

Approval

TO : General customer

Date : 2002. 10. 17.

**SAMSUNG TFT-LCD**

**MODEL NO. : LTM190E1-L01**

Approved by :

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\_\_\_\_\_  
\_\_\_\_\_

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

Senior Manager :



PREPARED BY : AMLCD Technical Customer Service Team

**Samsung Electronics Co . , LTD.**



# Approval

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## \* Revision History

| Date             | Rev. No | Page | Summary  |
|------------------|---------|------|--|
| Oct. 17,<br>2002 | 000     |      | Approval specification of LTM190E1-L01 mode was issued for the first time. |

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**General Description****\* Description**

LTM190E1-L01 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFTs as a switching devices. This model is composed of a TFT LCD panel, a driver circuit and a back-light system. The resolution of a 19.0" contains 1280 x 1024 pixels and can display up to 16.7 million colors with wide viewing angle of 85° or higher in all directions. (Vertical viewing angle : 170° , Horizontal viewing angle : 170°)

**\* Features**

- High contrast ratio, high aperture structure
- PVA(Patterned Vertical Alignment) mode
- Wide viewing angle
- High speed response
- SXGA(1280 x 1024 pixels) resolution
- Low power consumption
- 2 dual CCFT(Cold Cathode Fluorescent Tube)
- DE only mode
- LVDS(Low Voltage Differential Signaling) interface (2pixel/clock)

**\* Applications**

Workstation & desktop monitors

Display terminals for AV application products

Monitors for industrial machine

**\* General information**

| Items             | Specification                | Unit   | Note |
|-------------------|------------------------------|--------|------|
| Display area      | 376.32(H) × 301.056(V)       | mm     |      |
| Driver element    | a-Si TFT active matrix       |        |      |
| Display colors    | 16.7M (true)                 | colors |      |
| Number of pixels  | 1280 x 1024                  | pixel  |      |
| Pixel arrangement | RGB vertical stripe          |        |      |
| Pixel pitch       | 0.098(H) × 0.294(V)          | mm     |      |
| Display mode      | Normally Black               |        |      |
| Surface treatment | Haze 44% , Hard-coating (3H) |        |      |

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## \* Mechanical information

| Item        |               | Min.   | Typ.  | Max.   | Note |
|-------------|---------------|--------|-------|--------|------|
| Module size | Horizontal(H) | 404.15 | 404.2 | 404.25 | mm   |
|             | Vertical(V)   | 329.5  | 330.0 | 330.5  | mm   |
|             | Depth(D)      | -      | 20.0  | 20.3   | mm   |
| Weight      |               | -      | -     | 2,700  | g    |

## 1. Absolute Maximum Ratings

## 1.1 Absolute ratings of environment

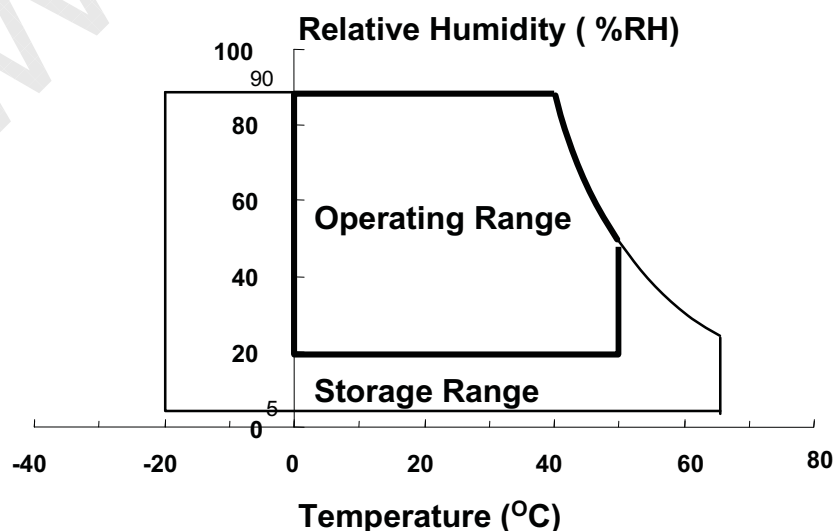
| Item  | Symbol           | Min. | Max. | Unit | Note    |
|---|------------------|------|------|------|---------|
| Storage temperature                                     | T <sub>STG</sub> | -20  | 65   | °C   | (1)     |
| Operating temperature<br>(Surface of glass temperature) | T <sub>OPR</sub> | 0    | 50   | °C   | (1)     |
| Shock ( non - operating )                               | Snop             | -    | 50   | G    | (2),(4) |
| Vibration ( non - operating )                           | Vnop             | -    | 1.5  | G    | (3),(4) |

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

90 % RH Max. ( 40 °C ≥ Ta )

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

- (2) 11ms, sine wave, one time for ±X, ±Y, ±Z axis
- (3) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis
- (4) 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.



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## 1.2 ELECTRICAL ABSOLUTE RATINGS

### (1) TFT LCD Module

(V<sub>ss</sub> = GND = 0 V)

| Item                 | Symbol | Min.                 | Max. | Unit | Note |
|----------------------|--------|----------------------|------|------|------|
| Power Supply Voltage | VDD    | V <sub>ss</sub> -0.5 | 6.5  | 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   | IL     | 2.0  | 7.0  | mArms | (1),(2) |
| Lamp Frequency | fL     | 30   | 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) Specified values are for a single lamp (Refer to the Note (1) in the page 13 for further information).

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## 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 : TOPCON BM-5A , BM-7, PHOTO RESEARCH PR650  
Eldim EZ-Contrast

(Inverter Freq. : 54kHz) \* Ta = 25 ± 2°C, VDD=5V, fv= 60Hz, fDCLK=54MHz, IL = 6.5mA<sub>rms</sub>

| Item                                     | Symbol  | Condition                            | Min.             | Typ.  | Max.          | Unit              | Note                   |
|--|---------|--------------------------------------|------------------|-------|---------------|-------------------|------------------------|
| Contrast Ratio<br>(Center of screen)     | C/R     |                                      | 400              | 500   | -             |                   | (3)<br>BM-5A           |
| Response<br>Time                         | Rising  | Tr                                   | -                | 15    | 20            | msec              | (4)                    |
|  | Falling | Tf                                   | -                | 10    | 15            |                   | BM-7                   |
| Luminance of White<br>(Center of screen) | YL      | Normal<br>$\phi = 0$<br>$\theta = 0$ | 220              | 250   | -             | cd/m <sup>2</sup> | (5)<br>BM-5A           |
| Color<br>Chromaticity<br>(CIE 1931)      | Red     | Rx                                   | Viewing<br>Angle | 0.634 | TYP.<br>-0.03 | TYP.<br>+0.03     | (6)<br>PR650           |
|  |         | Ry                                   |                  | 0.354 |               |                   |                        |
|  | Green   | Gx                                   |                  | 0.304 |               |                   |                        |
|  |         | Gy                                   |                  | 0.581 |               |                   |                        |
|  | Blue    | Bx                                   |                  | 0.143 |               |                   |                        |
|  |         | By                                   |                  | 0.102 |               |                   |                        |
|  | White   | Wx                                   |                  | 0.310 |               |                   |                        |
|  |         | Wy                                   |                  | 0.330 |               |                   |                        |
| Viewing<br>Angle                         | Hor.    | $\theta$ L                           | 70               | 85    | -             | Degrees           | (7)<br>EZ-<br>Contrast |
|  |         | $\theta$ R                           | 70               | 85    | -             |                   |                        |
|  | Ver.    | $\phi$ H                             | 70               | 85    | -             |                   |                        |
|  |         | $\phi$ L                             | 70               | 85    | -             |                   |                        |
| Brightness<br>Uniformity<br>(9 points)   | Buni    |                                      | -                | -     | 25            | %                 | (8)<br>BM-5A           |

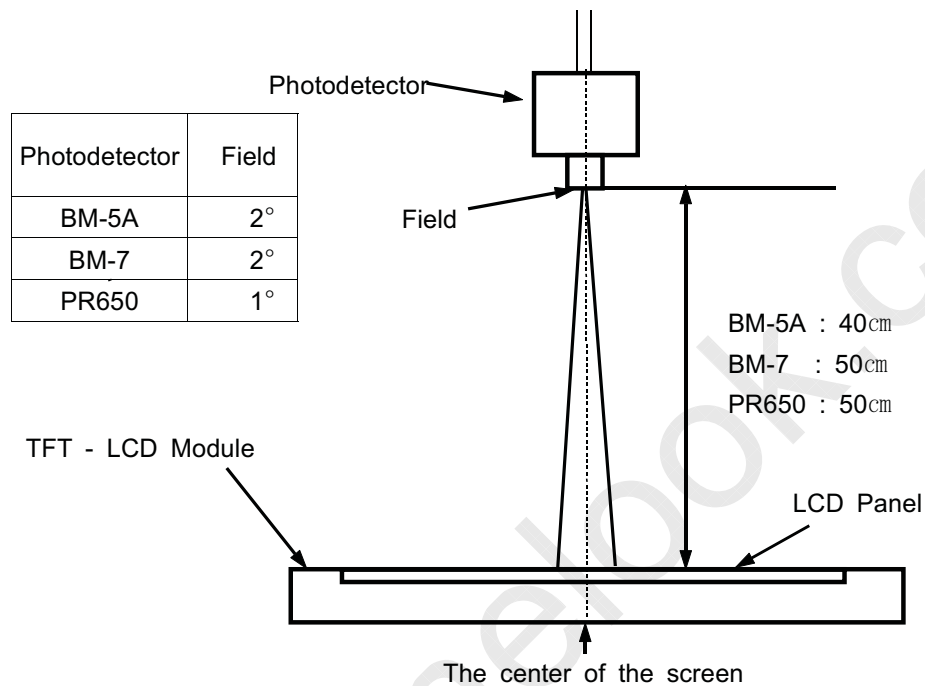
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## Note 1) Test Equipment Setup

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.

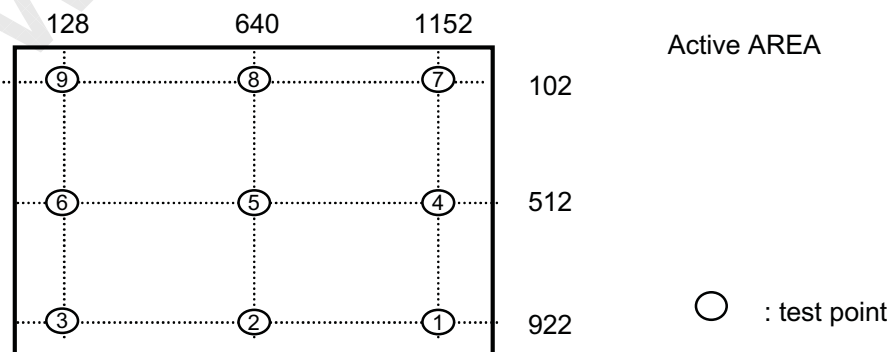
Single lamp current : 6.5mA (Refer to the note(1) in the page 11 for more information.)

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



Optical Measuring Equipment Setup

## Note 2) Definition of test point





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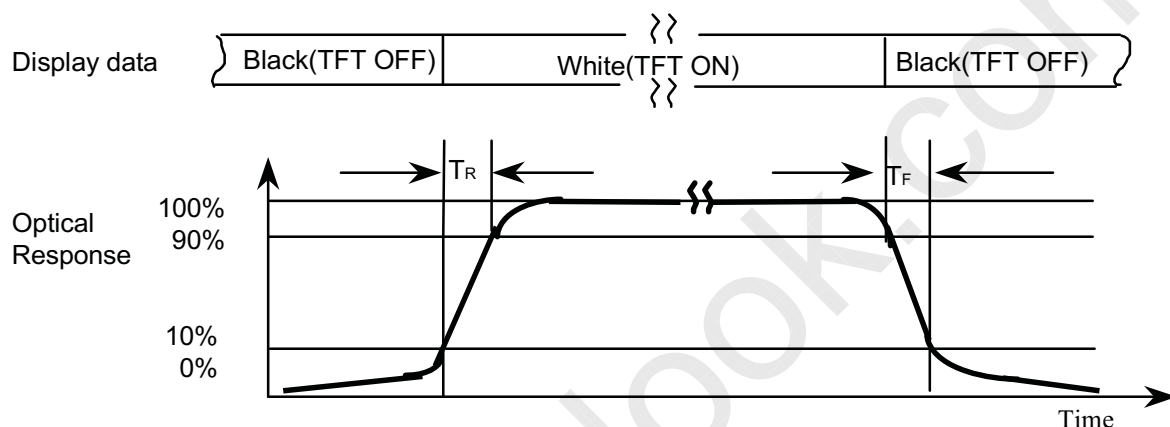
Note 3) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point(5) of the panel

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

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

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

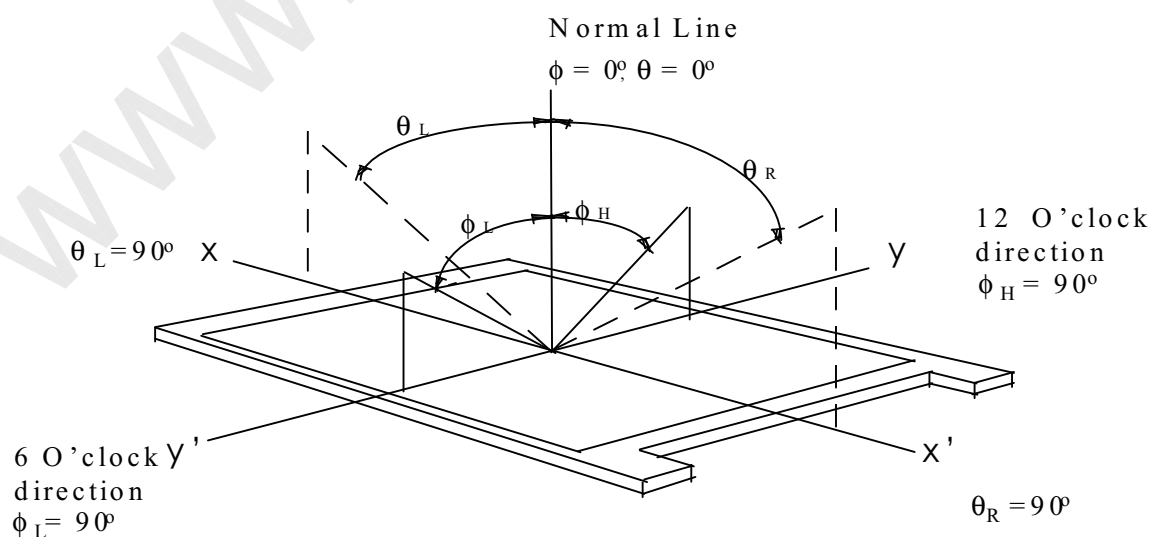


Note 5) Definition of Luminance of White : Luminance of white at center point(5).

Note 6) Definition of Color Chromaticity (CIE 1931)

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

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



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Note 8) Definition of 9 points brightness uniformity

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

Bmax : Maximum brightness

Bmin : Minimum brightness

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### 3. Electrical Characteristics

#### 3.1 TFT LCD MODULE

Ta = 25°C

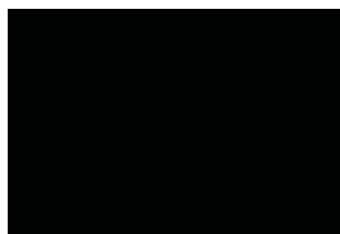
| Item                    | Symbol             | Min.             | Typ. | Max.          | Unit | Note    |
|-------------------------|--------------------|------------------|------|---------------|------|---------|
| Voltage of Power Supply | V <sub>DD</sub>    | 4.5              | 5.0  | 5.5           | V    | (1)     |
| Interface type          | LVDS               | DS90C383/385/387 |      | DS90C386 Pair |      |         |
| Current of Power Supply | (a)Black           | -                | 700  | 900           | mA   | (2),(3) |
|                         | (b)Mosaic          | -                | 700  | 900           | mA   |         |
|                         | (c)2 Line Vertical | -                | 800  | 1000          | mA   |         |
|                         | (d)White           | -                | 800  | 1000          | mA   |         |
| Vsync Frequency         | f <sub>V</sub>     | 59               | 60   | 61            | Hz   |         |
| Hsync Frequency         | f <sub>H</sub>     | 61               | 64   | 65            | kHz  |         |
| Main Frequency          | f <sub>DCLK</sub>  | 40               | 54   | 55            | MHz  |         |
| Rush Current            | I <sub>RUSH</sub>  | -                | -    | 4.0           | A    | (4)     |

Note (1) f<sub>V</sub>=60Hz, f<sub>DCLK</sub> =54MHz, V<sub>DD</sub> = 5.0V, DC Current.

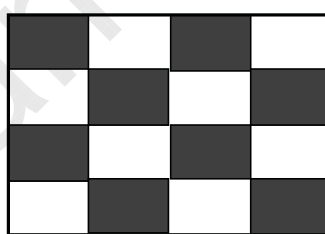
(2) Main pixel clock frequency is the value which is measured at the input of LVDS transmitter.

(3) Power dissipation check pattern(LCD Module only)

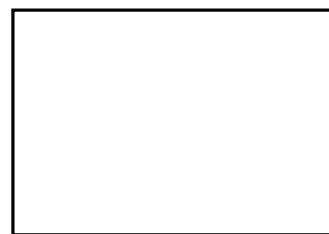
a)Black Pattern



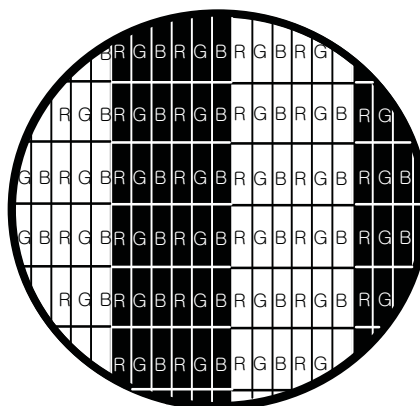
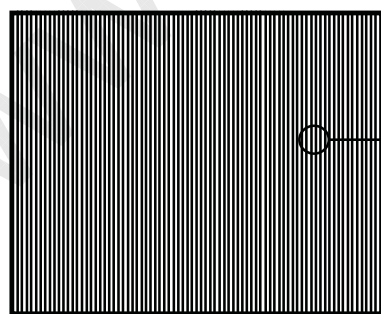
b)Mosaic Pattern



d)White Pattern

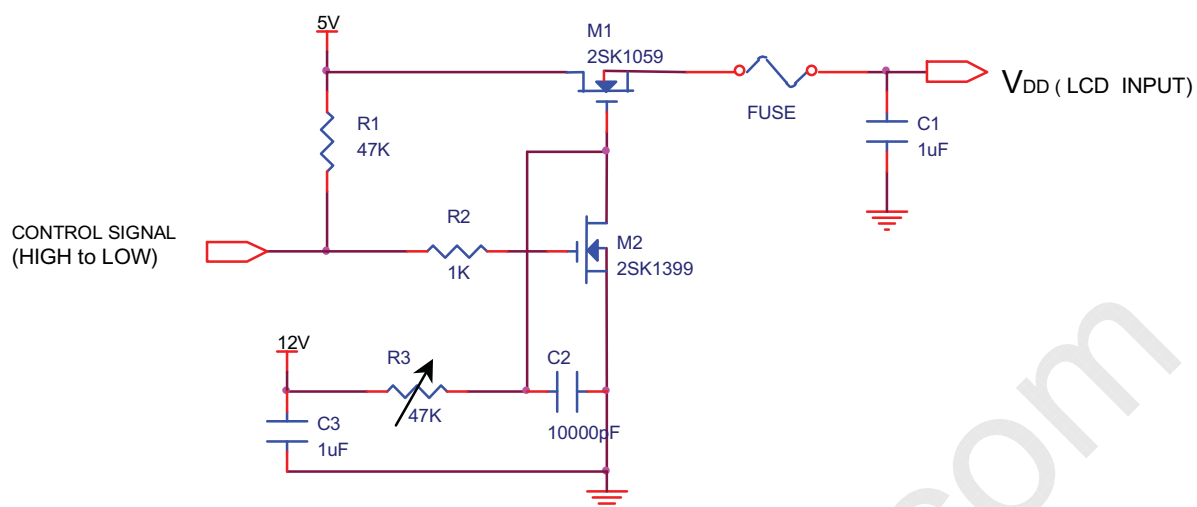


\*c) 2line Vertical stripe pattern



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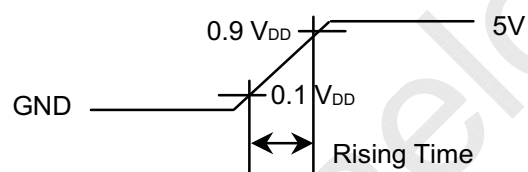
## (4) Measurement Conditions



Note : Control Signal : High(+5V) -->Low(Ground)

All Signal lines to panel except for power 5V : Ground

The rising time of supplied voltage is controlled to 470us by R3 and C2 value.



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## 3.2 BACK-LIGHT UNIT

The back-light system is an edge - lighting type with 2 dual CCFTs ( Cold Cathode Fluorescent Tube ) The characteristics of two dual lamps are shown in the following tables.

Ta=25 ± 2°C

| Item                | Symbol | Min.   | Typ. | Max.       | Unit  | Note    |
|---------------------|--------|--------|------|------------|-------|---------|
| Lamp Current        | IL     | 3.0    | 6.5  | 7.0        | mArms | (1)     |
| Lamp Voltage        | VL     | -      | 720  | -          | Vrms  |         |
| Lamp Frequency      | fL     | 40     | -    | 60         | kHz   | (2)     |
| Operating life time | T      | 50,000 | -    | -          | hr    | (3)     |
| Startup Voltage     | Vs     | -      | -    | 1260(25°C) | Vrms  | (4),(5) |
|                     |        |        |      | 1760(0°C)  |       |         |

**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.**

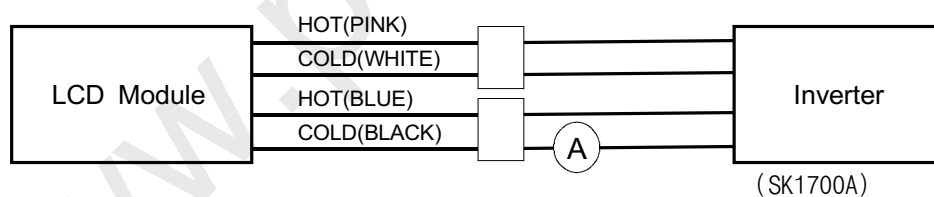
The performance of the back-light, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

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(miss lighting, flicker, etc.) 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 current meter for high frequency 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 may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency shall be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

(3) Operating condition is lamp unit itself, not module assembly and operating current is 6.5mA.

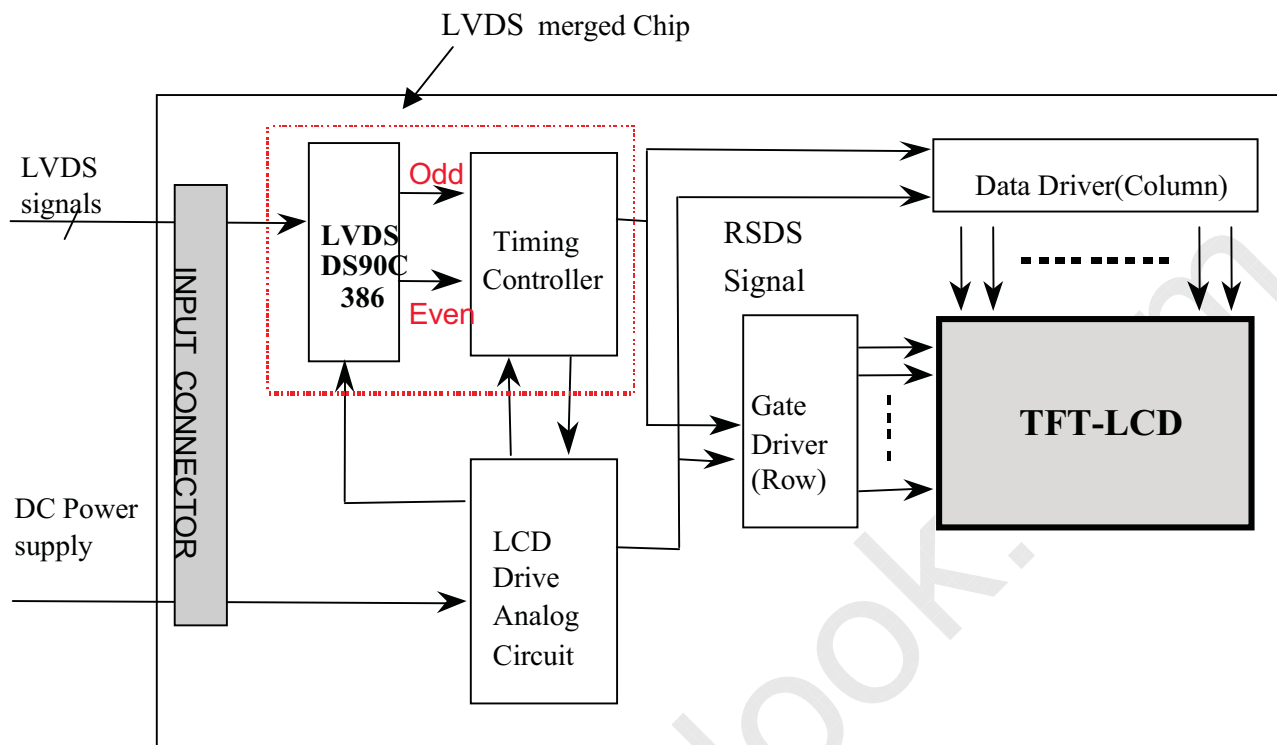
(4) If an inverter has shutdown function it should keep its output for more than 1 second even if the lamp connector open. Otherwise the lamps may not to be turned on.

(5) Inverter use high voltage. It should be disconnected power, before Inverter is assembled or disassembled.

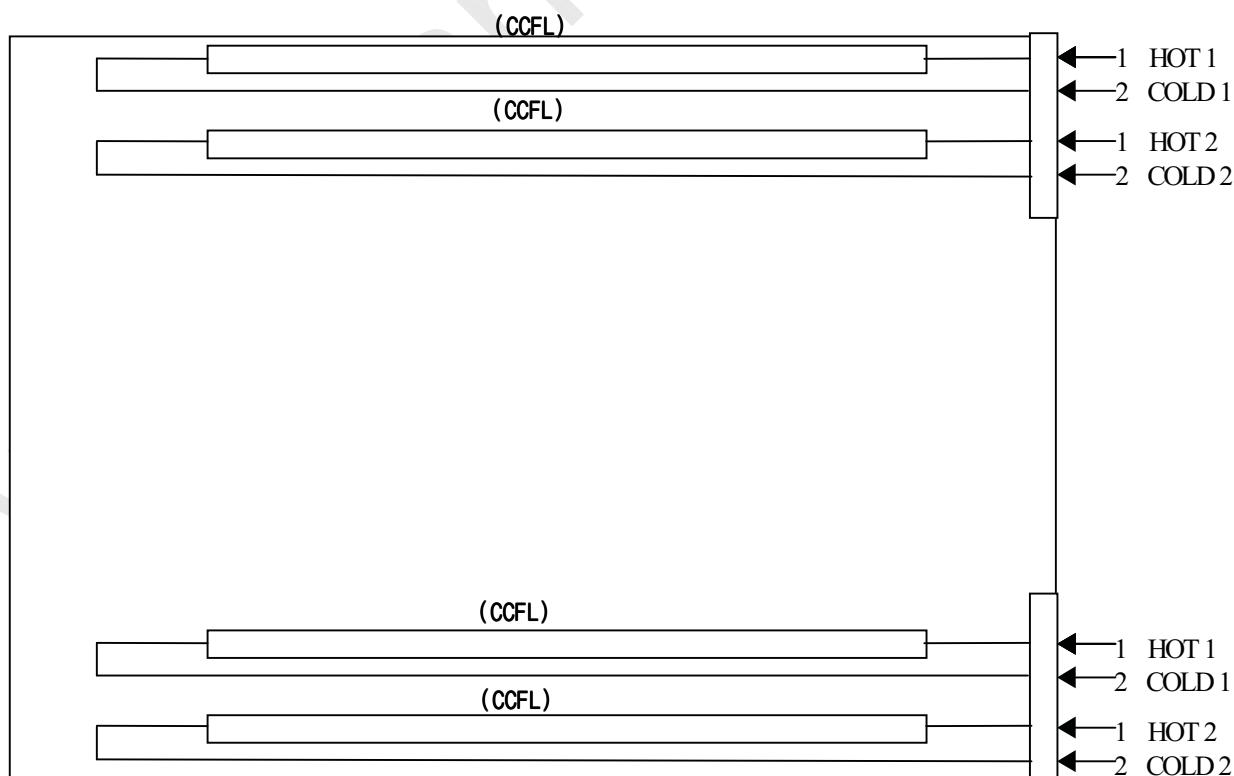
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### 4. Block Diagram

#### 4.1 TFT LCD MODULE



#### 4.2 BACK-LIGHT UNIT



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## 5. Input Terminal Pin Assignment

### 5.1. Input Signal & Power ( Connector : JAE FI-X30S-HF )

| PIN NO | SYMBOL          | FUNCTION  |
|--------|-----------------|---|
| 1      | RX00-           | Negative Transmission Data of Pixel 0 (ODD data)  |
| 2      | RX00+           | Positive Transmission Data of Pixel 0 (ODD data)  |
| 3      | RX01-           | Negative Transmission Data of Pixel 1 (ODD data)  |
| 4      | RX01+           | Positive Transmission Data of Pixel 1 (ODD data)  |
| 5      | RX02-           | Negative Transmission Data of Pixel 2 (ODD data)  |
| 6      | RX02+           | Positive Transmission Data of Pixel 2 (ODD data)  |
| 7      | GND             | Power Ground                                      |
| 8      | RXOC-           | Negative Sampling Clock (ODD data)                |
| 9      | RXOC+           | Positive Sampling Clock (ODD data)                |
| 10     | RX03-           | Negative Transmission Data of Pixel 3 (ODD data)  |
| 11     | RX03+           | Positive Transmission Data of Pixel 3 (ODD data)  |
| 12     | RXE0-           | Negative Transmission Data of Pixel 0 (EVEN data) |
| 13     | RXE0+           | Positive Transmission Data of Pixel 0 (EVEN data) |
| 14     | GND             | Power Ground                                      |
| 15     | RXE1-           | Negative Transmission Data of Pixel 1 (EVEN data) |
| 16     | RXE1+           | Positive Transmission Data of Pixel 1 (EVEN data) |
| 17     | GND             | Power Ground                                      |
| 18     | RXE2-           | Negative Transmission Data of Pixel 2 (EVEN data) |
| 19     | RXE2+           | Positive Transmission Data of Pixel 2 (EVEN data) |
| 20     | RXEC-           | Negative Sampling Clock (EVEN data)               |
| 21     | RXEC+           | Positive Sampling Clock (EVEN data)               |
| 22     | RXE3-           | Negative Transmission Data of Pixel 3 (EVEN data) |
| 23     | RXE3+           | Positive Transmission Data of Pixel 3 (EVEN data) |
| 24     | GND             | Power Ground                                      |
| 25     | NC              | No Connection                                     |
| 26     | DE              | DE Out  |
| 27     | NC              | No Connection                                     |
| 28     | V <sub>DD</sub> | Power Supply : +5V                                |
| 29     |                 |   |
| 30     |                 |   |

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## 5.2 LVDS Interface(1)

## 5.2.1 Odd pixel data (1st pixel data)

| 1st LVDS Transmitter ( <i>DS90C383</i> , <i>DS90C385</i> ) Signal Interface |        |                     |                            |                    |                                 |                |
|---|--------|---------------------|----------------------------|--------------------|---------------------------------|----------------|
| Device Input Pin  |        | Device Input Signal |                            | Output Signal      | To LTM190E1 Interface ( CN101 ) |                |
| No  | Symbol | Symbol              | Function                   |                    | Terminal                        | Symbol         |
| 51  | TXIN0  | RO0                 | Red Odd Pixel Data (LSB)   | TXOUT0-<br>TXOUT0+ | No. 1<br>No. 2                  | RXO0-<br>RXO0+ |
| 52  | TXIN1  | RO1                 | Red Odd Pixel Data         |                    |                                 |                |
| 54  | TXIN2  | RO2                 | Red Odd Pixel Data         |                    |                                 |                |
| 55  | TXIN3  | RO3                 | Red Odd Pixel Data         |                    |                                 |                |
| 56  | TXIN4  | RO4                 | Red Odd Pixel Data         |                    |                                 |                |
| 2   | TXIN5  | RO7                 | Red Odd Pixel Data (MSB)   | TXOUT3-<br>TXOUT3+ | No. 10<br>No. 11                | RXO3-<br>RXO3+ |
| 3   | TXIN6  | RO5                 | Red Odd Pixel Data         | TXOUT0-<br>TXOUT0+ | No. 1<br>No. 2                  | RXO0-<br>RXO0+ |
| 4   | TXIN7  | GO0                 | Green Odd Pixel Data (LSB) |                    |                                 |                |
| 6   | TXIN8  | GO1                 | Green Odd Pixel Data       | TXOUT1-<br>TXOUT1+ | No. 3<br>No. 4                  | RXO1-<br>RXO1+ |
| 7   | TXIN9  | GO2                 | Green Odd Pixel Data       |                    |                                 |                |
| 8   | TXIN10 | GO6                 | Green Odd Pixel Data       | TXOUT3-<br>TXOUT3+ | No. 10<br>No. 11                | RXO3-<br>RXO3+ |
| 10  | TXIN11 | GO7                 | Green Odd Pixel Data (MSB) |                    |                                 |                |
| 11  | TXIN12 | GO3                 | Green Odd Pixel Data       | TXOUT1-<br>TXOUT1+ | No. 3<br>No. 4                  | RXO1-<br>RXO1+ |
| 12  | TXIN13 | GO4                 | Green Odd Pixel Data       |                    |                                 |                |
| 14  | TXIN14 | GO5                 | Green Odd Pixel Data       |                    |                                 |                |
| 15  | TXIN15 | BO0                 | Blue Odd Pixel Data (LSB)  | TXOUT3-<br>TXOUT3+ | No. 10<br>No. 11                | RXO3-<br>RXO3+ |
| 16  | TXIN16 | BO6                 | Blue Odd Pixel Data        |                    |                                 |                |
| 18  | TXIN17 | BO7                 | Blue Odd Pixel Data (MSB)  |                    |                                 |                |
| 19  | TXIN18 | BO1                 | Blue Odd Pixel Data        | TXOUT1-<br>TXOUT1+ | No. 3<br>No. 4                  | RXO1-<br>RXO1+ |
| 20  | TXIN19 | BO2                 | Blue Odd Pixel Data        | TXOUT2-<br>TXOUT2+ | No. 5<br>No. 6                  | RXO2-<br>RXO2+ |
| 22  | TXIN20 | BO3                 | Blue Odd Pixel Data        |                    |                                 |                |
| 23  | TXIN21 | BO4                 | Blue Odd Pixel Data        |                    |                                 |                |
| 24  | TXIN22 | BO5                 | Blue Odd Pixel Data        |                    |                                 |                |
| 50  | TXIN27 | RO6                 | Red Odd Pixel Data         | TXOUT3-<br>TXOUT3+ | No. 10<br>No. 11                | RXO3-<br>RXO3+ |



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## 5.2.2 Even pixel data (2nd pixel data)

| 2nd LVDS Transmitter ( <i>DS90C383</i> , <i>DS90C385</i> ) Signal Interface |        |                     |                             |                    |                                 |                |
|---|--------|---------------------|-----------------------------|--------------------|---------------------------------|----------------|
| Device Input Pin  |        | Device Input Signal |                             | Output Signal      | To LTM190E1 Interface ( CN101 ) |                |
| No  | Symbol | Symbol              | Function                    |                    | Terminal                        | Symbol         |
| 51  | TXIN0  | RE0                 | Red Even Pixel Data (LSB)   | TXOUT0-<br>TXOUT0+ | No. 12<br>No. 13                | RXE0-<br>RXE0+ |
| 52  | TXIN1  | RE1                 | Red Even Pixel Data         |                    |                                 |                |
| 54  | TXIN2  | RE2                 | Red Even Pixel Data         |                    |                                 |                |
| 55  | TXIN3  | RE3                 | Red Even Pixel Data         |                    |                                 |                |
| 56  | TXIN4  | RE4                 | Red Even Pixel Data         |                    |                                 |                |
| 2   | TXIN5  | RE7                 | Red Even Pixel Data (MSB)   | TXOUT3-<br>TXOUT3+ | No. 22<br>No. 23                | RXE3-<br>RXE3+ |
| 3   | TXIN6  | RE5                 | Red Even Pixel Data         | TXOUT0-<br>TXOUT0+ | No. 12<br>No. 13                | RXE0-<br>RXE0+ |
| 4   | TXIN7  | GE0                 | Green Even Pixel Data (LSB) |                    |                                 |                |
| 6   | TXIN8  | GE1                 | Green Even Pixel Data       | TXOUT1-<br>TXOUT1+ | No. 15<br>No. 16                | RXE1-<br>RXE1+ |
| 7   | TXIN9  | GE2                 | Green Even Pixel Data       |                    |                                 |                |
| 8   | TXIN10 | GE6                 | Green Even Pixel Data       | TXOUT3-<br>TXOUT3+ | No. 22<br>No. 23                | RXE3-<br>RXE3+ |
| 10  | TXIN11 | GE7                 | Green Even Pixel Data (MSB) |                    |                                 |                |
| 11  | TXIN12 | GE3                 | Green Even Pixel Data       | TXOUT1-<br>TXOUT1+ | No. 15<br>No. 16                | RXE1-<br>RXE1+ |
| 12  | TXIN13 | GE4                 | Green Even Pixel Data       |                    |                                 |                |
| 14  | TXIN14 | GE5                 | Green Even Pixel Data       |                    |                                 |                |
| 15  | TXIN15 | BE0                 | Blue Even Pixel Data (LSB)  |                    |                                 |                |
| 16  | TXIN16 | BE6                 | Blue Even Pixel Data        | TXOUT3-<br>TXOUT3+ | No. 22<br>No. 23                | RXE3-<br>RXE3+ |
| 18  | TXIN17 | BE7                 | Blue Even Pixel Data (MSB)  |                    |                                 |                |
| 19  | TXIN18 | BE1                 | Blue Even Pixel Data        | TXOUT1-<br>TXOUT1+ | No. 15<br>No. 16                | RXE1-<br>RXE1+ |
| 20  | TXIN19 | BE2                 | Blue Even Pixel Data        |                    |                                 |                |
| 22  | TXIN20 | BE3                 | Blue Even Pixel Data        | TXOUT2-<br>TXOUT2+ | No. 18<br>No. 19                | RXE2-<br>RXE2+ |
| 23  | TXIN21 | BE4                 | Blue Even Pixel Data        |                    |                                 |                |
| 24  | TXIN22 | BE5                 | Blue Even Pixel Data        |                    |                                 |                |
| 50  | TXIN27 | RE6                 | Red Even Pixel Data         | TXOUT3-<br>TXOUT3+ | No. 22<br>No. 23                | RXE3-<br>RXE3+ |

Approval

## 5.3 LVDS Interface (2)

## 5.3.1 Odd pixel data (1st pixel data)

| LVDS Transmitter ( <b>DS90C387</b> ) Signal Interface |        |                     |                            |               |                                 |                |
|---|--------|---------------------|----------------------------|---------------|---------------------------------|----------------|
| Device Input Pin                                      |        | Device Input Signal |                            | Output Signal | To LTM190E1 Interface ( CN101 ) |                |
| No  | Symbol | Symbol              | Function                   |               | Terminal                        | Symbol         |
| 10  | R10    | RO0                 | Red Odd Pixel Data (LSB)   | A0M<br>A0P    | No. 1<br>No. 2                  | RXO0-<br>RXO0+ |
| 9   | R11    | RO1                 | Red Odd Pixel Data         |               |                                 |                |
| 8   | R12    | RO2                 | Red Odd Pixel Data         |               |                                 |                |
| 7   | R13    | RO3                 | Red Odd Pixel Data         |               |                                 |                |
| 6   | R14    | RO4                 | Red Odd Pixel Data         |               |                                 |                |
| 3   | R17    | RO7                 | Red Odd Pixel Data (MSB)   | A3M<br>A3P    | No. 10<br>No. 11                | RXO3-<br>RXO3+ |
| 5   | R15    | RO5                 | Red Odd Pixel Data         | A0M<br>A0P    | No. 1<br>No. 2                  | RXO0-<br>RXO0+ |
| 2   | G10    | GO0                 | Green Odd Pixel Data (LSB) |               |                                 |                |
| 1   | G11    | GO1                 | Green Odd Pixel Data       | A1M<br>A1P    | No. 3<br>No. 4                  | RXO1-<br>RXO1+ |
| 100   | G12    | GO2                 | Green Odd Pixel Data       |               |                                 |                |
| 94  | G16    | GO6                 | Green Odd Pixel Data       | A3M<br>A3P    | No. 10<br>No. 11                | RXO3-<br>RXO3+ |
| 93  | G17    | GO7                 | Green Odd Pixel Data (MSB) |               |                                 |                |
| 99  | G13    | GO3                 | Green Odd Pixel Data       | A1M<br>A1P    | No. 3<br>No. 4                  | RXO1-<br>RXO1+ |
| 96  | G14    | GO4                 | Green Odd Pixel Data       |               |                                 |                |
| 95  | G15    | GO5                 | Green Odd Pixel Data       |               |                                 |                |
| 92  | B10    | BO0                 | Blue Odd Pixel Data (LSB)  | A3M<br>A3P    | No. 10<br>No. 11                | RXO3-<br>RXO3+ |
| 86  | B16    | BO6                 | Blue Odd Pixel Data        |               |                                 |                |
| 85  | B17    | BO7                 | Blue Odd Pixel Data (MSB)  | A1M<br>A1P    | No. 3<br>No. 4                  | RXO1-<br>RXO1+ |
| 91  | B11    | BO1                 | Blue Odd Pixel Data        |               |                                 |                |
| 90  | B12    | BO2                 | Blue Odd Pixel Data        | A2M<br>A2P    | No. 5<br>No. 6                  | RXO2-<br>RXO2+ |
| 89  | B13    | BO3                 | Blue Odd Pixel Data        |               |                                 |                |
| 88  | B14    | BO4                 | Blue Odd Pixel Data        |               |                                 |                |
| 87  | B15    | BO5                 | Blue Odd Pixel Data        | A3M<br>A3P    | No. 10<br>No. 11                | RXO3-<br>RXO3+ |
| 4   | R16    | RO6                 | Red Odd Pixel Data         |               |                                 |                |

Approval

## 5.3.2 Even pixel data (2nd pixel data)

| LVDS Transmitter ( <i>DS90C387</i> ) Signal Interface |        |                     |                             |               |                                 |                |
|---|--------|---------------------|-----------------------------|---------------|---------------------------------|----------------|
| Device Input Pin                                      |        | Device Input Signal |                             | Output Signal | To LTM190E1 Interface ( CN101 ) |                |
| No  | Symbol | Symbol              | Function                    |               | Terminal                        | Symbol         |
| 84  | R20    | RE0                 | Red Even Pixel Data (LSB)   | A4M<br>A4P    | No. 12                          | RXE0-<br>RXE0+ |
| 81  | R21    | RE1                 | Red Even Pixel Data         |               |                                 |                |
| 80  | R22    | RE2                 | Red Even Pixel Data         |               |                                 |                |
| 79  | R23    | RE3                 | Red Even Pixel Data         |               |                                 |                |
| 78  | R24    | RE4                 | Red Even Pixel Data         |               |                                 |                |
| 75  | R27    | RE7                 | Red Even Pixel Data (MSB)   | A7M<br>A7P    | No. 22<br>No. 23                | RXE3-<br>RXE3+ |
| 77  | R25    | RE5                 | Red Even Pixel Data         | A4M<br>A4P    | No. 12<br>No. 13                | RXE0-<br>RXE0+ |
| 74  | G20    | GE0                 | Green Even Pixel Data (LSB) |               |                                 |                |
| 73  | G21    | GE1                 | Green Even Pixel Data       | A5M<br>A5P    | No. 15<br>No. 16                | RXE1-<br>RXE1+ |
| 72  | G22    | GE2                 | Green Even Pixel Data       |               |                                 |                |
| 66  | G26    | GE6                 | Green Even Pixel Data       | A7M<br>A7P    | No. 22<br>No. 23                | RXE3-<br>RXE3+ |
| 65  | G27    | GE7                 | Green Even Pixel Data (MSB) |               |                                 |                |
| 71  | G23    | GE3                 | Green Even Pixel Data       | A5M<br>A5P    | No. 15<br>No. 16                | RXE1-<br>RXE1+ |
| 70  | G24    | GE4                 | Green Even Pixel Data       |               |                                 |                |
| 69  | G25    | GE5                 | Green Even Pixel Data       |               |                                 |                |
| 64  | B20    | BE0                 | Blue Even Pixel Data (LSB)  | A7M<br>A7P    | No. 22<br>No. 23                | RXE3-<br>RXE3+ |
| 58  | B26    | BE6                 | Blue Even Pixel Data        |               |                                 |                |
| 57  | B27    | BE7                 | Blue Even Pixel Data (MSB)  | A5M<br>A5P    | No. 15<br>No. 16                | RXE1-<br>RXE1+ |
| 63  | B21    | BE1                 | Blue Even Pixel Data        |               |                                 |                |
| 62  | B22    | BE2                 | Blue Even Pixel Data        |               |                                 |                |
| 61  | B23    | BE3                 | Blue Even Pixel Data        | A6M<br>A6P    | No. 18<br>No. 19                | RXE2-<br>RXE2+ |
| 60  | B24    | BE4                 | Blue Even Pixel Data        |               |                                 |                |
| 59  | B25    | BE5                 | Blue Even Pixel Data        | A7M<br>A7P    | No. 22<br>No. 23                | RXE3-<br>RXE3+ |
| 76  | R26    | RE6                 | Red Even Pixel Data         |               |                                 |                |

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## 5.4 BACK-LIGHT UNIT

| Pin No.               | Input [ch1] ,[ch2] | Color | Fucntion     |
|-----------------------|--------------------|-------|--------------|
| 1                     | Hot1               | Pink  | High Voltage |
| 2                     | Cold1              | White | Ground       |
| 3                     | Hot2               | Blue  | High Voltage |
| 4                     | Cold2              | Black | Ground       |
| Connector<br>Part No. | JST BHSR-02VS-1    |       |              |

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## 5.5 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  | 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 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 ↑              | 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  | R1      |
|                    |                     | 0           | 1  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0                | 0  | 0  | 0  | R2      |
|                    |                     | :           | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :                | :  | :  | :  | R3~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  | 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    |
|                    |                     | 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 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  | 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 ↓            |                     | 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    |
|                    |                     | 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 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  | 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~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  | 1  | B253    |
|                    |                     | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 1  | 1  | 1  | 1  | 1                | 1  | 1  | 1  | B254    |
|                    |                     | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 1  | 1  | 1  | 1  | 1  | 1                | 1  | 1  | 1  | B255    |

Note) Definition of Gray :

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

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

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## 6. Interface Timing

### 6.1 Timing Parameters ( DE only mode )

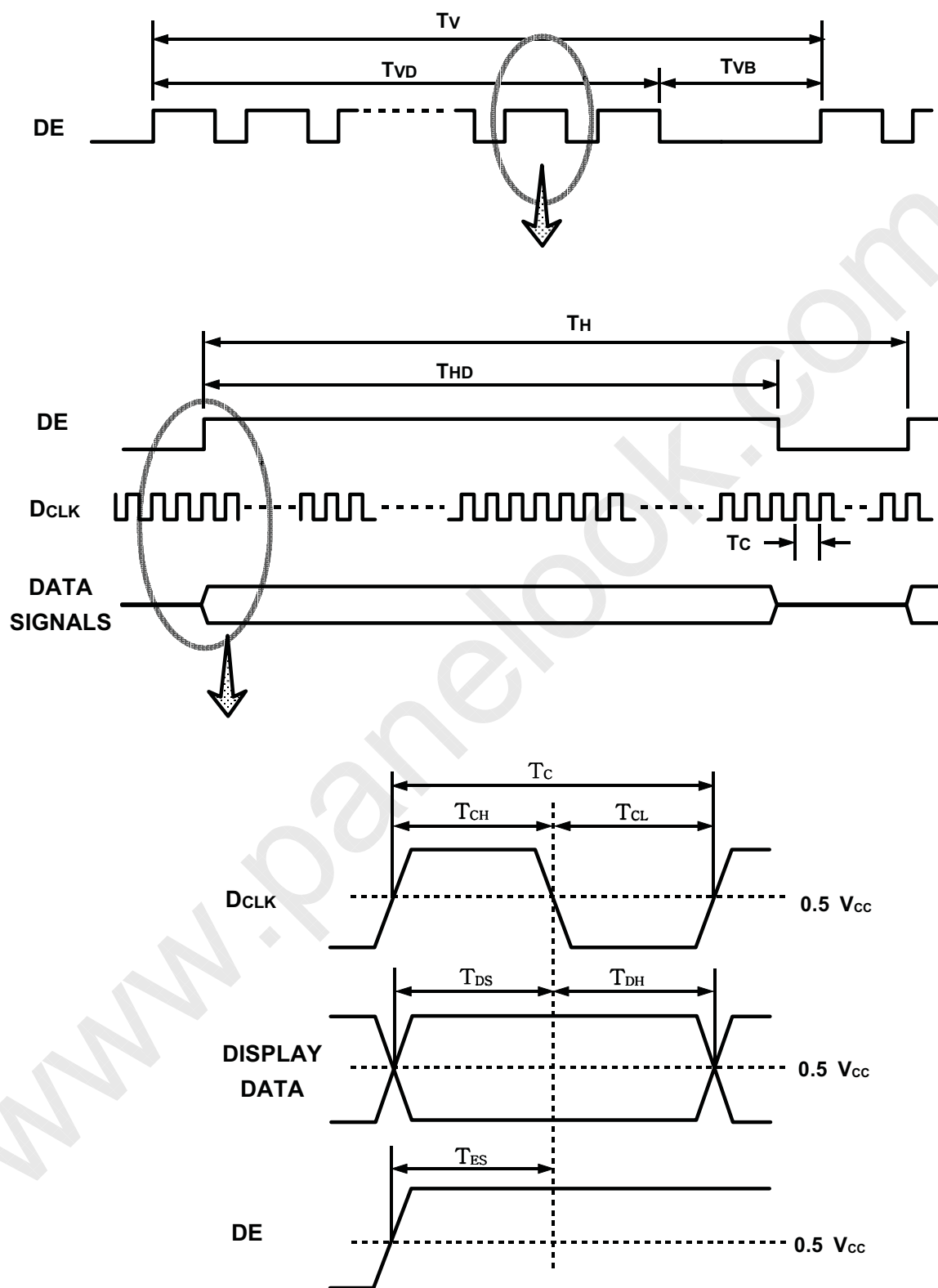
| Signal                            | Item                     | Symbol | Min. | Typ. | Max. | Unit   | Note |
|-----------------------------------|--------------------------|--------|------|------|------|--------|------|
| Clock                             | Frequency                | 1/TC   | 40   | 54   | 55   | MHz    | (2)  |
|                                   | Hgh Time                 | TCH    | 4    | -    | -    | nsec   |      |
|                                   | Low Time                 | TCL    | 4    | -    | -    | nsec   |      |
| Data                              | Setup Time               | TDS    | 4    | -    | -    | nsec   | (1)  |
|                                   | Hold Time                | TDH    | 4    | -    | -    | nsec   |      |
| Data Enable                       | Setup Time               | TES    | 4    | -    | -    | nsec   | (1)  |
| Frame Frequency                   | Cycle                    | TV     | 16.9 | 16.7 | 16.3 | msec   |      |
|                                   |                          |        | 59   | 60   | 61   | Hz     |      |
|                                   |                          |        | 1032 | 1066 | 1066 | lines  |      |
| Vertical Active<br>Disply Term    | Display Period           | TVD    | 1024 | 1024 | 1024 | lines  |      |
|                                   | Verticle Blank<br>Period | TVB    | 8    | -    | -    | lines  |      |
| One Line<br>Scanning Time         | Cycle                    | TH     | 672  | -    | 844  | clocks |      |
| Horizontal Active<br>Display Term | Display Period           | THD    | 640  | 640  | 640  | clocks |      |

Note (1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

(2) Internal Vcc = 3.3V

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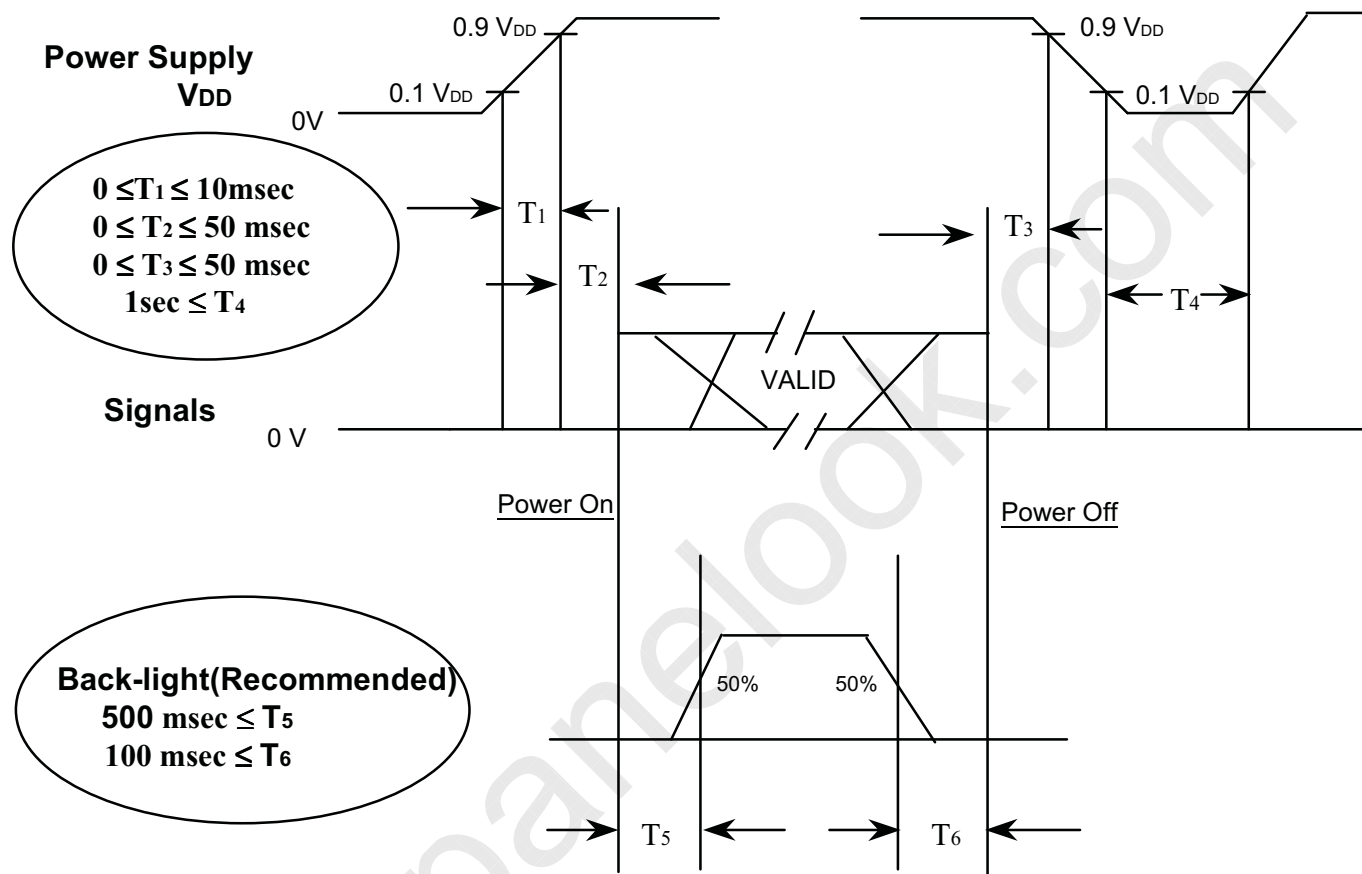
## 6.2 Timing diagrams of interface signal ( DE only mode )



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## 6.3 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.



Power ON/OFF Sequence

## NOTE.

- (1) The supply voltage of the external system for the module input should be the same as the definition of VDD.
- (2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily become abnormal screen.
- (3) In case of VDD = off level, please keep the level of input signals on the low or keep a high impedance.
- (4) T<sub>4</sub> should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.





## **7. Outline Dimension**

( Refer to next page )

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## 8. Reliability Test

| Test Items                   | Conditions   | Time/Cycle       | Sample |
|------------------------------|--|------------------|--------|
| HTOL*                        | 50°C , Bias  | 500 hrs          | 12     |
| LTOL*                        | 0°C , Bias   | 500 hrs          | 5      |
| THB**                        | 40°C / 95% , Bias  | 500 hrs          | 5      |
| HTS***                       | 70°C , No Bias   | 500 hrs          | 5      |
| LTS***                       | -30°C , No Bias  | 500 hrs          | 5      |
| Thermal Cycle                | 0°C/30min ~ +50°C/30min , Bias   | 10 cycle         | 5      |
| Box Drop                     | 1 angle , 3 edge , 6 side , 10 cm  |                  | 5      |
| Shock<br>(Non-operatine)     | 50G , 11msec<br>Sine wave , ± x/y/z axis   | 1 time/axis      | 3      |
| Vibration<br>(Non-operating) | 1.5G , 10~300 Hz<br>x/y/z axis , sweep rate : 10 min                                   | 30min/axis       | 3      |
| ESD<br>(Non-Operating)       | contact : 150pF , 330 ohm ,9point<br>Air : 150pF , 330 ohm ,9point<br>* oprating : TBD | ± 10kV<br>± 20kV | 3<br>3 |

## [ 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

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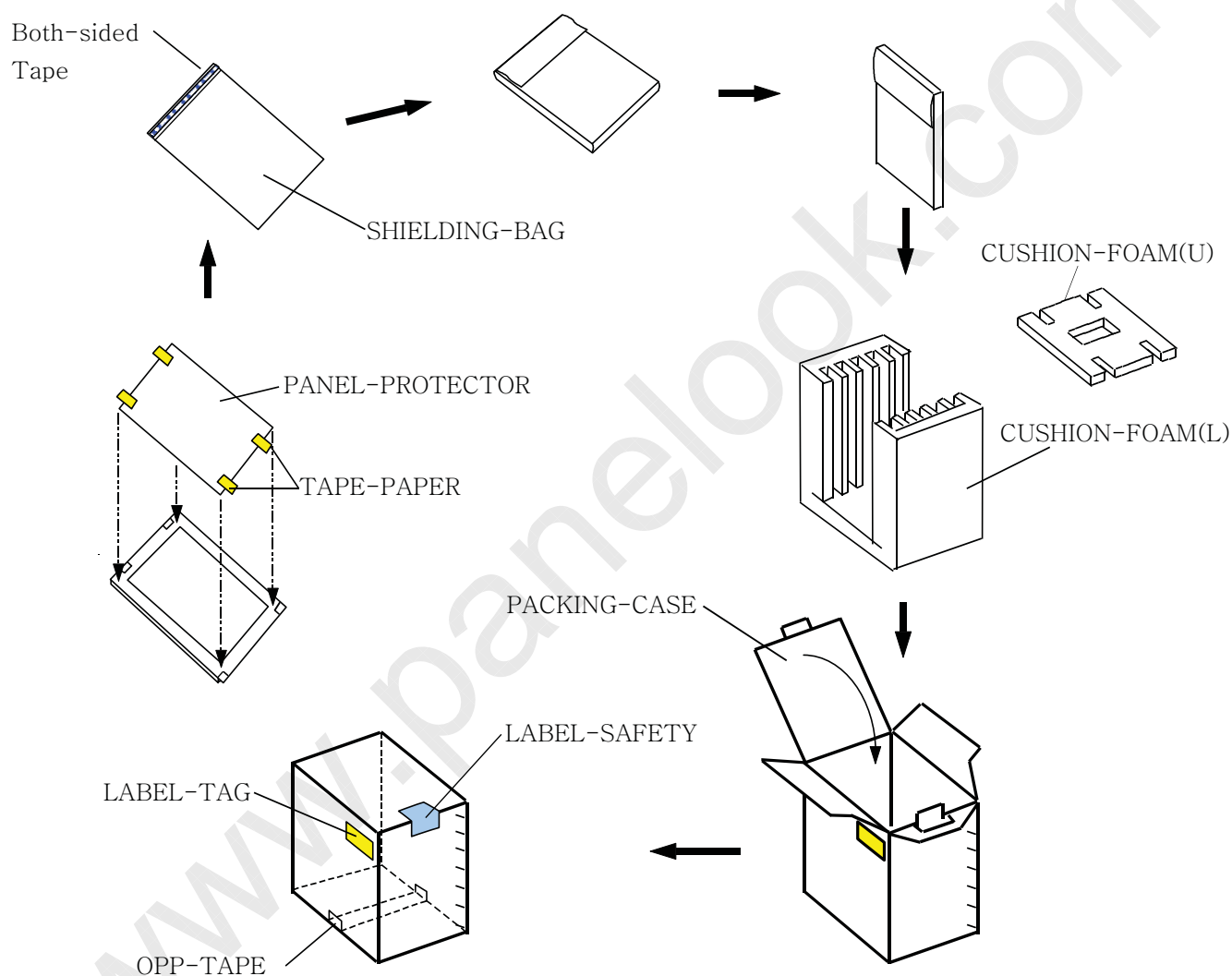
## 9. Packing

### 9.1 CARTON(Internal Packing)

#### (1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber.

#### (2) Packing Method



- Note
- 1) Total : Approx. 16.0kg
  - 2) Acceptance number of piling : 5 sets
  - 3) Carton size : 401(W) X 365(D) X 477(H)
  - 4) Max accumulation quantity : 5 cartons

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### (3) Packing Material

| No | Part Name   | Quantity |
|----|---|----------|
| 1  | Static electric protective sack                     | 5pcs     |
| 2  | Packing case(inner box)<br>including shock absorber | 1set     |
| 3  | Pictorial marking                                   | 2pics    |
| 4  | Carton  | 1set     |

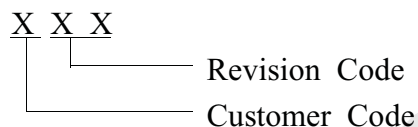
## 10. Marking & Others

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

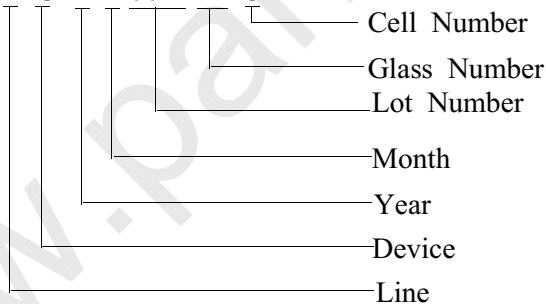
(1)Parts number : LTM190E1-L01-XXX

(2)Revision : Two letter

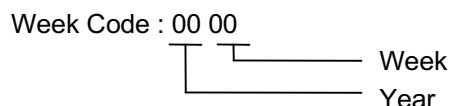
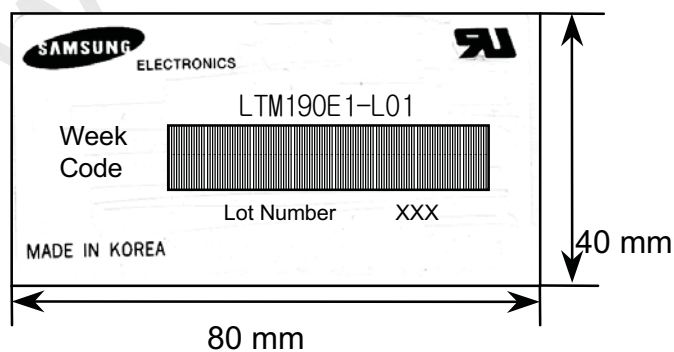
(3)Control Code : One letter



(4)Lot number : 4 G 2 D001 11 C

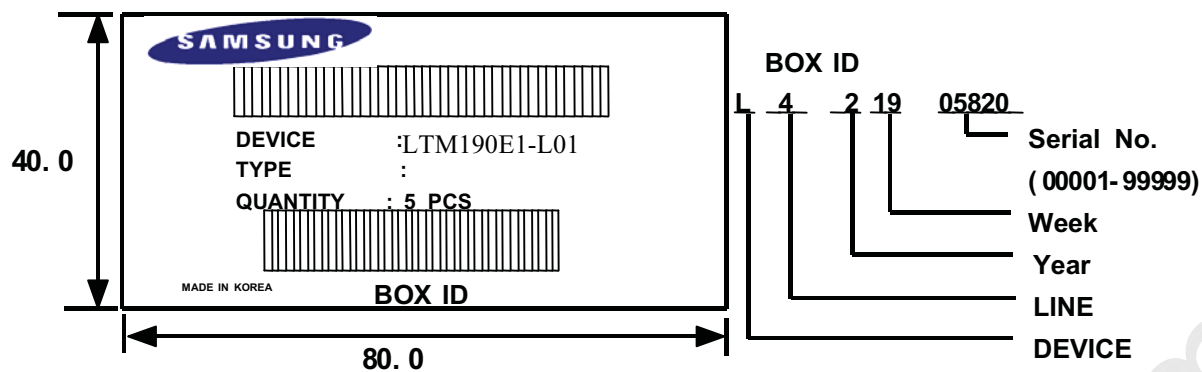


### (5) Nameplate Indication



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(6) Packing box attach



(7) Others

1.After service part

| Part Name     | Description                      |
|---------------|----------------------------------|
| ASS'Y-LAMP(U) | LTM190E1-L01,D2.6,L362,4PIN,L150 |
| ASS'Y-LAMP(L) | LTM190E1-L01,D2.6,L362,4PIN,L150 |

## 11. Inspection Criteria

When products are shipped, incoming inspection shall be carried out with a sampling inspection based on MIL-STD-105E level II by AQL 1.0%.

### CHANGE CONTROL

Design changes may be made for this product related to the specifications, appearance, parts used, circuits, etc., for the purpose of product improvement.

If a design change is judged to affect the specifications of this product, supplier shall inform customer of the change in advance.

### QUALITY CONTROL

In the event of a product failure under normal operating conditions, and in the event of product trouble or a functional disorder that can be deemed to be the responsibility of supplier, supplier shall repair the fault or replace the product free of charge within one year of the product delivery date.

However, supplier shall not bear responsibility for the quality of a product in the case of modifications other than those specified by supplier.

### MAINTENANCE

The specifications of the functions of maintenance parts may be partially changed with in a range which provides for equivalent or better quality. Maintenance parts shall in principle be product units.

If manufacture of this product is stopped, supplier shall notify customer in advance.

### HANDLING OF DOUBTFUL POINTS

If any doubt arises concerning a matter not stipulated in this specification, the matter is to be resolved by mutual agreement between customer and supplier, and supplier shall make efforts for improvement in good faith.

## 12. General Precautions

### 12.1 Handling

- (a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.
- (b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT back-light.
- (c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.
- (d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.
- (e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (f) The desirable cleaners are water, IPA(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 CMOS Gate Array IC.
- (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 pull or fold the lamp wire.
- (l) Do not adjust the variable resistor which is located on the module.
- (m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (n) Pins of I/F connector shall not be touched directly with bare hands.



# Approval

## 12.2 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 35C 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.

## 12.3 Operation

- (a) Do not connect,disconnect the module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the item 6.3 "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.
- (d) The cable between the back-light connector and its inverter power supply shall be a minimized length and be connected directly . The longer cable between the back-light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).


## 12.4 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. ( the 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 period of time,it can be the situation when the image "Sticks" to the screen.
- (e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

# Cosmetic Outgoing Inspection Specification

## (190E1-L01 SXGA Monitor TFT LCD )

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Samsung 

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Group

**LCD TCS Group**  
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Cosmetic Outgoing Inspection Specification(Rev.0) 2001-07-06



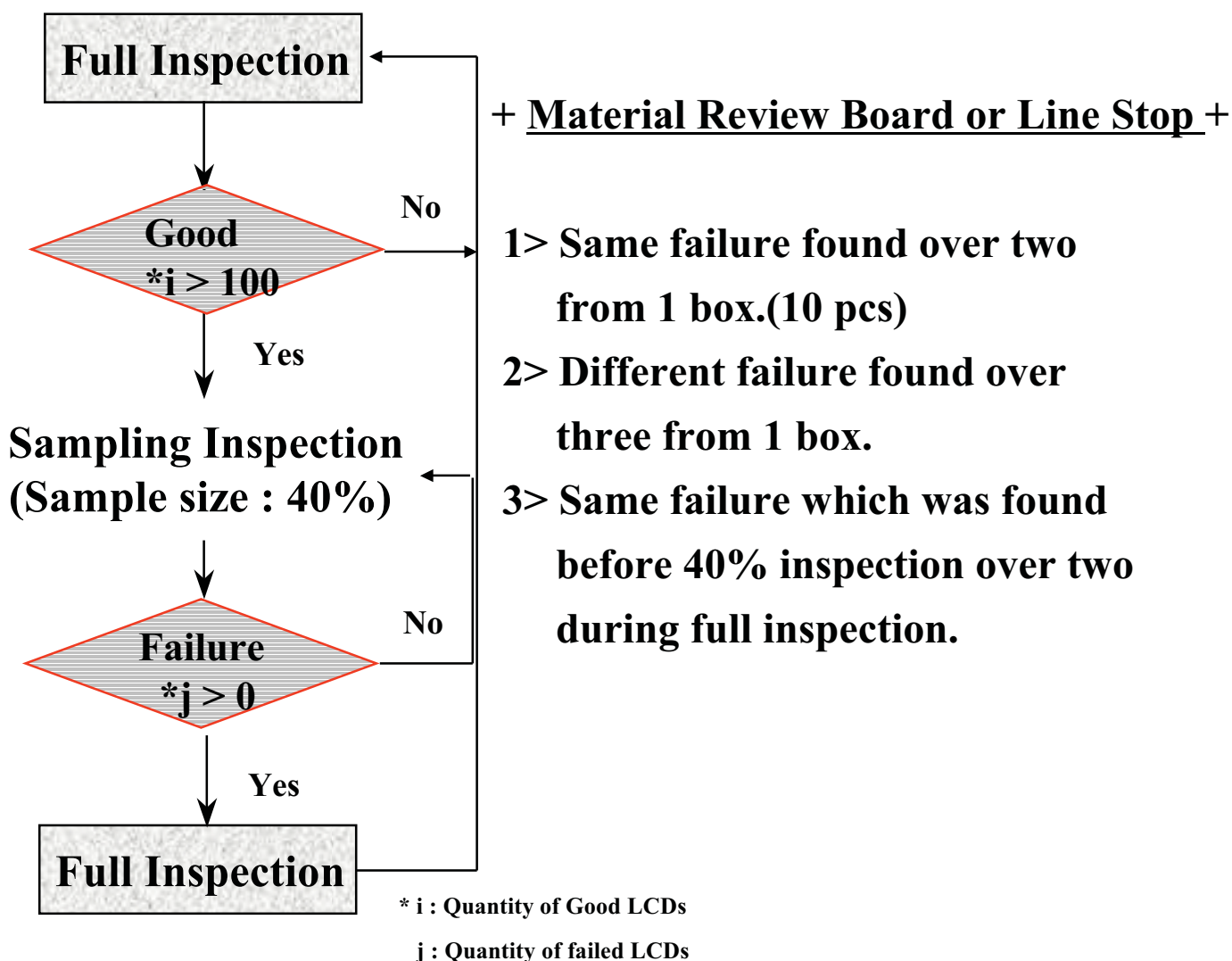
# 1. Outgoing Inspection

## 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>     | 35 ~ 50 cm   |
| <i>ambient illumination</i> | 300 ~ 700 Lux (nominal 500 Lux)  |
| <i>ambient temperature</i>  | 25 + - 5 '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>      | Pure R, G, B, Black and White  |
| <i>inspection area</i>      | active area  |

#### 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

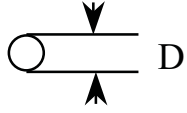
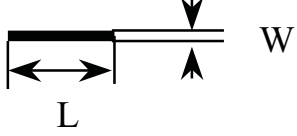
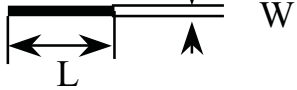
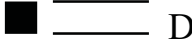
## 1.2.2 Mechanical Inspection

|                               |   |
|-------------------------------|---|
| <i>Chassis Gap</i>            | max. 0.7mm  |
| <i>Silicone Gasket (Glue)</i> | silicone material shall not be exposed beyond the metal frame edge into the view area |
| <i>Light Leakage</i>          | 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 (foreign material, Stain, Dust)</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>$0.3 < L \leq 2.0$<br>$N \leq 4$ | $W > 0.08$<br>$L > 2.0$ |
| <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>                                     | $D \leq 0.8$<br>$N \leq 6$                               | $D > 0.8$               |
| <i>Maximum allowable number of defects</i>  | $N \leq 10$  | $N > 10$                |

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

## 1.2.4 Electrical Inspection

| Defect Type                                       | Accept               | Reject               |
|---|----------------------|----------------------|
| <i>Bright dot (Fig. 1)</i>                        |                      |                      |
| <i>random</i>                                     | N ≤ 3<br>(green ≤ 2) | N > 3<br>(green > 2) |
| <i>two adjacent</i>                               | N ≤ 1                | N > 1                |
| <i>three adjacent</i>                             | N ≤ 0                | N > 0                |
| <i>Dark dot, (Fig. 2)</i>                         |                      |                      |
| <i>random</i>                                     | N ≤ 7                | N > 7                |
| <i>two adjacent</i>                               | N ≤ 2                | N > 2                |
| <i>three adjacent</i>                             | N ≤ 1                | N > 1                |
| <i>Maximum allowable number of dot defect</i>     | N ≤ 7                | N > 7                |
| <i>Minimum distance between defects, (Fig. 3)</i> |                      |                      |
| <i>bright dot - to - bright dot</i>               | L ⇒ 15mm             | L < 15mm             |
| <i>dark dot - to - dark dot</i>                   | L ⇒ 5mm              | L < 5mm              |

[ L : length, N : count ]

### Definitions/ Notes;

- A bright dot any Red, Green, or Blue pixel suck in the “On” mode.
- A dark dot any Red, Green, or Blue pixel suck in the “Off” mode.

Fig. 1. Bright dot defect description

【two adjacent】

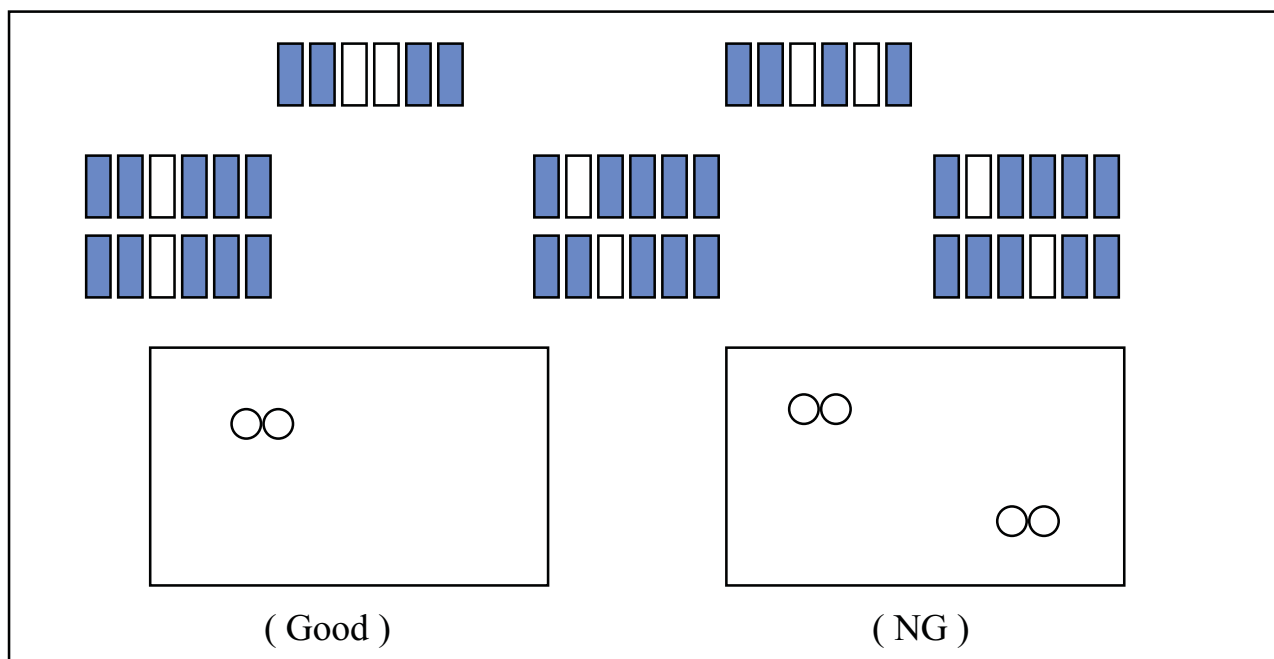


Fig. 2. Dark dot defect description

【two adjacent】

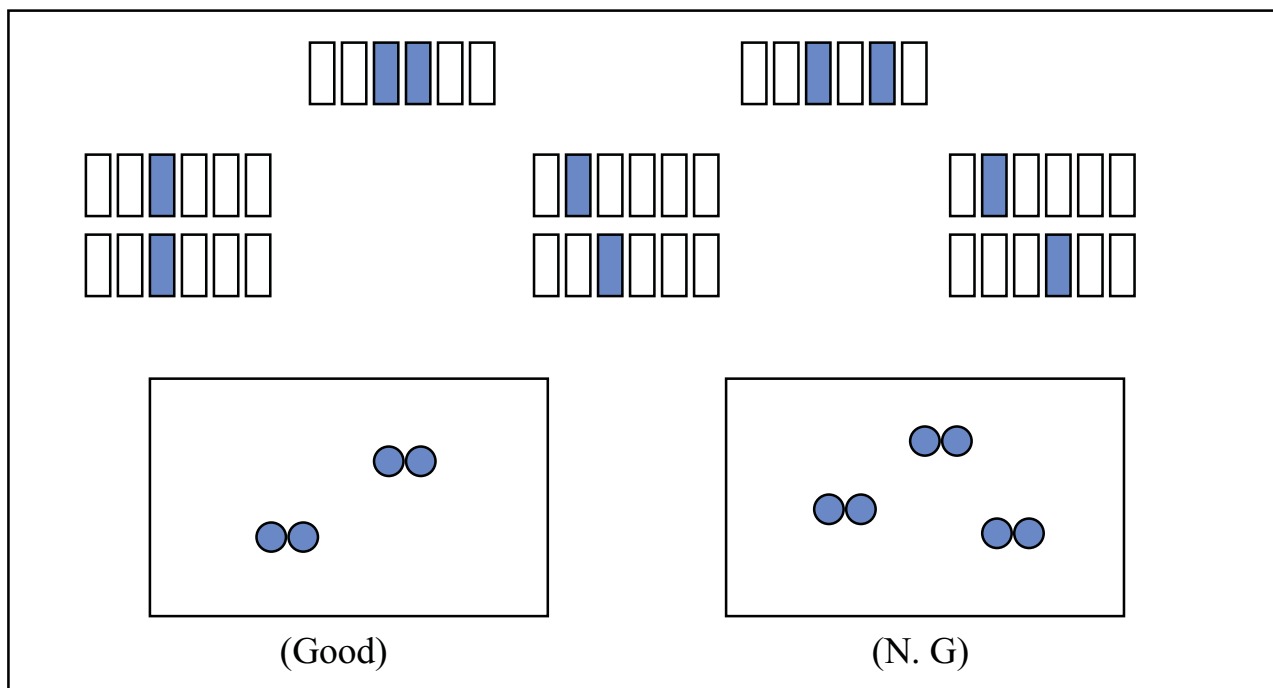


Fig. 2. Dark dot defect description

【three adjacent】

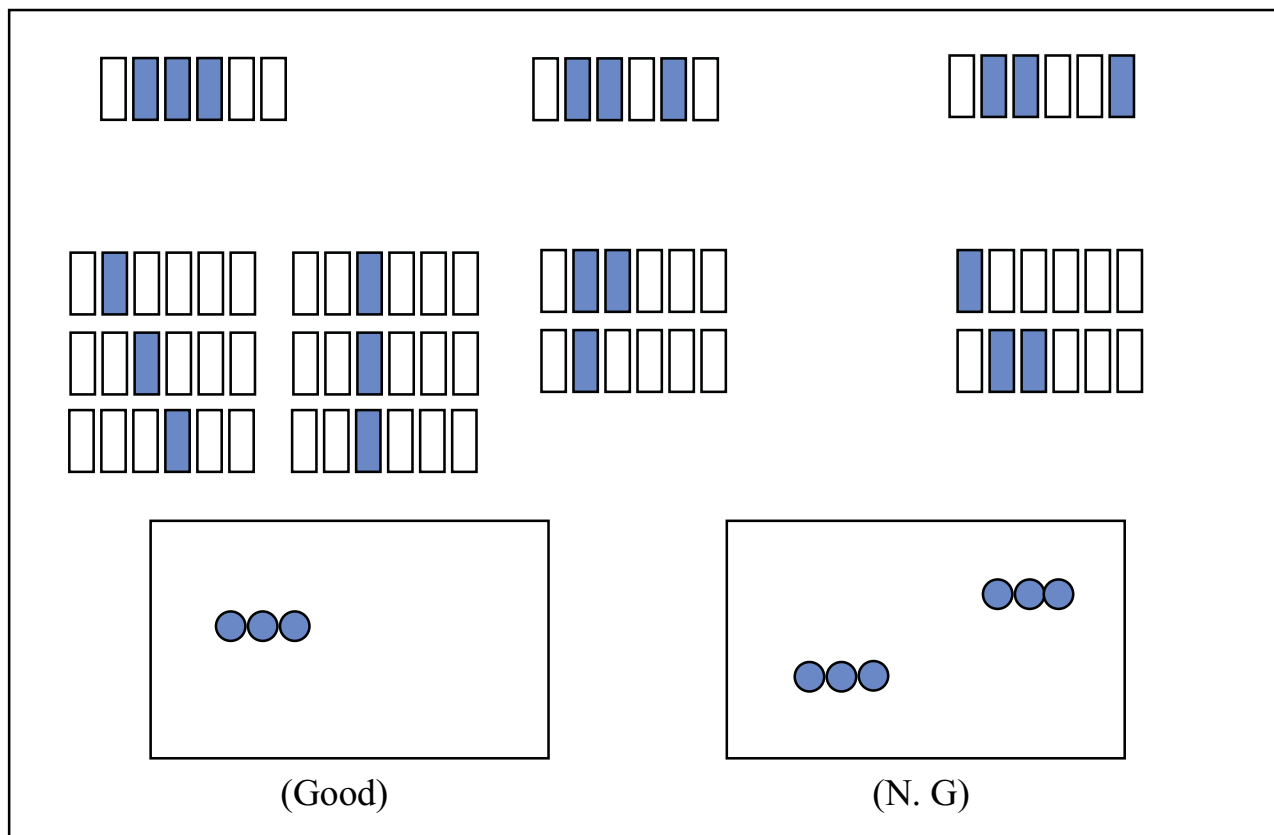
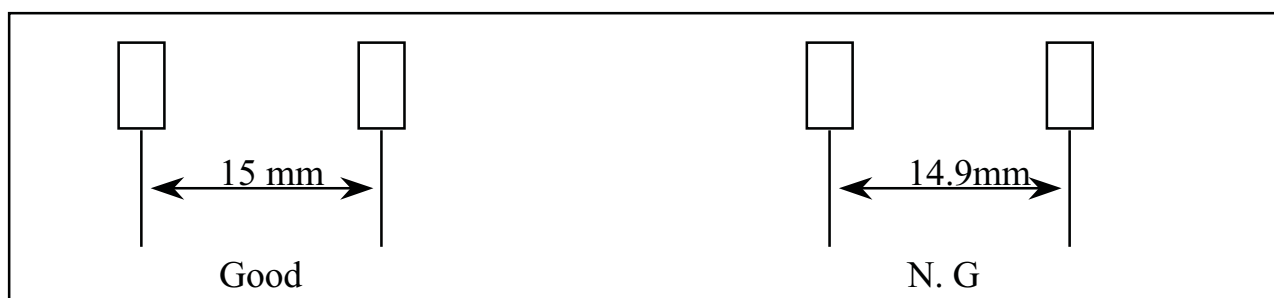


Fig. 3. Minimum distance between dot defects

【bright dot - to - bright dot】



【dark dot - to - dark dot】

