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Date: February 3, 2005

Product Functional Specification
15 inch XGA Color TFT-LCD Module
Model Name: G150XG02 V.0

(*) Draft

Note: This Specification is subject to change without notice.



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| No | ITEM |
|-----|----------------------------------|
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1. General Description

This specification applies to the 15.0 inch Color TFT-LCD Module G150XG02.

This module supports the XGA (1024(H) x 768(V)) screen format and 16.2M colors (6-bits + FRC).

All input signals are 1 channel LVDS interface compatible.

All the design rules of this module can correspond to PSWG standard.

This module is without any inverter card for backlight.

Features

- XGA 1024(H) x 768(V) resolution
- 50,000 hours lamp life
- 4 CCFL (Cold Cathode Fluorescent Lamp)
- High brightness, High contrast ratio
- Wide viewing angle
- Fast response Time
- Low power consumption

Application

Industrial Applications



* General Information

The following items are characteristics summary on the table 25 °C condition:

| Items | Specification | Unit | Note |
|-------------------------|--------------------------------------|----------------------|------------------|
| Active Screen Size | 15.0 inches | | 38.1cm diagonal |
| Display Area | 304.128(H) × 228.096(V) | mm | |
| Outline Dimension | 326.5(H) × 253.5(V) × 14.4(D) (typ.) | mm | Without inverter |
| Resolution | 1024(R,G,B×3) × 768 | Pixels | |
| Pixel Pitch | 0.297 × 0.297 | | |
| Pixel Arrangement | RGB vertical stripe | | |
| Display mode | TN mode, Normally White | | |
| Display Colors | 16.2M (6-bit + FRC for R,G,B) | Colors | |
| Typical White Luminance | 550 nit (typ.) @ 6.5mA | [cd/m ²] | |
| Contrast Ratio | 500:1(typ.) | | |
| Color Gamut | 60%(typ.) of NTSC | | |
| Response Time | 12ms(typ.) (Tr+Tf) | ms | |
| Viewing Angle (H/V) | 140/120 | | CR ≥ 10 |
| Power Consumption | 21 W (typ.)(VDD line +CCFL line) | W | @6.5mA |
| Electronic Interface | 1ch LVDS (6 bit + FRC) | | |
| Frame rate | 60Hz(typ.), 75Hz(max.) | Hz | |
| Weight | 1350(max) | g | |
| Surface Treatment | Hard-Coating 3H, AG | | |



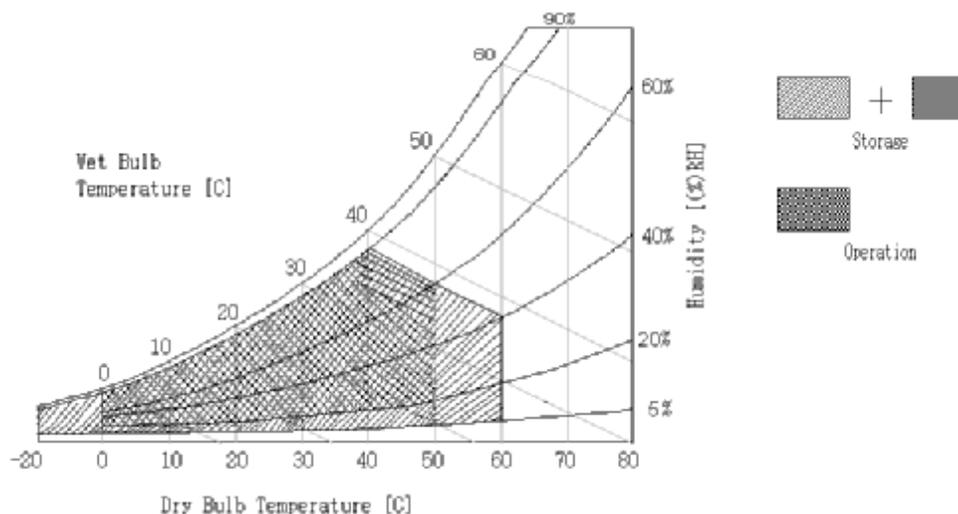
2. Absolute Maximum Ratings

The following table shows the maximum values which, if exceeded (8.5mA), may cause faulty operation or damage to the unit.

| Item | Symbol | Min. | Max. | Unit | Note |
|-------------------------|-----------------|------|----------|----------|----------------|
| Logic/LCD Drive Voltage | VDD | -0.3 | +3.6 | 【Volt】 | |
| Input Voltage of Signal | Vin | -0.3 | +3.6 | 【Volt】 | |
| CCFL Current | ICFL | +2.5 | +8.5 | 【mA】 rms | |
| Operating Temperature | T _{OP} | 0 | +50 | °C | Note 1 |
| Storage Temperature | H _{ST} | -20 | +60 | °C | Note 1 |
| Operating Humidity | H _{OP} | 20 | 85 | %RH | Note 1 |
| Storage Humidity | H _{ST} | 10 | 90 | %RH | Note 1 |
| Vibration | | - | 1/10-200 | 【G/Hz】 | |
| Shock | | - | 50/20 | 【G/ms】 | Half sine wave |

Note: 1. Temperature and relative humidity range are shown in the figure below. Wet bulb temperature should be 39°C and No condensation.

Wet bulb temperature chart





3. Electrical Specification

3-1 Signal Electrical Characteristics

Each signal characteristics are as follows:

| Parameter | Symbol | Values | | | Unit | Notes |
|----------------------------|-------------------|--------|--------|------|-------------------|-------|
| | | Min | Typ | Max | | |
| LCD: | | | | | | |
| Power Supply Input Voltage | Vcc | 3.0 | 3.3 | 3.6 | Vdc | |
| Power Supply Input Current | Icc | - | 1.0 | 1.1 | A | 1 |
| Power Consumption | Pc | - | 3.3 | 3.96 | Watt | 1 |
| Allowable Ripple & Noise | VDDns | - | - | 100 | mVp-p | |
| Inrush Current | I _{RUSH} | - | - | 1.2 | A _{peak} | 1 |
| Lamp Power Consumption | | - | 17.7 | 24.7 | W | 2 |
| Life Time | | 50,000 | 60,000 | - | hr | 4 |



3-2 Interface Connections

- LCD connector (CN1): DF-14H-20P-1.25H (Hirose) or equivalent
- LVDS Transmitter : DS90C385 (N.S.) or THC63LVDM83A (THINE) or equivalent

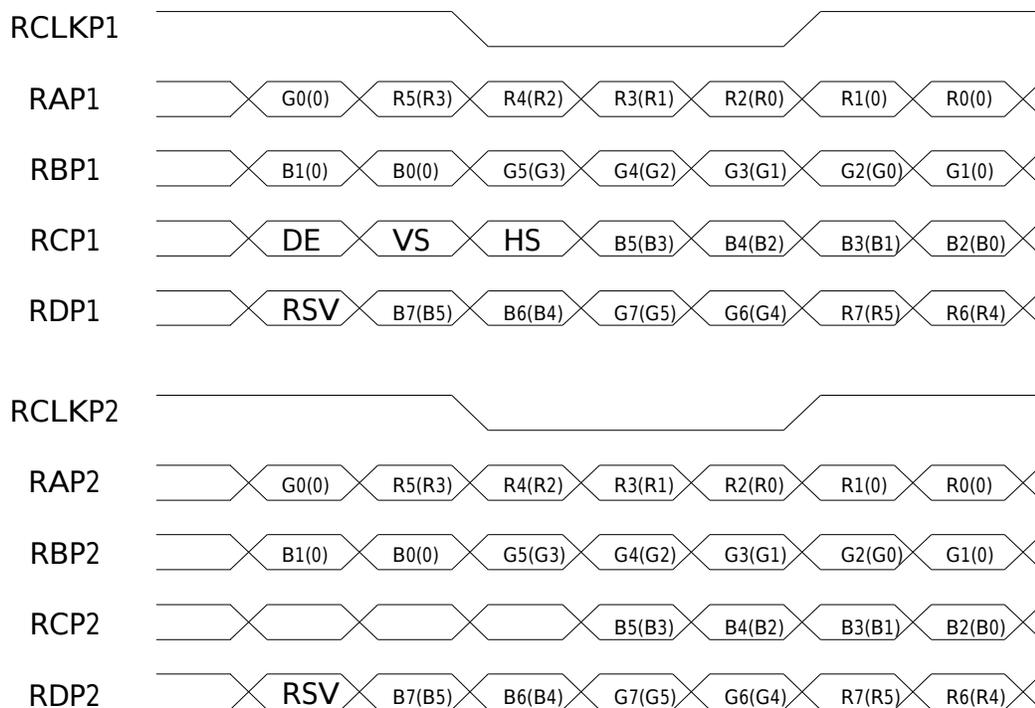
| Pin No. | Symbol | Function |
|---------|---------|--|
| 1 | VDD | Power Supply +3.3V |
| 2 | VDD | Power Supply +3.3V |
| 3 | GND | Power Ground |
| 4 | GND | Power Ground |
| 5 | Rx0- | - LVDS Receiver Signal (R0-R5, G0) |
| 6 | Rx0+ | + LVDS Receiver Signal (R0-R5, G0) |
| 7 | GND | Ground |
| 8 | Rx1- | - LVDS Receiver Signal (G0-G5, B0-B1) |
| 9 | Rx1+ | + LVDS Receiver Signal (G0-G5, B0-B1) |
| 10 | GND | Ground |
| 11 | Rx2- | - LVDS Receiver Signal (B2-B5, HS, VS, DE) |
| 12 | Rx2+ | + LVDS Receiver Signal (B2-B5, HS, VS, DE) |
| 13 | GND | Ground |
| 14 | RxCLK2- | - LVDS Receiver Clock Signal |
| 15 | RxCLK2+ | + LVDS Receiver Clock Signal |
| 16 | GND | Ground |
| 17 | Rx3- | - LVDS Receiver Signal (R6-R7, G6-G7, B6-B7) |
| 18 | Rx3+ | + LVDS Receiver Signal (R6-R7, G6-G7, B6-B7) |
| 19 | GND | Ground |
| 20 | NC | Reserved |

Note: All GND (ground) pins should be connected together and to Vss, which should also be connected to the LCD's metal frame. All Vcc (power input) pins should be connected together.



8bits input: G150XG02 V0 only catch bit 2 to bit 7 for 6 bit display

6bits input data format marked with ().





Backlight Connector Pin Configuration

| Pin# | Signal Name |
|------|-------------------|
| 1 | Lamp High Voltage |
| 2 | Ground |

Electrical specification (Lamp spec.)

| Symbol | Parameter | Min | Typ | Max | Units | Condition |
|--------|---|------|------|------|------------|--------------------------|
| IRCFL | CCFL operation range | 3.0 | 6.5 | 8.5 | [mA] rms | (Ta=25°C) |
| ICFL | CCFL Inrush current | - | - | 20 | [mA] | (Ta=25°C) |
| FCFL | CCFL Frequency | 40 | 55 | 60 | [KHz] | (Ta=25°C) |
| ViCFL | CCFL Ignition Voltage | 1000 | - | - | [Volt] rms | (Ta=25°C) (Reference) |
| ViCFL | CCFL Ignition Voltage | 1300 | - | - | [Volt] rms | (Ta= 0°C) (Reference) |
| VCFL | CCFL Discharge Voltage | - | 680 | 725 | [Volt] rms | (Ta=25°C) |
| PCFL | CCFL Power consumption @ 6.5 mA (excluding inverter) | - | 17.7 | 24.7 | [Watt] | (Ta=25°C) |

Note1: CCFL Frequency should be carefully determined to avoid interference between inverter and TFT LCD

Note2: Calculate value for reference (IRCFL x VCFL x 4 = PCFL)

Note3: CCFL inverter should be able to give out a power that has a generating capacity of over 1300 voltage.
Lamp units need 1300 voltage minimum for ignition

Note4: CCFL life time 50,000 hr at 6.5 mA, it's defined as when the brightness is reduced by half.

It's recommended not to exceed 6.5 mA for CCFL life time concern and it's prohibited to exceed 8.5mA for safety concern



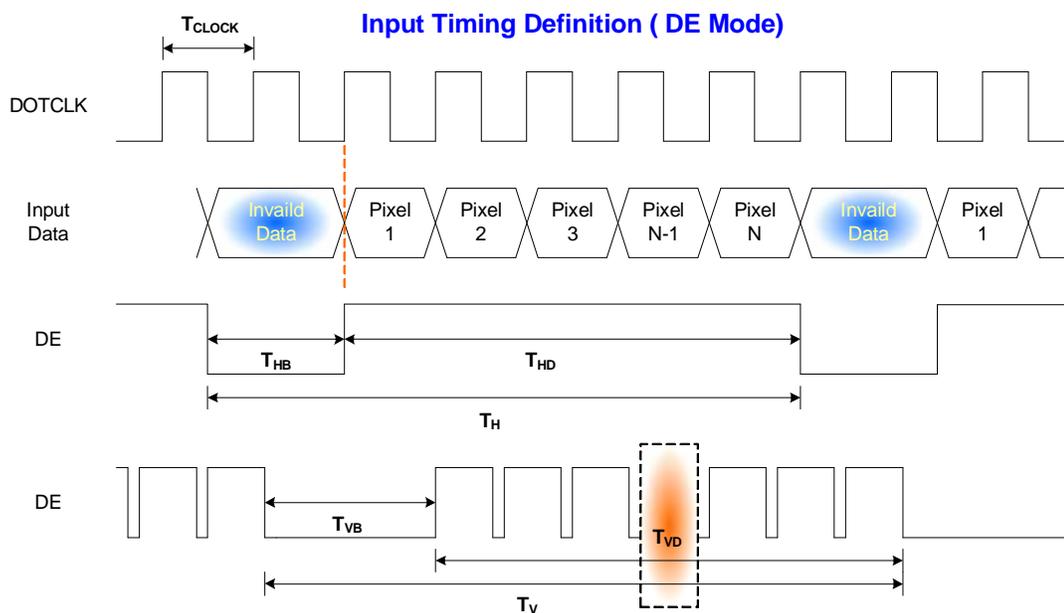
3-3 Signal Timing Specifications

This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications for its proper operation.

Timing Table (DE mode only)

| Parameter | | Symbol | Min. | Typ. | Max. | Unit |
|--------------------|----------|----------------------|------|------|------|--------------------|
| Clock frequency | | $1/T_{\text{Clock}}$ | 50 | 65 | 81 | MHz |
| Vertical Section | Period | T_V | 776 | 806 | 1024 | T_{Line} |
| | Active | T_{VD} | 768 | 768 | 768 | |
| | Blanking | T_{VB} | 8 | 38 | 256 | |
| Horizontal Section | Period | T_H | 1054 | 1344 | 2048 | T_{Clock} |
| | Active | T_{HD} | 1024 | 1024 | 1024 | |
| | Blanking | T_{HB} | 30 | 320 | 1024 | |

3-4 Signal Timing Waveforms



Note : Since this is DE mode only, please set the HS and VS to logic 1.



3-5 Color Input Data Reference

The brightness of each primary color (red, green and blue) is based on the 8 bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

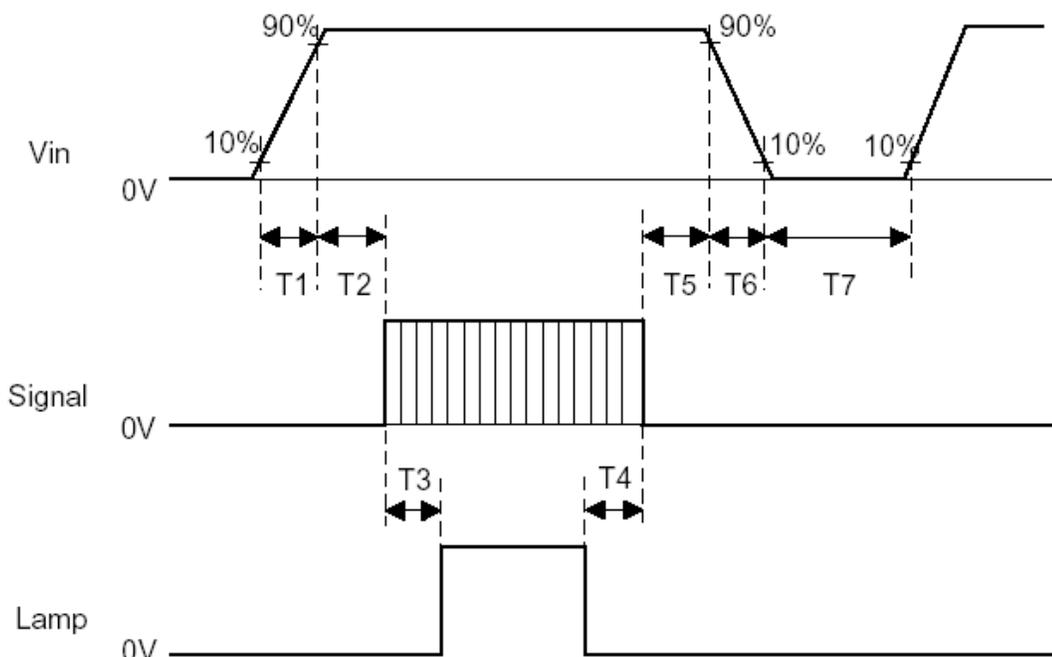
COLOR DATA REFERENCE

| Color | | Input Color Data | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|------------|------------------|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|------|----|----|----|----|----|----|----|
| | | RED | | | | | | | | GREEN | | | | | | | | BLUE | | | | | | | |
| | | MSB | | | | | | | | MSB | | | | | | | | MSB | | | | | | | |
| | | LSB | | | | | | | | LSB | | | | | | | | LSB | | | | | | | |
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| 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 |
| | Red(255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 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 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| RED | RED(000) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ---- | | | | | | | | | | | | | | | | | | | | | | | | |
| | RED(254) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED(255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| GREEN | GREEN(000) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ---- | | | | | | | | | | | | | | | | | | | | | | | | |
| | GREEN(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BLUE | BLUE(000) | 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(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | ----- | | | | | | | | | | | | | | | | | | | | | | | | |
| | BLUE(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | BLUE(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |



3-6 Power On/Off Sequence

Vin and lamp power on/off sequence are as follows. The timing of interface signal are shown in the table.



| Symbol | Values | | | Unit |
|--------|--------|-----|-----|------|
| | Min | Typ | Max | |
| T1 | 0.5 | - | 10 | 【ms】 |
| T2 | 0.5 | 25 | 50 | 【ms】 |
| T3 | 200 | - | - | 【ms】 |
| T4 | 200 | - | - | 【ms】 |
| T5 | 0.5 | 16 | 50 | 【ms】 |
| T6 | 0.5 | - | 10 | 【ms】 |
| T7 | 1000 | - | - | 【ms】 |

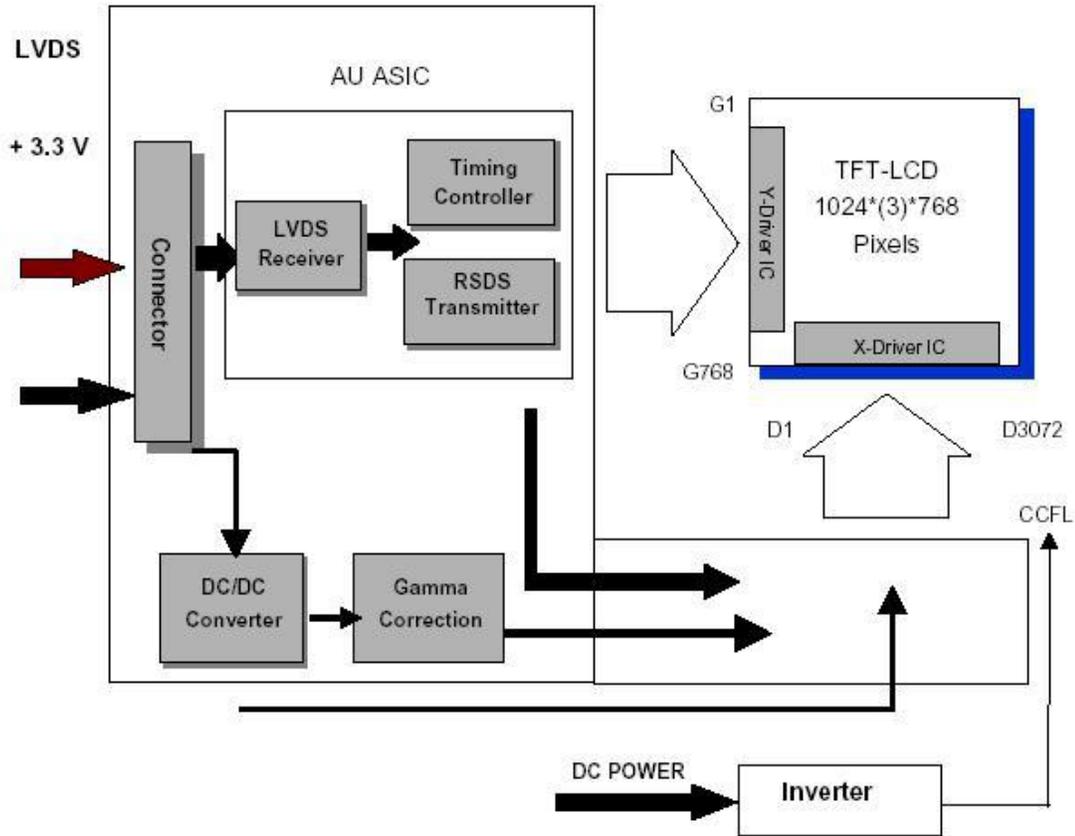
Apply the lamp voltage within the LCD operating range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal.

Caution : The above on/off sequence should be applied to avoid abnormal function in the display. In case of handling, make sure to turn off the power when you plug the cable into the input connector or pull the cable out of the connector.



3-7 Function Block Diagram

The following diagram shows the functional block of 15.0 inches Color TFT-LCD Module:



DF-14H-20P-1.25H (Hirose)
CWY20G-A0D1T (PTWO)

JST BHR-03VS-1



4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0°.

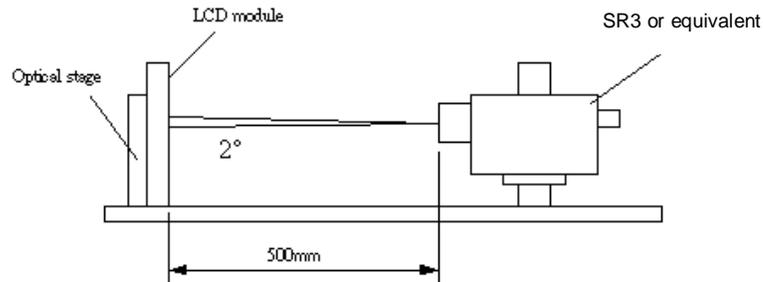


Fig.4-1 Optical measurement equipment and method

| Parameter | Symbol | Values | | | Units | Notes | |
|--------------------------------------|----------------------|--------|-------|------|-------------------|-------|--|
| | | Min. | Typ. | Max. | | | |
| Contrast Ratio | CR | 400 | 500 | - | | 1, 2 | |
| Surface Luminance, white | L_{WH} | - | 550 | - | cd/m ² | 1, 3 | |
| Uniformity of Luminance | δ_{WHITE} 5 p | - | - | - | | 1, 4 | |
| Response Time | T_r (90%-10%) | - | | | ms | 1, 5 | |
| | T_f (10%-90%) | - | | | ms | | |
| | $T_r + T_f$ | | 12 | | ms | | |
| Color Coordinates | | - | - | - | | 1 | |
| RED | R_x | | - | | | | |
| | R_y | | - | | | | |
| | GREEN | G_x | | - | | | |
| | | G_y | | - | | | |
| | BLUE | B_x | TYP. | - | TYP. | | |
| | | B_y | -0.03 | - | +0.03 | | |
| | WHITE | W_x | | - | | | |
| | | W_y | | - | | | |
| BLACK | D_x | | - | | | | |
| | D_y | | - | | | | |
| Viewing Angle (Contrast Ratio>10) | | - | - | - | | | |
| x axis, right ($\varphi=0^\circ$) | θ_r | - | 70 | - | Degree | 6 | |
| x axis, left ($\varphi=180^\circ$) | θ_l | - | 70 | - | | | |
| y axis, up ($\varphi=90^\circ$) | θ_u | - | 60 | - | | | |
| y axis, down ($\varphi=0^\circ$) | θ_d | - | 60 | - | | | |



Note:

1. Optical test condition:

| Test System | Detector | Inverter | Lamp Current | Warm Up |
|-------------|----------|---------------|--------------|---------|
| FPM-520 | SR3 | FINE QF132-V1 | 6.5 mA | 30 min |

2. Contrast Ratio (CR) is defined mathematically as:

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "white" state}}{\text{Brightness on the "black" state}}$$

3. Surface luminance is luminance value at point 1 across the LCD surface 50cm from the surface with all pixels displaying white. From more information see FIG 4-2. When $I_{BL} = 6.5\text{mA}$, $L_{WH} = 450\text{cd/m}^2$ (typ.) $L_{WH} = L_{on1}$, Where L_{on1} is the luminance with all pixels displaying white at center 1 location.

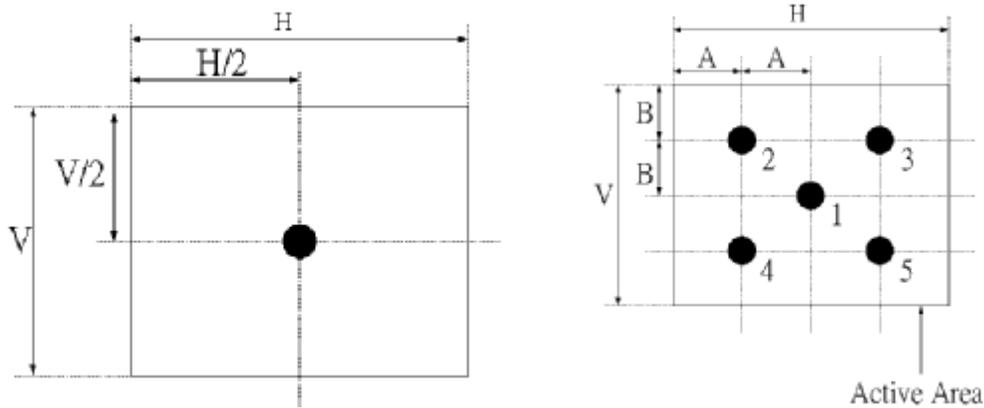


Fig.4-2 Optical measurement point

4. The variation in surface luminance, δ WHITE is defined (center of Screen) as:

$$\delta_{\text{WHITE(5P)}} = \frac{\text{Maximum}(L_{on1}, L_{on2}, \dots, L_{on5})}{\text{Minimum}(L_{on1}, L_{on2}, \dots, L_{on5})}$$



5. Definition of response time:

The output signals of photo-detector are measured when the input signals are changed from "Black" to "White" (falling time) and from "White" to "Black" (rising time), respectively. The response time interval between the 10% and 90% of amplitudes. Refer to figure as below.

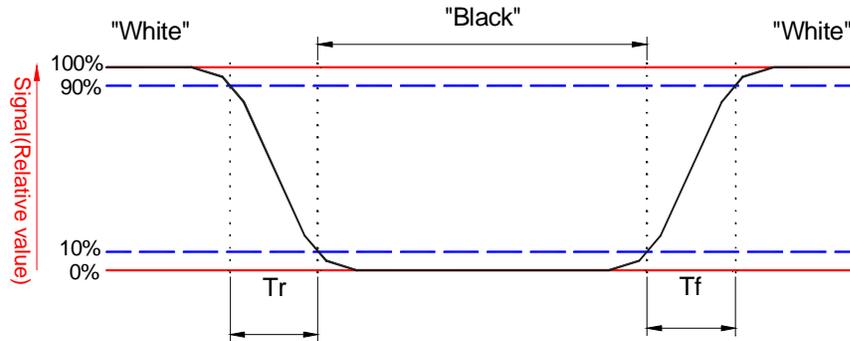


Fig.4-3 Response time



6. Viewing Angle:

Viewing angle is the measurement of contrast ratio, at the screen center, over a 180° horizontal and 180° vertical range (off-normal viewing angles). The 180° viewing angle range is broken down as follows; 90° (θ) horizontal left and right and 90° (Φ) vertical, high (up) and low (down). The measurement direction is typically perpendicular to the display surface with the screen rotated about its center to develop the desired measurement viewing angle.

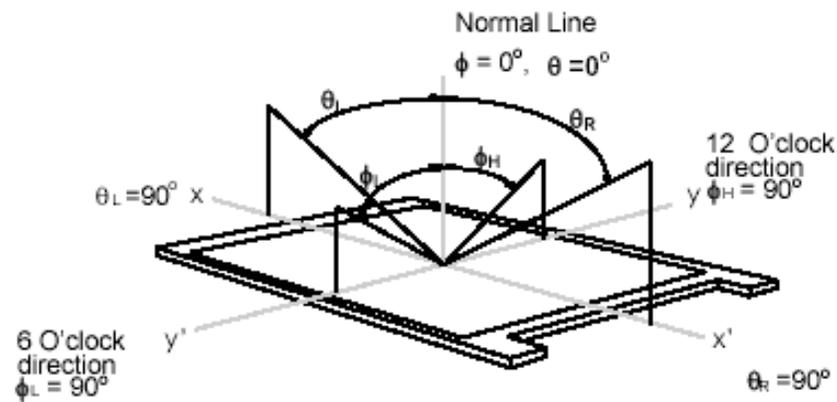
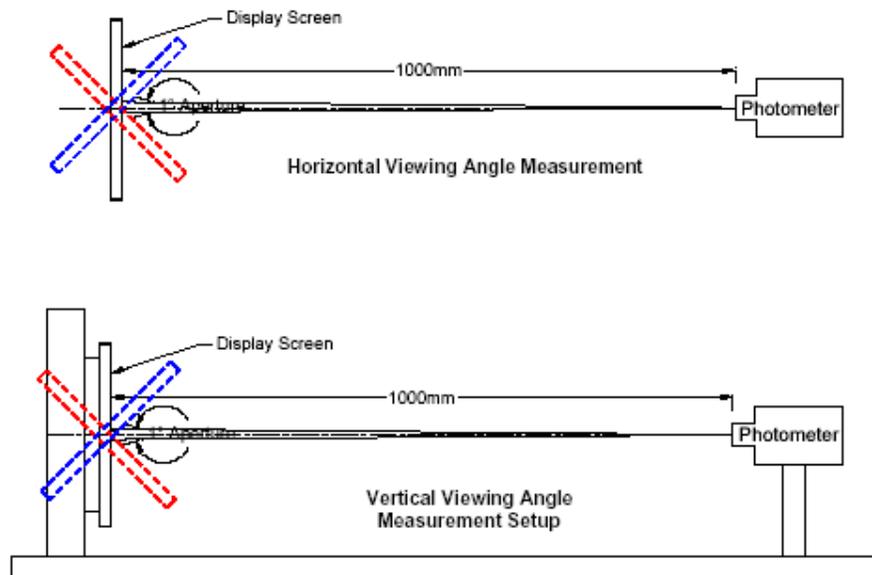


Fig.4-4 Viewing Angle Definition

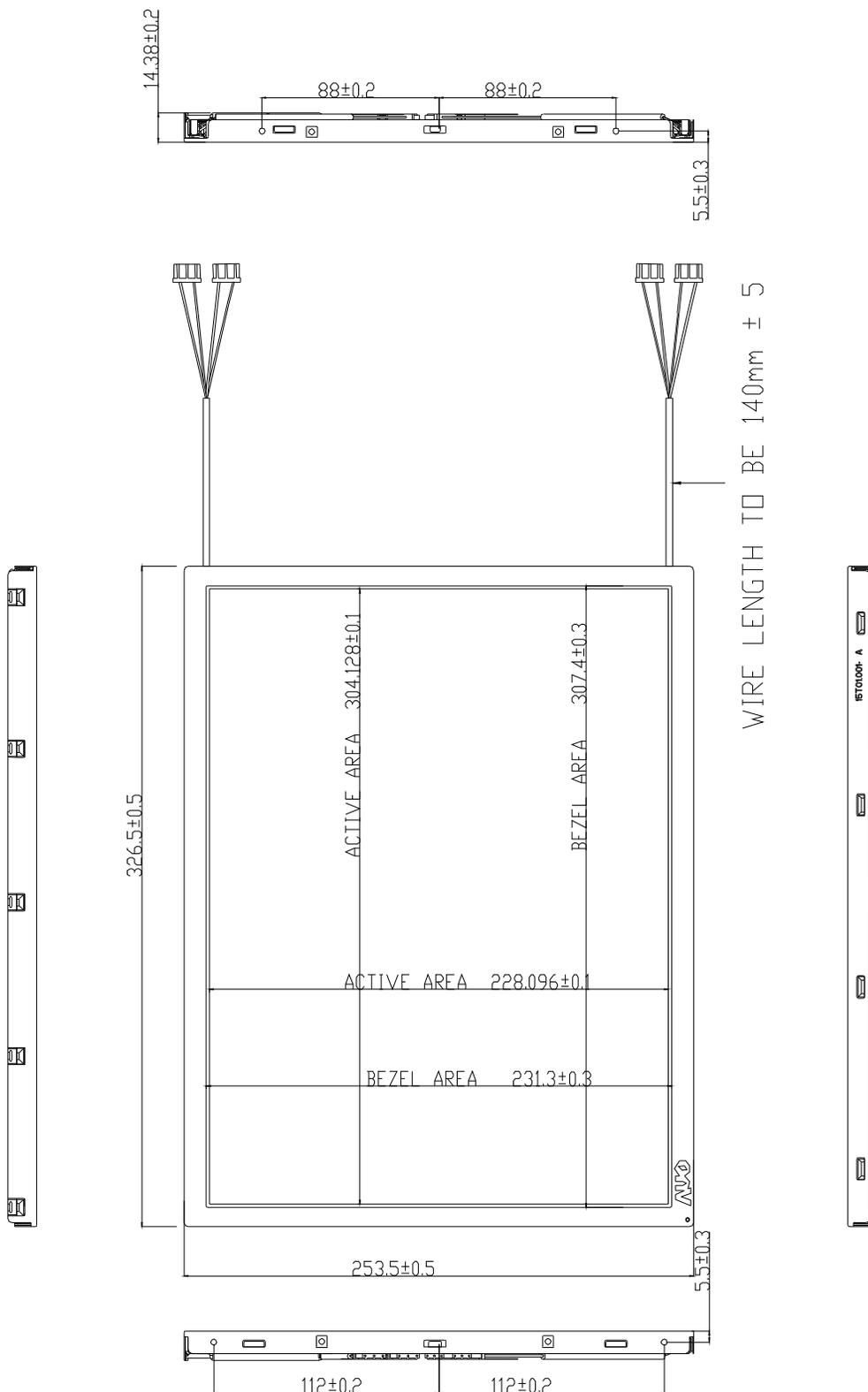


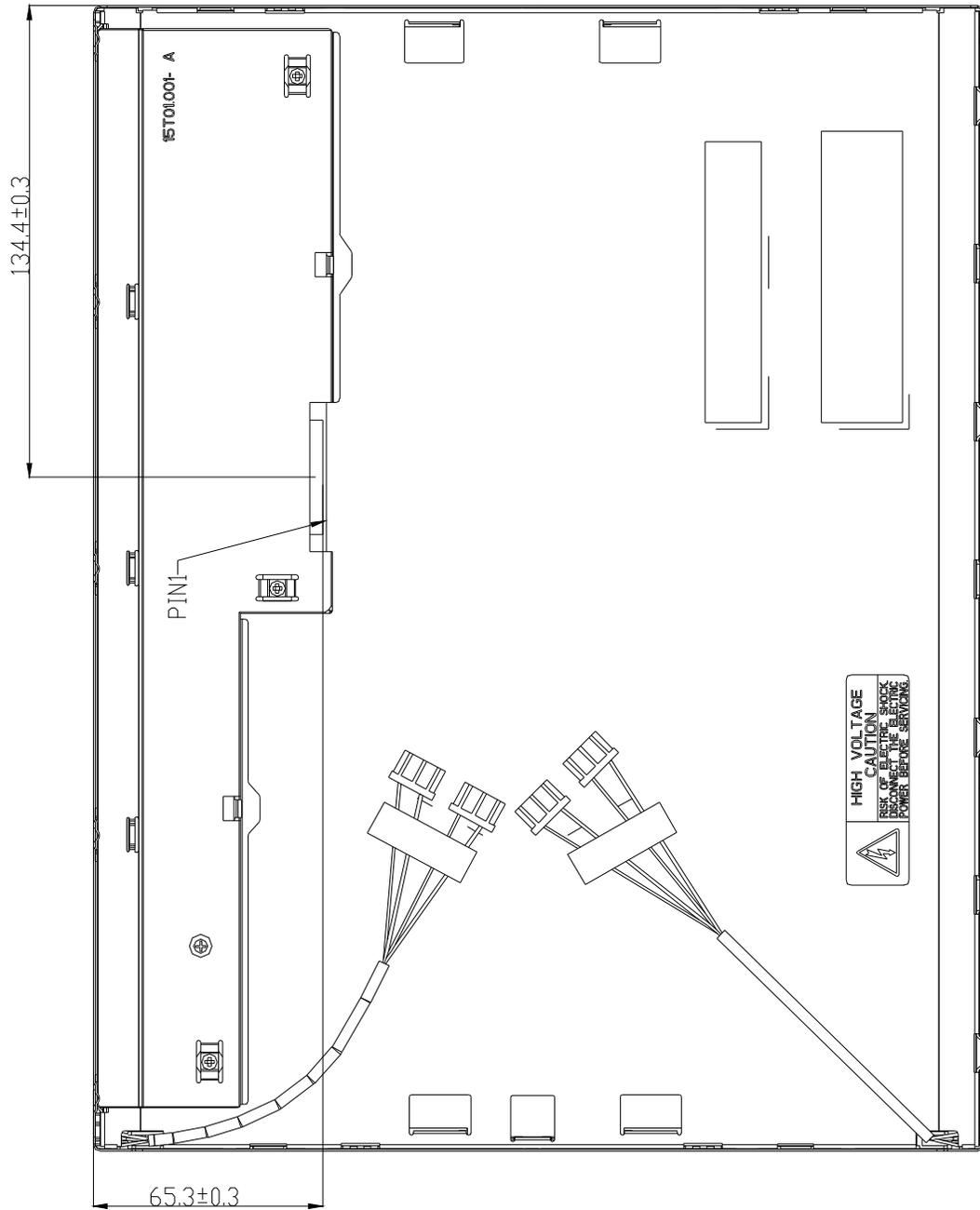


5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model T150XG01. In addition the figures in the next page are detailed mechanical drawing of the LCD.

| | | |
|---------------------|-----------------------|----------------------|
| Outline Dimension | Horizontal | 326.5mm |
| | Vertical | 253.5mm |
| | Depth | 14.4mm(w/o inverter) |
| Active Display Area | Horizontal | 304.128mm |
| | Vertical | 228.096mm |
| Weight | 1350g (typ.) | |
| Surface Treatment | Hard Coating (3H), AG | |







6. Reliability Test Items

Environment test condition

| No | Test Item | Condition | Remark |
|----|--|--|------------|
| 1 | High temperature storage test | Ta=60°C 300h | Note 1,2,3 |
| 2 | Low temperature storage test | Ta= -20°C 300h | Note 1,2,3 |
| 3 | High temperature operation test | Ta=50°C 300h | Note 1,2,3 |
| 4 | Low temperature operation test | Ta=0°C 300h | Note 1,2,3 |
| 5 | High temperature & high humidity operation | 50°C, 80%RH, 300Hrs (No condensation) | Note 1,2,3 |
| 6 | Temperature cycling (non-operation) | -20°C ~60°C 1H, 10mins, 1H, 5cycles | Note 1,2,3 |
| 7 | Vibration test (non-operation) | Vibration level : 1G RMS Bandwidth : 10-200-10Hz Duration: X, Y, Z 120min One time each direction | Note 1,2,3 |
| 8 | Shock test (non-operation) | Shock level: 50G Waveform: half sine wave, 20ms Direction: ±X, ±Y, ±Z One time each direction | Note 1,2,3 |
| 9 | Electrostatic discharge (non-operation) | 150 pF, 150Ω, 10kV, 1 second, 9 position on the panel, 10 times each place | Note 3 |

Note 1: Evaluation should be tested after storage at room temperature for one hour.

Note 2: There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

Note 3: Judgment: Function and display OK.



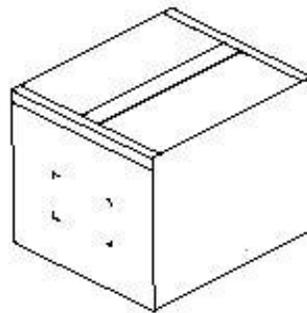
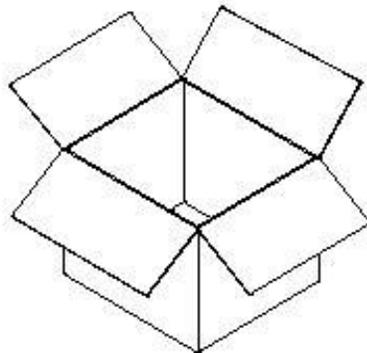
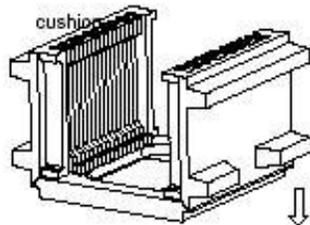
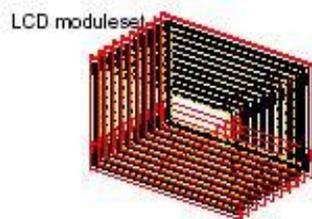
7. International Standard

7-1. Safety

(1) UL1950 Third Edition, Underwriters Laboratories, Inc. Jan. 28, 1995

Standard for Safety of Information Technology Equipment Including electrical Business Equipment.

8. Packing



Notes:

1. Max Capacity: 10 LCD module/Carton
2. Max Weight: 14kg/Carton
3. The outside dimension of carton is 490(L)mmx390(W)mmx360(H)mm



9. PRECAUTIONS

Please pay attention to the followings when you use this TFT LCD module.

9-1 MOUNTING PRECAUTIONS

- (1) You must mount a module using holes arranged in four corners or four sides.
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front/ rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

9-2 OPERATING PRECAUTIONS

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage: $V=\pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer..)
- (3) Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear



or spot will occur.

- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (6) 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 interface.

9-3 ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4 PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

9-5 STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

9-6 HANDLING PRECAUTIONS FOR PROTECTION FILM

- (1) The protection film is attached to the bezel with a small masking tape. When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the Bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the Bezel or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.