

TO :

DATE :

**SAMSUNG TFT-LCD****MODEL NO. : LTM121SI-T01**

APPROVED BY :

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

Approved by :

PREPARED BY : AMLCD Technical Customer Service Team**SAMSUNG ELECTRONICS CO., LTD.**

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## Revision History

| Date         | Rev.No. | Page | Summary                                                       |
|--------------|---------|------|---------------------------------------------------------------|
| Oct. 17 2001 | 000     | All  | Approval specification of LTM121SI-T01 model is issued first. |

## GENERAL DESCRIPTION

### DESCRIPTION

LTM121SI-T01 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFTs as switching devices. this model is composed of a TFT LCD panel, a driving circuit and a backlight system. The resolution of a 12.1" contains 800 x 600 pixels and can display up to 262,144 colors. 6 o'clock direction is the optimum viewing angle.

### FEATURES

- Thin and Light weight
- High contrast ratio, High aperture structure.
- High-speed response
- SVGA (800 x600 pixels) resolution
- Low power consumption
- Dual CCFLs(Cold Cathode Fluorescent Lamp)
- DE (Data enable) mode.
- 3.3V Power Supply

### APPLICATIONS

- Notebook PC and desktop monitors
- Display terminals for AV application products
- Monitors for Industrial machine and P.O.S.

### General Information

| ITEM              | SPECIFICATION                        | UNIT  | NOTE |
|-------------------|--------------------------------------|-------|------|
| Display area      | 246.0(H) x 184.5(V) (12.1"diagonal ) | mm    |      |
| Driver element    | a-si TFT active matrix               |       |      |
| Display colors    | 262,144                              |       |      |
| Number of pixel   | 800 x 600                            | pixel |      |
| Pixel arrangement | RGB vertical stripe                  |       |      |
| Pixel pitch       | 0.3075 (H) x 0.3075 (V) (TYP.)       | mm    |      |
| Display Mode      | Normally white                       |       |      |
| Surface treatment | Haze 25, Hard-Coating (3H)           |       |      |

## Mechanical Information

| ITEM        |                | MIN.  | TYP.  | MAX.  | NOTE |
|-------------|----------------|-------|-------|-------|------|
| Module size | Horizontal (H) | 274.5 | 275.0 | 275.5 | mm   |
|             | Vertical (V)   | 205.0 | 205.5 | 206.0 | mm   |
|             | Depth (D)      | 9.2   | 10.2  | 10.7  | mm   |
| Weight      |                | -     | 650   | 680   | g    |

## 1. ABSOLUTE MAXIMUM RATINGS

### 1.1 ABSOLUTE RATINGS OF ENVIRONMENT

| ITEM                                                  | SYMBOL    | MIN. | MAX. | UNIT | NOTE    |
|-------------------------------------------------------|-----------|------|------|------|---------|
| Storage temperate                                     | $T_{STG}$ | -25  | 60   | °C   | (1)     |
| Operating temperate<br>(Temperature of glass surface) | $T_{OPR}$ | 0    | 50   | °C   | (1)     |
| Shock ( nonoperating )                                | Snop      | -    | 50   | G    | (2),(4) |
| Vibration (nonoperating)                              | Vnop      | -    | 1.5  | G    | (3),(4) |

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

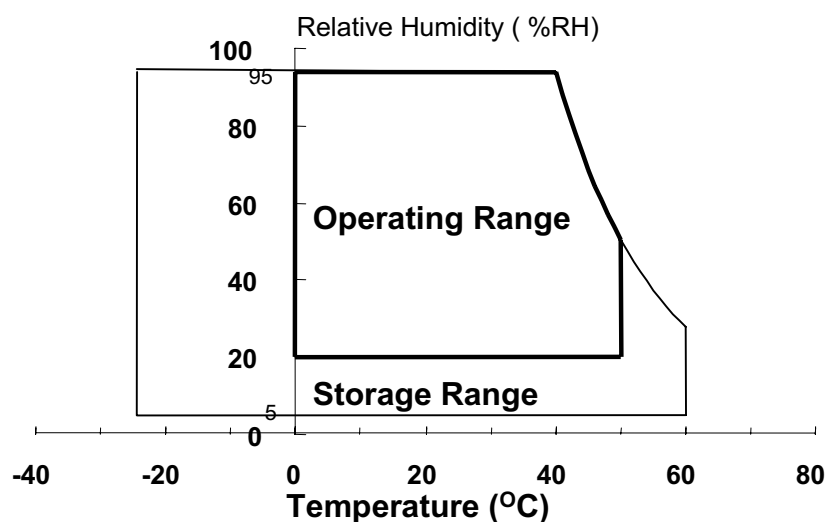
95 % RH Max. (  $40^{\circ}\text{C} \geq T_a$  )

Maximum wet - bulb temperature at  $39^{\circ}\text{C}$  or less. (  $T_a > 40^{\circ}\text{C}$  ) No condensation.

(2) 11 ms, half sine wave, one time per  $\pm X$ ,  $\pm Y$ ,  $\pm Z$ .

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

(4) In testing Vibration and Shock, the fixture which holds the module to be tested has to be hard and rigid enough so that the module would neither be twisted nor bent by the fixture.



## 1.2 ELECTRICAL ABSOLUTE RATINGS

## (1) TFT LCD MODULE

( GND= 0 V, V<sub>DD</sub>=3.3V)

| ITEM                 | SYMBOL          | MIN.    | MAX. | UNIT | NOTE |
|----------------------|-----------------|---------|------|------|------|
| Power Supply Voltage | V <sub>DD</sub> | GND-0.3 | 3.6  | V    | (1)  |

NOTE (1) Within Ta ( 25 ± 2 °C )

## (2) BACK-LIGHT UNIT

Ta = 25 ± 2 °C

| ITEM           | SYMBOL         | MIN. | MAX. | UNIT.             | NOTE |
|----------------|----------------|------|------|-------------------|------|
| Lamp current   | I <sub>L</sub> | 2.0  | 7.0  | mA <sub>rms</sub> | (1)  |
| Lamp frequency | F <sub>L</sub> | 40   | 80   | KHz               | (1)  |

NOTE (1) Permanent damage to the device may occur if maximum values are exceeded.  
Functional operation should be restricted to the conditions described under Normal Operating Conditions.

## 2. OPTICAL CHARACTERISTICS

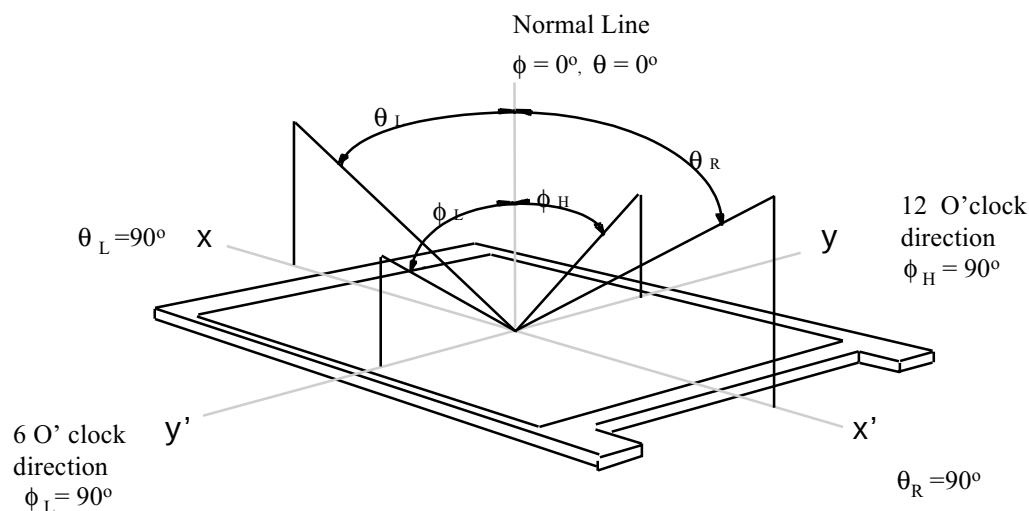
The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).

Measuring equipment : TOPCON BM-5A

\* Ta = 25± 2°C , VDD=3.3V, fv= 60Hz, fDCLK=40MHz, IL = 6.0mA

| ITEM                                  |               | SYMBOL             | CONDITION                  | MIN.       | TYP.   | MAX.  | UNIT |                   |
|---------------------------------------|---------------|--------------------|----------------------------|------------|--------|-------|------|-------------------|
| Contrast Ratio                        |               | CR                 | $\phi = 0$<br>$\theta = 0$ | 200        | 300    | -     |      | (2),(5)           |
| Response Time at 25 °C                | Rise          | T <sub>R</sub>     |                            | -          | 5      | 10    | msec | (3)               |
|                                       | Fall          | T <sub>F</sub>     |                            | -          | 20     | 30    |      |                   |
| Average Luminance of White (5 Points) |               | Y <sub>L,AVE</sub> |                            |            | 250    | 300   | -    | cd/m <sup>2</sup> |
| Color Chromaticity ( CIE )            | Red           | R <sub>x</sub>     | Viewing Normal Angle       | 0.560      | 0.590  | 0.620 |      | (1),(5)           |
|                                       |               | R <sub>y</sub>     |                            | 0.325      | 0.355  | 0.385 |      |                   |
|                                       | Green         | G <sub>x</sub>     |                            | 0.270      | 0.300  | 0.330 |      |                   |
|                                       |               | G <sub>y</sub>     |                            | 0.515      | 0.535  | 0.565 |      |                   |
|                                       | Blue          | B <sub>x</sub>     |                            | 0.125      | 0.155  | 0.185 |      |                   |
|                                       |               | B <sub>y</sub>     |                            | 0.110      | 0.140  | 0.170 |      |                   |
|                                       | White         | W <sub>x</sub>     |                            | 0.280      | 0.310  | 0.340 |      |                   |
|                                       |               | W <sub>y</sub>     |                            | 0.310      | 0.340  | 0.370 |      |                   |
|                                       | Viewing Angle | Hor.               |                            | $\theta_L$ | CR≥ 10 | 50    |      |                   |
| $\theta_R$                            |               |                    | 50                         | 60         |        | -     |      |                   |
| Ver.                                  |               | $\phi_H$           | 40                         | 45         |        | -     |      |                   |
|                                       |               | $\phi_L$           | 50                         | 55         |        | -     |      |                   |
| 13 Points White Variation             |               | δ <sub>w</sub>     |                            |            |        | 2.0   |      | (6)               |

Note (1) Definition of Viewing Angle : Viewing angle range ( $10 \leq CR$ )



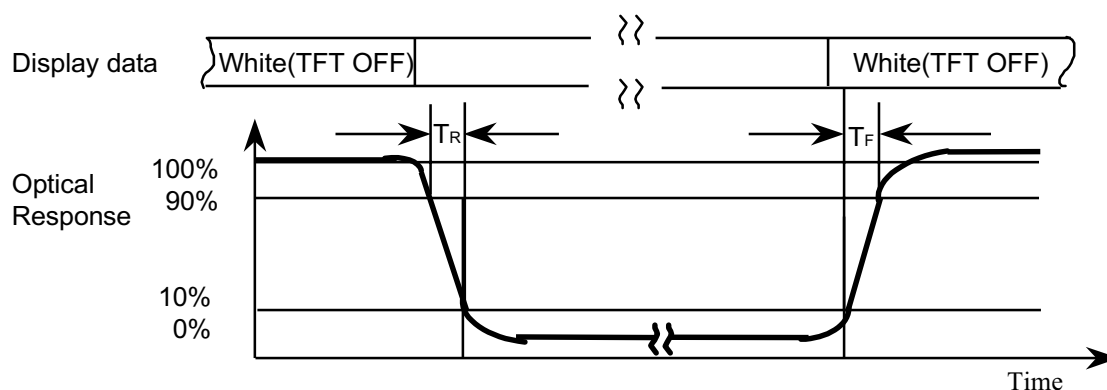
Note (2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin)

at 5 points(4, 5, 7, 9, 10)

$$CR = \frac{CR1 + CR2 + CR3 + CR4 + CR5}{5}$$

POINTS : (4) , (5) , (7) , (9) , (10) at FIGURE OF NOTE (6)

Note (3) Definition of Response time :



Note(4) Definition of Average Luminance of White : measure the luminance of white at 5 points.

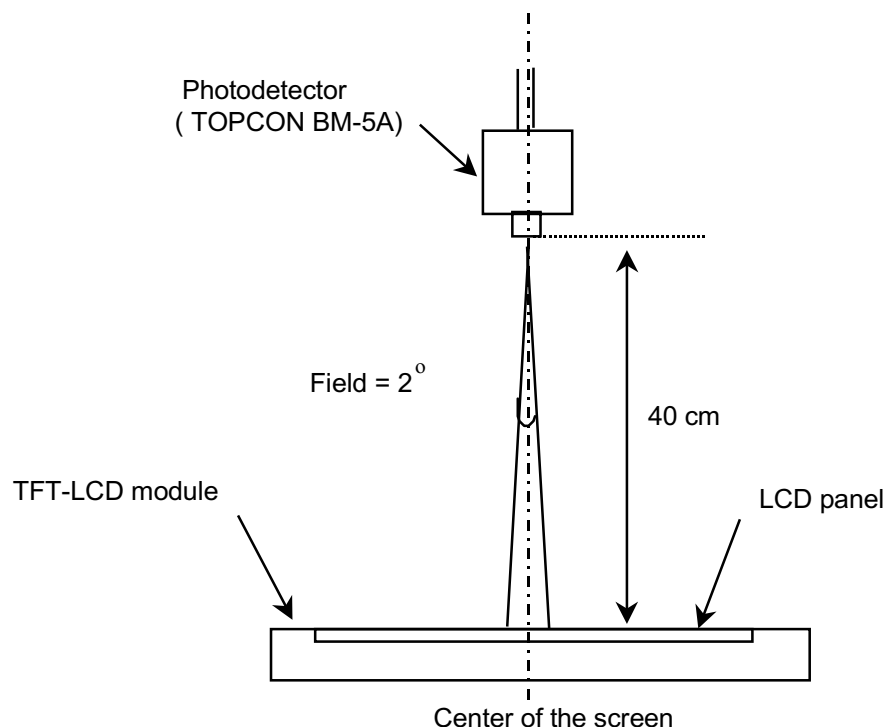
Average Luminance of White (  $Y_{L,AVE}$  )

$$Y_{L,AVE} = \frac{Y_{L4} + Y_{L5} + Y_{L7} + Y_{L9} + Y_{L10}}{5}$$

POINTS : (4) , (5) , (7) , (9) , (10) at FIGURE OF NOTE (6)

Note ( 5) Measurement should be executed in a stable, windless, and dark room after lighting the back-light for 30 min to stabilize at a given temperature. This should be measured in the center of screen.

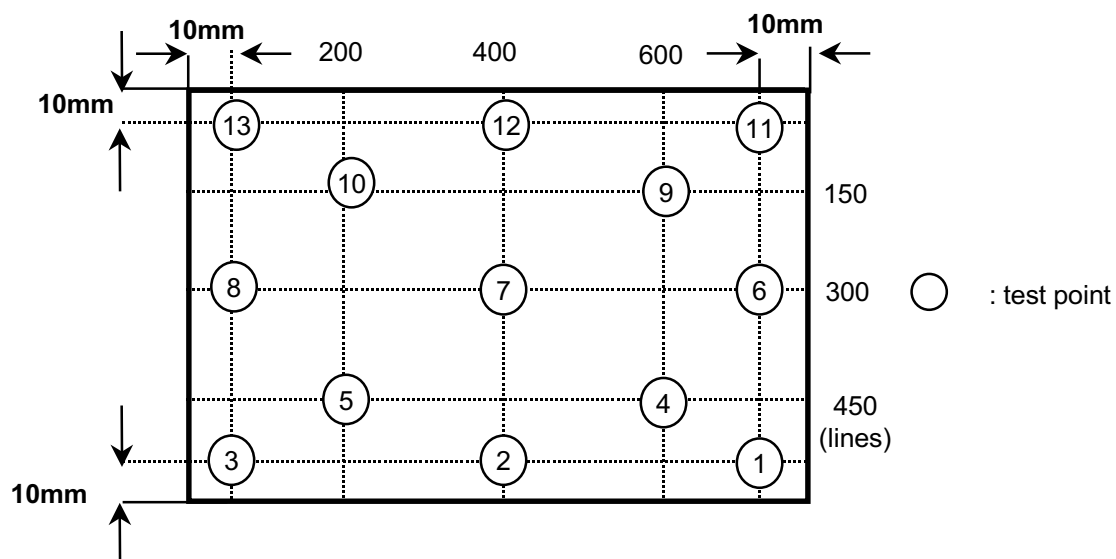
Lamp current : 6.0mA , Environment condition :  $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$



Optical characteristics measurement setup

Note( 6) Definition of 13-point white variation ( $\delta_w$ )

$$\delta_w = \frac{\text{Maximum luminance of 13 points}}{\text{Minimum luminance of 13 points}}$$



### 3. ELECTRICAL CHARACTERISTICS

#### 3.1 TFT LCD MODULE

Ta=25°C ±2 °C

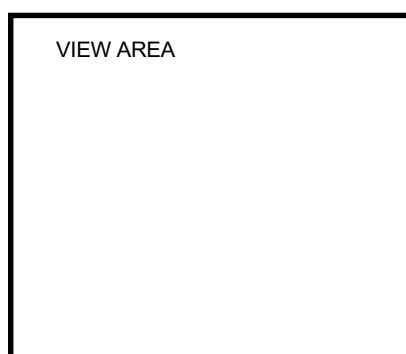
| ITEM                            |          | SYMBOL            | MIN                | TYP    | MAX                | UNIT | NOTE      |
|---------------------------------|----------|-------------------|--------------------|--------|--------------------|------|-----------|
| Voltage of Power Supply         |          | V <sub>DD</sub>   | 3.0                | 3.3    | 3.6                | V    |           |
| Input Voltage for Logic Signals | High     | V <sub>ih</sub>   | 0.7V <sub>dd</sub> | -      | -                  | V    | (1)       |
|                                 | Low      | V <sub>il</sub>   | -                  | -      | 0.3V <sub>dd</sub> | V    | (1)       |
| Vsync Frequency                 |          | f <sub>v</sub>    | -                  | 60     | -                  | Hz   |           |
| Hsync Frequency                 |          | f <sub>H</sub>    | -                  | 37.879 | -                  | kHz  |           |
| Main Frequency                  |          | f <sub>DCLK</sub> | 38                 | 40     | 42                 | MHz  |           |
| Rush Current                    |          | I <sub>RUSH</sub> | -                  | -      | 1.5                | A    | (4)       |
| Current of Power Supply         | White    | I <sub>DD</sub>   | -                  | 290    | -                  | mA   | (2)(3) *a |
|                                 | Mosaic   |                   | -                  | 320    | -                  | mA   | (2)(3) *b |
|                                 | V.Stripe |                   | -                  | 350    | 450                | mA   | (2)(3) *c |

Note (1) Display data pins and timing signal pins should be connected.(GND=0V)

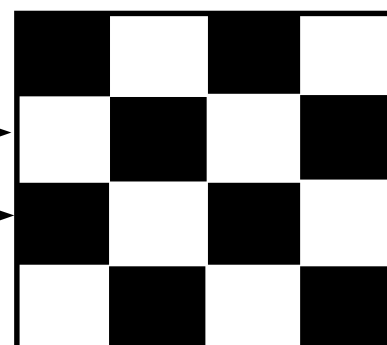
(2) f<sub>v</sub>= 60Hz, f<sub>DCLK</sub> = 40MHz, V<sub>DD</sub> =3.3V, DC Current.

(3) Power dissipation pattern.

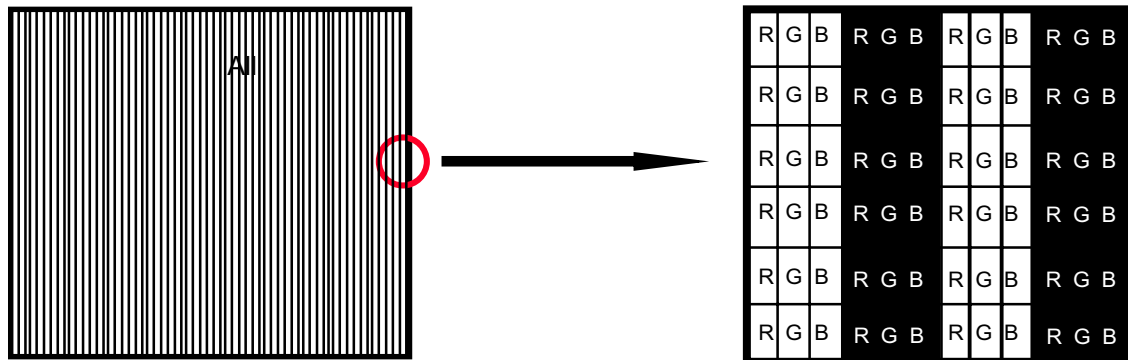
\*a) White Pattern



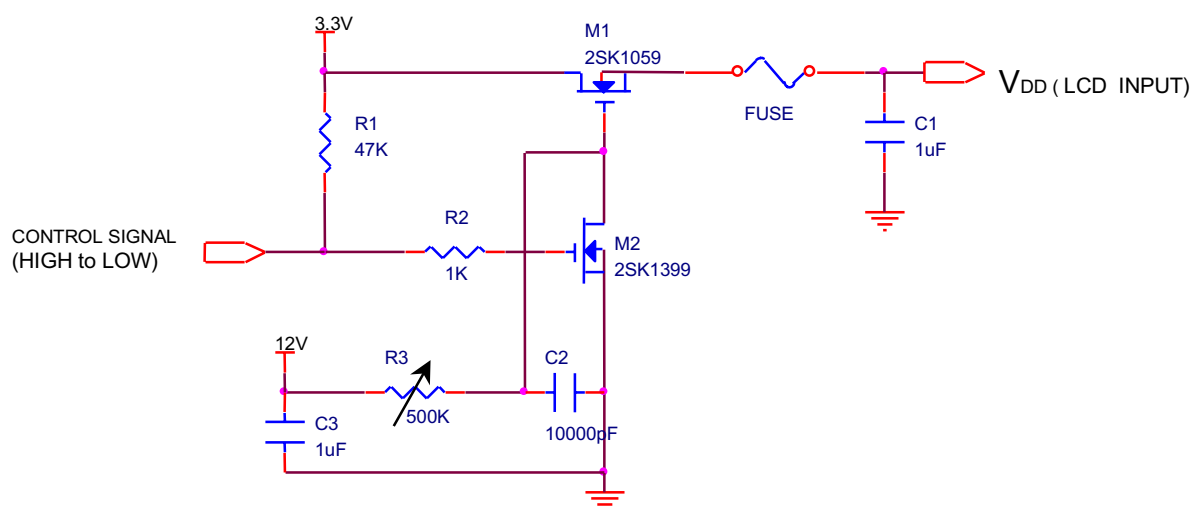
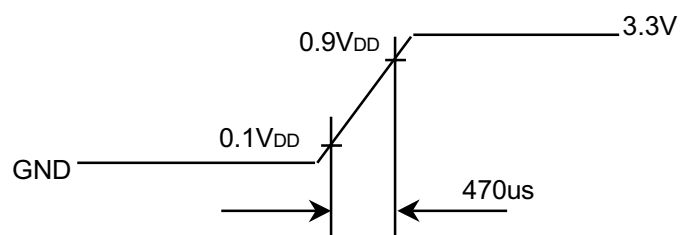
\*b)Mosaic Pattern



\*c) V.Stripe



(4) Rush current measurement condition

V<sub>DD</sub> rising time is 470us

### 3.2 BACK-LIGHT UNIT

The backlight system is an edge - lighting type with 2 single CCFLs( Cold Cathode Fluorescent Tube ).  
The characteristics of a single lamp are shown in the following tables.

INVERTER : SEC 130

Ta=25°C±2 °C

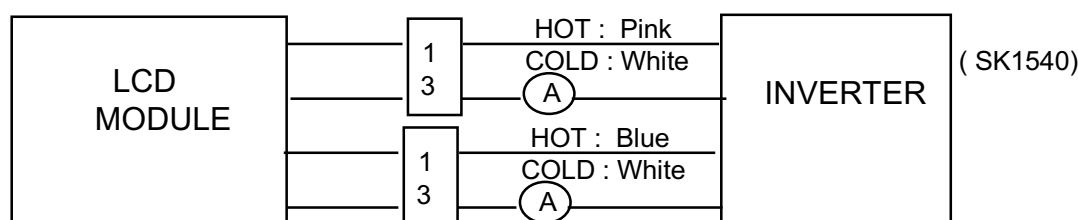
| ITEM                | SYMB           | MIN    | TYP | MAX          | UNIT              | NOTE                       |
|---------------------|----------------|--------|-----|--------------|-------------------|----------------------------|
| Lamp Current        | I <sub>L</sub> | 2.0    | 6.0 | 7.0          | mA <sub>rms</sub> | (1)                        |
| Lamp Voltage        | V <sub>L</sub> | -      | 500 | -            | V <sub>rms</sub>  | I <sub>L</sub> =6.0mA      |
| Frequency           | f <sub>L</sub> | 40     | 60  | 80           | KHz               | (2)                        |
| Power Consumption   | P <sub>L</sub> | -      | 6.0 | -            | W                 | (3), I <sub>L</sub> =6.0mA |
| Operating Life Time | Hr             | 50,000 |     | -            | Hour              | (4)                        |
| Startup Voltage     | V <sub>s</sub> | -      | -   | 1236 (25 °C) | V <sub>rms</sub>  | (5)                        |
|                     |                |        |     | 1740 (0 °C)  |                   |                            |

**Note) The inverter must have a symmetric output voltage waveform and be designed on the basis of the modularized lamp.**

The performance of the backlight, 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 backlight and the inverter(miss lighting, flicker, etc.) will 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 a high frequency current meter as shown below.



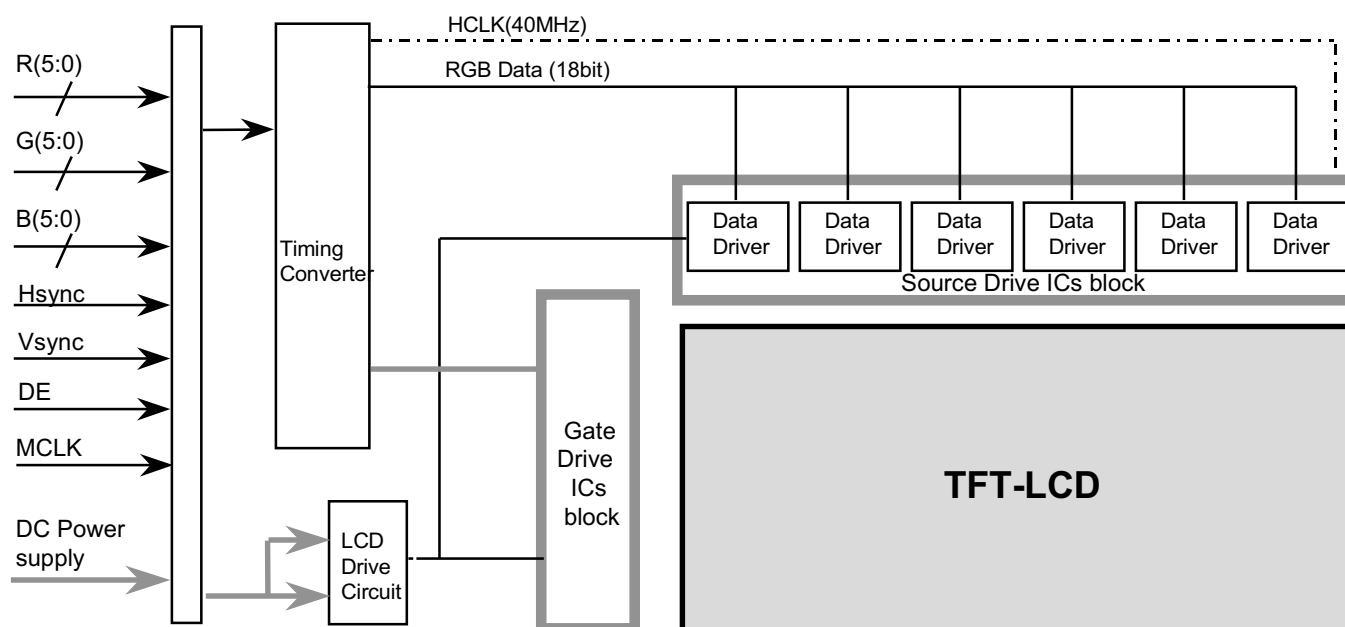
No 3 Pin is V<sub>Low</sub>.

Switching Frequency : 40 ~ 80 KHz

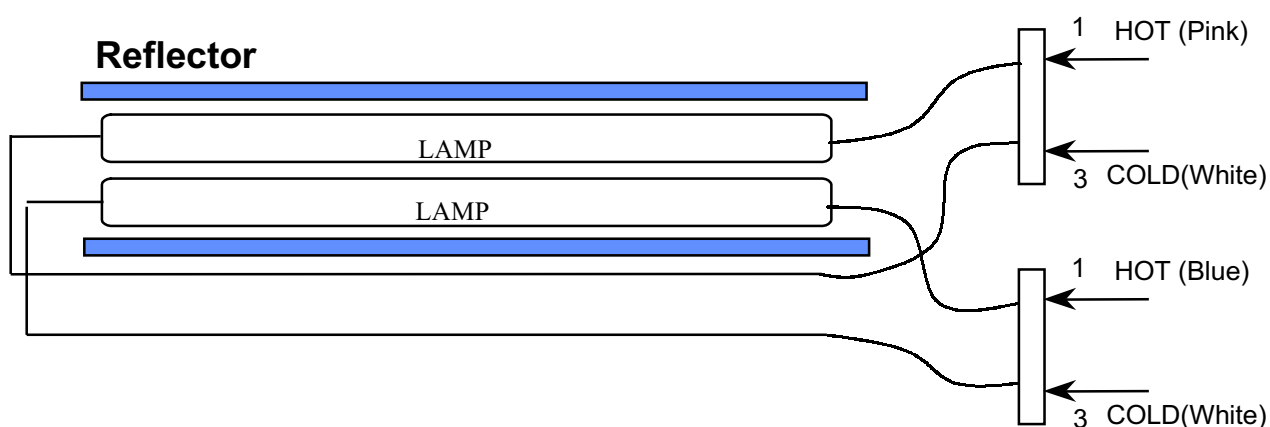
- (2) Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.
- (3) refer to  $I_L \times V_L \times 2$  (2 lamps) to calculate.
- (4) 50,000 Hr can be defined as the lifetime of a lamp which continues to operate under the condition Ta = 25 °C ± 2 °C and I<sub>L</sub> = 6 mA<sub>rms</sub> until one of the following events occur.
1. When the brightness becomes 50% or lower than it's original.
  2. When the Effective ignition length becomes 80% or lower than it's original value.  
(Effective ignition length is defined as an area that has over 70% brightness of one at the center point.)
- (5) The voltage above this value should be applied to the lamp for more than 1 second to startup. Otherwise the lamp may not be turned on.

## 4. BLOCK DIAGRAM

### 4.1 TFT LCD Module



### 4.2 BACK-LIGHT UNIT



Note) The output of the inverter may change according to the material of the reflector.

## 5. INPUT TERMINAL PIN ASSIGNMENT

### 5.1. Input Signal & Power

Connector : Hirose DF9B-41P-1V

| Pin NO. | Symbol    | Function                       | Polarity | Remark |
|---------|-----------|--------------------------------|----------|--------|
| 1       | GND       | Power Ground                   | -        | -      |
| 2       | DCLK      | Data Clock                     | -        | (1)    |
| 3       | GND       | Power Ground                   | -        | -      |
| 4       | Hsync     | Horizontal Sync Signal         | Negative | -      |
| 5       | Vsync     | Vertical Sync Signal           | Negative | -      |
| 6       | GND       | Power Ground                   | -        | -      |
| 7       | GND       | Power Ground                   | -        | -      |
| 8       | GND       | Power Ground                   | -        | -      |
| 9       | R0        | Red Data [ LSB ]               | Positive | (2)    |
| 10      | R1        | Red Data                       | Positive |        |
| 11      | R2        | Red Data                       | Positive |        |
| 12      | GND       | Power Ground                   | -        | -      |
| 13      | R3        | Red Data                       | Positive | (2)    |
| 14      | R4        | Red Data                       | Positive |        |
| 15      | R5        | Red Data [ MSB ]               | Positive |        |
| 16      | GND       | Power Ground                   | -        | -      |
| 17      | GND       | Power Ground                   | -        | -      |
| 18      | GND       | Power Ground                   | -        | -      |
| 19      | G0        | Green Data [ LSB ]             | Positive | (2)    |
| 20      | G1        | Green Data                     | Positive |        |
| 21      | G2        | Green Data                     | Positive |        |
| 22      | GND       | Power Ground                   | -        | -      |
| 23      | G3        | Green Data                     | Positive | (2)    |
| 24      | G4        | Green Data                     | Positive |        |
| 25      | G5        | Green Data [ MSB ]             | Positive |        |
| 26      | GND       | Power Ground                   | -        | -      |
| 27      | GND       | Power Ground                   | -        | -      |
| 28      | GND       | Power Ground                   | -        | -      |
| 29      | B0        | Blue Data                      | Positive | (2)    |
| 30      | B1        | Blue Data                      | Positive |        |
| 31      | B2        | Blue Data                      | Positive |        |
| 32      | GND       | Power Ground                   | -        | -      |
| 33      | B3        | Blue Data                      | Positive | (2)    |
| 34      | B4        | Blue Data                      | Positive |        |
| 35      | B5        | Blue Data [ MSB ]              | Positive |        |
| 36      | GND       | Power Ground                   | -        | -      |
| 37      | DE [DTMG] | Data Enable [ Display Timing ] | Positive | -      |
| 38      | N.C.      | No Connection                  | -        | Open   |
| 39      | VDD       | Power Supply [ +3.3V ]         | -        | -      |
| 40      | VDD       | Power Supply [ +3.3V ]         | -        | -      |
| 41      | N.C.      | No Connection                  | -        | Open   |

Remark : (1) Display Data is sampled at the negative edge of Data Clock.

(2) Data level 0 means no color ( Black ).

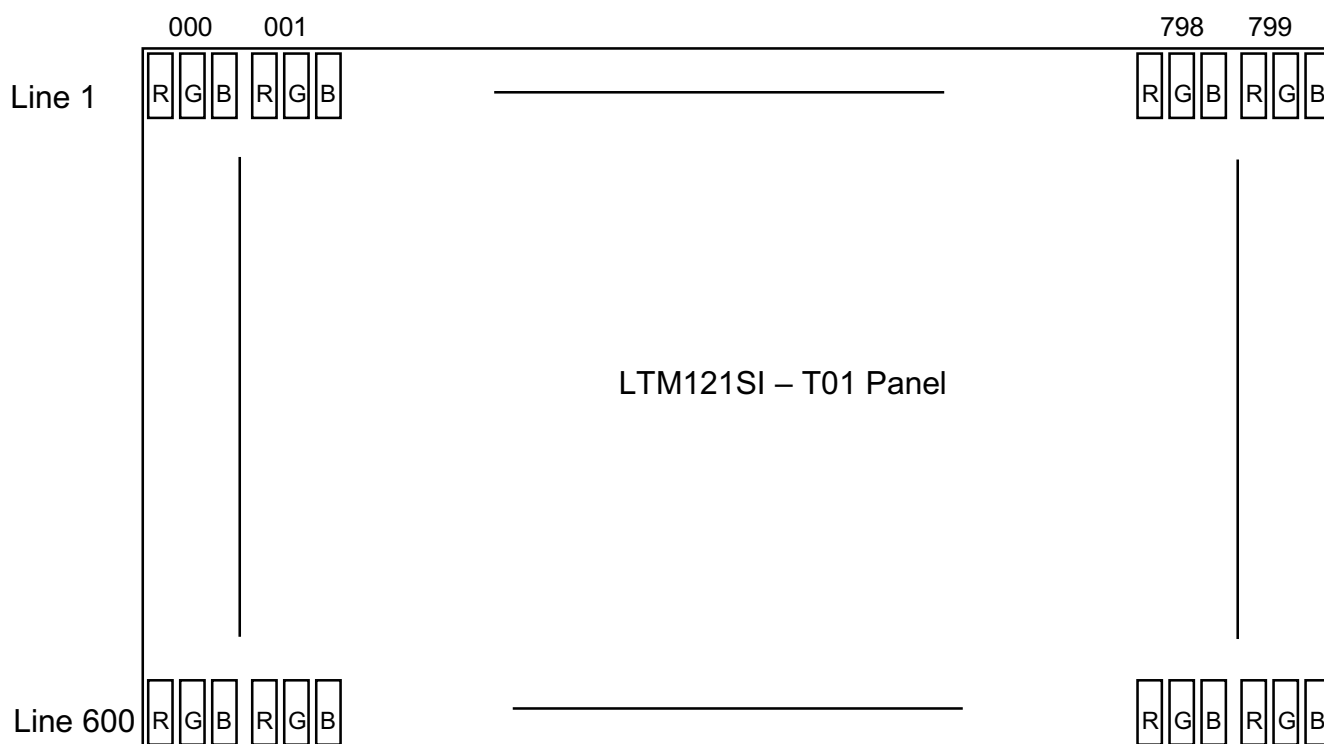
## 5.2 BACK LIGHT UNIT

Connector : JST BHR-03VS-01

| Pin NO. | Symbol | Color | Function     |
|---------|--------|-------|--------------|
| 1       | HOT    | PINK  | High Voltage |
| 3       | COLD   | WHITE | Low Voltage  |

| Pin NO. | Symbol | Color | Function     |
|---------|--------|-------|--------------|
| 1       | HOT    | BLUE  | High Voltage |
| 3       | COLD   | WHITE | Low Voltage  |

## 5.3 PIXEL FORMAT



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

Approval

| COLOR               | DISPLAY    | DATA SIGNAL |    |    |    |    |    |       |    |    |    |    |    |      |    |    |    | GRAY SCALE LEVEL |    |        |
|---------------------|------------|-------------|----|----|----|----|----|-------|----|----|----|----|----|------|----|----|----|------------------|----|--------|
|                     |            | RED         |    |    |    |    |    | GREEN |    |    |    |    |    | BLUE |    |    |    |                  |    |        |
|                     |            | R0          | R1 | R2 | R3 | R4 | R5 | G0    | G1 | G2 | G3 | G4 | G5 | B0   | B1 | B2 | B3 |                  | B4 | B5     |
| COLOR               | BLACK      | 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  | 1    | 1  | 1  | 1  | 1                | 1  | -      |
|                     | GREEN      | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0                | 0  | -      |
|                     | CYAN       | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1                | 1  | -      |
|                     | RED        | 1           | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0                | 0  | -      |
|                     | MAGENTA    | 1           | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1                | 1  | -      |
|                     | YELLOW     | 1           | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 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  | -      |
| GRAY SCALE OF RED   | BLACK      | 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  | R1     |
|                     |            | 0           | 1  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0                | 0  | R2     |
|                     |            | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :                | :  | R3~R60 |
|                     |            | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :                |    |        |
|                     | ↓<br>LIGHT | 1           | 0  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0                | 0  | R61    |
|                     |            | 0           | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0                | 0  | R62    |
|                     | RED        | 1           | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0                | 0  | R63    |
| GRAY SCALE OF GREEN | BLACK      | 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  | 1     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0                | 0  | G1     |
|                     |            | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 1  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0                | 0  | G2     |
|                     |            | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :                | :  | G3~G60 |
|                     |            | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :                |    |        |
|                     | ↓<br>LIGHT | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 0  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0                | 0  | G61    |
|                     |            | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0                | 0  | G62    |
|                     | GREEN      | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0                | 0  | G63    |
| GRAY SCALE OF BLUE  | BLACK      | 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  | 1    | 0  | 0  | 0  | 0                | 0  | B1     |
|                     |            | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 1  | 0  | 0  | 0                | 0  | B2     |
|                     |            | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :                | :  | B3~B60 |
|                     |            | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :                |    |        |
|                     | ↓<br>LIGHT | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 0  | 1  | 1  | 1                | 1  | B61    |
|                     |            | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 1  | 1  | 1  | 1                | 1  | B62    |
|                     | BLUE       | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1                | 1  | B63    |

Note 1) Definition of gray :

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

Note 2) Input signal: 0 =Low level voltage, 1=High level voltage

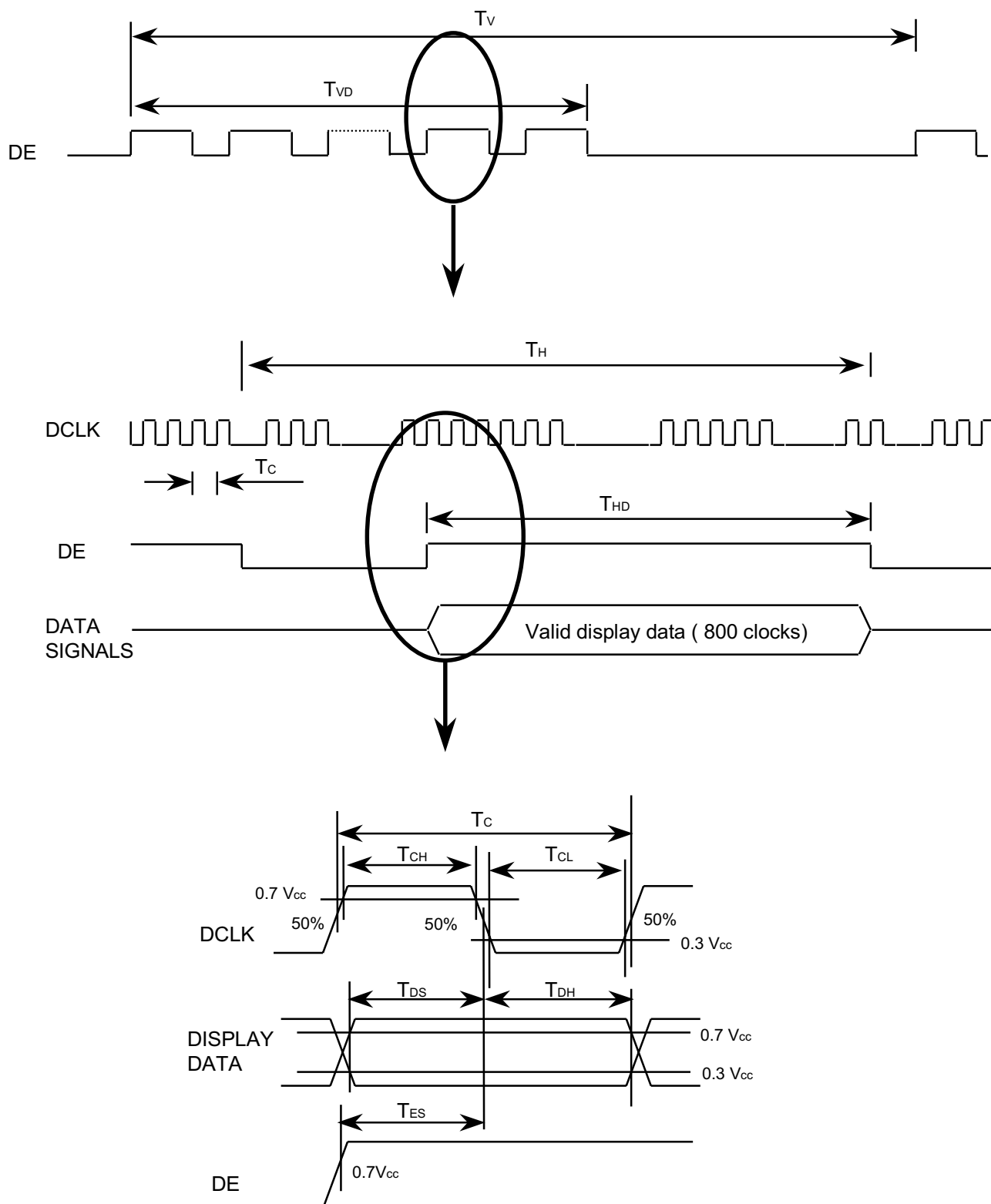
## 6. INTERFACE TIMING

### 6.1 Timing Parameters ( DE mode )

| Signal                         | Item           | Symbol | MIN  | TYP  | MAX  | Unit   | Note |
|--------------------------------|----------------|--------|------|------|------|--------|------|
| Clock                          | Frequency      | 1/Tc   | 38.0 | 40.0 | 42.0 | MHz    |      |
|                                | High Time      | TCH    | 10   | -    | -    | nsec   |      |
|                                | Low Time       | TCL    | 10   | -    | -    | nsec   |      |
| Data                           | Setup Time     | Tds    | 2    | -    | -    | nsec   |      |
|                                | Hold Time      | TDH    | 0    | -    | -    | nsec   |      |
| Data Enable                    | Setup Time     | TES    | 5    | -    | -    | nsec   | (1)  |
| One Line Scanning Time         | Cycle          | TH     | 1024 | 1056 | 1056 | clocks |      |
| Frame Frequency                | Cycle          | Tv     | 620  | 628  | 664  | lines  |      |
| Vertical Active Display Term   | Display Period | TvD    | 600  | 600  | 600  | lines  |      |
| Horizontal Active Display Term | Display Period | THD    | 800  | 800  | 800  | clocks |      |

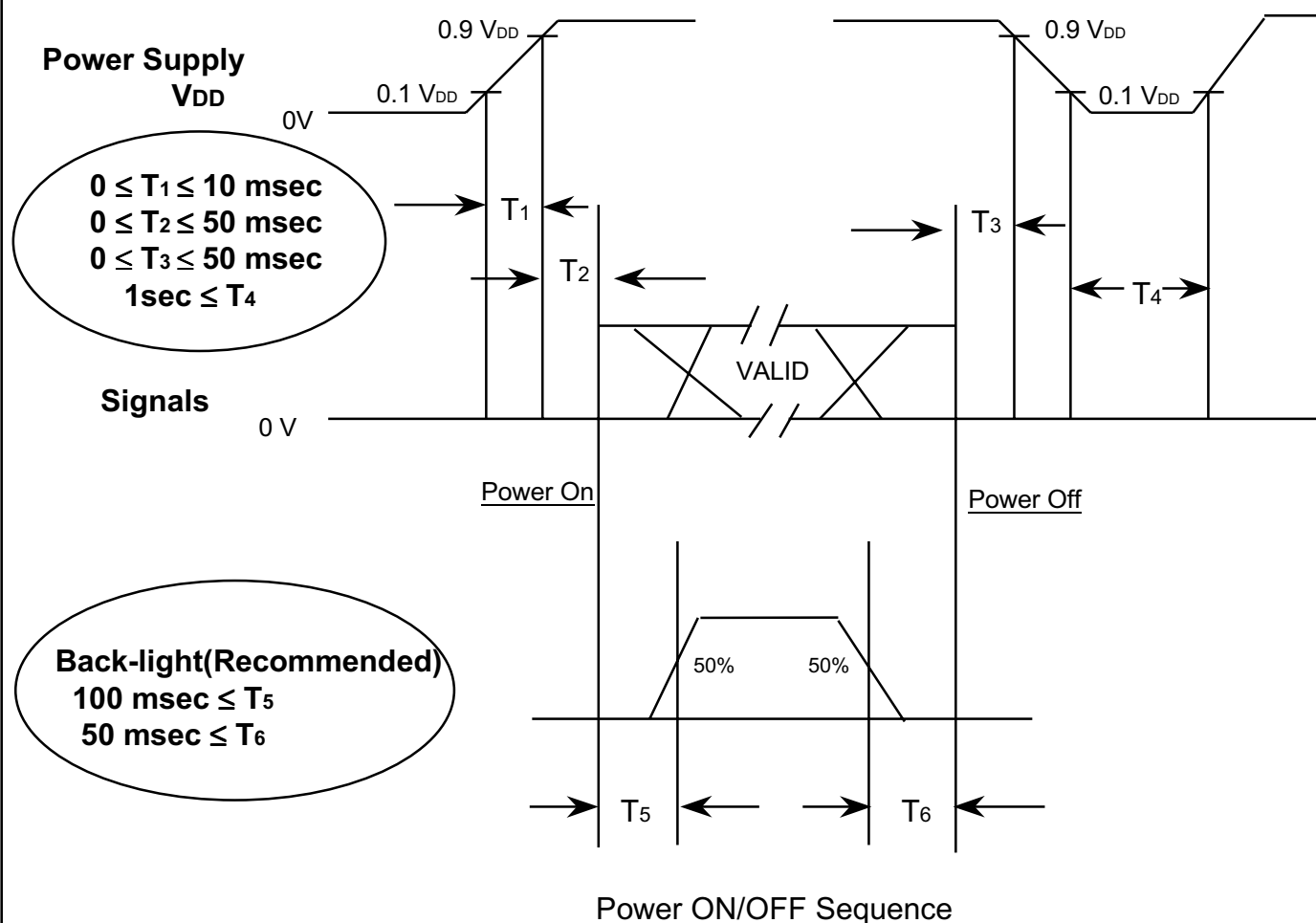
Note (1) The duration of DE [DTMG] signal must be longer than 1 clock period at every horizontal sync. period

## 6.2 Timing diagrams of interface signal



### 6.3. Power ON/OFF Sequence

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



#### NOTE.

- (1) The supply voltage applied to the module input should be the same as with  $V_{DD}$ .
- (2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight does, the display may momentarily become white.
- (3) In case of  $V_{DD}$  = off level, please keep the level of input signals on the low or a high impedance.
- (4)  $T_4$  should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal should not be kept at high impedance when the power is on.

7. Mechanical Outline Dimension

Approval

[ Refer to the Next Page ]



## 8. RELIABILITY TEST

| Test Items                                       | Conditions                                                                                                                                                                                                                                       | Time / Cycle     | Sample |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------|
| HTOL*                                            | 50°C, Dynamic                                                                                                                                                                                                                                    | 500 hrs          | 12     |
| LTOL*                                            | 0 °C, Dynamic                                                                                                                                                                                                                                    | 500 hrs          | 5      |
| THB*                                             | 40°C / 90%, Dynamic                                                                                                                                                                                                                              | 500 hrs          | 5      |
| HTS****                                          | 70°C, No Bias                                                                                                                                                                                                                                    | 250 hrs          | 5      |
| LTS****                                          | -30°C, No Bias                                                                                                                                                                                                                                   | 250 hrs          | 5      |
| Thermal Shock<br>(Non-operating)                 | -20 ~ 60°C, No bias,<br>Ramp-up & down : 1 min.,<br>Soak time : 30min.                                                                                                                                                                           | 100 Cyc.         | 5      |
| Temperature<br>Characteristics<br>& Power on/off | Storage : 0°C, 30min., 10 times (power on/off)<br>Ramp up : 0~ 25°C, 30 min<br>Storage : 25°C, 30 min., 10 times (power on/off)<br>Ramp up : 20~ 50°C, 30 min.<br>Storage : 50°C, 30 min., 10 times (power on/off)<br>Ramp up : 50~ 0°C, 30 min. | 10Cyc.           | 10     |
| Shock<br>(Non-operating)                         | 50 G, 11 msec,<br>Sine wave, ± x/y/z axis                                                                                                                                                                                                        | one time/axis    | 3      |
| Vibration<br>(Non-operating)                     | 1.5G, 10 ~ 300 ~ 10 Hz,<br>x/y/z axis, sweep rate : 10 min.                                                                                                                                                                                      | 30 min/axis      | 3      |
| ESD<br>(Non-operating)                           | Contact : 150pF, 330 ohm<br>Air : 150pF, 330 ohm                                                                                                                                                                                                 | ± 10KV<br>± 20KV | 3<br>3 |
| Box<br>Vibration                                 | 1.1G, 5 ~ 100Hz,<br>1hour / y axis(up/down), sweep rate : 5min                                                                                                                                                                                   |                  | 10     |
| Box Drop                                         | Height : 66cm                                                                                                                                                                                                                                    |                  | 10     |

### [ Result Evaluation Criteria]

Under the display quality test conditions with normal operation state, these shall be no change which may affect practical display function.

\* HTOL/ LTOL : High/Low Temperature Operating Life, \*\* THB : Temperature Humidity Bias

\*\*\*\* HTS/LTS : High/Low Temperature Storage

## 9. Packing

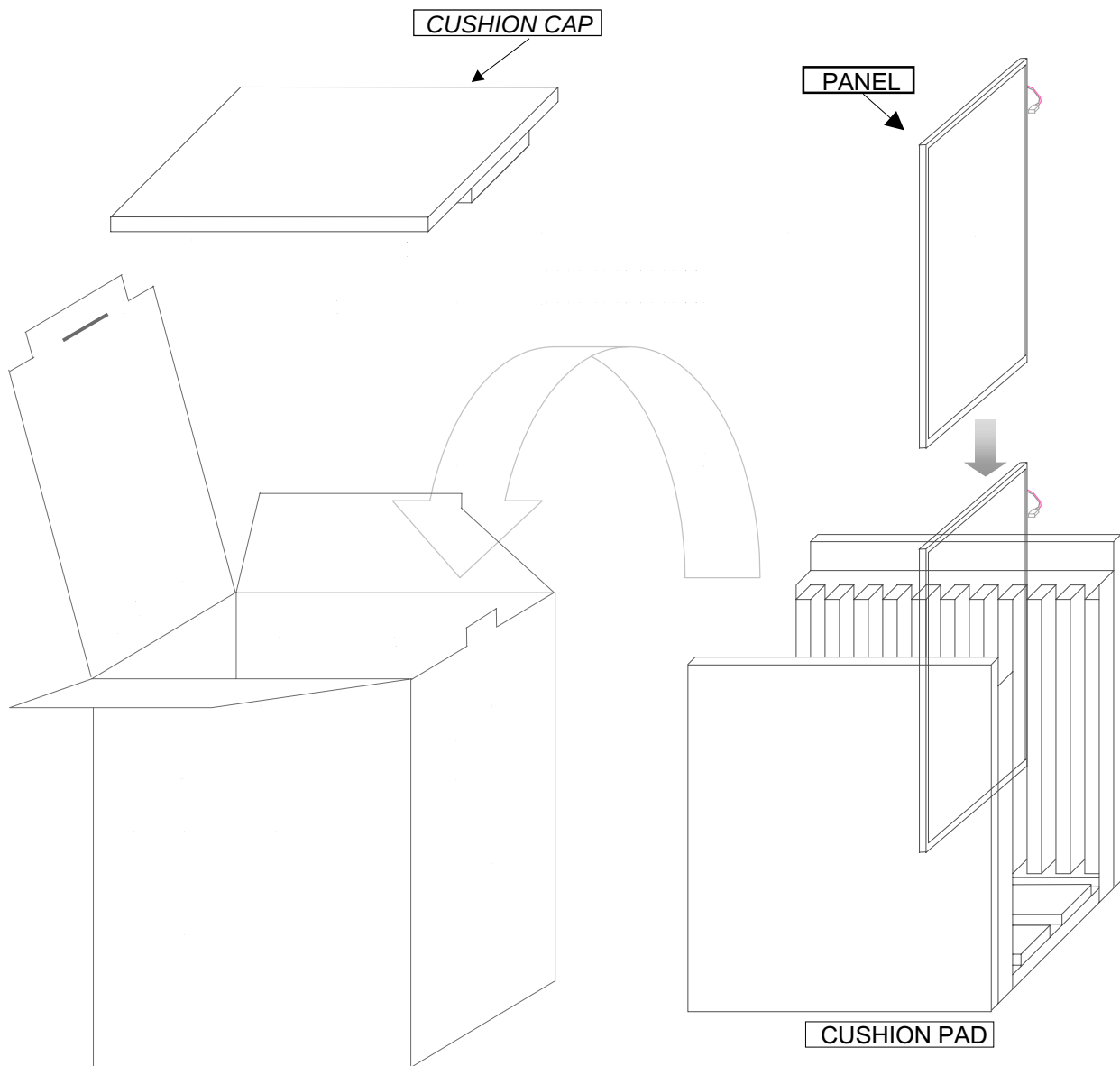
### 9.1 Packing

CARTON(Internal Package)

#### (1)Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

#### (2)Packing Method



Note (1)Total : Approx. 8.5Kg

(2)Acceptance number of piling : 10 sets

(3)Carton size : 267(W) X 228(D) X 340(H)

(4)Max accumulation quality : 5cartons

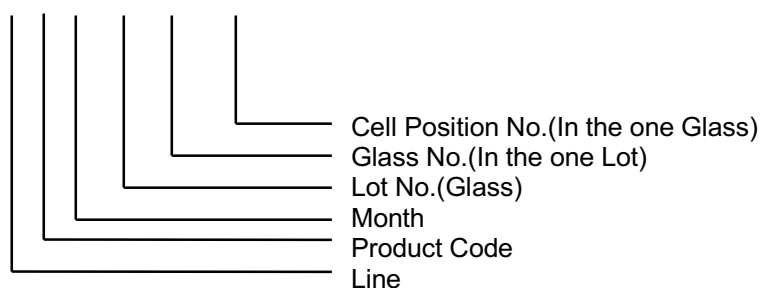
## (3)Packing Material

| NO. | Parts name                                           | Quantity |
|-----|------------------------------------------------------|----------|
| 1.  | Static electric protective sack                      | 10       |
| 2.  | Packing case( inner box )<br>included shock absorber | 1 set    |
| 3.  | Pictorial marking                                    | 2 pics   |
| 4.  | Silica gel( 50g X 2 )                                | 2        |
| 5.  | Carton                                               | 1 set    |

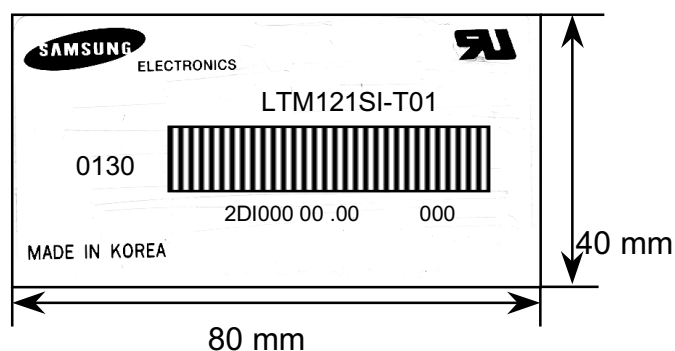
## 10. MARKINGS &amp; OTHERS

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

- (1)Parts number : LTM121SI – T01  
 (2)Revision : One letter  
 (3)Control code : One letter  
 (4)Lot number : 2D I XXX XX XX

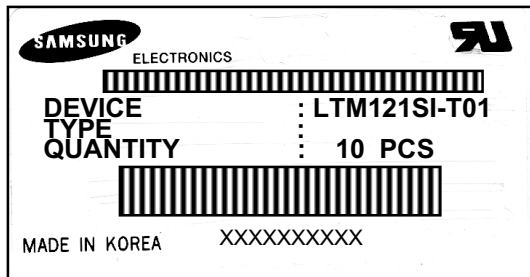


## (5) Nameplate Indication



*LTM...* : Parts name  
*2DI...* : Lot number  
*0130* : Inspected work week

## (6) Packing 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 hole. 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 CCFT back-light.
- (c) Note that polarizers are very fragile and could be damaged easily. Do neither press nor 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 cause 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 which may cause damage to the C-MOS Gate Array IC.
- (i) Use finger-stalls with soft gloves in order to keep display clean during incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Do neither pull nor fold the lamp wire.
- (l) Do not adjust the variable resistor which locates on the back side.
- (m) Pins of I/F connector should not be touched directly with bare hands.

## 10.2 Storage

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

## 10.3 Operation

- (a) Do neither connect nor disconnect the module in the “Power On” condition.
- (b) Power supply should always be turned on/off by following item 6.3 “Power on/off sequence”.
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) A cable between the backlight connector and its inverter power supply should be a minimized length and be connected directly. A longer cable between the backlight and the inverter may cause lower luminance of lamp(CCFT) and require higher startup voltage(Vs).

## 10.4 Others

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. ( supply voltage variation, input voltage variation, variation in part contents and environmental temperature and so on) Otherwise the module may be damaged.
- (d) If the module displays the same pattern continuously for a long time, it can bring about the situation that the image “sticks” to the screen.
- (e) Because this module has its circuitry PCB on the rear side, it should be handled carefully in order not to be stressed.

# Cosmetic Outgoing Inspection Specification

## (LTM121SI SVGA TFT - LCD)

Customer \_\_\_\_\_

SAMSUNG 

J.S.Shim  
Sr. Manager, LCD CS Group

**LCD CS Group**  
**AMLCD Division**

Address : San 24 Nongseo-Lee, Kihung-Eup, Yongin Si, Kyungki-Do, Korea  
Tel. 82-2-760-7838 Fax. 82-2-760-7369

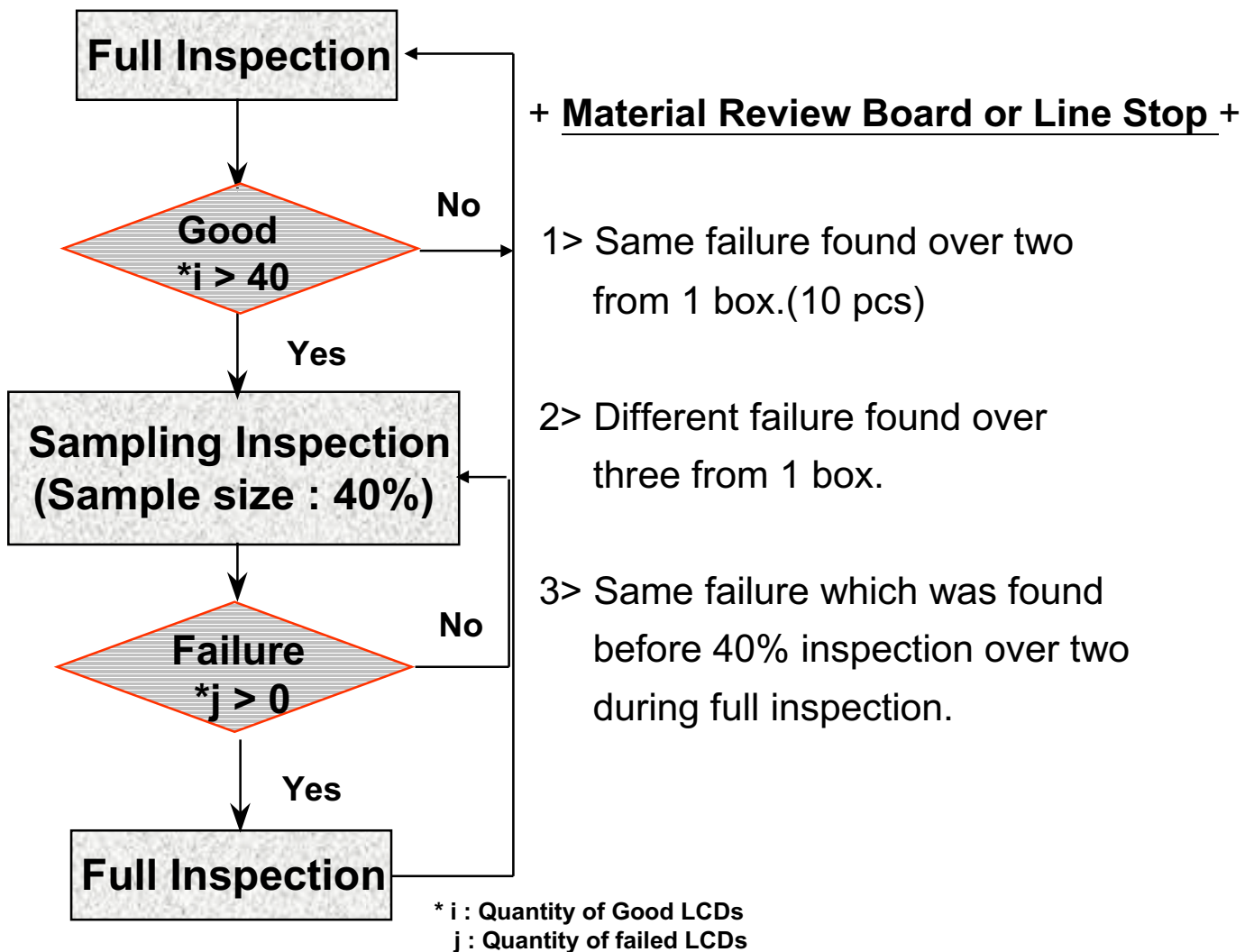
## 1. Outgoing Inspection

### 1.1 Outgoing Inspection Plan

#### 1.1-1 Sampling Plan

+ Sample size : 40 %

#### 1.1-2 Flow Chart



## 1.2 Outgoing Inspection Criteria

### 1.2.1 Inspection Introduction

#### 1.2.1.1 Conditions

|                                                |                                                                                    |
|------------------------------------------------|------------------------------------------------------------------------------------|
| <i>viewing distance</i>                        | 30 ~ 50 cm                                                                         |
| <i>ambient illumination</i>                    | 300 ~ 700 Lux (nominal 500 Lux)                                                    |
| <i>ambient temperature</i>                     | 25 + - 3 'C                                                                        |
| <i>viewing angle</i>                           | The surface of the module and the inspector's line of view shall be at 90 degrees. |
| <i>display pattern</i><br>(SEC's test program) | 12.1" SVGA - SLT                                                                   |

#### 1.2.1.2 Defect Modes

##### *dark / bright spots*

points on the display which appear dark / bright and remain unchanged in size

##### *dark / bright lines*

lines on the display which appear dark / bright and remain unchanged in size

##### *polarizer scratch*

when the unit is lit a light, line is seen across a darker background; line does not vary in size

##### *polarizer dent*

when the unit is lit a light, light(white) spots appear against a darker background, and do not vary in size

##### *bright/dark dot*

a sub-pixel (R, G, B dot) stuck off / on

## 1.2.2 Mechanical Inspection

*Chassis Gap* max. 0.7mm

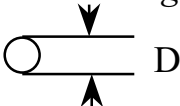
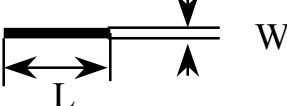
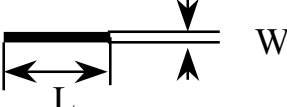
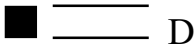
*Silicone Gasket (Glue)* silicone material shall not be exposed beyond the metal frame edge into the view area

*Light Leakage* there shall be no visible light around the edges of the screen.

*\* If there is none identified criteria in this specification, Samsung will refer production specification that Customer and Samsung agreed.*

*\* If there is mechanical dimension issue which has no designated tolerance, Samsung will apply natural tolerance.*

## 1.2.3 Visual Inspection

| Defect Type                                                                                                                                                               | Count (mm)                                               | Reject (mm)             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-------------------------|
| <i>Dark / bright spot *1</i><br><i>(foreign circular matter on the back light)</i><br> | $0.1 < D \leq 0.8$<br>$N \leq 4$                         | $D > 0.8$               |
| <i>Bright line (light lint), or dark line (dark lint / hair)</i><br>                   | $0.01 < W \leq 0.08$<br>$0.3 < L \leq 1.0$<br>$N \leq 4$ | $W > 0.08$<br>$L > 1.0$ |
| <i>Polarizer scratch</i><br>                                                           | $0.01 < W \leq 0.1$<br>$0.3 < L \leq 5.0$<br>$N \leq 3$  | $W > 0.1$<br>$L > 5.0$  |
| <i>Polarizer dent/bubble</i><br>                                                       | $D \leq 0.5$<br>$N \leq 6$                               | $D > 0.5$               |
| <i>Maximum allowable number of defects</i>                                                                                                                                | $N \leq 7$                                               | $N > 7$                 |

[ D : diameter, W : width, L : length, N : count ]

*\*1. Translucent edge is ignored in measuring the diameter of spot.*

### 1.2.4. Electrical Inspection

| Defect Type                                      | Accept               | Reject            |
|--------------------------------------------------|----------------------|-------------------|
| <i>Bright dot, (Fig. 1)</i>                      |                      |                   |
| <i>Random</i>                                    | $N \leq 4$           | $N > 4$           |
| <i>two adjacent</i>                              | $N \leq 1$           | $N > 1$           |
| <i>Dark dot , (Fig. 2)</i>                       |                      |                   |
| <i>random</i>                                    | $N \leq 6$           | $N > 6$           |
| <i>two adjacent</i>                              | $N \leq 2$           | $N > 2$           |
| <i>three adjacent</i>                            | $N \leq 1$           | $N > 1$           |
| <i>four or more adjacent</i>                     | not allowed          |                   |
| <i>Maximum allowable number of dot defect</i>    | $N \leq 8$           | $N > 8$           |
| <i>Minimum distance between defects, (Fig.3)</i> |                      |                   |
| <i>bright dot - to - bright dot</i>              | $L \geq 15\text{mm}$ | $L < 15\text{mm}$ |
| <i>dark dot - to - dark dot</i>                  | $L \geq 5\text{mm}$  | $L < 5\text{mm}$  |

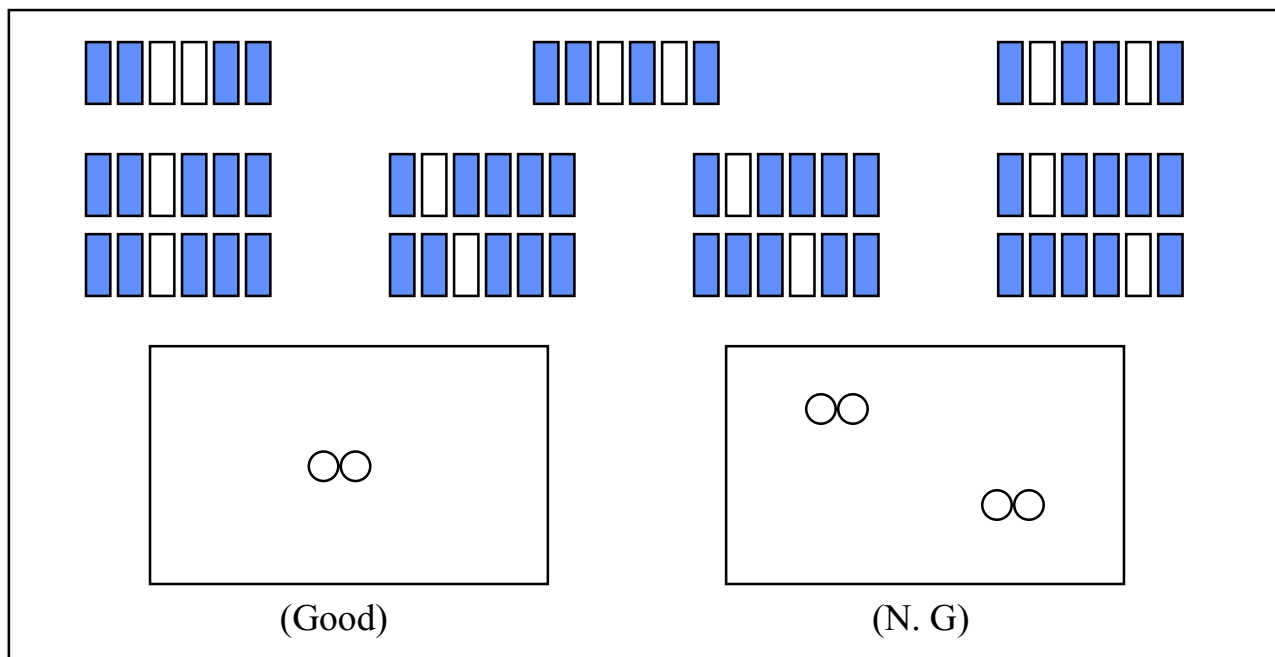
[ L : length, N : count ]

*Off dot count method* add all dot defects in individual patterns (R, G, B, Black and White). A dot defect appeared repeatedly is counted as one (1) dot defect.

*Adjacent dot count* Samsung uses standard pattern -- R, G, B, Black and White.

*Fig. 1. Bright dot defect description*

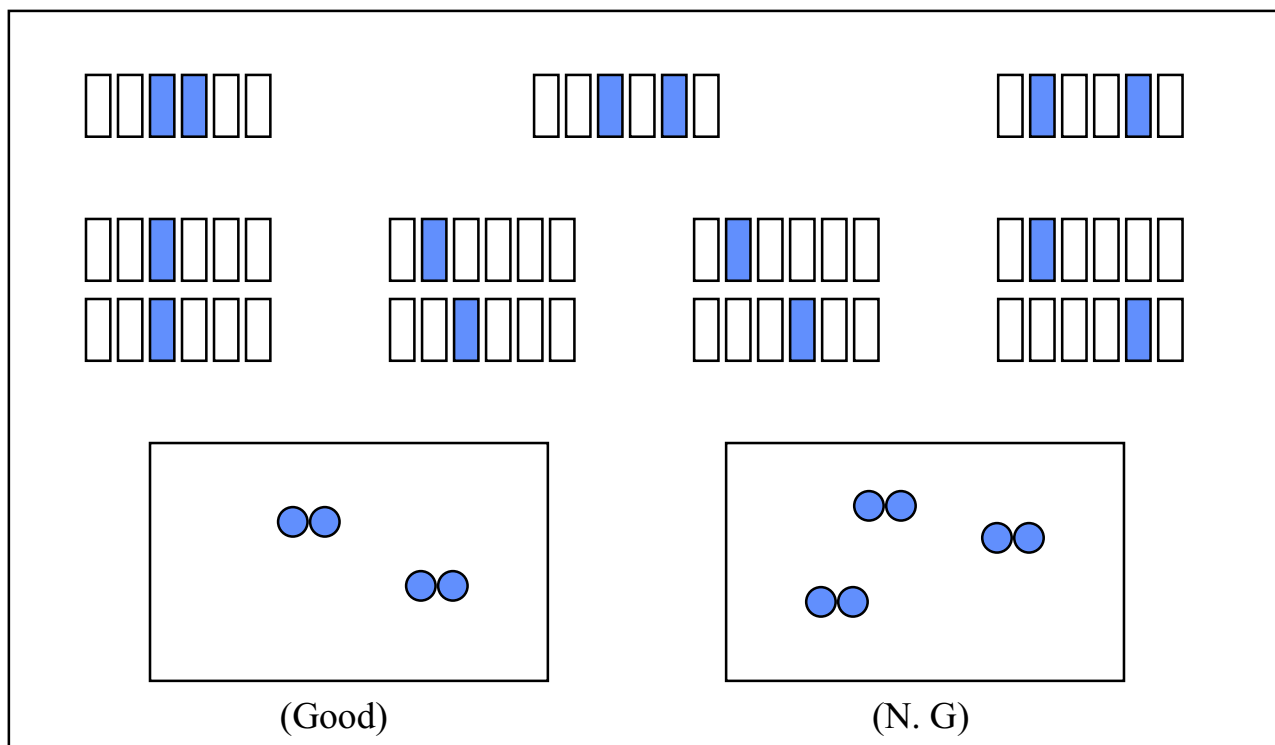
【two adjacent】



\* adjacent two dots in horizontal direction will be considered as one dot

*Fig. 2. Dark dot defect description*

【two adjacent】



\* adjacent two dots in horizontal direction will be considered as one dot

【three adjacent】

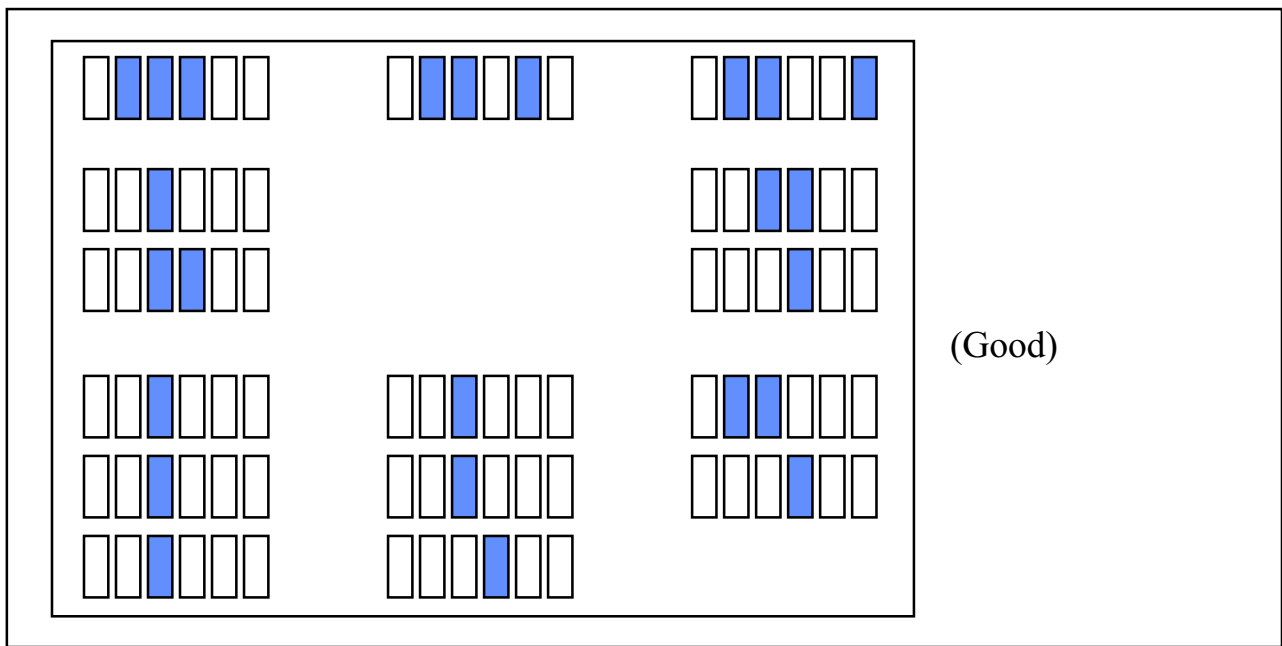


Fig. 3. Minimum distance between dot defects

【bright dot - to - bright dot】



【dark dot - to - dark dot】

