

**SAMSUNG**

**ELECTRONICS**

Approval

TO : Apple-Compal

DATE : Oct. 31, 2003

**SAMSUNG TFT-LCD**

**MODEL NO. : LTN152W5-L02**

NOTE :

Any Modification of Spec is not allowed without SEC' permission

APPROVED BY :

*K. H. Shin*

PREPARED BY : Technical Customer Service Team

**SAMSUNG ELECTRONICS CO., LTD.**

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Doc.No.

LTN152W5-L02

Rev.No

04-000-G-031031

Page

1 / 24

## CONTENTS

|                                                                       |              |
|-----------------------------------------------------------------------|--------------|
| Revision History                                                      | ----- ( 3 )  |
| General Description                                                   | ----- ( 4 )  |
| 1. Absolute Maximum Ratings                                           | ----- ( 5 )  |
| 1.1 Absolute Ratings of environment                                   |              |
| 1.2 Electrical Absolute Ratings                                       |              |
| 2. Optical Characteristics                                            | ----- ( 7 )  |
| 3. Electrical Characteristics                                         | ----- ( 10 ) |
| 3.1 TFT LCD Module                                                    |              |
| 3.2 Backlight Unit                                                    |              |
| 4. Block Diagram                                                      | ----- ( 13 ) |
| 4.1 TFT LCD Module                                                    |              |
| 4.2 Backlight Unit                                                    |              |
| 5. Input Terminal Pin Assignment                                      | ----- ( 14 ) |
| 5.1 Input Signal & Power                                              |              |
| 5.2 LVDS Interface                                                    |              |
| 5.3 Backlight Unit                                                    |              |
| 5.4 Timing Diagrams of LVDS For Transmitting                          |              |
| 5.5 Input Signals, Basic Display Colors and Gray Scale of Each Color. |              |
| 5.6 Pixel format                                                      |              |
| 6. Interface Timing                                                   | ----- ( 19 ) |
| 6.1 Timing Parameters                                                 |              |
| 6.2 Timing Diagrams of interface Signal                               |              |
| 6.3 Power ON/OFF Sequence                                             |              |
| 7. Outline Dimension                                                  | ----- ( 21 ) |
| 8. Packing                                                            | ----- ( 22 ) |
| 9. Markings & Others                                                  |              |
| 10. General Precaution                                                |              |

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## REVISION HISTORY

Approval

| Date         | Rev.No. | Page | Summary                                     |
|--------------|---------|------|---------------------------------------------|
| Oct.31, 2003 | 000     | All  | Approval SPEC of LTN152W5 was first issued. |

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|                |              |               |                 |             |        |
|----------------|--------------|---------------|-----------------|-------------|--------|
| <b>Doc.No.</b> | LTN152W5-L02 | <b>Rev.No</b> | 04-000-G-031031 | <b>Page</b> | 3 / 24 |
|----------------|--------------|---------------|-----------------|-------------|--------|

## GENERAL DESCRIPTION

### DESCRIPTION

LTN152W5-L02 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight system. The resolution of a 15.2" contains 1,280 x 854 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
- XGA ((1280x854) pixels) resolution
- Low power consumption
- DE (Data enable) only mode.
- 3.3V LVDS (FPD Link) Interface with 1 pixel / clock

### APPLICATIONS

- Notebook PC and desktop monitors
- Display terminals for AV application products
- If the usage of this product is not for PC application, but for others, please contact SEC

## GENERAL INFORMATION

| ITEM              | SPECIFICATION                       | UNIT  | NOTE |
|-------------------|-------------------------------------|-------|------|
| Display area      | 320.64(H)X213.93(V) (15.2"diagonal) | mm    |      |
| Driver element    | a-si TFT active matrix              |       |      |
| Display colors    | 262,144                             |       |      |
| Number of pixel   | 1280 x 854                          | pixel |      |
| Pixel arrangement | RGB vertical stripe                 |       |      |
| Pixel pitch       | 0.2505(H) x 0.2505(V) (TYP.)        | mm    |      |
| Display Mode      | Normally white                      |       |      |
| Surface treatment | Haze 25, Hard-Coating 3H            |       |      |

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## Mechanical Information

| ITEM        |                | MIN.  | TYP.  | MAX.  | NOTE |
|-------------|----------------|-------|-------|-------|------|
| Module size | Horizontal (H) | 336.0 | 336.5 | 337.0 | mm   |
|             | Vertical (V)   | 227.0 | 227.5 | 228.0 | mm   |
|             | Depth (D)      |       | 5.7   | 6.0   | mm   |
| Weight      |                |       | 525   | 540   | g    |

## 1. ABSOLUTE MAXIMUM RATINGS

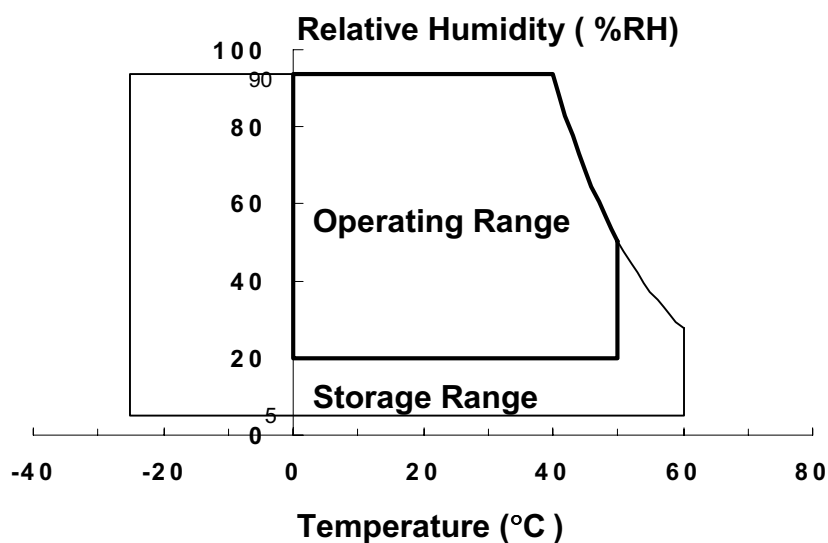
## 1.1 ENVIRONMENTAL ABSOLUTE RATINGS

| 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 )                                | $S_{nop}$ | -    | 220  | G    | (2),(4) |
| Vibration (nonoperating)                              | $V_{nop}$ | -    | 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) 2ms, half sine wave, one time for  $\pm X$ ,  $\pm Y$ ,  $\pm Z$ .

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

(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

 $V_{DD} = 3.3V, V_{SS} = GND = 0V$ 

| ITEM                 | SYMBOL   | MIN.           | MAX.           | UNIT | NOTE |
|----------------------|----------|----------------|----------------|------|------|
| Power Supply Voltage | $V_{DD}$ | $V_{SS} - 0.3$ | $V_{DD} + 0.3$ | V    |      |
| Logic Input Voltage  | $V_{IN}$ | $V_{SS} - 0.3$ | $V_{DD} + 0.3$ | V    |      |

Note 1) Within  $T_a = (25 \pm 2^\circ C)$

### (2) BACK-LIGHT UNIT

 $T_a = 25 \pm 2^\circ C$ 

| ITEM           | SYMBOL | MIN. | MAX. | UNIT  | NOTE |
|----------------|--------|------|------|-------|------|
| Lamp Current   | $I_L$  | 2.0  | 7.0  | mArms | (1)  |
| Lamp frequency | $F_L$  | 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 condition

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## 2. OPTICAL CHARACTERISTICS

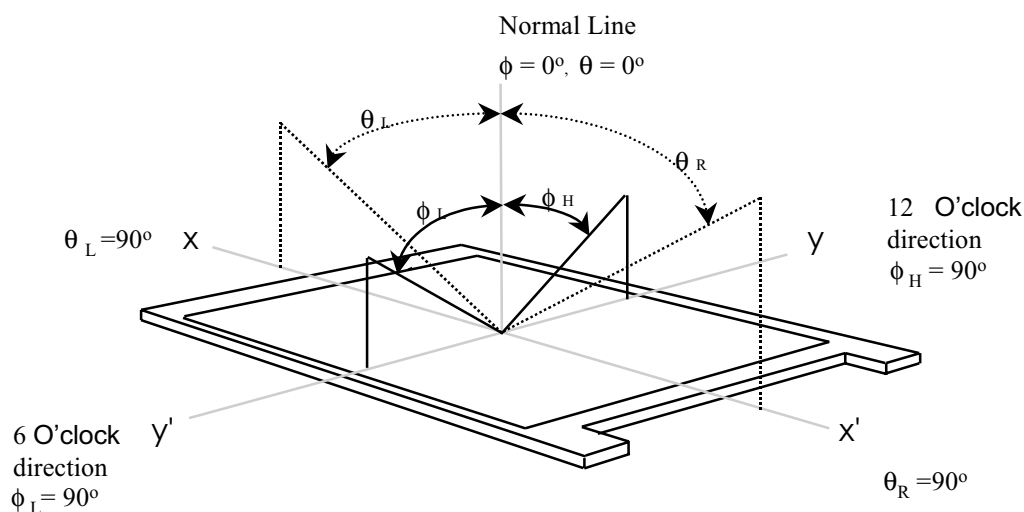
The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).  
Measuring equipment : TOPCON BM-5A and PR-650

\* Ta = 25 ± 2 °C, VDD=3.3V, fv= 60Hz, fdCLK=65MHz, ( IL = 5 mA)

| ITEM                                  |         | SYMBOL             | CONDITION                                               | MIN.  | TYP.  | MAX.  | UNIT              | NOTE                              |
|---------------------------------------|---------|--------------------|---------------------------------------------------------|-------|-------|-------|-------------------|-----------------------------------|
| Contrast Ratio<br>(5 Points)          |         | CR                 | $\phi = 0,$<br>$\theta = 0$<br><br>Normal Viewing Angle | 180   | 250   | -     |                   | (1), (2), (5)                     |
| Response Time at Ta                   | Rising  | T <sub>R</sub>     |                                                         | -     | 6     | 10    | msec              | (1), (3)                          |
|                                       | Falling | T <sub>F</sub>     |                                                         | -     | 25    | 30    |                   |                                   |
| Average Luminance of White (5 Points) |         | Y <sub>L,AVE</sub> |                                                         | 130   | 150   | -     | cd/m <sup>2</sup> | I <sub>L</sub> =5.5mA<br>(1), (4) |
| Color Chromaticity<br>( CIE )         | Red     | R <sub>X</sub>     |                                                         | 0.570 | 0.600 | 0.630 |                   | (1), (5)<br>PR-650                |
|                                       |         | R <sub>Y</sub>     |                                                         | 0.320 | 0.350 | 0.380 |                   |                                   |
|                                       | Green   | G <sub>X</sub>     |                                                         | 0.280 | 0.310 | 0.340 |                   |                                   |
|                                       |         | G <sub>Y</sub>     |                                                         | 0.520 | 0.550 | 0.580 |                   |                                   |
|                                       | Blue    | B <sub>X</sub>     |                                                         | 0.120 | 0.150 | 0.180 |                   |                                   |
|                                       |         | B <sub>Y</sub>     |                                                         | 0.085 | 0.115 | 0.145 |                   |                                   |
|                                       | White   | W <sub>X</sub>     |                                                         | 0.283 | 0.313 | 0.343 |                   |                                   |
|                                       |         | W <sub>Y</sub>     |                                                         | 0.299 | 0.329 | 0.359 |                   |                                   |
| Viewing Angle                         | Hor.    | $\theta_L$         | CR≥ 10                                                  | 60    | -     | -     | Degrees           |                                   |
|                                       |         | $\theta_R$         |                                                         | 60    | -     | -     |                   |                                   |
|                                       | Ver.    | $\phi_H$           |                                                         | 45    | -     | -     |                   |                                   |
|                                       |         | $\phi_L$           |                                                         | 50    | -     | -     |                   |                                   |
| 13 Points White Variation             |         | ΔL                 |                                                         | -     | -     | 1.7   |                   | (6)                               |

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Note 1) Definition of Viewing Angle : Viewing angle range( $10 \leq C/R$ )

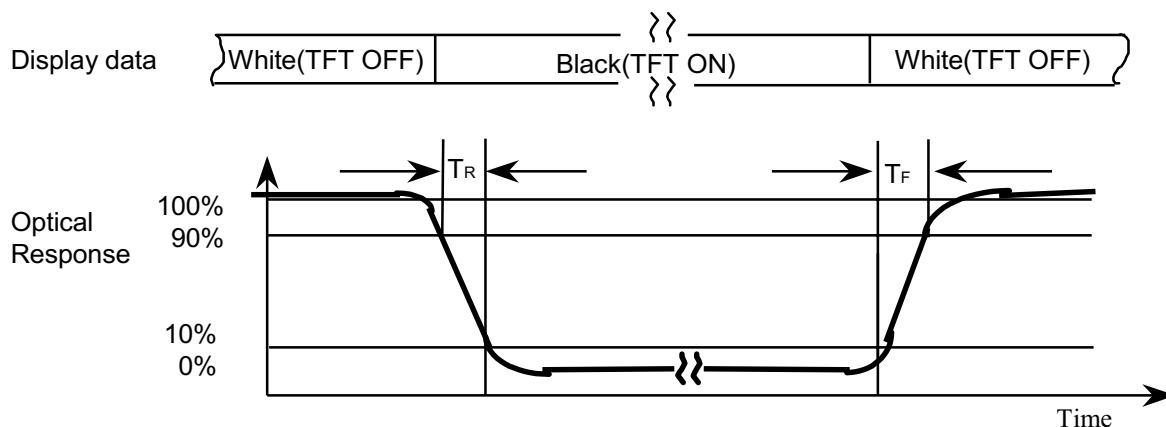


Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

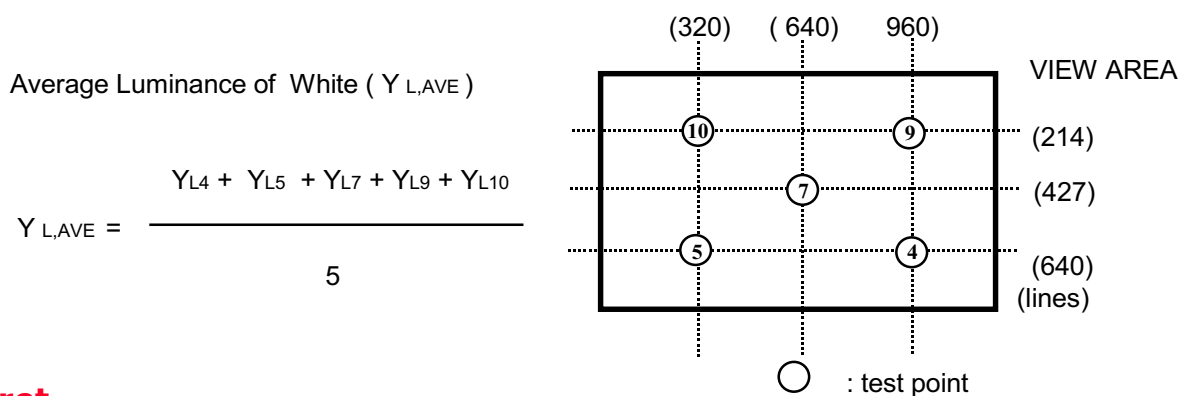
$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

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.

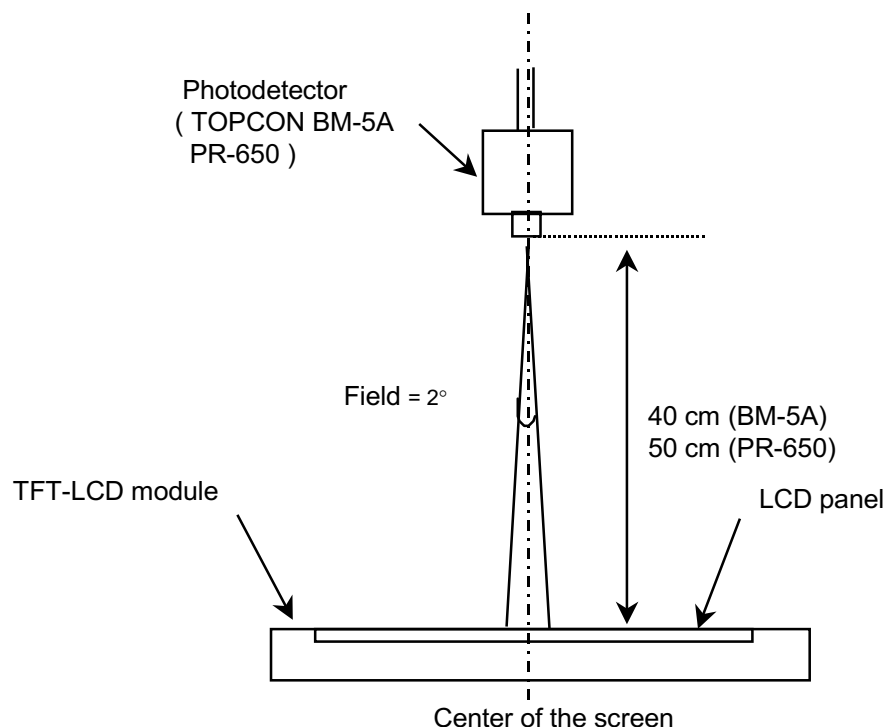


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Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the backlight. This should be measured in the center of screen.

Lamp current : 5.0mA

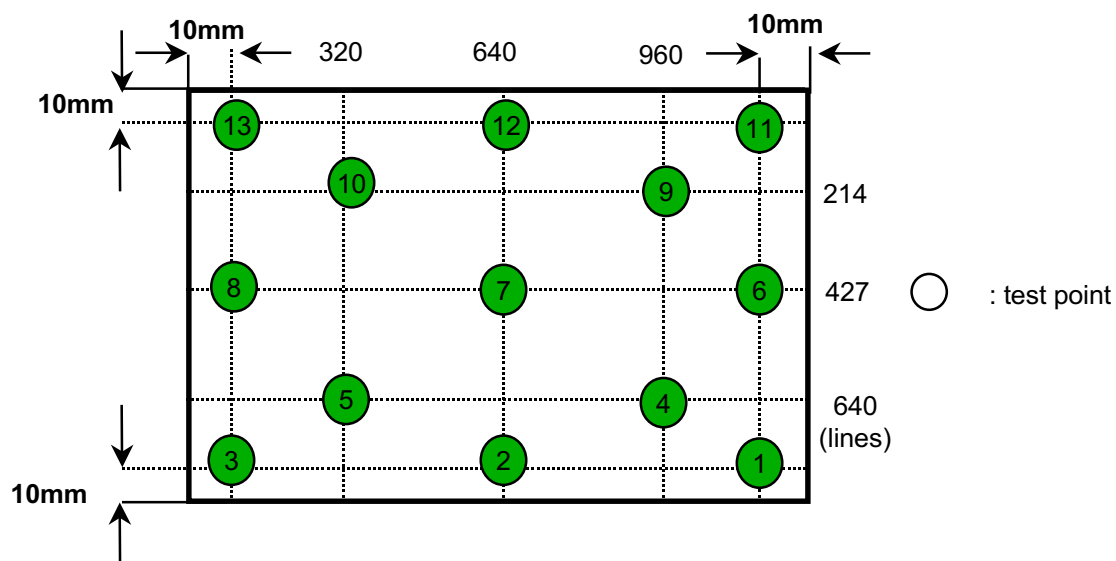
Environment condition :  $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$



Optical characteristics measurement setup

Note 6) Definition of 13 points white variation ( $\delta L$ ), CR variation( $C_{VER}$ ) [ ① ~ ⑬ ]

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



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### 3. ELECTRICAL CHARACTERISTICS

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#### 3.1 TFT LCD MODULE

Ta= 25 ± 2 °C

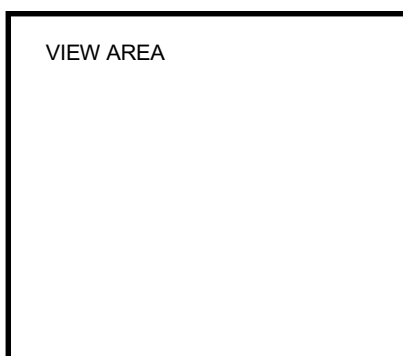
| ITEM                                                   |          | SYMBOL            | MIN  | TYP   | MAX  | UNIT | NOTE                   |
|--------------------------------------------------------|----------|-------------------|------|-------|------|------|------------------------|
| Voltage of Power Supply                                |          | V <sub>DD</sub>   | 3.0  | 3.3   | 3.6  | V    |                        |
| Differential Input Voltage for LVDS Receiver Threshold | High     | V <sub>IH</sub>   | -    | -     | +100 | mV   | V <sub>CM</sub> =+1.2V |
|                                                        | Low      | V <sub>IL</sub>   | -100 | -     | -    | mV   |                        |
| Vsync Frequency                                        |          | f <sub>v</sub>    | -    | 60    | -    | Hz   |                        |
| Hsync Frequency                                        |          | f <sub>H</sub>    | -    | 51.96 | -    | KHz  |                        |
| Main Frequency                                         |          | f <sub>DCLK</sub> | -    | 79.81 | -    | MHz  |                        |
| Rush Current                                           |          | I <sub>RUSH</sub> | -    | -     | 1.5  | A    | (4)                    |
| Current of Power Supply                                | White    | I <sub>DD</sub>   | -    | 460   | -    | mA   | (2),(3)*a              |
|                                                        | Mosaic   |                   | -    | 500   | -    | mA   | (2),(3)*b              |
|                                                        | V.stripe |                   | -    | 610   | 700  | mA   | (2),(3)*c              |

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

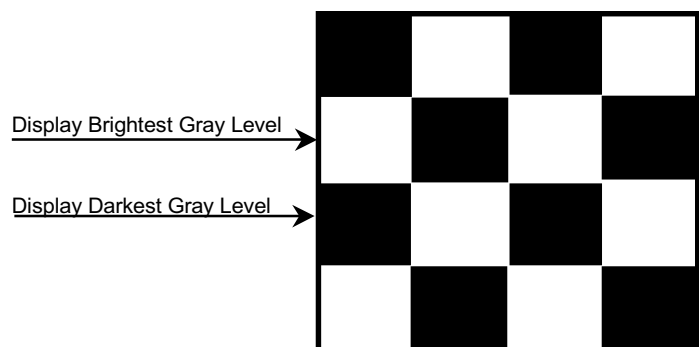
(2) f<sub>v</sub>=60Hz, f<sub>DCLK</sub> =79.81MHZ, V<sub>dd</sub> = 3.3V

(3) Power dissipation pattern are as follows.

\*a) White Pattern

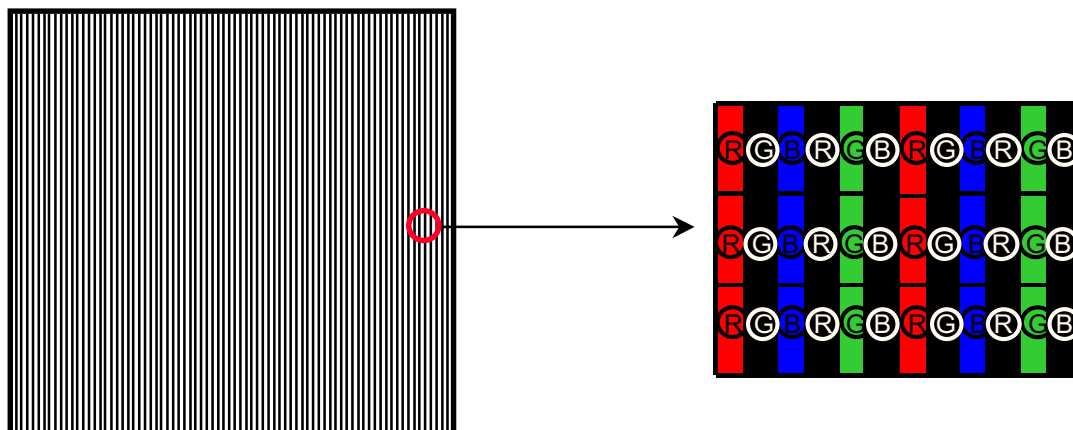


\*b) Mosaic Pattern

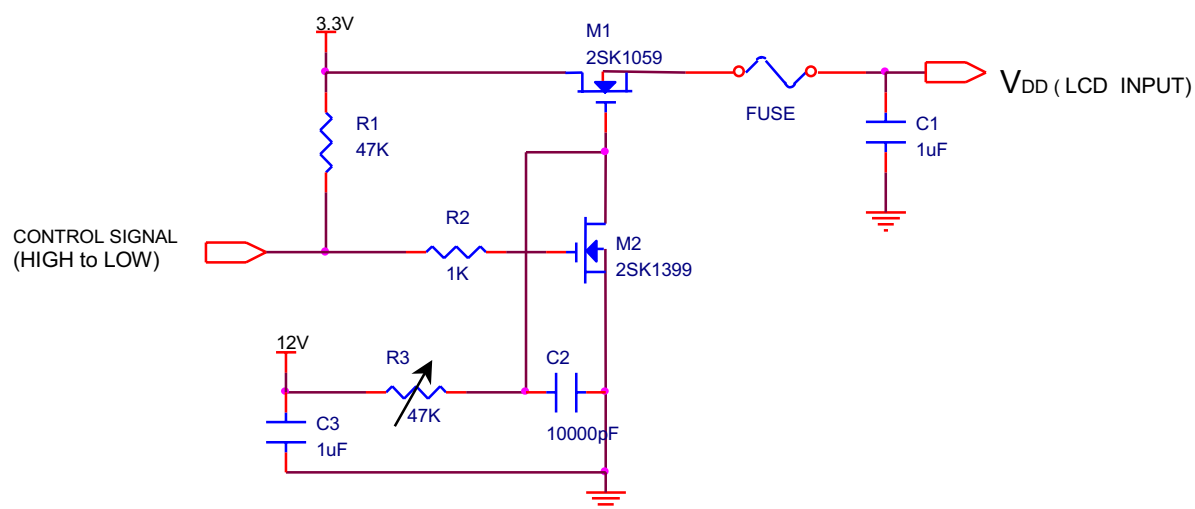


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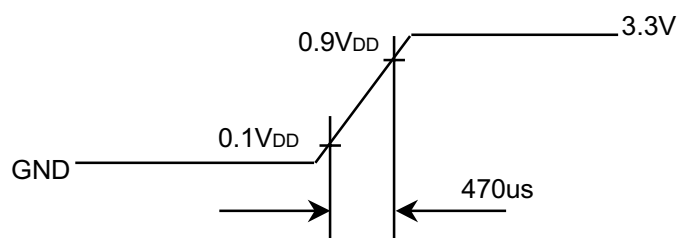
\*c) 1dot Vertical stripe pattern



#### 4) Rush current measurement condition



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



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### 3.2 BACK-LIGHT UNIT

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

INVERTER : Apple Inverter

LAMP : KON6327R2913090

Ta= 25 ± 2 °C

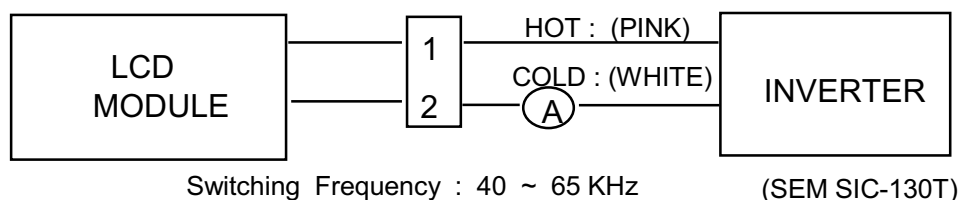
| ITEM                | SYMBOL         | MIN    | TYP    | MAX          | UNIT             | NOTE                         |
|---------------------|----------------|--------|--------|--------------|------------------|------------------------------|
| Lamp Current        | I <sub>L</sub> | 2.0    | 6.0    | 6.5          | mArms            | (1)                          |
| Lamp Voltage        | V <sub>L</sub> | -      | 720    | -            | V <sub>rms</sub> | I <sub>L</sub> =6.0mA        |
| Frequency           | f <sub>L</sub> | 40     | 60     | 65           | KHz              | (2)                          |
| Power Consumption   | P <sub>L</sub> | -      | 4.3    | -            | W                | (3)<br>I <sub>L</sub> =6.0mA |
| Operating Life Time | Hr             | 10,000 | 15,000 | -            | Hour             | (4)                          |
| Startup Voltage     | V <sub>s</sub> | -      | -      | 1270 (25 °C) | V <sub>rms</sub> | (5)                          |
|                     |                |        |        | 1500 (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 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.) 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.



(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<sub>L</sub> × V<sub>L</sub> to calculate.

(4) Life time (Hr) of a lamp can be defined as the time in which it continues to operate under the condition Ta= 25 ± 2 °C and I<sub>L</sub> = 5.0 mArms until one of the following event occurs.

1. When the brightness becomes 50% or lower than the original.

2. When the Effective ignition length becomes 80% or lower than the original value.

(Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

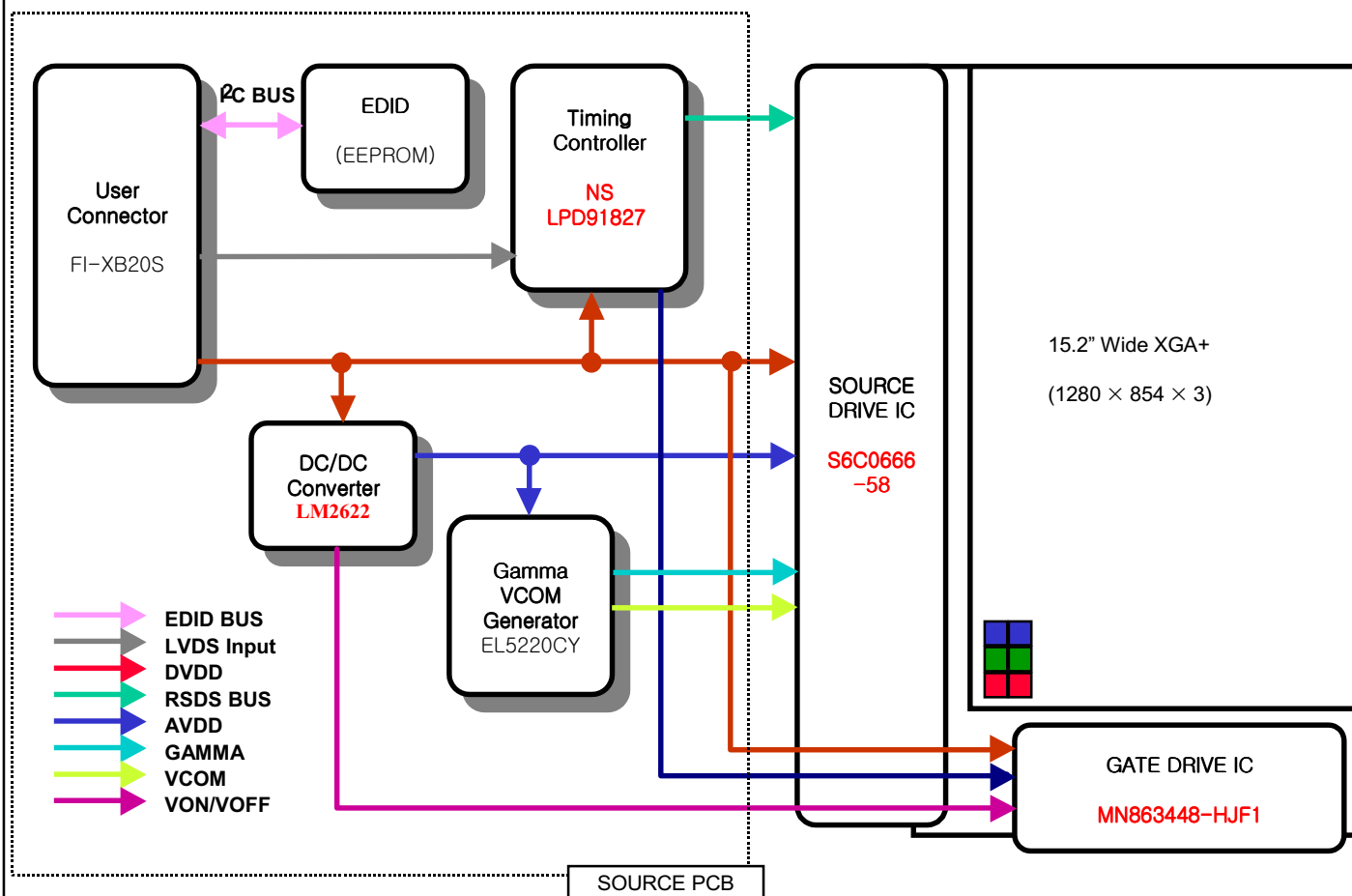
(5) The inverter open voltage - this voltage should be measured after ballast capacitor- have to be larger than the lamp startup voltage, otherwise backlight may has blinking for a moment after turns on or not be turned on.

If an inverter has shutdown function it should keep its open voltage for longer than 1 second even if lamp connector open.

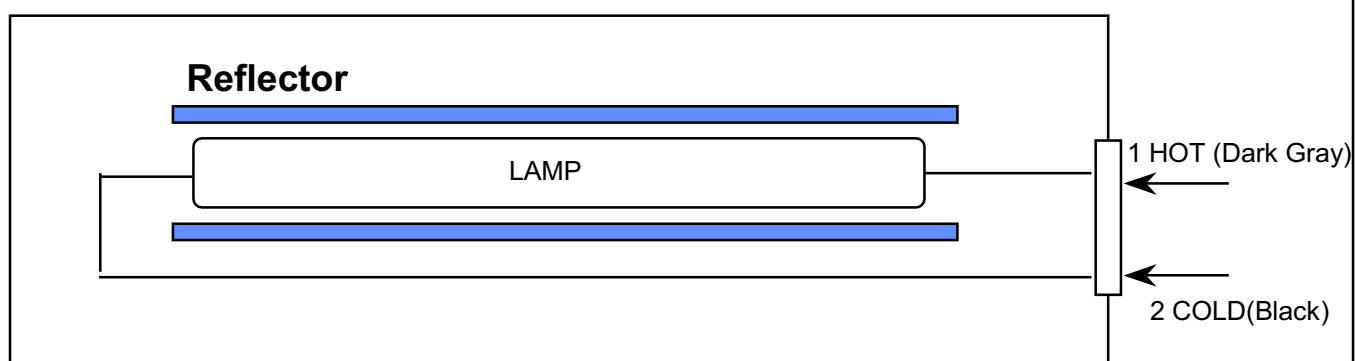
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## 4. BLOCK DIAGRAM

### 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.

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## 5. INPUT TERMINAL PIN ASSIGNMENT

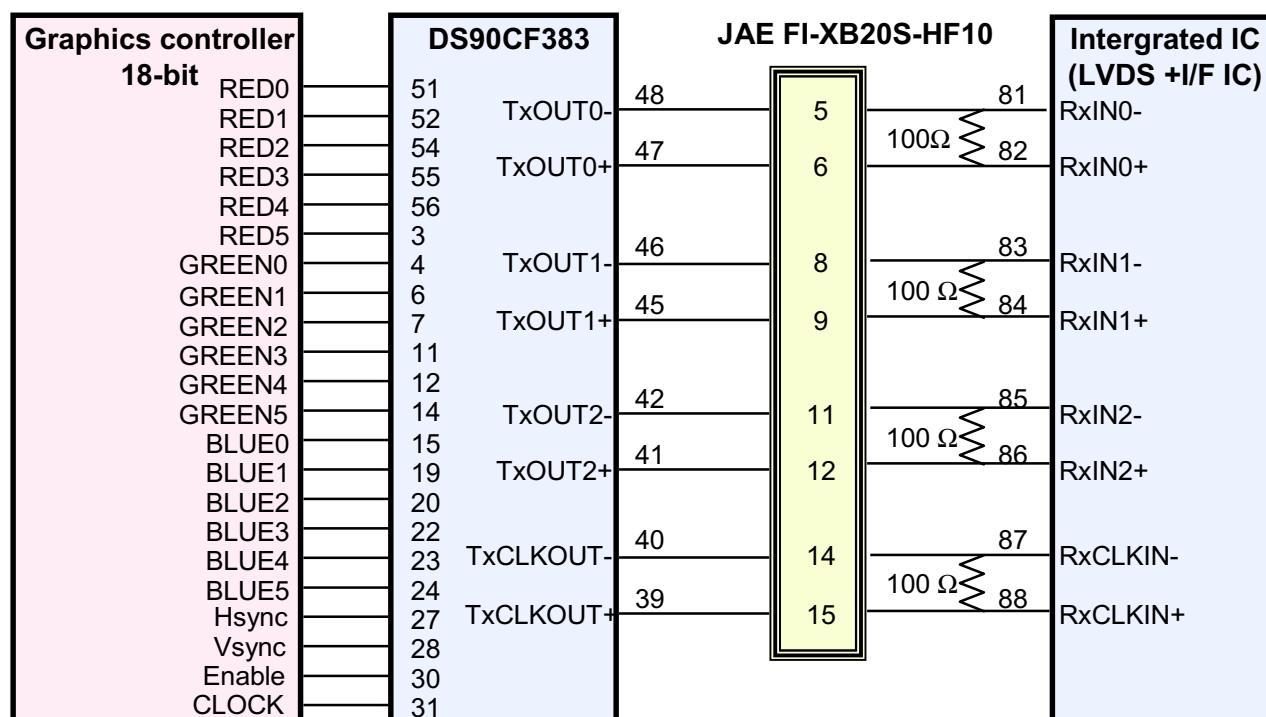
5.1. Input Signal & Power (LVDS, Connector : JAE FI-XB20S-HF10  
Mating Connector : JAE FI-X20M)

| PIN NO | SYMBOL   | FUNCTION                     | POLARITY | REMARK                  |
|--------|----------|------------------------------|----------|-------------------------|
| 1      | VDD      | POWER SUPPLY +3.3V           | Positive |                         |
| 2      | VDD      | POWER SUPPLY +3.3V           | Positive |                         |
| 3      | GND      | GROUND                       |          |                         |
| 4      | GND      | GROUND                       |          |                         |
| 5      | RxIN0-   | LVDS Differential Data INPUT | Negative | R0~R5<br>G0             |
| 6      | RxIN0+   | LVDS Differential Data INPUT | Positive |                         |
| 7      | GND      | GROUND                       |          |                         |
| 8      | RxIN1-   | LVDS Differential Data INPUT | Negative | G1~G5<br>B0~B1          |
| 9      | RxIN1+   | LVDS Differential Data INPUT | Positive |                         |
| 10     | GND      | GROUND                       |          |                         |
| 11     | RxIN2-   | LVDS Differential Data INPUT | Negative | B2~B5,DE<br>Hsync,Vsync |
| 12     | RxIN2+   | LVDS Differential Data INPUT | Positive |                         |
| 13     | GND      | GROUND                       |          |                         |
| 14     | RxCLKIN- | LVDS Differential Data INPUT | Negative |                         |
| 15     | RxCLKIN+ | LVDS Differential Data INPUT | Positive |                         |
| 16     | GND      | GROUND                       |          |                         |
| 17     | VEDID    | DDC 3.3V Power               |          | EDID                    |
| 18     | NC       | No connection                |          |                         |
| 19     | CLKEDID  | DDC Clock                    |          | EDID                    |
| 20     | DATAEDID | DDC Data                     |          | EDID                    |

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## 5.2 LVDS Interface : Transmitter DS90CF383 (National Semiconductor) or Compatible

| Pin No. | Name   | RGB Signal | Pin No. | Name    | RGB Signal |
|---------|--------|------------|---------|---------|------------|
| 51      | TxIN0  | R0         | 14      | TxIN14  | G5         |
| 52      | TxIN1  | R1         | 15      | TxIN15  | B0         |
| 54      | TxIN2  | R2         | 19      | TxIN18  | B1         |
| 55      | TxIN3  | R3         | 20      | TxIN19  | B2         |
| 56      | TxIN4  | R4         | 22      | TxIN20  | B3         |
| 3       | TxIN6  | R5         | 23      | TxIN21  | B4         |
| 4       | TxIN7  | G0         | 24      | TxIN22  | B5         |
| 6       | TxIN8  | G1         | 27      | TxIN24  | Hsync      |
| 7       | TxIN9  | G2         | 28      | TxIN25  | Vsync      |
| 11      | TxIN12 | G3         | 30      | TxIN26  | DE         |
| 12      | TxIN13 | G4         | 31      | TxCLKIN | Clock      |

**FLAT LINK INTERFACE**

Note : The LCD Module uses 2 51ohm resistors and 47pF between positive and negative lines of each receiver input.

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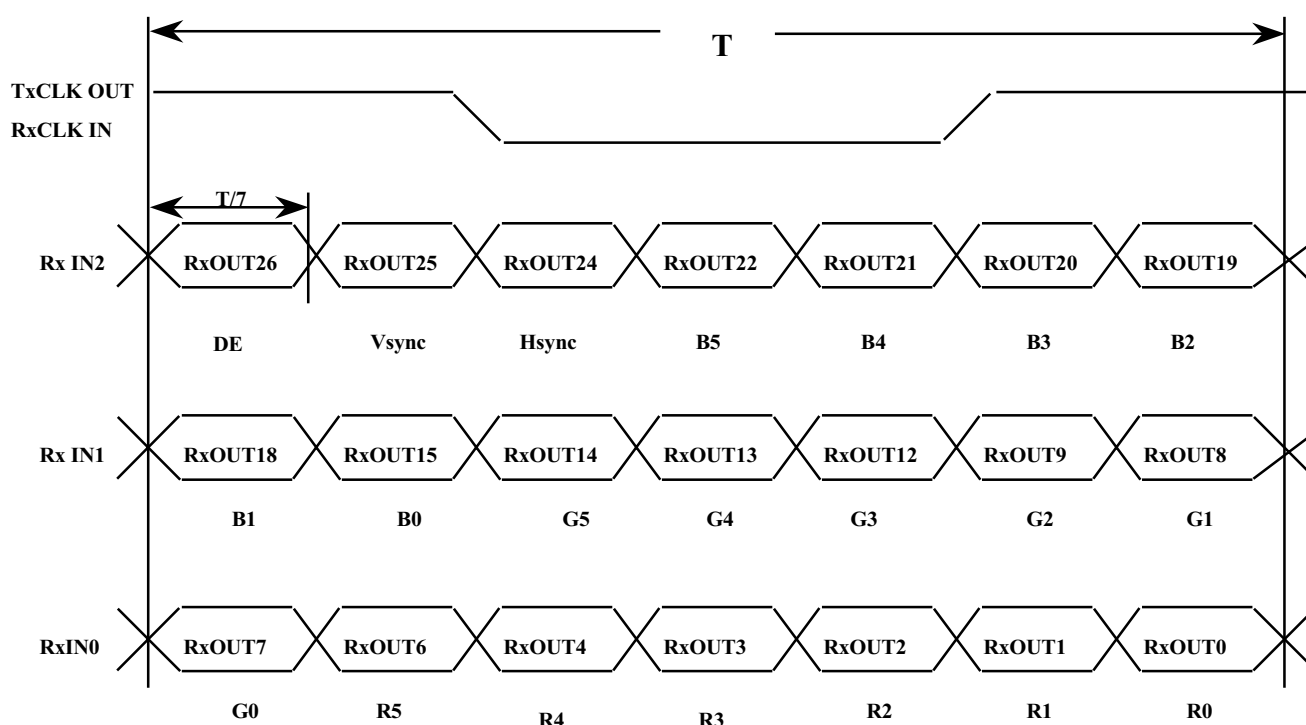
### 5.3 BACK LIGHT UNIT

Connector : JST BHSR - 02VS -1  
Mating Connector : SM02B-BHSS-1(JST)

| Pin NO. | Symbol | Color     | Function     |
|---------|--------|-----------|--------------|
| 1       | HOT    | Dark gray | High Voltage |
| 2       | COLD   | Black     | Low Voltage  |

### 5.4 Timing Diagrams of LVDS For Transmission

LVDS Receiver : Integrated T-CON(LPD91827)



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

| 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 |                  |
| BASIC 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 ↑  | 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           |
|                     |         | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  |    |                  |
|                     | ↓ 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 ↑  | 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           |
|                     |         | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  |    |                  |
|                     | ↓ 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 ↑  | 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           |
|                     |         | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  |    |                  |
|                     | ↓ 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              |

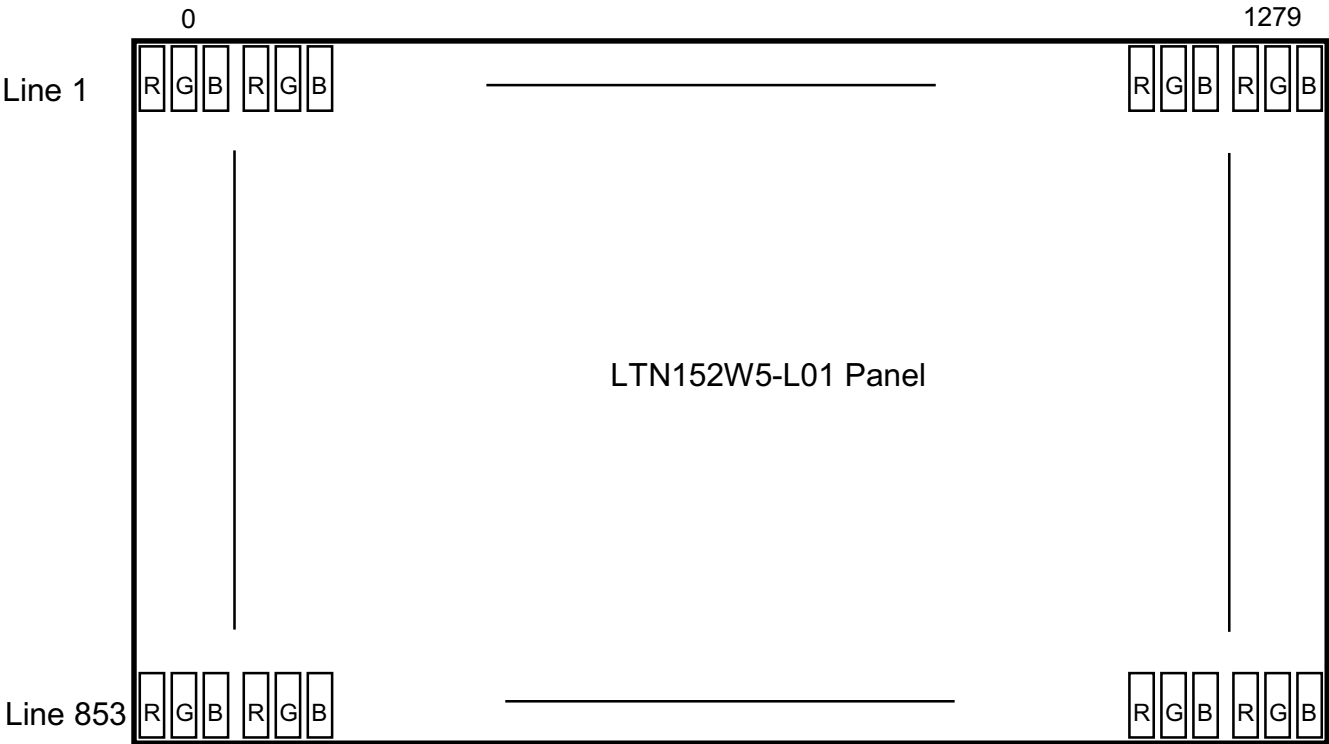
Note 1) Definition of gray :

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

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

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5.6 Pixel Format in the display

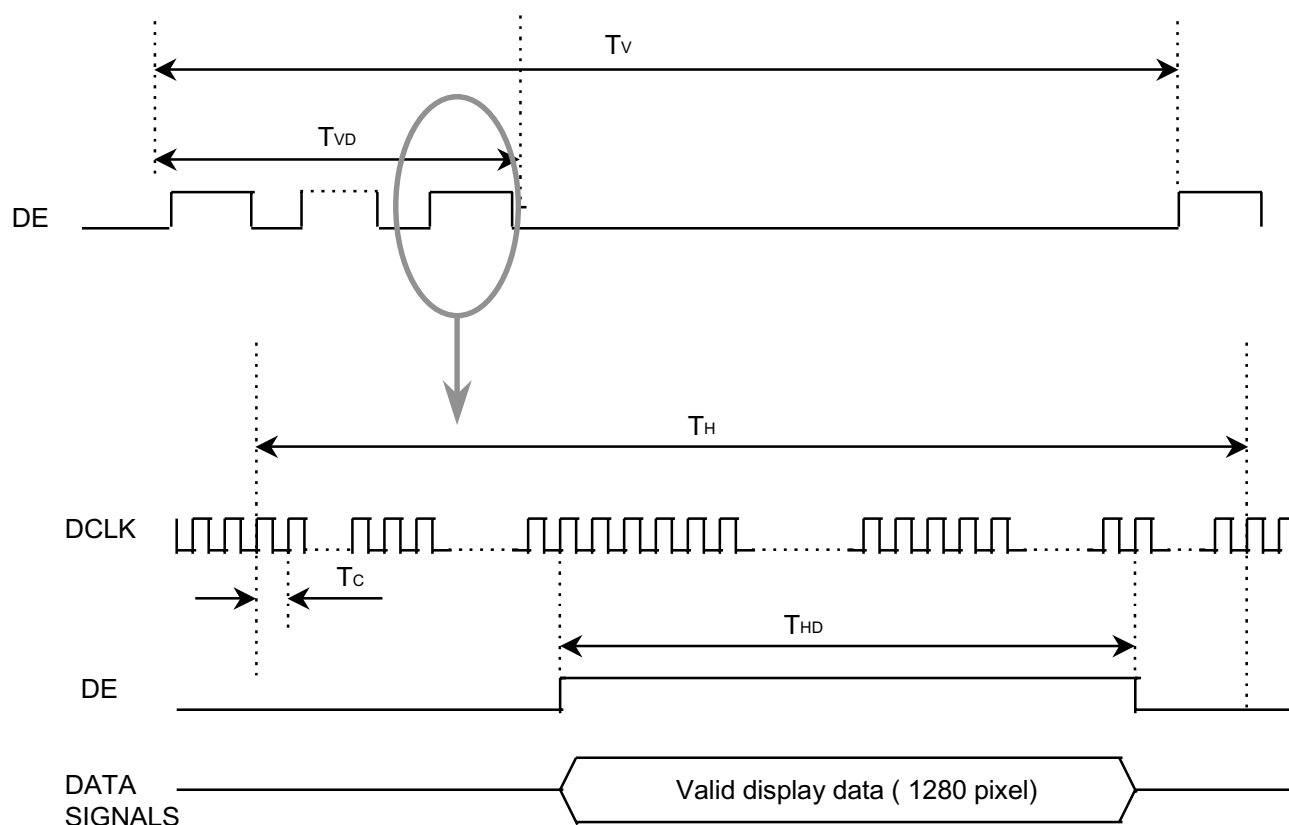


## 6. INTERFACE TIMING

### 6.1 Timing Parameters

| Signal                         | Item           | Symbol   | MIN | TYP  | MAX | Unit   | Note |
|--------------------------------|----------------|----------|-----|------|-----|--------|------|
| Frame Frequency                | Cycle          | $T_v$    | -   | 866  | -   | lines  |      |
| Vertical Active Display Term   | Display Period | $T_{vD}$ | -   | 854  | -   | lines  |      |
| One Line Scanning Time         | Cycle          | $T_H$    | -   | 1536 | -   | clocks |      |
| Horizontal Active Display Term | Display Period | $T_{HD}$ | -   | 1280 | -   | clocks |      |

### 6.2 Timing diagrams of interface signal



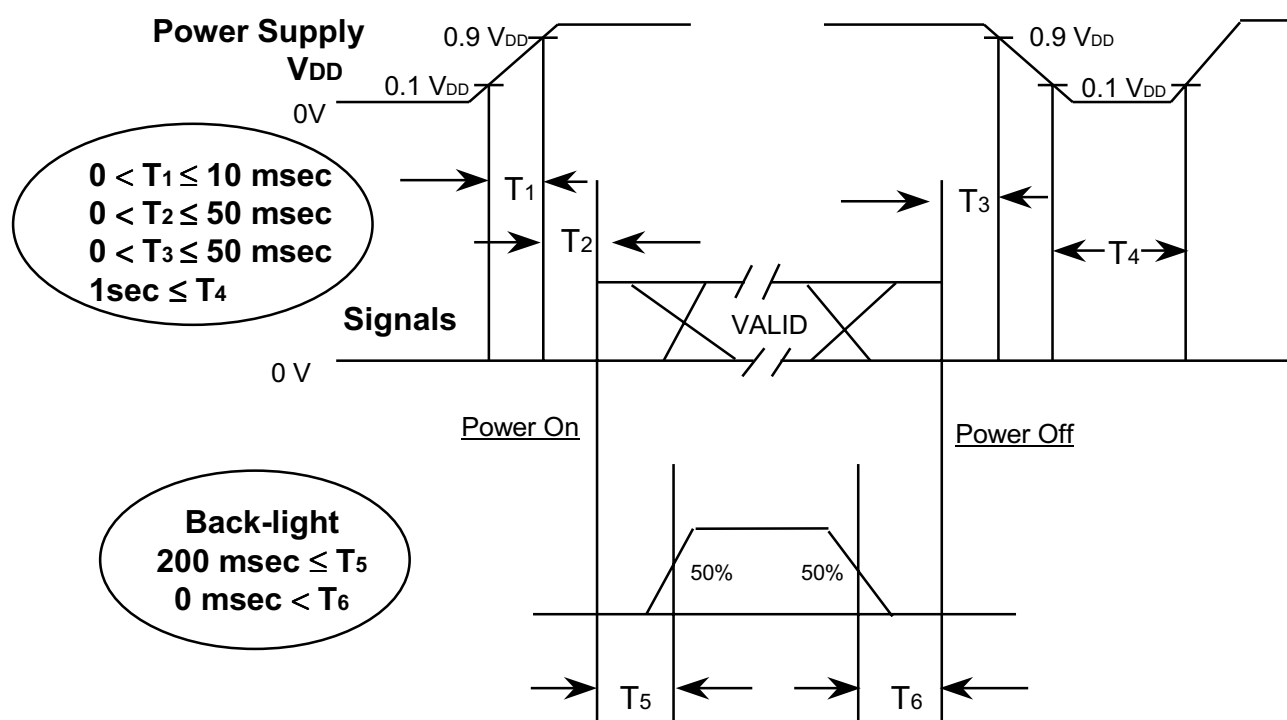
Note : All input condition(level&timing) for FPD85310 are the same with those of NS DS90CF384 or compatible.

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### 6.3 Power ON/OFF Sequence

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: 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

- T1 : Vdd rising time from 10% to 90%
- T2 : The time from Vdd to valid data at power ON.
- T3 : The time from valid data off to Vdd off at power Off.
- T4 : Vdd off time for Windows restart
- T5 : The time from valid data to B/L enable at power ON.
- T6 : The time from valid data off to B/L disable at power Off.

#### 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 white.
- (3) In case of VDD = off level, please keep the level of input signals on the low or keep a high impedance.
- (4) T4 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.

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|         |              |        |                 |      |         |
|---------|--------------|--------|-----------------|------|---------|
| Doc.No. | LTN152W5-L02 | Rev.No | 04-000-G-031031 | Page | 20 / 24 |
|---------|--------------|--------|-----------------|------|---------|

**7. Mechanical Outline Dimension**

Refer to the attachment at the last page (A3 size format)

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|                |              |               |                 |             |         |
|----------------|--------------|---------------|-----------------|-------------|---------|
| <b>Doc.No.</b> | LTN152W5-L02 | <b>Rev.No</b> | 04-000-G-031031 | <b>Page</b> | 21 / 24 |
|----------------|--------------|---------------|-----------------|-------------|---------|

## 8. PACKING

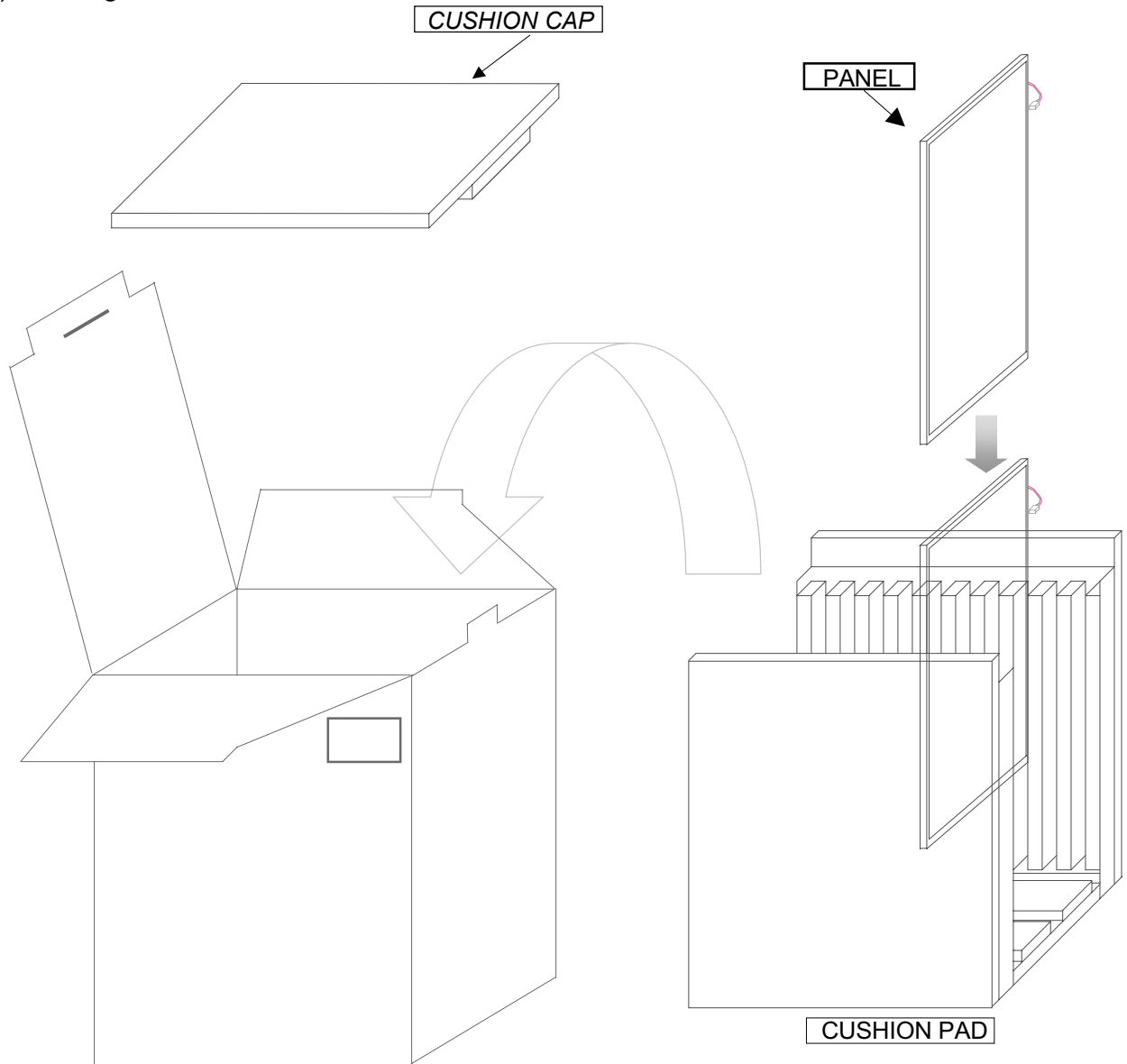
Approval

### 1. CARTON(Internal Package)

#### (1) Packing Form

Corrugated Cardboard box and Corrupad form as shock absorber

#### (2) Packing Method



- Note 1) Total Weight : Approximately 6.0 kg  
2) Acceptance number of piling : 10 sets  
3) Carton size : 317(W)×286(D)×355(H)  
4) MAX accumulation quantity : 5 cartons

PACKING CASE

**SEC Secret**

Doc.No.

LTN152W5-L02

Rev.No

04-000-G-031031

Page

22 / 24

## 8. GENERAL PRECAUTIONS

### 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 backlight.
- (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 C-MOS Gate Array IC.
- (i) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Do not pull or fold the lamp wire.
- (l) Do not adjust the variable resistor which is located on the back side.
- (m) Pins of I/F connector shall not be touched directly with bare hands.

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|         |              |        |                 |      |         |
|---------|--------------|--------|-----------------|------|---------|
| Doc.No. | LTN152W5-L02 | Rev.No | 04-000-G-031031 | Page | 23 / 24 |
|---------|--------------|--------|-----------------|------|---------|

## 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 shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

## 3. OPERATION

- (a) Do not connect, 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 shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the backlight connector and its inverter power supply shall be a minimized length and be connected directly . The longer cable between the backlight and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

## 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, 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.

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|                |              |               |                 |             |         |
|----------------|--------------|---------------|-----------------|-------------|---------|
| <b>Doc.No.</b> | LTN152W5-L02 | <b>Rev.No</b> | 04-000-G-031031 | <b>Page</b> | 24 / 24 |
|----------------|--------------|---------------|-----------------|-------------|---------|

