sup>3</sup> 10<br>B/L On                                                 | 60    | 80    | Degree<br>s | (6)<br>Ez-<br>Contrast |               |
|                                      |            | q <sub>R</sub> |                                                                               | 60    | 80    |             |                        |               |
|                                      | Ver.       | f <sub>H</sub> |                                                                               | 60    | 80    |             |                        |               |
|                                      |            | f <sub>L</sub> |                                                                               | 40    | 65    |             |                        |               |

## Note (1) Test Equipment Setup

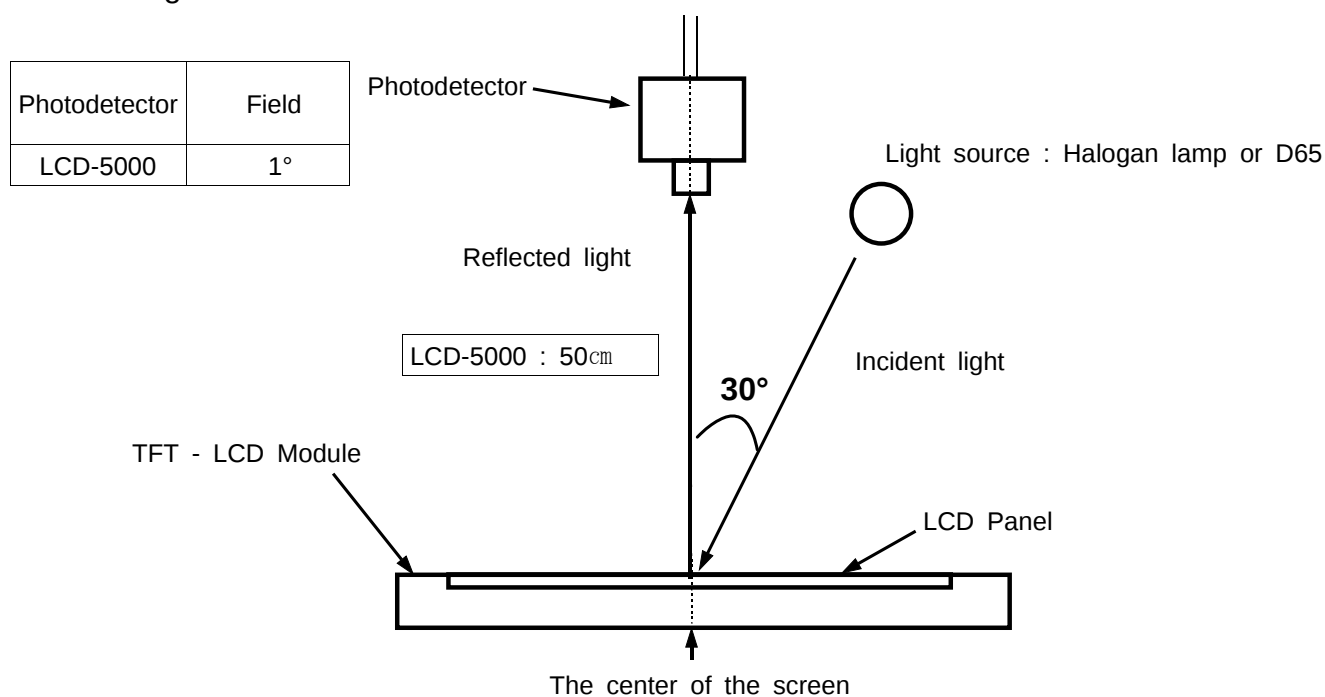
After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of screen.

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

Back-Light On condition



Back-Light Off condition



Optical Measuring Equipment Setup

Note (2) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point

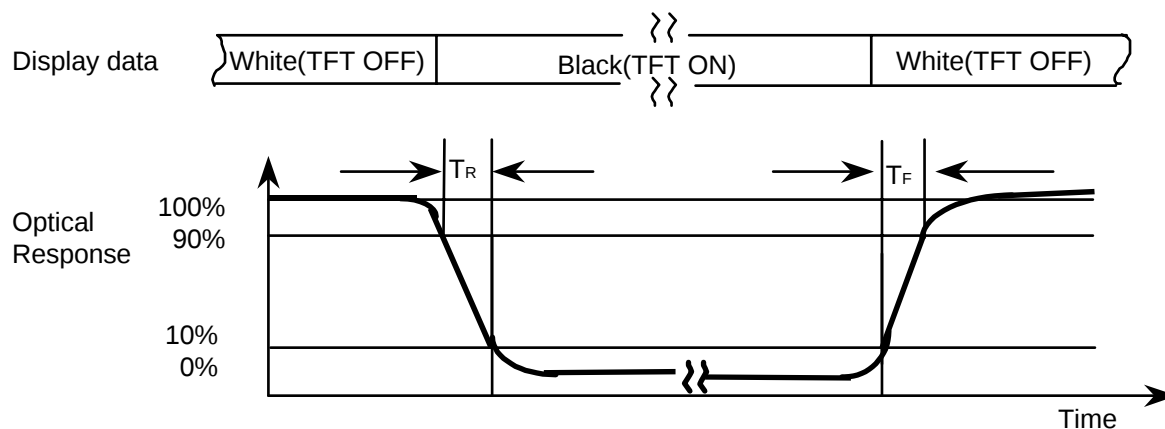
$$CR = \frac{G_{\max}}{G_{\min}}$$

\* Gmax : Luminance with all pixels white

\* Gmin : Luminance with all pixels black

Note (3) Definition of Luminance of White : Luminance of white at the center point

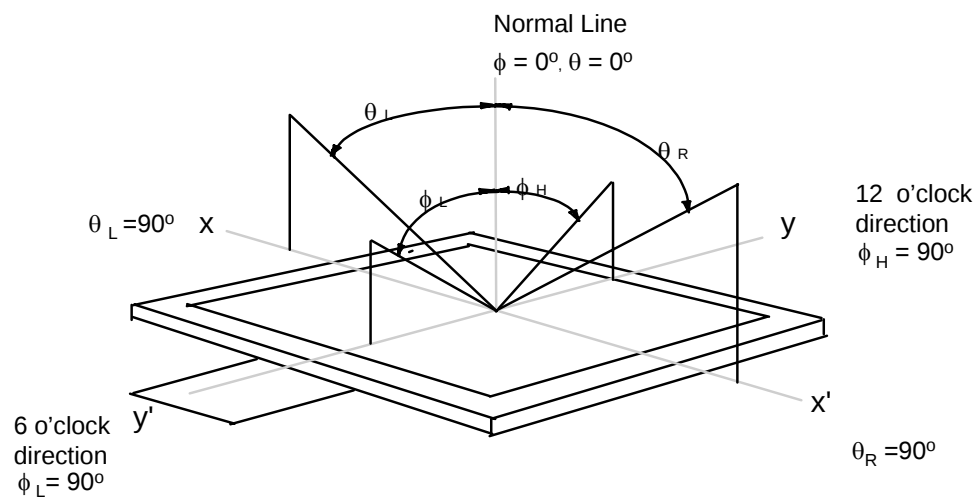
Note (4) Definition of Response time : Sum of  $T_r$ ,  $T_f$



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

Color coordinate of white & red, green, blue at center point.

Note (7) Definition of Viewing Angle : Viewing angle range ( $CR \geq 10$  )



### 3. Electrical Characteristics

#### 3.1 TFT-LCD Module

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

| Characteristics        |      | Symbol      | Min.  | Typ. | Max. | Unit | Note |
|------------------------|------|-------------|-------|------|------|------|------|
| Digital supply voltage |      | $V_{CC}$    | 2.5   | 3.0  | 3.3  | V    | -    |
| Analog supply voltage  |      | DDVDH       | 4.85  | 5.0  | 5.15 | V    | -    |
| Gate On voltage        |      | $V_{GH}$    | 17.5  | 18.0 | 18.5 | V    | -    |
| Gate Off voltage       |      | $V_{GL}$    | -10.5 | -10  | -9.5 | V    | -    |
| Power Dissipation      | Full | $P_{FULL}$  |       | 40   |      | mW   | -    |
| Frame frequency        |      | $f_{Frame}$ |       | -    | 90   | Hz   | -    |
| Dot Clock              |      | DOTCLK      | -     | -    | 30.0 | MHz  | -    |
| Serial Clock           |      | SCL         | -     | -    | 10.0 | MHz  | -    |

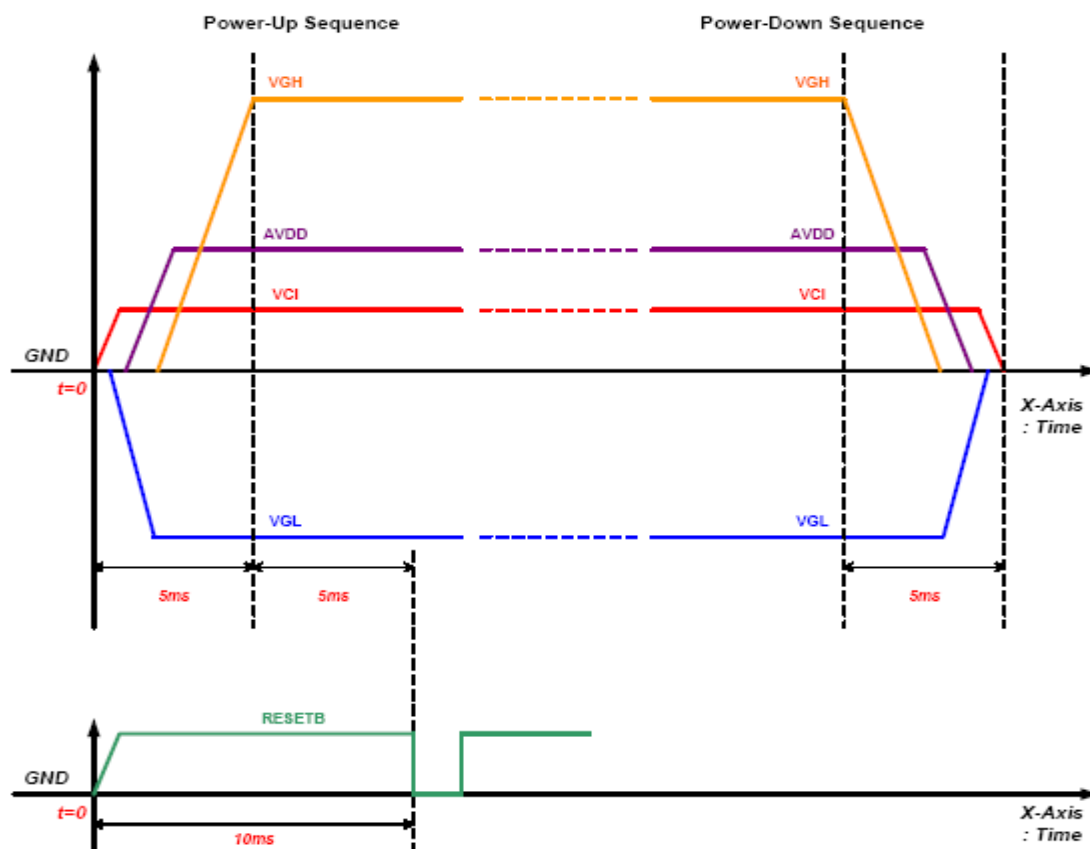
\* To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the Chapter 9. Power On/Off Sequence.

\*  $|V_{GH} - 0.7 \cdot |V_{GL}|| \text{ MAX} = 25.0\text{V}$

\* Keep  $|0.7 \cdot |V_{GL}| - V_{GL}|$  greater than or equal to 3.0V when  $|V_{GH} - 0.7 \cdot |V_{GL}|| = 25.0\text{V}$

- Power On :  $V_{CC} \rightarrow V_{GL} \rightarrow DDVDH \rightarrow V_{GH} \rightarrow \text{Data}$

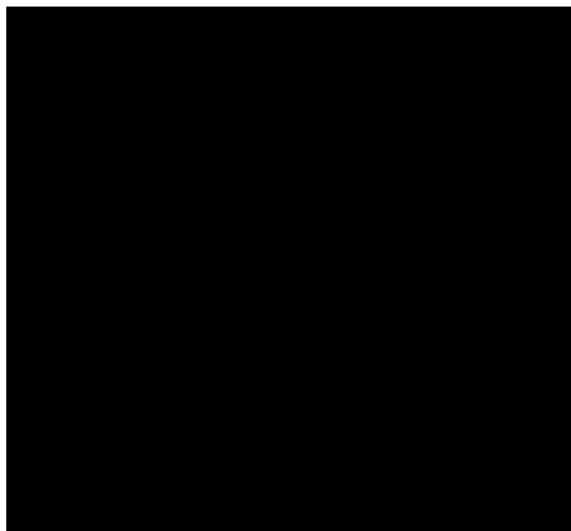
- Power Off :  $\text{Data} \rightarrow V_{GH} \rightarrow DDVDH \rightarrow V_{GL} \rightarrow V_{CC}$





## #2. Dissipation current check pattern

▶ 0 Gray black pattern



### 3.2 Back-Light unit

The back-light system is an edge-lighting type with 4 white LED(Light Emitting Diode)s.

(Ta=25 ± 2°C)

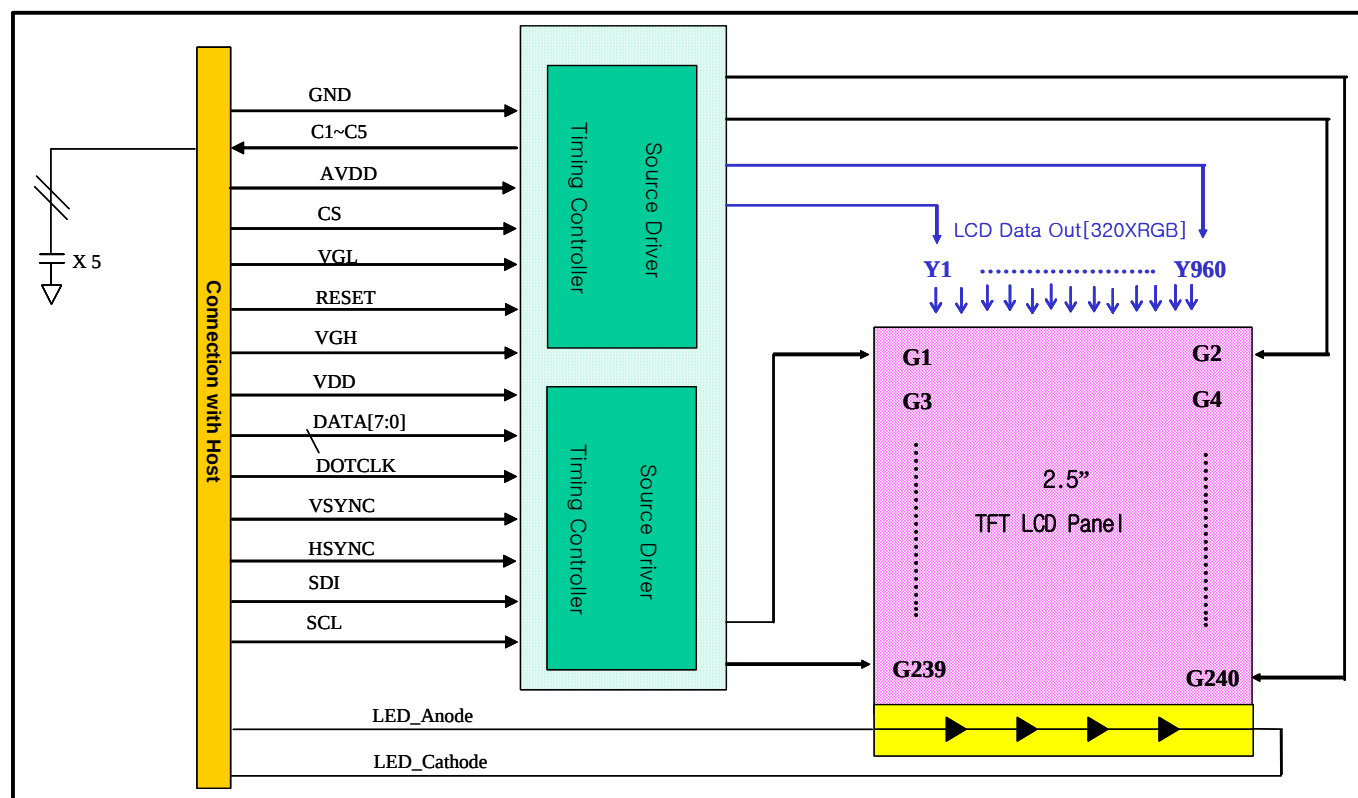
| Item              | Symbol   | Min. | Typ. | Max. | Unit | Note |
|-------------------|----------|------|------|------|------|------|
| Current           | $I_B$    | 10   | 15   | 25   | mA   | (1)  |
| Power Consumption | $P_{BL}$ | -    | 200  | -    | mW   | (2)  |

Note (1) 4 LEDs serial type.

(2) Where  $I_B = 15\text{mA}$ ,  $V_B = P_{BL} / I_B$

## 4. Block Diagram

### 4.1 TFT-LCD Module (Interface System Structure) with Back Light Unit



## 5. Input Terminal Pin Assignment

### 5.1 Input Signal & Power (Connector type : 31Pin / 0.3mm pitch / Bottom contact)

| Pin No | Symbol      | Description                   | Input/Output | Note |
|--------|-------------|-------------------------------|--------------|------|
| 1      | LED_Cathode | LED_Cathode                   | Input        |      |
| 2      | LED_Anode   | LED_Anode                     | Input        |      |
| 3      | /RESET      | /RESET                        | Input        |      |
| 4      | /CS         | Chip Select                   | Input        |      |
| 5      | SCL         | Serial Clock                  | Input        |      |
| 6      | SDI         | Serial Data Input             | Input        |      |
| 7      | DATA0       | Graphic Data 0                | Input        |      |
| 8      | DATA1       | Graphic Data 1                | Input        |      |
| 9      | DATA2       | Graphic Data 2                | Input        |      |
| 10     | DATA3       | Graphic Data 3                | Input        |      |
| 11     | DATA4       | Graphic Data 4                | Input        |      |
| 12     | DATA5       | Graphic Data 5                | Input        |      |
| 13     | DATA6       | Graphic Data 6                | Input        |      |
| 14     | DATA7       | Graphic Data 7                | Input        |      |
| 15     | HSYNC       | Horizontal Synchronous Signal | Input        |      |
| 16     | VSYNC       | Vertical Synchronous Signal   | Input        |      |
| 17     | DOTCLK      | Data Clock                    | Input        |      |
| 18     | AVDD        | Vanalog voltage               | Input        |      |
| 19     | AVDD        | Vanalog voltage               | Input        |      |
| 20     | VDD         | Vdigital voltage              | Input        |      |
| 21     | VDD         | Vdigital voltage              | Input        |      |
| 22     | C5          | Connect Capacitor(10μF)       | -            |      |
| 23     | C4          | Connect Capacitor(10μF)       | -            |      |
| 24     | VGL         | Vgoff voltage                 | Input        |      |
| 25     | VGL         | Vgoff voltage                 | Input        |      |
| 26     | C3          | Connect Capacitor(10μF)       | -            |      |
| 27     | VGH         | Vgon voltage                  | Input        |      |
| 28     | C2          | Connect Capacitor(10μF)       | -            |      |
| 29     | C1          | Connect Capacitor(10μF)       | -            |      |
| 30     | GND         | Ground                        | GND          |      |
| 31     | GND         | Ground                        | GND          |      |

## 5.2 Input Signal, Basic Display Colors and Gray Scale of Each Colors

| COLOR                        | DISPLAY    | 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  | 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  | R1      |         |  |  |                        |
|                              |            | 0           | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | R2      |         |  |  |                        |
|                              |            | :           | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | R3-R252 |         |  |  |                        |
|                              |            | :           | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |         |         |  |  |                        |
|                              | LIGHT<br>↓ | 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  | G0      |         |  |  |                        |
|                              | DARK<br>↑  | 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-G252 |  |  |                        |
|                              |            | :           |    |    | :  | :  | :  | :  | :  | :  |       |    | :  | :  | :  | :  | :  | :  |    |      | :  | :  | :  | :  | :  | :       |         |  |  |                        |
|                              | LIGHT<br>↓ | 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<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>↑  | 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-B60  |  |  |                        |
|                              |            | :           | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :       |         |  |  |                        |
|                              | LIGHT<br>↓ | 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       | B61     |  |  |                        |
|                              |            | 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       | B62     |  |  |                        |
|                              | 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       | B63     |  |  |                        |

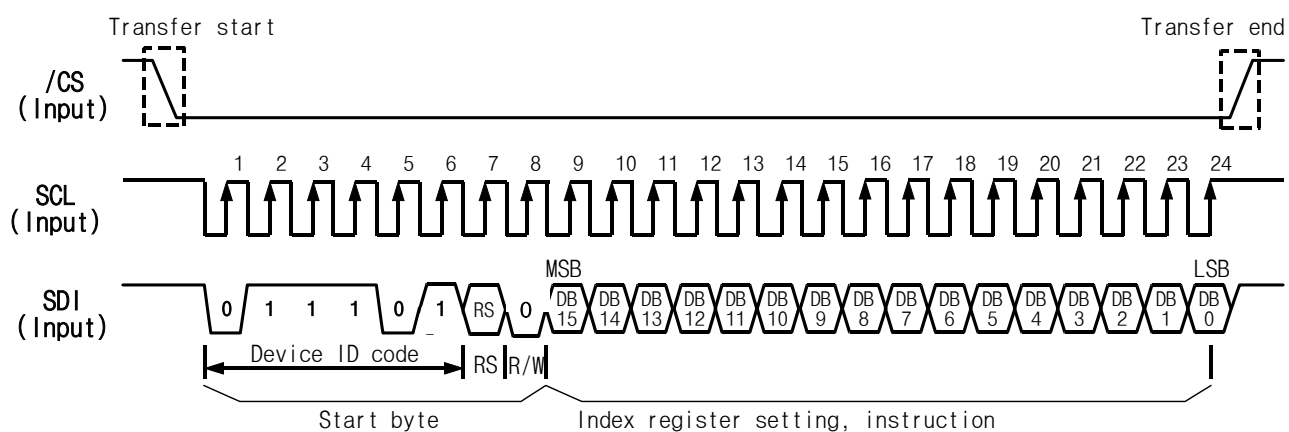
Note) Definition of Gray :

R<sub>n</sub> : Red Gray, G<sub>n</sub> : Green Gray, B<sub>n</sub> : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

## 6. Operation Specifications

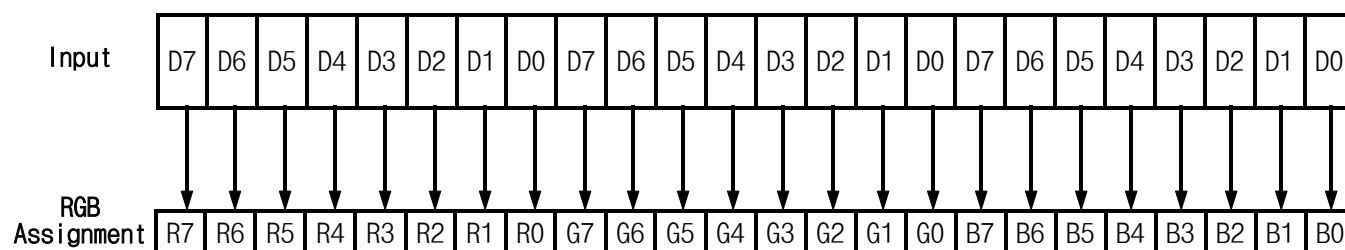
### 6.1 Serial Peripheral Interface



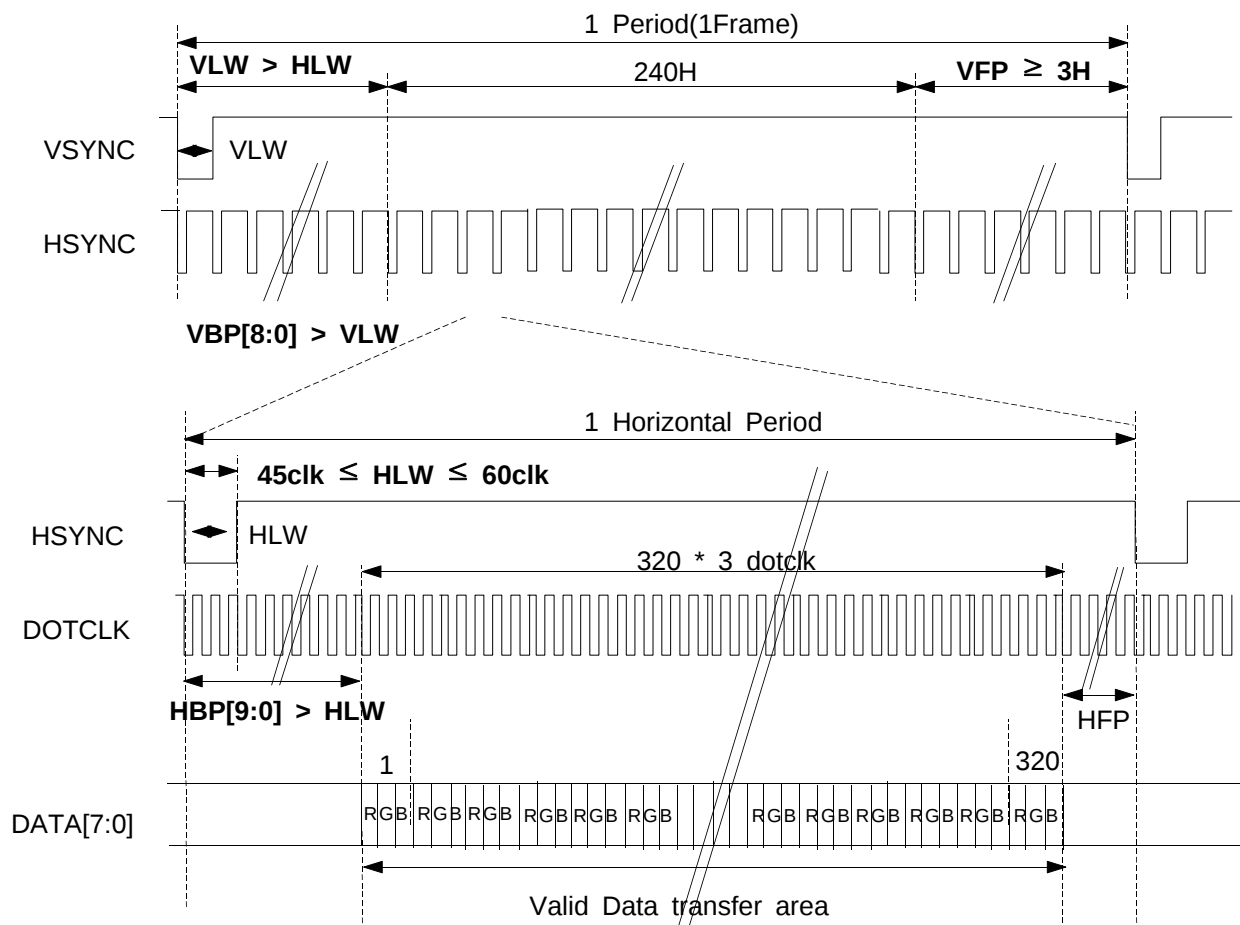
(Note) RS="0": Index data

RS="1": Instruction data

### 6.2 Data Format for 8bit RGB Interface



### 6.3 8bit RGB Interface Timing



$$* \text{DOTCLK} = f_{\text{frame}} \times (240 + \text{VBP} + \text{VFP}) \times (320 \times 3 + \text{HBP} + \text{HFP})$$

$$* 3H \leq \text{VFP}$$

$$* \text{HBP} > \text{HLW}$$

$$* \text{VBP} > \text{VLW}$$

$$* 45\text{clk} \leq \text{HLW} \leq 60\text{clk}$$

$$* \text{VLW} > \text{HLW}$$

Note 1. Polarity register setting : VPL = 0, HPL = 0, DPL=0

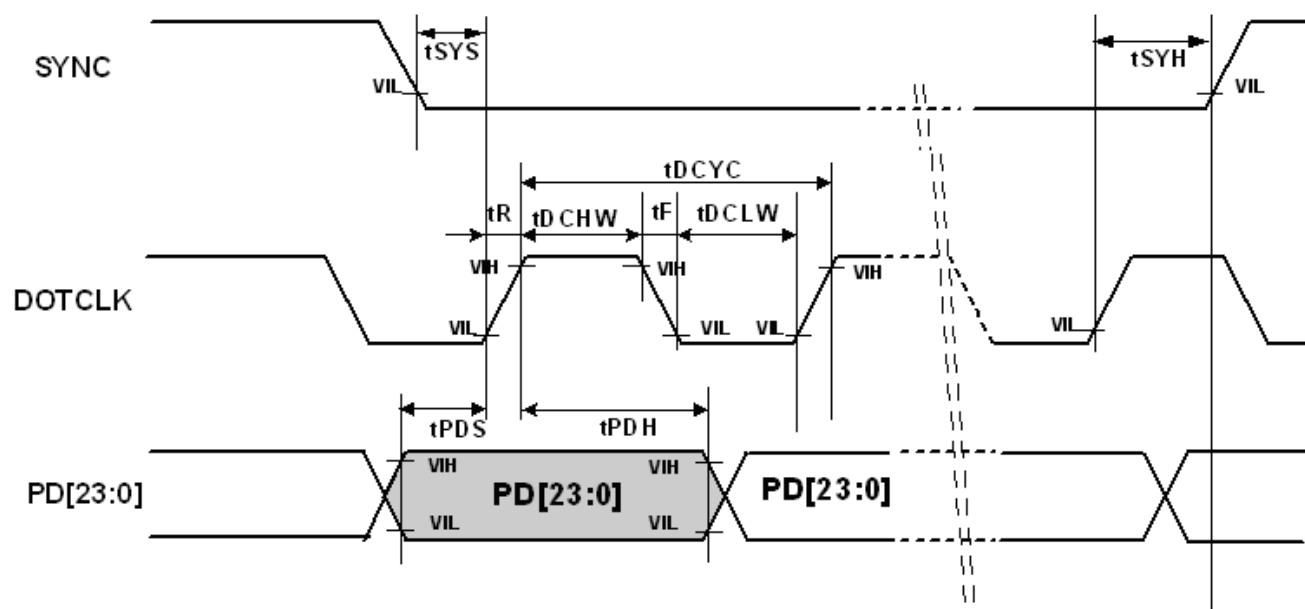
2. The rising edge of DOTCLK is used to fetch display data

## 6.4 Electrical Specifications

### a. RGB Data Interface Characteristics

( $T_A = -40$  to  $+85$  °C)

| Characteristic          | Symbol | 8bit RGB Interface |     | Unit |
|-------------------------|--------|--------------------|-----|------|
|                         |        | Min                | Max |      |
| DOTCLK cycle time       | tDCYC  | 30                 | -   | ns   |
| DOTCLK rise/fall time   | tR,tF  | -                  | 2   |      |
| DOTCLK Pulse width high | tDCHW  | 15                 | -   |      |
| DOTCLK Pulse width low  | tDCLW  | 15                 | -   |      |
| Sync Setup time         | tSYS   | 10                 | -   |      |
| Sync Hold time          | tSYH   | 10                 | -   |      |
| PD data setup time      | tPDS   | 15                 | -   |      |
| PD data hold time       | tPDH   | 15                 | -   |      |



### AC Characteristics

**b. Clock Synchronized Serial Mode Characteristics**(T<sub>A</sub> = -40 to +85 °C)

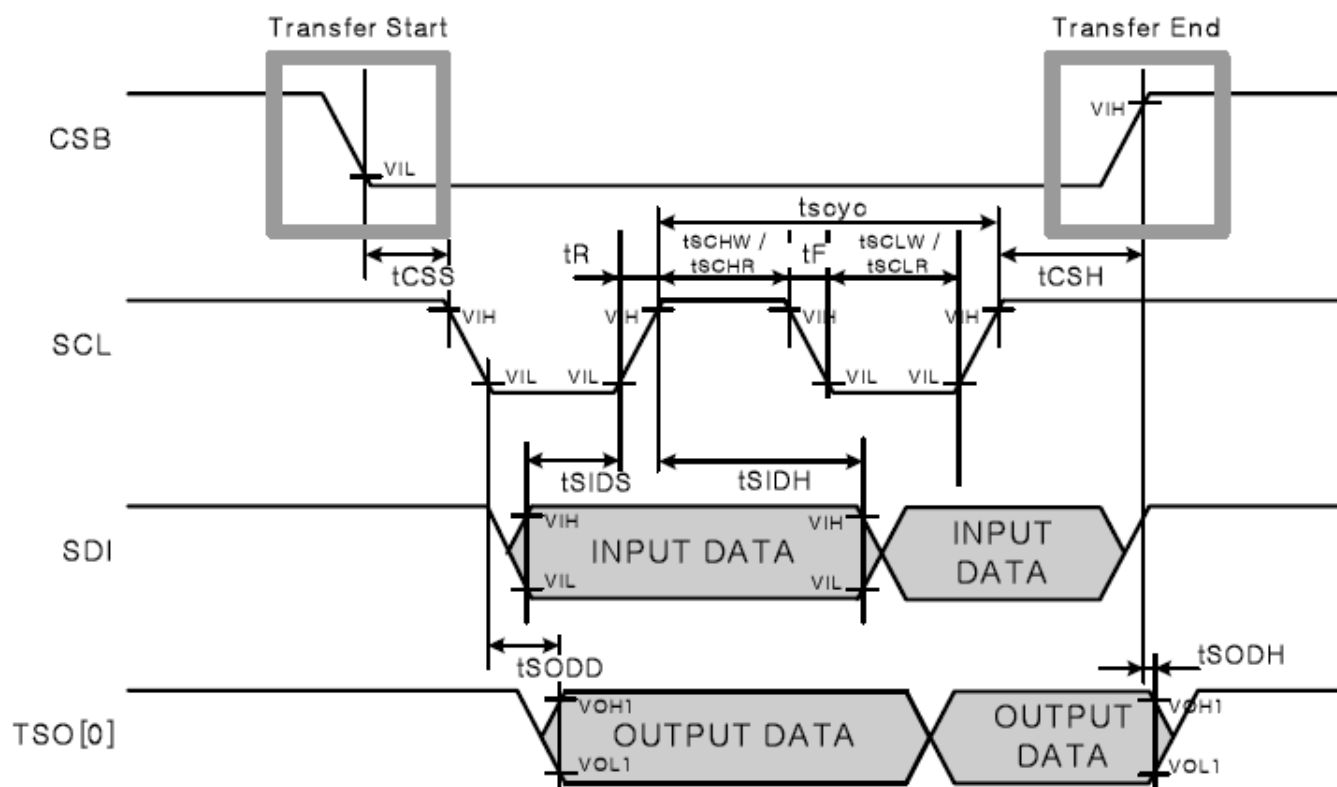
| Characteristic                | Symbol | Min | Max | Unit |
|-------------------------------|--------|-----|-----|------|
| Serial clock cycle time       | tscyc  | 100 | -   | ns   |
| Serial clock rise/fall time   | tR,tF  | -   | 2   |      |
| Pulse width high for write    | tSCHW  | 30  | -   |      |
| Pulse width high for read     | tSCHR  | 50  | -   |      |
| Pulse width low for write     | tSCLW  | 30  | -   |      |
| Pulse width low for read      | tSCLR  | 50  | -   |      |
| Chip Select setup time        | tCSS   | 20  | -   |      |
| Chip Select hold time         | tCSH   | 50  | -   |      |
| Serial input data setup time  | tSIDS  | 30  | -   |      |
| Serial input data hold time   | tSIDH  | 30  | -   |      |
| Serial output data delay time | tSODD  | -   | 100 |      |
| Serial output data hold time  | tSODH  | 5   | -   |      |

**c. Reset Timing Characteristics**(T<sub>A</sub> = -40 to +85 °C)

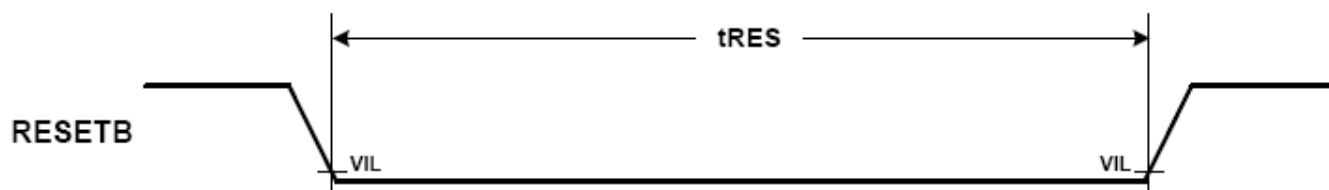
| Characteristic        | Symbol | Min | Max | Unit |
|-----------------------|--------|-----|-----|------|
| Reset low pulse width | tRES   | 3*  | -   | us   |

**\*NOTE.** Reset low pulse width shorter than 1us do not make reset. It means undesired short pulse such as glitch, bouncing noise or electorstatic discharge do not cause irregular system reset. Please refer to the table below.

| tRES Pulse            | Action         |
|-----------------------|----------------|
| Shorter than 1 us     | No reset       |
| Longer than 3 us      | Reset          |
| Between 1 us and 3 us | Not determined |



AC Characteristics(SPI Mode)



AC Characteristics(RESET timing)

## 7. Command List & Instruction Descriptions

### 7.1 Command List

Refer to the Appendix 1: S6F2002 IC Specification

### 7.2 Instruction Descriptions

Refer to the Appendix 1: S6F2002 IC Specification

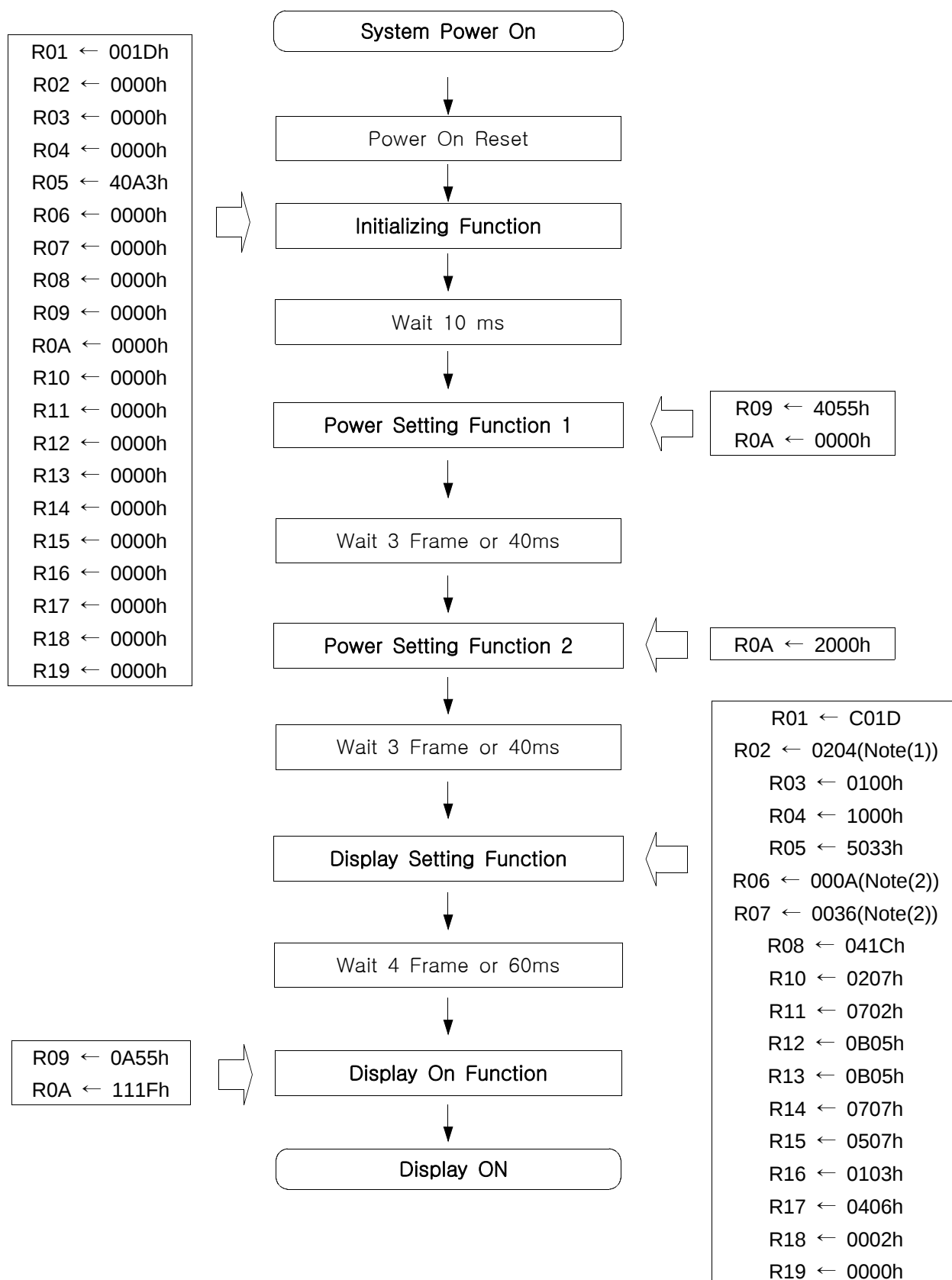
## 8. Reset

If the /RESET input becomes "L" or the reset command is input, the each register to its default value. These default values are listed in the table below.

| Register                     |              | Default | Note |
|------------------------------|--------------|---------|------|
| Display Interface Control    | R01          | 001DH   | -    |
| Display Data Control         | R02          | 0000H   | -    |
| Entry Mode                   | R03          | 0000H   | -    |
| Gate Control 1               | R04          | 0000H   | -    |
| Gate Control 2               | R05          | 0000H   | -    |
| Display Control 1            | R06          | 50A3H   | -    |
| Display Control 1            | R07          | 0000H   | -    |
| Source Output Timing Control | R08          | 0000H   | -    |
| Power Control 1              | R09          | 0000H   | -    |
| Power Control 2              | R0A          | 0000H   | -    |
| Gamma Control                | R10 ~<br>R19 | 0000H   | -    |

## 9. Power On/Off Sequence

### 9.1 Power On Sequence



## &lt; Note (1) &gt;

- Register 'R02' determines Data format

(R02H)

| IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7        | IB6        | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|------|------|------|------|------|------|-----|-----|------------|------------|-----|-----|-----|-----|-----|-----|
| 0    | 0    | 0    | 0    | 0    | 0    | 1   | 0   | <b>DF1</b> | <b>DF0</b> | 0   | 0   | 0   | 1   | 0   | 0   |

- DF Bits Setting

| DF1 | DF0 | Data Format       | R02H        |
|-----|-----|-------------------|-------------|
| 0   | 0   | RGB RGB           | <b>0204</b> |
| 0   | 1   | RGBX RGBX         | <b>0244</b> |
| 1   | 0   | XRGB XRGB         | <b>0284</b> |
| 1   | 1   | Setting Inhibited |             |

## &lt; Note (2) &gt;

- Register 'R06', 'R07' determine Vsync Backporch('R06') & Hsync Backporch period('R07')

- Backporch limit

(1) 7clk < Hsync Backporch < 1024clk

(2) 3line < Vsync Backporch < 512line

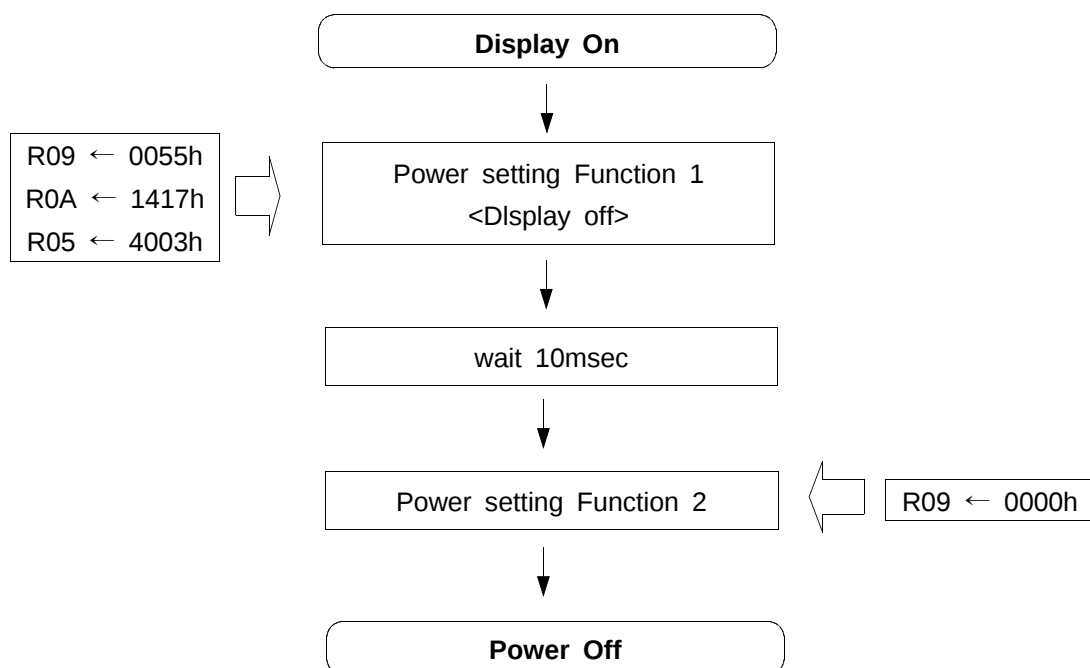
(R06H)

| IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8         | IB7         | IB6         | IB5         | IB4         | IB3         | IB2         | IB1         | IB0         |
|------|------|------|------|------|------|-----|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 0    | 0    | 0    | 0    | 0    | 0    | 0   | <b>VBP8</b> | <b>VBP7</b> | <b>VBP6</b> | <b>VBP5</b> | <b>VBP4</b> | <b>VBP3</b> | <b>VBP2</b> | <b>VBP1</b> | <b>VBP0</b> |

(R07H)

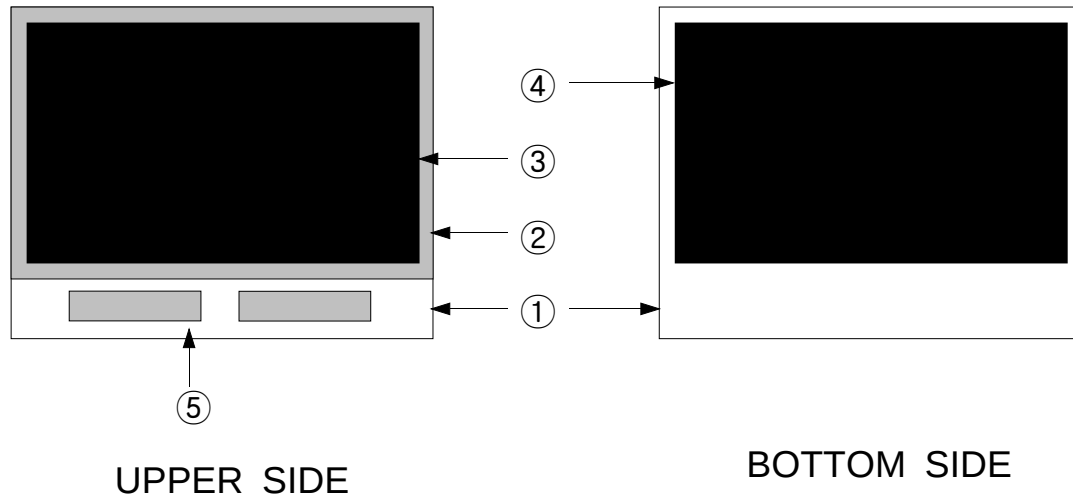
| IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8         | IB7         | IB6         | IB5         | IB4         | IB3         | IB2         | IB1         | IB0         |
|------|------|------|------|------|------|-----|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 0    | 0    | 0    | 0    | 0    | 0    | 0   | <b>HBP8</b> | <b>HBP7</b> | <b>HBP6</b> | <b>HBP5</b> | <b>HBP4</b> | <b>HBP3</b> | <b>HBP2</b> | <b>HBP1</b> | <b>HBP0</b> |

## 9.2 Power Off Sequence



## 10. Part List of Components

### 10.1 Panel, Driver IC

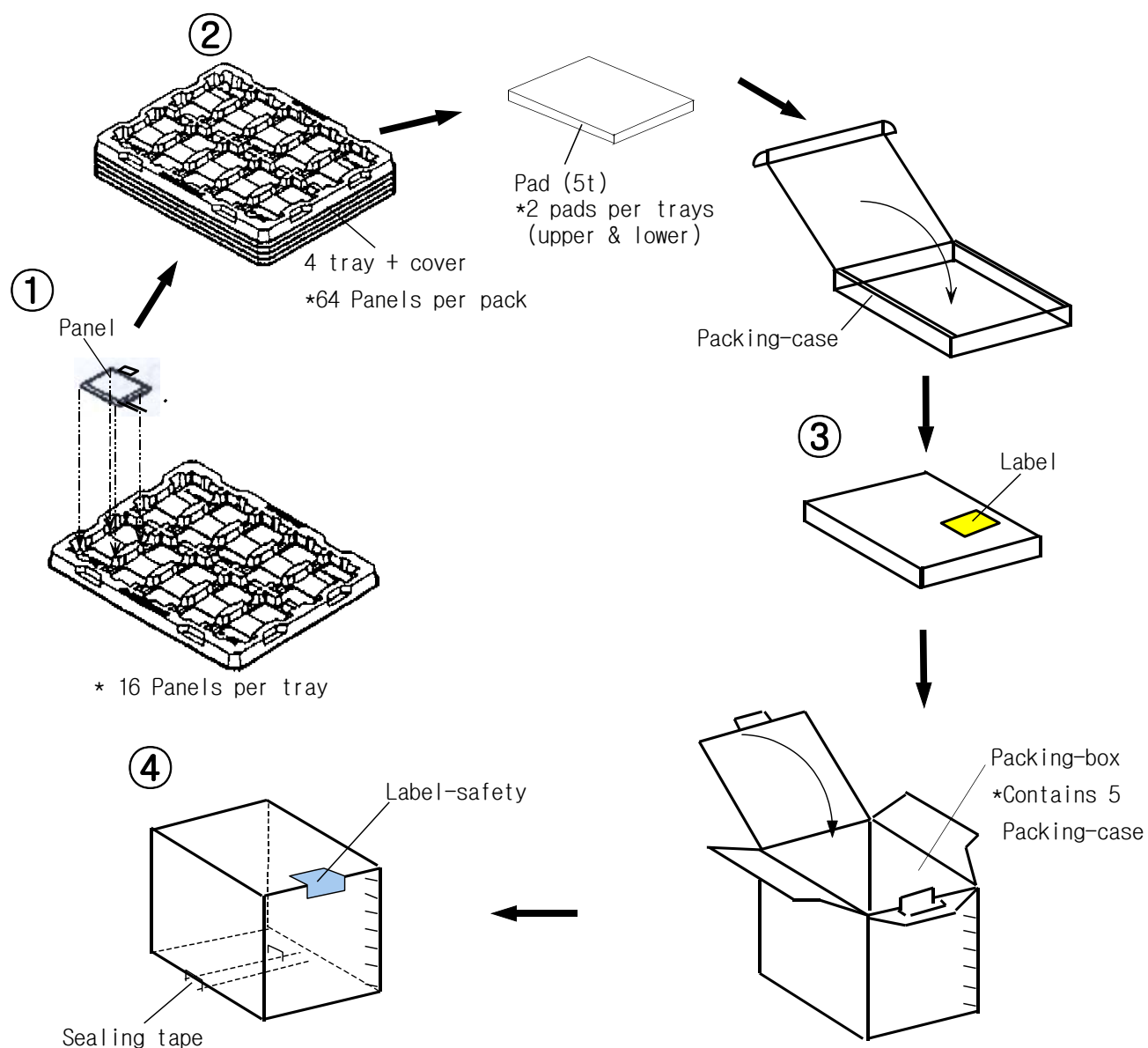


| No. | Part Name          | Specification                 | Maker              | EA | Note |
|-----|--------------------|-------------------------------|--------------------|----|------|
| 1   | TFT GLASS          | T0.5                          | SAMSUNG<br>CORNING | 1  | ①    |
| 2   | COLOR FILTER GLASS | T0.5                          | SEC                | 1  | ②    |
| 3   | UPPER POLARIZER    | NWF-LESEG-HC (SA -<br>Type)   | KORENO             | 1  | ③    |
| 4   | LOWER POLARIZER    | NWF-LESEG-APCF (SA -<br>Type) | KORENO             | 1  | ④    |
| 5   | DRIVER IC          | S6F2002                       | LDI                | 2  | ⑤    |





## 13. Packing



Note (1) Total : Case: Approx. 2.39 Kg

Box: Approx. 12.65 Kg

(2) Size : Case: 490(W) x 342(D) x 58(H)

Box: 505(W) x 355(D) x 312(H)

(3) Place the panels in the tray facing the direction shown in the figure.

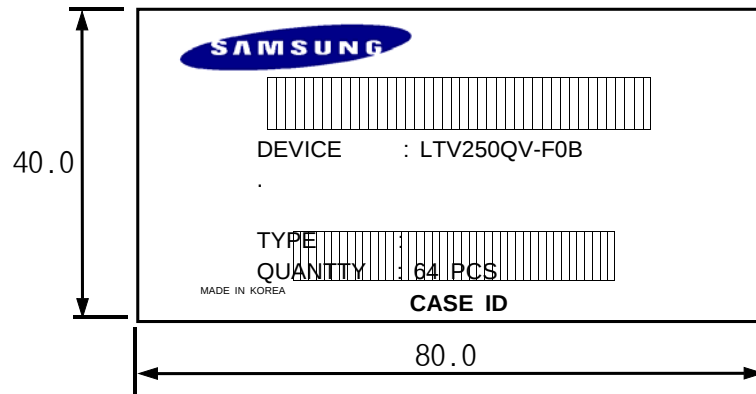
(4) Place 5 tray and cover(empty tray) and pads inside the packing-case.

(5) Place 5 packing-case inside the packing-box.(Affix the label)

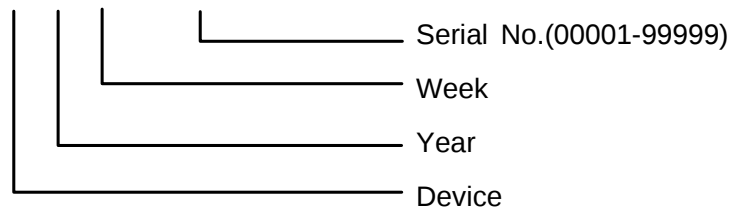
(6) Seal the packing-box. Affix the label-safety.

## 14. Marking & Others

### (1) Packing case attach



**CASE ID : V 00 00 00001**





## 15. General Precautions

### 15.1 Handling

- (a) When the module is assembled, it should be attached to the system firmly. Be careful not to twist and bend the module.
- (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 back-light unit.
- (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(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (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 Integrated Gate Circuit.
- (i) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (l) Pins of I/F connector shall not be touched directly with bare hands

## 15.2 Storage

- (a) Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35°C and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD module in direct sunlight.
- (c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

## 15.3 Operation

- (a) Do not connect, disconnect the module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the "Power on/off sequence"

## 15.4 Others

- (a) The Liquid crystal is deteriorated by ultraviolet, do not leave it in direct sunlight and strong ultraviolet ray for many hours.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. ( the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the panel may be damaged.
- (d) If the panel displays the same pattern continuously for a long period of time, it can be the situation when the image "Sticks" to the screen.
- (e) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.