



ELECTRONICS

Approval

TO : Celizion Inc.

DATE : Jan. 22. 2007

SAMSUNG TFT-LCD

**MODEL NO.:LTE700WQ-F05**

Customer Approval

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

APPROVED BY : *S.C. OH*

**Mobile Display Business Team**

**LCD Business**

**SAMSUNG ELECTRONICS CO., LTD.**



|         |              |          |     |      |       |
|---------|--------------|----------|-----|------|-------|
| Doc.No. | LTE700WQ-F05 | Rev. No. | 001 | Page | 1 /28 |
|---------|--------------|----------|-----|------|-------|

## Approval

## Revision History

| Date         | Rev. No. | Page | Summary             |
|--------------|----------|------|---------------------|
| 26.July.2006 | 001      |      | Rev.001 was issued. |

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## General Description

### \* Description

LTE700WQ-F05 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 7.0" contains 480x234(RGB) dots and can display up to 16.7M colors. 12 o'clock direction is the optimum viewing angle.

### \* Features

- triple-gate & Dual ASG
- Transmissive with Micro Reflective type and back-light with CCFL are available.
- TN(Twisted Nematic) mode.
- Dot inversion mode.
- 24bit RGB Interface
- DE(Data Enable) & SYNC mode - DE, Vsync, Hsync, DOTCLK

### \* Applications

- Display terminals for PMP(Portable Multimedia Player) , Portable CNS(P-CNS) , MP3 application products.
- Display terminals for AV application products.

## \* General information

| Items             | Specification                      | Unit    | Note |
|-------------------|------------------------------------|---------|------|
| Display area      | 154.08(H) x 86.58(V) (7" diagonal) | mm      | -    |
| Driver element    | a-Si TFT active matrix             | -       | -    |
| Display colors    | 16,777,212                         | colors  | -    |
| Number of dots    | 480(H) x 234 x RGB(V)              | dot     | -    |
| Pixel arrangement | RGB stripe                         | -       | -    |
| Pixel pitch       | 0.321(H) x 0.370(V)                | mm      | -    |
| Display mode      | Normally White                     | -       | -    |
| Viewing direction | 12                                 | o'clock | -    |

## \* Mechanical information

| Item        |               | Min.  | Typ. | Max.  | Unit | Note |
|-------------|---------------|-------|------|-------|------|------|
| Module size | Horizontal(H) | 165.7 | 166  | 166.3 | mm   | -    |
|             | Vertical(V)   | 99.7  | 100  | 100.3 | mm   | (1)  |
|             | Depth(D)      | 5.4   | 5.7  | 6.0   | mm   | (1)  |
| Weight      |               | -     | 160  | -     | g    | (2)  |

Note (1) Not include FPC.

Refer to the Outline Dimension in the "8. Outline Dimension" for further information.

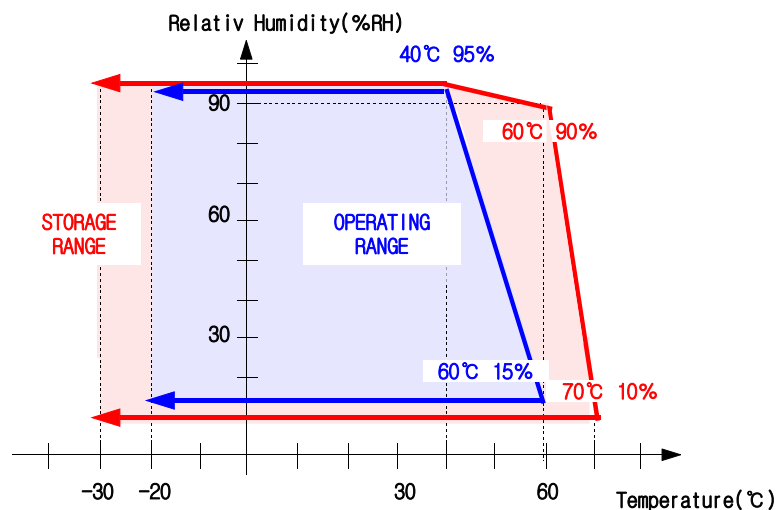
## 1. Absolute Maximum Ratings

### 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) |
| Shock(non operating)                           | S <sub>nop</sub> | -    | 100  | G    | (3),(5) |
| Vibration(non operating)                       | V <sub>nop</sub> | -    | 1.5  | G    | (4),(5) |

Note (1) 95 % RH Max. ( 40 °C <sup>3</sup> 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.
- (3) 6ms,(half)sine wave, 3times for ±X, ±Y, ±Z.
- (4) 10~500Hz, Sweep rate 10min, 30min for X,Y,Z.
- (5) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.

## 1.2 Electrical Absolute Ratings

### (1) TFT-LCD Module

(Ta = 25 ± 2°C, VSS=GND=0V)

| Item          | Symbol | Min. | Max. | Unit | Note |
|---------------|--------|------|------|------|------|
| Input voltage | VDD    | -0.3 | 4.6  | V    | -    |

### (2) Back-Light Unit

(Ta = 25 ± 2°C)

| Item           | Symbol         | Min. | Max. | Unit. | Note   |
|----------------|----------------|------|------|-------|--------|
| CCFL Frequency | f <sub>B</sub> | 40   | 80   | kHz   | (1)    |
| CCFL Current   | I <sub>B</sub> | 4    | 7.5  | mArms | (1)(2) |

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

(2) Lamp Current 7.0mArms

## 2. 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 , VDD=2.5V or 3.3V , fv=60Hz , fDCLK=8MHz , IL=7mA<sub>rms</sub>)

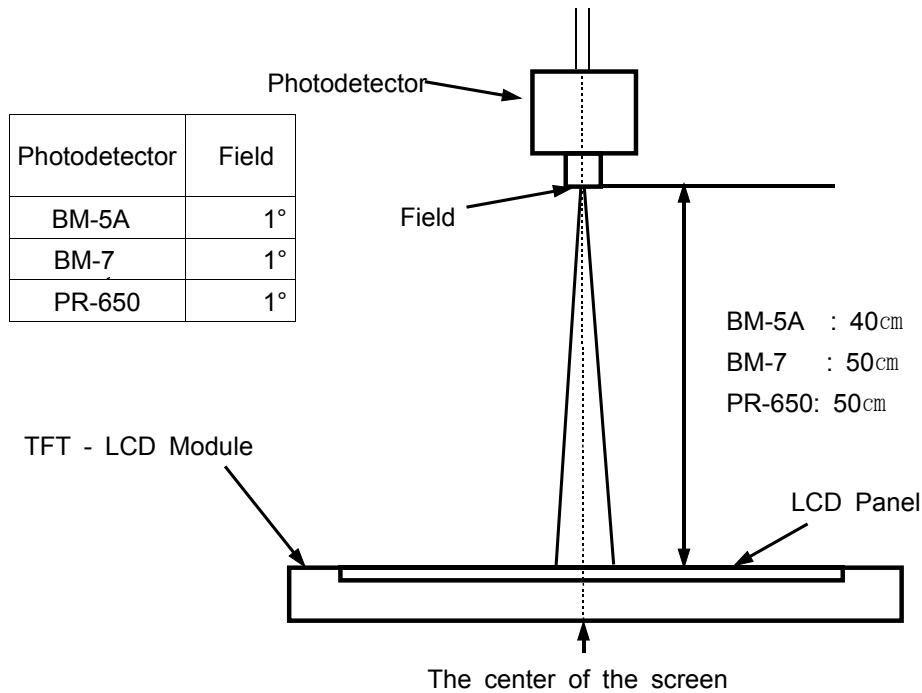
| Item                                 |         | Symbol         | Condition                                                                    | Min. | Typ.  | Max. | Unit              | Note               |
|--------------------------------------|---------|----------------|------------------------------------------------------------------------------|------|-------|------|-------------------|--------------------|
| Contrast ratio<br>(Center point)     |         | C/R            | NOTE (1)<br><br>$\Theta = 0$<br>$\Phi = 0$<br>Normal Viewing Angle<br>B/L On | 300  | 500   | -    | -                 | (2)<br>BM-5A       |
| Luminance of white<br>(Center point) |         | Y <sub>L</sub> |                                                                              | 400  | 450   | -    | cd/m <sup>2</sup> | (3)<br>BM-5A       |
| Response time                        | Rising  | T <sub>R</sub> |                                                                              | -    | 13    | 18   | msec              | (4)<br>BM-7        |
|                                      | Falling | T <sub>F</sub> |                                                                              | -    | 17    | 22   |                   |                    |
| Color chromaticity<br>(CIE 1931)     | White   | W <sub>x</sub> |                                                                              | -    | 0.310 | -    | -                 | (5)<br>PR-650      |
|                                      |         | W <sub>y</sub> |                                                                              | -    | 0.350 | -    |                   |                    |
|                                      | Red     | R <sub>x</sub> |                                                                              | -    | 0.604 | -    |                   |                    |
|                                      |         | R <sub>y</sub> |                                                                              | -    | 0.345 | -    |                   |                    |
|                                      | Green   | G <sub>x</sub> |                                                                              | -    | 0.318 | -    |                   |                    |
|                                      |         | G <sub>y</sub> |                                                                              | -    | 0.562 | -    |                   |                    |
|                                      | Blue    | B <sub>x</sub> |                                                                              | -    | 0.152 | -    |                   |                    |
|                                      |         | B <sub>y</sub> |                                                                              | -    | 0.135 | -    |                   |                    |
| Viewing angle                        | Hor.    | $\Theta_L$     | C/R ≥ 10<br>B/L On                                                           | -    | 65    | -    | Degrees           | (6)<br>EZ-Contrast |
|                                      |         | $\Theta_R$     |                                                                              | -    | 65    | -    |                   |                    |
|                                      | Ver.    | $\Phi_H$       |                                                                              | -    | 55    | -    |                   |                    |
|                                      |         | $\Phi_L$       |                                                                              | -    | 50    | -    |                   |                    |

## Note (1) Test Equipment Setup

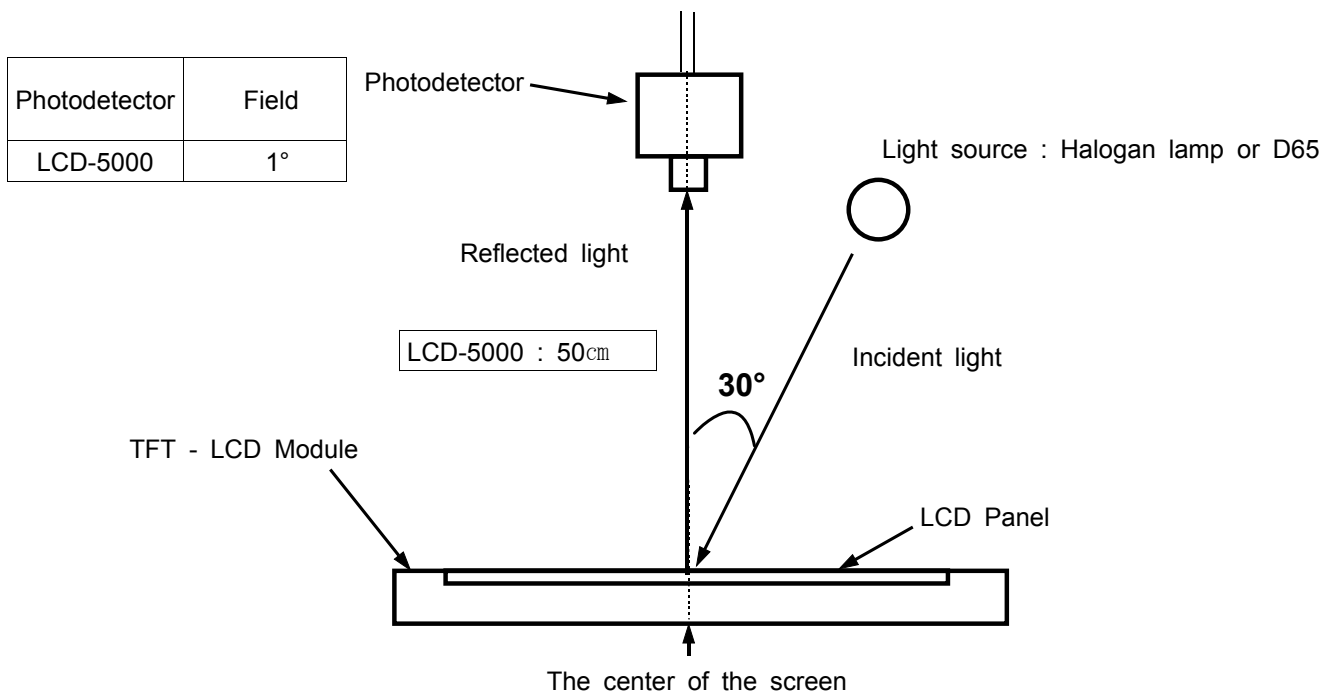
After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of screen.

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

Back-Light On condition



Back-Light Off condition



Optical Measuring Equipment Setup

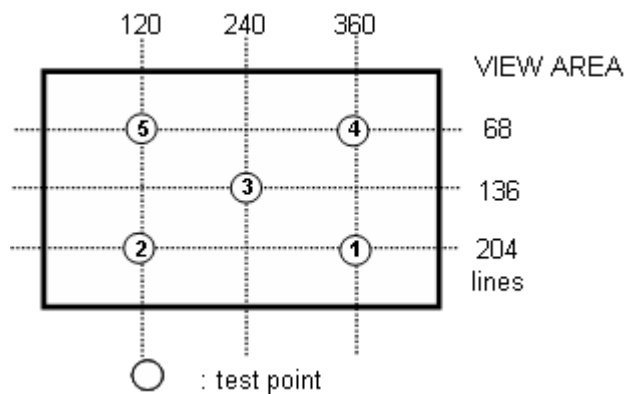
Note (2) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point

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

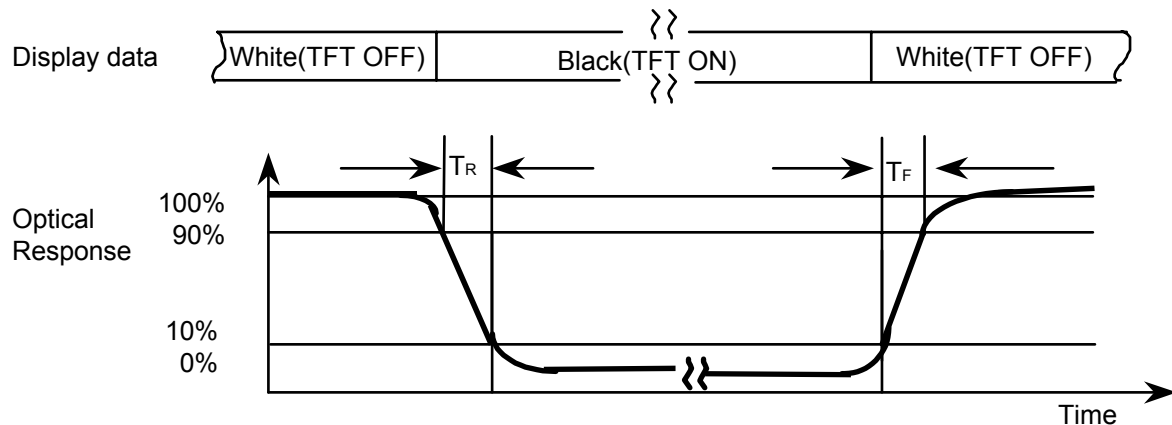
\* Gmax : Luminance with all pixels white

\* Gmin : Luminance with all pixels black

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



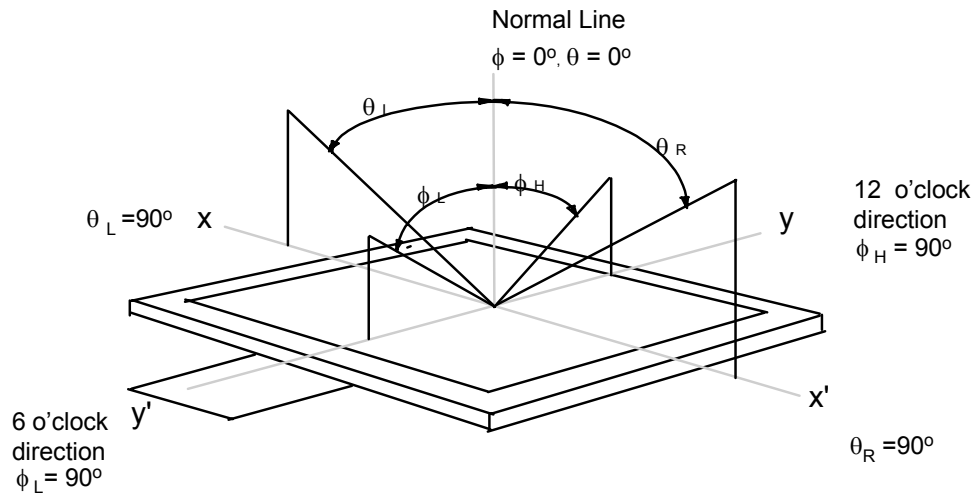
Note (4) Definition of Response time : Sum of  $T_r$ ,  $T_f$



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

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

Note (6) Definition of Viewing Angle : Viewing angle range ( $CR \geq 10$  )



## 3. Electrical Characteristics

### 3.1 TFT-LCD Module

Ta = 25 ± 2°C

| ITEM                 |       | Symbol            | Min. | Typ. | Max. | Unit | Note    |
|----------------------|-------|-------------------|------|------|------|------|---------|
| Logic supply voltage |       | VDD               | 2.25 | 2.5  | 2.9  | V    | (1)     |
|                      |       |                   | 2.9  | 3.3  | 3.5  | V    | (2)     |
| Vsync Frequency      |       | f <sub>v</sub>    | -    | 60   | 70   | Hz   |         |
| Hsync Frequency      |       | f <sub>H</sub>    | -    | 15   | -    | kHz  |         |
| Main Frequency       |       | f <sub>DCLK</sub> | -    | 8    | 15.0 | MHZ  |         |
| Power Dissipation    | White | -                 | -    | 84   | -    | mW   | (3),(4) |
|                      | Black |                   | -    | 90   | -    | mW   |         |

Note (1). PWRSEL = Low

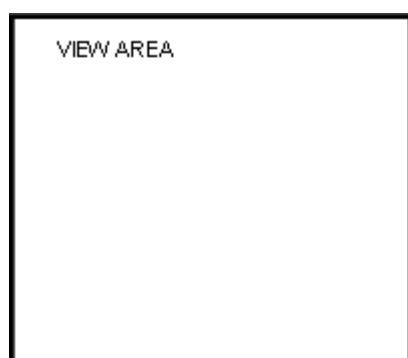
Note (2). PWRSEL = High

※ Refer to the "5. Input Terminal Pin Assignment"

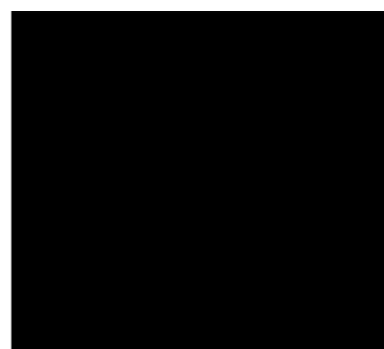
Note (3). f<sub>v</sub>=60Hz, f<sub>DCLK</sub>=8MHZ, VDD=2.5V or 3.3V

Note (4). Power Dissipation check pattern

a) White Pattern



b) Black Pattern



## 3.2 Back-Light unit

The back-light system is an edge-lighting type with a single CCFL(Cold Cathode Fluorescent Lamp). The characteristics of a single lamp are shown in the following tables.

(Ta=25 ± 2°C)

| Item                | Symbol         | Min.  | Typ. | Max.                    | Unit  | Note   |
|---------------------|----------------|-------|------|-------------------------|-------|--------|
| CCFL Current        | I <sub>B</sub> | 4.0   | 7.0  | 7.5                     | mArms | (1)    |
| CCFL Frequency      | F <sub>B</sub> | 40    | -    | 80                      | kHz   | (2)    |
| CCFL Voltage        | V <sub>B</sub> | -     | 540  | -                       | Vrms  | (1)    |
| Startup Voltage     | V <sub>s</sub> | -     | -    | 1050(25°C)<br>1320(0°C) | Vrms  | (3)(4) |
| Operating Life Time | Hr             | 20000 | -    | -                       | Hour  | (6)    |

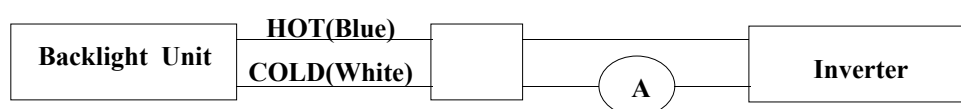
**Note) The waveform of the inverter output voltage must be area symmetric and the design of the inverter must have specifications for the modularized lamp.**

The performance of the Back-Light, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter. When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the Back-Light and the inverter never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

Note (1) Lamp current is measured with high frequency current meter as shown below.

Refer to the block diagram of the back-light unit in the next page for more information.

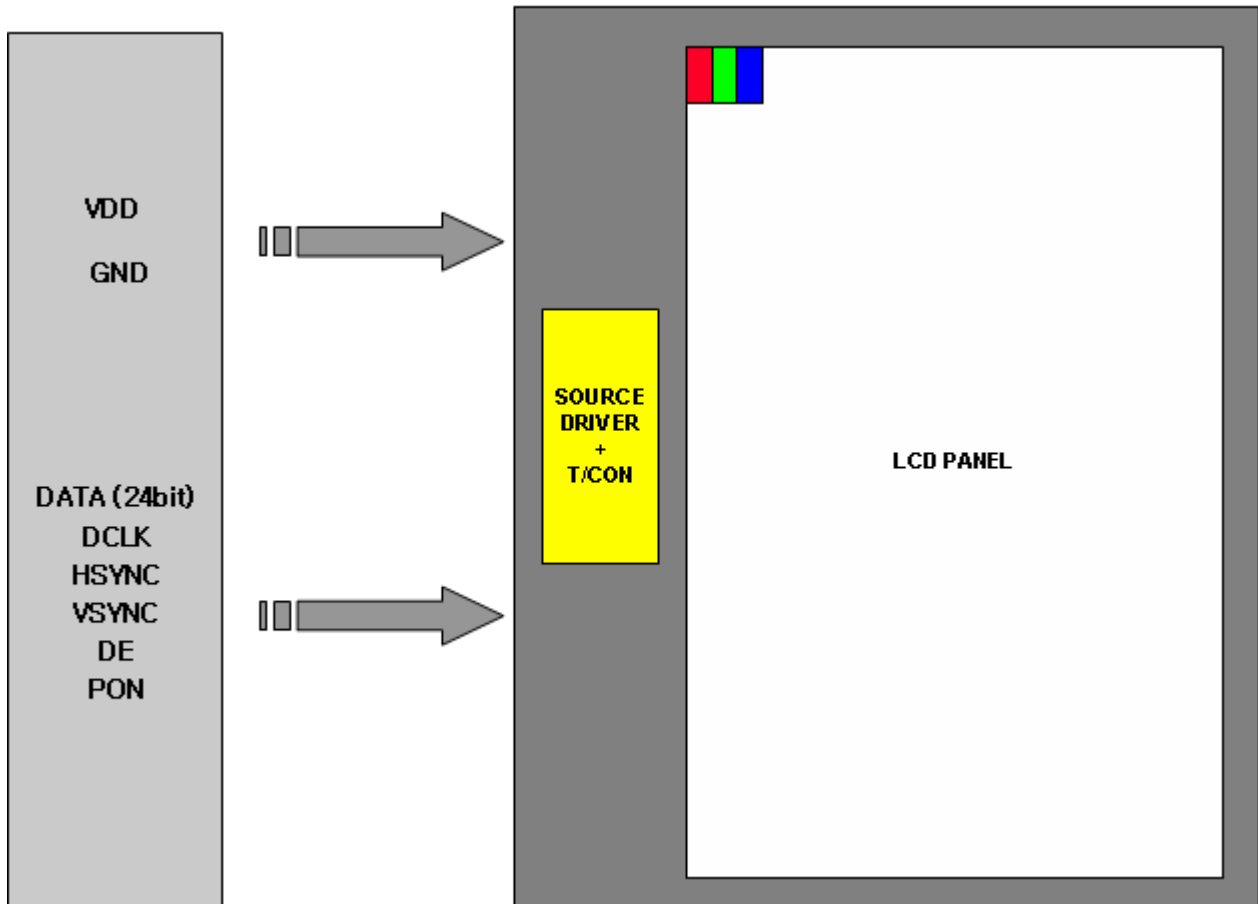
Specified values are for a single lamp.



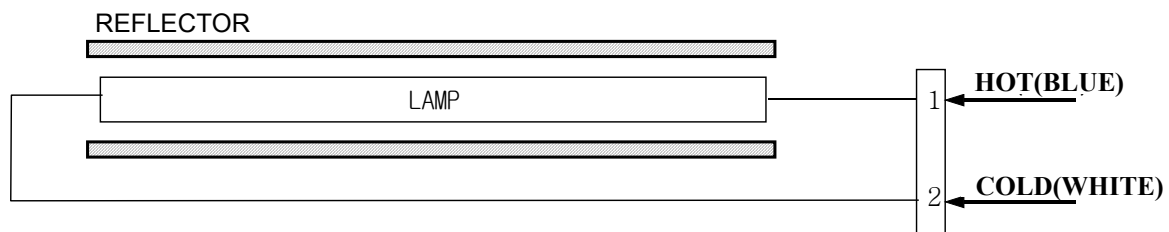
- (2) Lamp frequency which may produce interference with horizontal synchronous frequency may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.
- (3) If an inverter has shutdown function, it should keep its output for over 1 second even if the lamp connector is open. Otherwise the lamps may not be turned on.
- (4) For starting the backlight unit, the output voltage of inverter should be larger than the maximum lamp starting voltage.
- (5) Because the inverter uses high voltage, please disconnect it from the power before assembling or disassembling.
- (6) End of life is defined by following items. Lifetime test conditions are ambient temperature 25±5°C and I<sub>B</sub>=7mArms.
  - Luminance at the center point decreases by 50% or lower than it's original.

## 4. Block Diagram

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



### 4.2 Back-light Unit



## 5. Input Terminal Pin Assignment

### 5.1 Input Signal & Power (Connector type : 40Pin / 0.5mm pitch / Bottom contact)

| Pin No. | Symbol | Description                 | Remark | Pin No. | Symbol | Description      | Remark                |
|---------|--------|-----------------------------|--------|---------|--------|------------------|-----------------------|
| 1       | VSS    | Ground                      |        | 21      | B0     | Blue data (LSB)  |                       |
| 2       | VSS    | Ground                      |        | 22      | B1     | Blue data        |                       |
| 3       | VDD    | Power Supply (2.5V or 3.3V) |        | 23      | B2     | Blue data        |                       |
| 4       | VDD    | Power Supply (2.5V or 3.3V) |        | 24      | B3     | Blue data        |                       |
| 5       | R0     | Red data (LSB)              |        | 25      | B4     | Blue data        |                       |
| 6       | R1     | Red data                    |        | 26      | B5     | Blue data        |                       |
| 7       | R2     | Red data                    |        | 27      | B6     | Blue data        |                       |
| 8       | R3     | Red data                    |        | 28      | B7     | Blue data (MSB)  |                       |
| 9       | R4     | Red data                    |        | 29      | VSS    | Ground           |                       |
| 10      | R5     | Red data                    |        | 30      | PCLK   | dot clock        |                       |
| 11      | R6     | Red data                    |        | 31      | PON    | Display on/off   | 22,23page             |
| 12      | R7     | Red data (MSB)              |        | 32      | HSYNC  | Horizontal Sync  |                       |
| 13      | G0     | Green data (LSB)            |        | 33      | YSYNC  | Vertical Sync    |                       |
| 14      | G1     | Green data                  |        | 34      | DE     | Data Enable      |                       |
| 15      | G2     | Green data                  |        | 35      | PWRSEL | VDD Power select | Low:2.5V<br>High:3.3V |
| 16      | G3     | Green data                  |        | 36      | N/C    | No Connect       |                       |
| 17      | G4     | Green data                  |        | 37      | VSS    | Ground           |                       |
| 18      | G5     | Green data                  |        | 38      | VSS    | Ground           |                       |
| 19      | G6     | Green data                  |        | 39      | N/C    | No Connect       |                       |
| 20      | G7     | Green data (MSB)            |        | 40      | N/C    | No Connect       |                       |

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

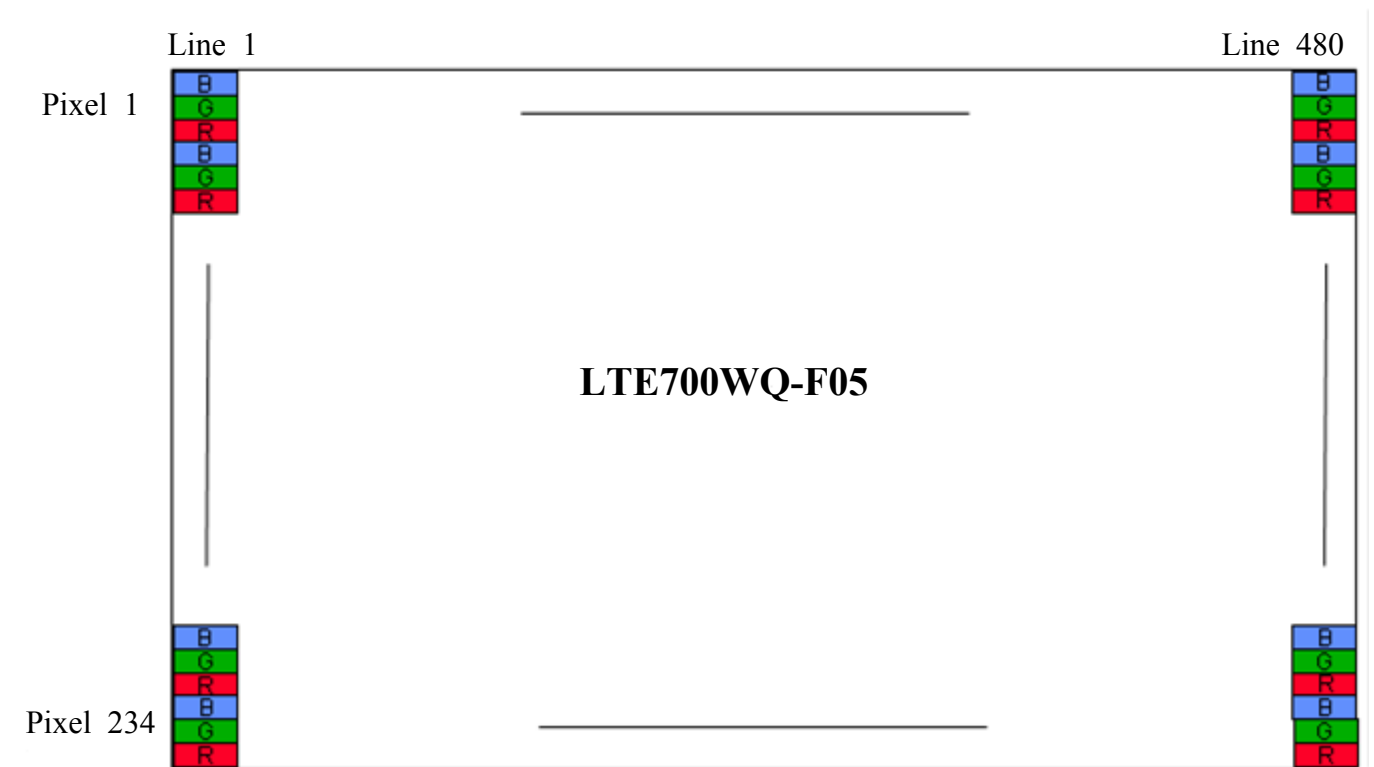
| COLOR               | DISPLAY | DATA SIGNAL |    |    |    |    |    |    |    |    |       |    |    |    |    |    |    |    |      |    |    |    |    |    |    |         |  | GRAY SCALE LEVEL |
|---------------------|---------|-------------|----|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|------|----|----|----|----|----|----|---------|--|------------------|
|                     |         | 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 COLOR         | BLACK   | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | -       |  |                  |
|                     | BLUE    | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | -       |  |                  |
|                     | GREEN   | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | -       |  |                  |
|                     | CYAN    | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | -       |  |                  |
|                     | RED     | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | -       |  |                  |
|                     | MAGENTA | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | -       |  |                  |
|                     | YELLOW  | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | -       |  |                  |
|                     | WHITE   | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | -       |  |                  |
| GRAY SCALE OF RED   | BLACK   | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | R0      |  |                  |
|                     | DARK ↑  | 1           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | R1      |  |                  |
|                     |         | 0           | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | R2      |  |                  |
|                     |         | :           | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | R3~R252 |  |                  |
|                     |         | :           | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  |         |  |                  |
|                     | ↓ LIGHT | 1           | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | R253    |  |                  |
|                     |         | 0           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | R254    |  |                  |
|                     | RED     | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | R255    |  |                  |
| GRAY SCALE OF GREEN | BLACK   | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | G0      |  |                  |
|                     | DARK ↑  | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | G1      |  |                  |
|                     |         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | G2      |  |                  |
|                     |         | :           |    |    | :  | :  | :  | :  | :  | :  |       |    | :  | :  | :  | :  | :  | :  |      |    | :  | :  | :  | :  | :  | G3~G252 |  |                  |
|                     |         | :           |    |    | :  | :  | :  | :  | :  | :  |       |    | :  | :  | :  | :  | :  | :  |      |    | :  | :  | :  | :  | :  |         |  |                  |
|                     | ↓ LIGHT | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0     | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | G253    |  |                  |
|                     |         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | G254    |  |                  |
|                     | GREEN   | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | G255    |  |                  |
| GRAY SCALE OF BLUE  | BLACK   | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | B0      |  |                  |
|                     | DARK ↑  | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | B1      |  |                  |
|                     |         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 0  | 0  | 0  | 0  | 0  | 0  | B2      |  |                  |
|                     |         | :           | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | B3~B252 |  |                  |
|                     |         | :           | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  |         |  |                  |
|                     | ↓ LIGHT | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0    | 1  | 1  | 1  | 1  | 1  | 1  | B253    |  |                  |
|                     |         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | B254    |  |                  |
|                     | BLUE    | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | B255    |  |                  |

Note) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

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

### 5.3 PIXEL FORMAT



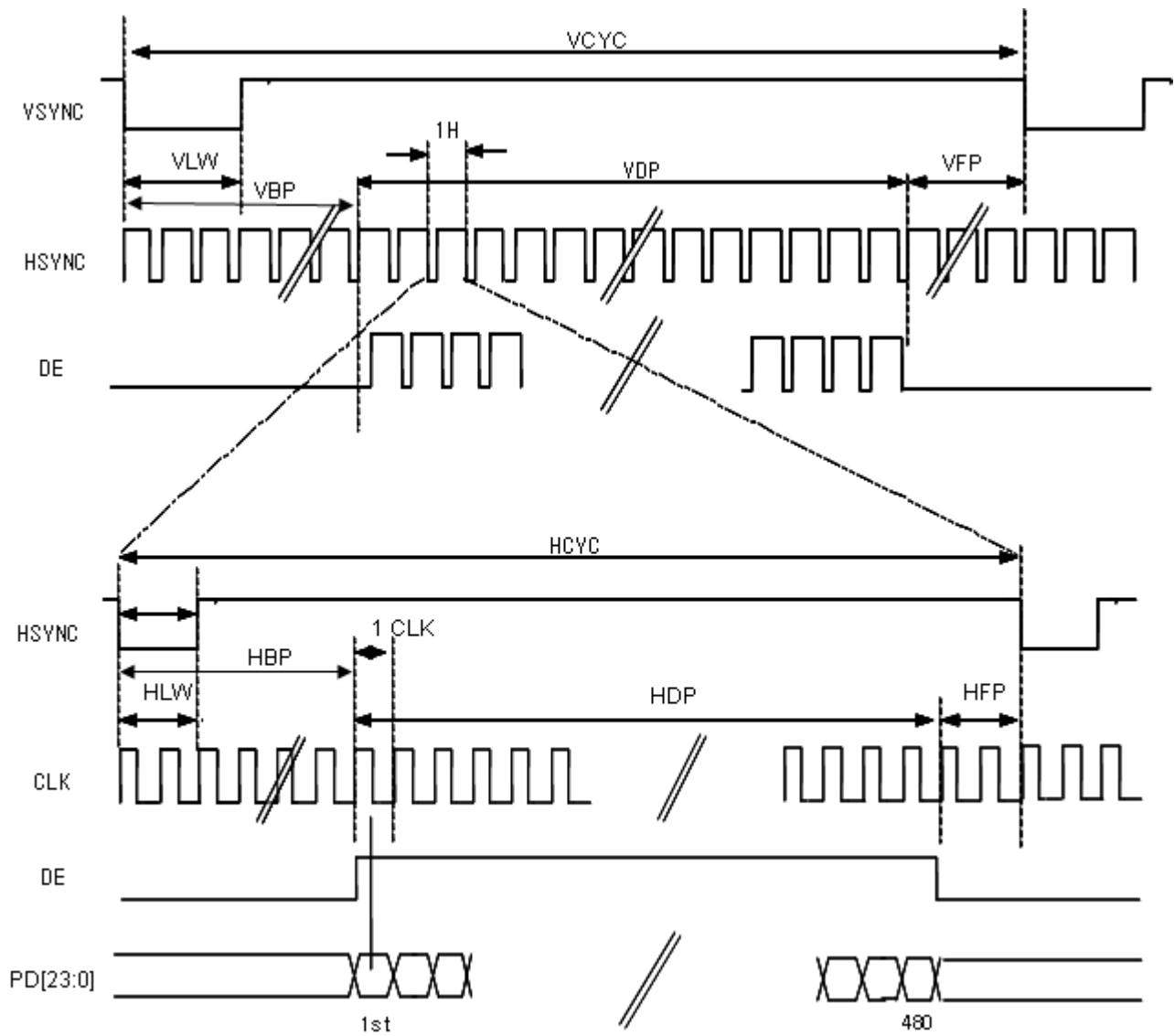
## 6. INTERFACE TIMING

### 6-1. Vertical timing

| Signal                  | Symbol | Min. | Typ. | Max. | Unit | Note |
|-------------------------|--------|------|------|------|------|------|
| Frame Frequency         | fFRM   | -    | 60   | 70   | Hz   |      |
| VSYNC(Frame) Period     | VCYC   | 239  | 250  | 335  | H    |      |
| VSYNC Low width         | VLW    | 1    | 10   | -    | H    |      |
| Vertical Display Period | VDP    |      | 234  | -    | H    |      |
| Vertical Back porch     | VBP    | -    | 12   | -    | H    |      |
| Vertical Front porch    | VFP    | 2    | 4    | -    | H    |      |

### 6-2. Horizontal timing

| Signal                    | Symbol              | Min. | Typ. | Max. | Unit   | Note       |
|---------------------------|---------------------|------|------|------|--------|------------|
| HSYNC(1H) Period          | HCYC                | 490  | 533  | 605  | DOTCLK |            |
| HSYNC Low width           | HLW                 | 4    | 41   | -    | DOTCLK |            |
| Horizontal Display Period | HDP                 | -    | 480  | -    | DOTCLK |            |
| Horizontal Back porch     | HBP                 | 8    | 45   | -    | DOTCLK |            |
| Horizontal Front porch    | HFP                 | 2    | 8    | -    | DOTCLK |            |
| DOTCLK Frequence          | f <sub>DOTCLK</sub> | -    | 8    | 15   | MHz    | @fFRM=60Hz |



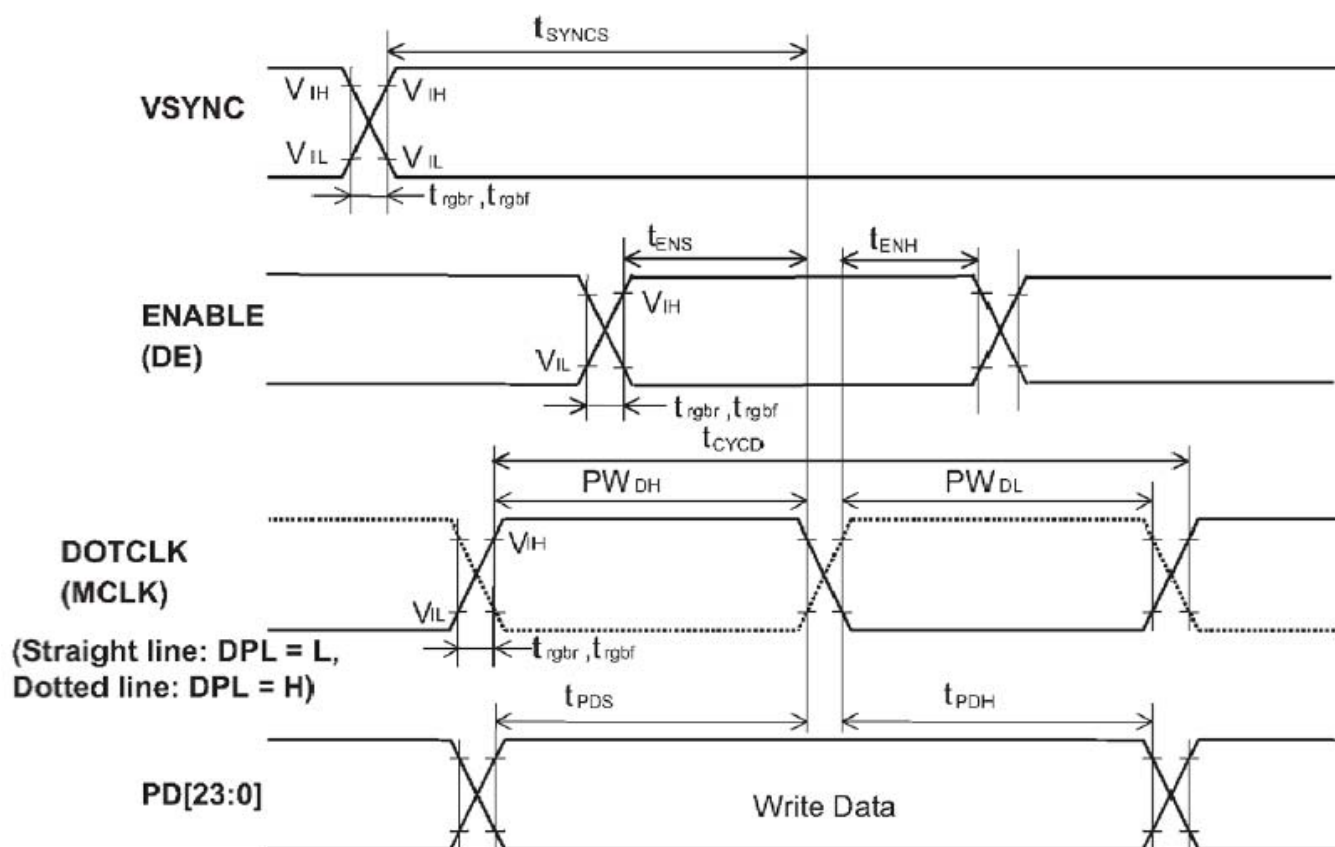
## 6-3. AC characteristics

※ Operating at VDD=2.25~2.9V , Ta = -40℃~+85℃

| Parameter                                  | Symbol             | Min. | Typ. | Max. | Unit |
|--------------------------------------------|--------------------|------|------|------|------|
| VSYNC,HSYNC setup time                     | t <sub>SYNCS</sub> | 10   | -    | -    | ns   |
| ENABLE (DE) setup time                     | t <sub>ENS</sub>   | 10   | -    | -    |      |
| ENABLE (DE) hold time                      | t <sub>ENH</sub>   | 15   | -    | -    |      |
| DOTCLK "Low" level pulse width             | P <sub>WDL</sub>   | 25   | -    | -    |      |
| DOTCLK "High" level pulse width            | P <sub>WDH</sub>   | 25   | -    | -    |      |
| DOTCLK cycle time                          | t <sub>CYCD</sub>  | 66.7 | -    | -    |      |
| Data setup time                            | t <sub>PDS</sub>   | 10   | -    | -    |      |
| Data hold time                             | t <sub>PDH</sub>   | 15   | -    | -    |      |
| DOTCLK,VSYNC,HSYNC<br>clock rise/fall time | trgbr<br>trgbf     | -    | -    | 5    |      |

※ Operating at VDD=2.9~3.5V , Ta = -40℃~+85℃

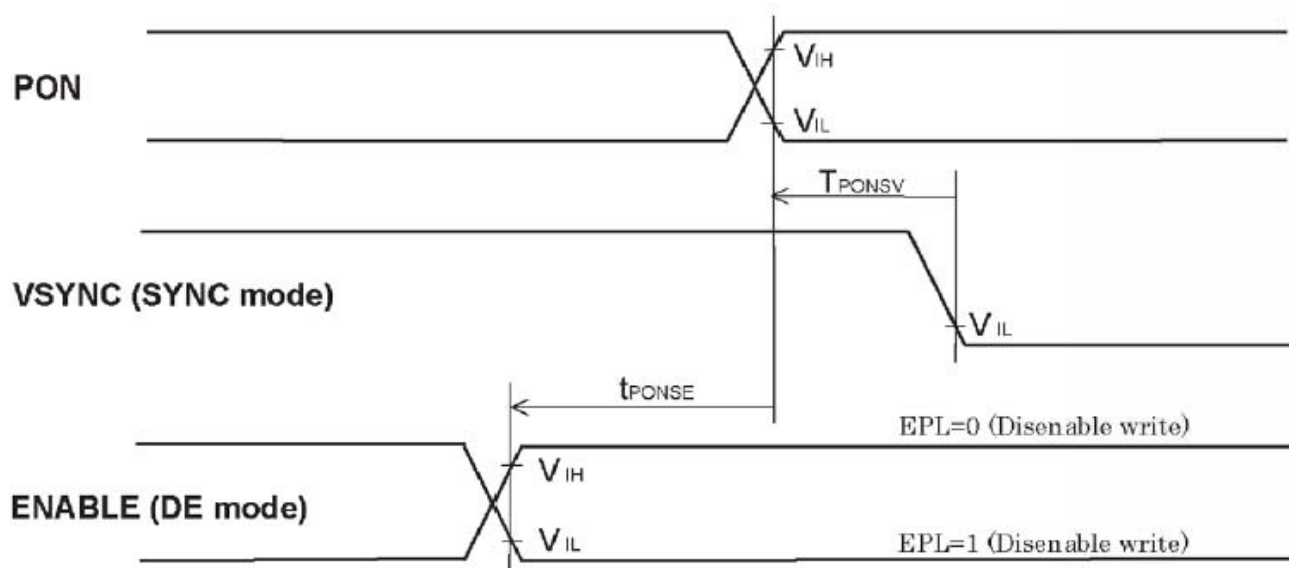
| Parameter                                  | Symbol             | Min. | Typ. | Max. | Unit |
|--------------------------------------------|--------------------|------|------|------|------|
| VSYNC,HSYNC setup time                     | t <sub>SYNCS</sub> | 10   | -    | -    | ns   |
| ENABLE (DE) setup time                     | t <sub>ENS</sub>   | 10   | -    | -    |      |
| ENABLE (DE) hold time                      | t <sub>ENH</sub>   | 10   | -    | -    |      |
| DOTCLK "Low" level pulse width             | P <sub>WDL</sub>   | 25   | -    | -    |      |
| DOTCLK "High" level pulse width            | P <sub>WDH</sub>   | 25   | -    | -    |      |
| DOTCLK cycle time                          | t <sub>CYCD</sub>  | 66.7 | -    | -    |      |
| Data setup time                            | t <sub>PDS</sub>   | 10   | -    | -    |      |
| Data hold time                             | t <sub>PDH</sub>   | 10   | -    | -    |      |
| DOTCLK,VSYNC,HSYNC<br>clock rise/fall time | trgbr<br>trgbf     | -    | -    | 5    |      |



## 6-4. PON timing characteristics.

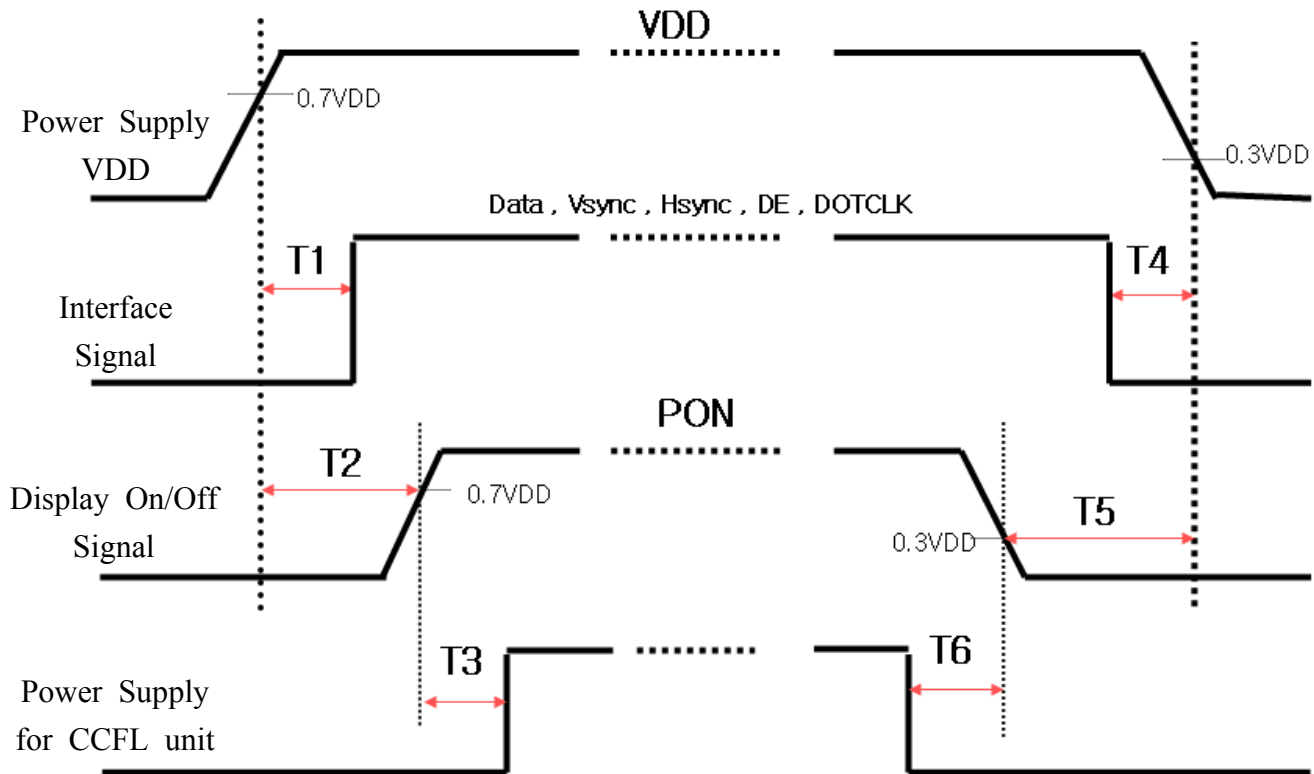
※ Operating at VDD=2.25~3.5V , Ta = -40℃~+85℃

| Item                  | Symbol            | Min. | Typ. | Max. | unit   |
|-----------------------|-------------------|------|------|------|--------|
| PON setup (SYNC mode) | $t_{PONS\bar{V}}$ | 10   | —    | —    | DOTCLK |
| PON setup (DE mode)   | $t_{PONS\bar{E}}$ | —    | —    | 4    | H      |



## 7. Power On/Off Sequence

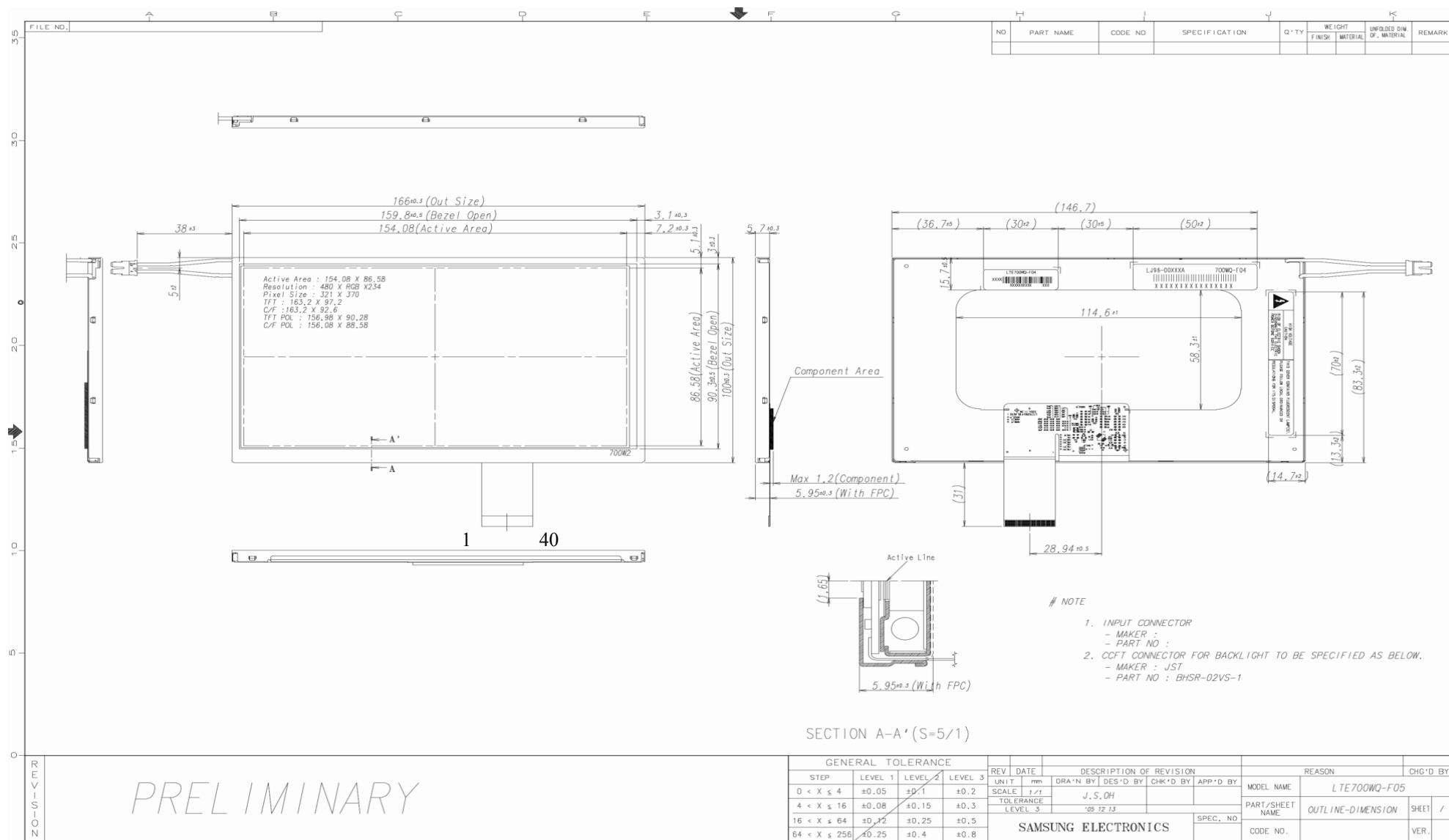
- To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.



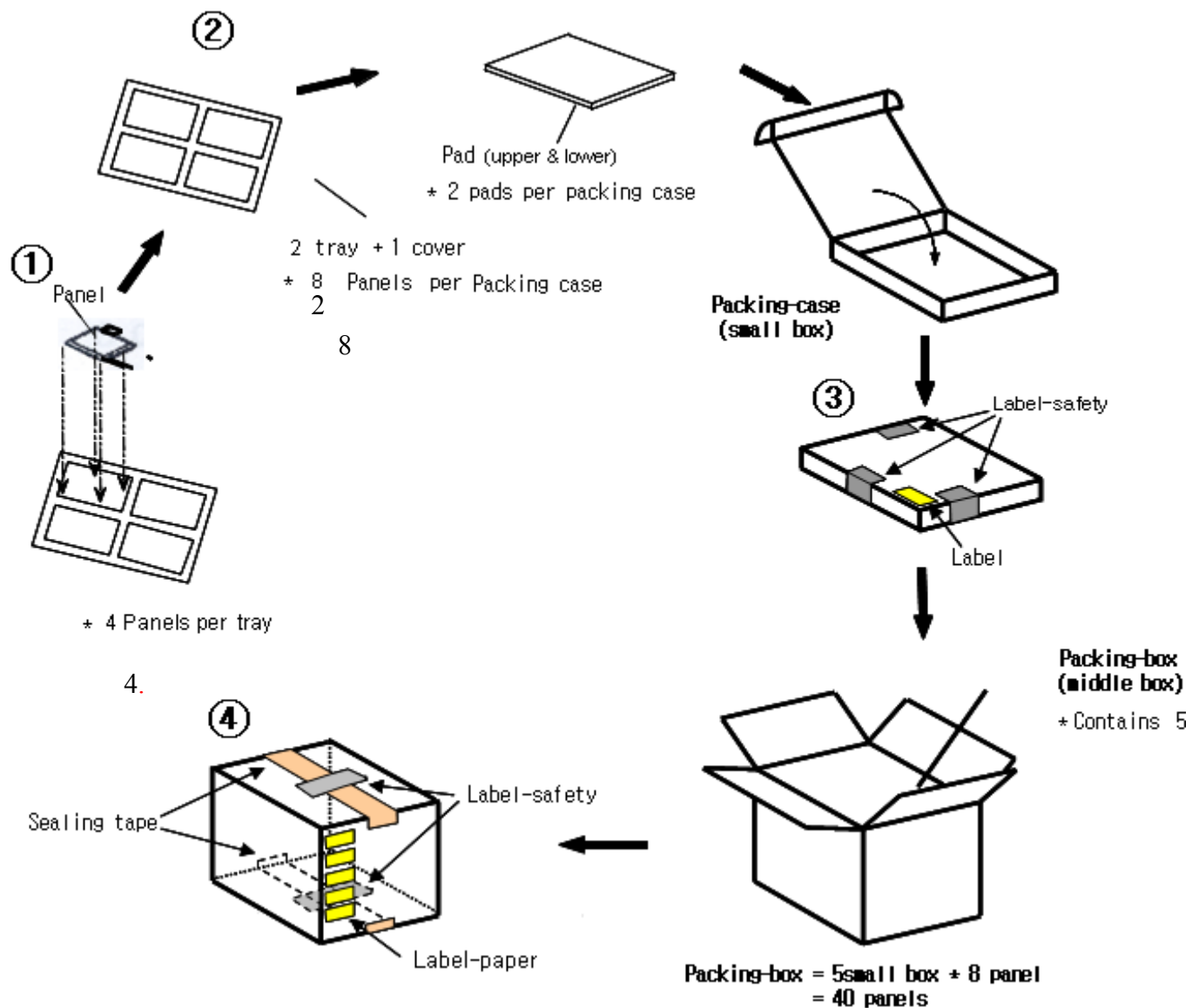
| Symbol | Specification                  | Note |
|--------|--------------------------------|------|
| T1     | $0 \text{ ms} < T1 < T2$       |      |
| T2     | $5 \text{ ms} < T2$            | (1)  |
| T3     | $10 \text{ frames} < T3$       |      |
| T4     | $10 \text{ ms} < T4$           |      |
| T5     | $(5 \text{ frames} + T4) < T5$ | (1)  |
| T6     | $10 \text{ frames} < T6$       |      |

Note(1) Refer to "6-4. PON timing characteristics."

## 8. Outline Dimension



## 9. Packing



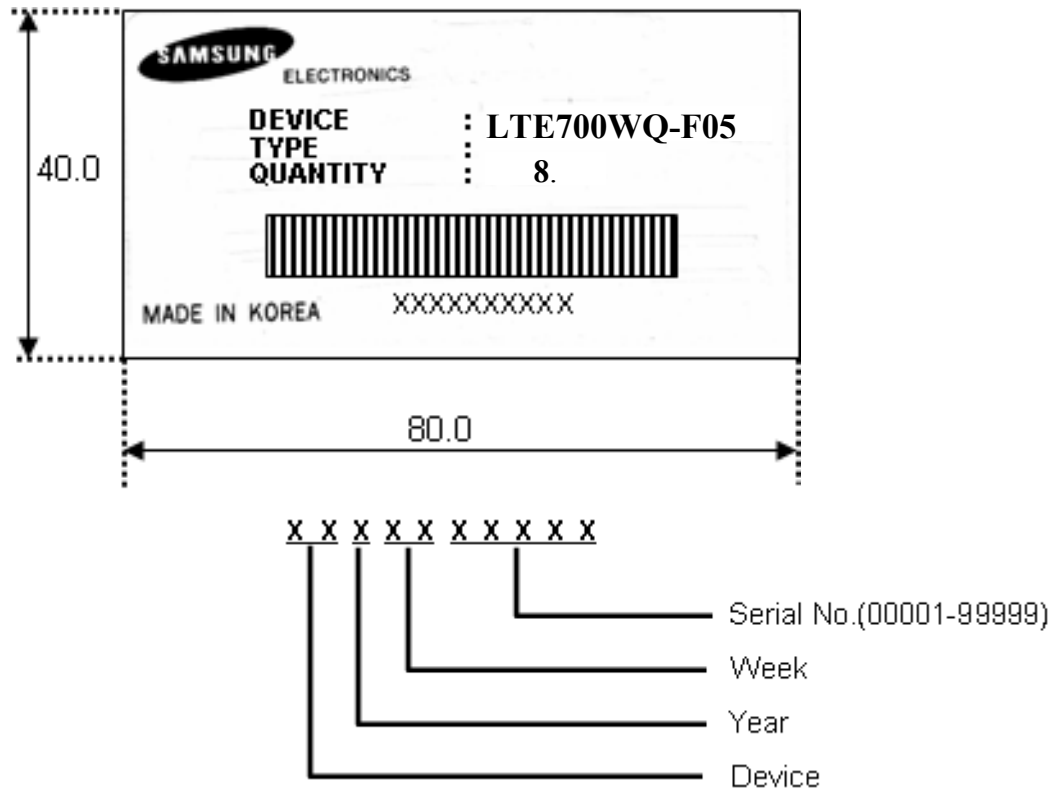
### Note

- (1) Total : Case: Approx. : 2.2 Kg  
Box: Approx. : 12 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 2 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.

## 10. Marking & Others

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

### (1) Packing case attach



## 11. General Precautions

### 11.1 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) Do not adjust the variable resistor which is located on the back side.
- (l) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (m) Pins of I/F connector shall not be touched directly with bare hands
- (n) Connect the metallic shielding cases of the module and the ground pattern of the inverter circuit surely. If that connection is not perfect, there may be a possibility of some problems happen.

## 11.2 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.

## 11.3 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"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

## 11.4 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.
- (f) Avoid shortness between LED soldering pad and TSP soldering pad.