**(V ) Preliminary Specification**

**(   ) Final Specification**

| | |
|---|---|
| **Module** | 22" WSXGA+ Color TFT-LCD |
| **Model Name** | G220SW01 V0 |

| **Customer** | **Date** |
|---|---|
| | |

**Approved by**

| **Checked & Approved by** | **Date** |
|---|---|
| Debbie Chiu | 2008/09/02 |

**Prepared by**

Jimmy Tsai        2008/09/02

Note: This Specification is subject to change without notice.

General Display Business Division / AU Optronics corporation

# Contents

# Record of Revision

| Version and Date | Page | Old description | New Description | Remark |
|---|---|---|---|---|
| 0.1    2008/09/02 | All | First Edition for Customer | All | |
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# 1. Operating Precautions

1) Since front polarizer is easily damaged, pay attention not to scratch it.

2) Be sure to turn off power supply when inserting or disconnecting from input connector.

3) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.

4) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.

5) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface.

6) Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.

7) Do not open or modify the Module Assembly.

8) Do not press the reflector sheet at the back of the module to any directions.

9) In case if a Module has to be put back into the packing container slot after once it was taken out from the container, do not press the center of the CCFL reflector edge. Instead, press at the far ends of the CCFL Reflector edge softly. Otherwise the TFT Module may be damaged.

10) At the insertion or removal of the Signal Interface Connector, be sure not to rotate nor tilt the Interface Connector of the TFT Module.

11) After installation of the TFT Module into an enclosure, do not twist nor bend the TFT Module even momentary. At designing the enclosure, it should be taken into consideration that no bending/twisting forces are applied to the TFT Module from outside. Otherwise the TFT Module may be damaged.

12) Cold cathode fluorescent lamp in LCD contains a small amount of mercury. Please follow local ordinances or regulations for disposal.

13) Small amount of materials having no flammability grade is used in the LCD module. The LCD module should be supplied by power complied with requirements of Limited Power Source (IEC60950 or UL1950), or be applied exemption.

14) The LCD module is designed so that the CCFL in it is supplied by Limited Current Circuit (IEC60950 or UL1950). Do not connect the CCFL in Hazardous Voltage Circuit.

15) Severe temperature condition may result in different luminance, response time and lamp ignition voltage.

16) Continuous operating TFT-LCD display under low temperature environment may accelerate lamp exhaustion and reduce luminance dramatically.

17) The data on this specification sheet is applicable when LCD module is placed in landscape position.

18) Continuous displaying fixed pattern may induce image sticking. It is recommended to use screen saver or shuffle content periodically if fixed pattern is displayed on the screen.

## 2. General Description

This specification applies to the 22 inch-wide Color TFT-LCD Module G220SW01-V0.

The display supports the WSXGA+ (1680(H) x 1050(V)) screen format and 16.7M colors. All input signals are 2 Channels LVDS interface compatible.

Inverter card of backlight is not included. G220SW01-V0 is designed for industrial display applications.

## 2.1 Display Characteristics

The following items are characteristics summary on the table under 25 ℃ condition:

| Items | Unit | Specifications |
|---|---|---|
| Screen Diagonal | [inch] | 22 |
| Active Area | [mm] | 473.76 (H) x 296.1(V) |
| Pixels H x V | | 1680x3(RGB) x 1050 |
| Pixel Pitch | [mm] | 0.282x 0.282 |
| Pixel Arrangement | | R.G.B. Vertical Stripe |
| Display Mode | | P-MVA Mode,Normally Black |
| Nominal Input Voltage VDD | [Volt] | +5.0 V |
| Typical Power Consumption | [Watt] | 39 W (Typ)<br>(Without Invertor, All white pattern) |
| Weight | [Grams] | 2950 (Typ) |
| Physical Size | [mm] | 493.7(W) x 320.1(H) x 18.7(D) (Typ) |
| Electrical Interface | | Dual Channel LVDS |
| Surface Treatment | | Anti-glare, Hardness 3H |
| Support Color | | 16.7M colors (6-bits + HiFRC) |
| Temperature Range<br>  Operating<br>  Storage (Non-Operating) | [$^{o}$C]<br>[$^{o}$C] | 0 to +50<br>-20 to +60 |
| RoHS Compliance | | RoHS Compliance |

## 2.2 Optical Characteristics

The optical characteristics are measured under stable conditions at 25℃ (Room Temperature):

| Item | Unit | Conditions | Min. | Typ. | Max. | Note |
|------|------|-----------|------|------|------|------|
| White Luminance | [cd/m2] | IRCFL= 6.5mA (center point) | 240 | 300 | - | 1 (4mA) |
| Uniformity | % | 9 Points | 75 | 80 | - | 1, 2, 3 |
| Contrast Ratio | | | 600 | 1000 | - | 4 |
| Cross talk | % | | - | - | 1.5 | 5 |
| Response Time | [msec] | Rising | - | 15 | - | 6 |
| | | Falling | - | 5 | - | |
| | | Rising + Falling | - | 20 | - | |
| | | Gray to Gray | - | 8 | - | |
| Viewing Angle | [degree] [degree] | Horizontal (Right) CR = 10 (Left) | 75 75 | 89 89 | - - | 7 |
| | [degree] [degree] | Vertical (Upper) CR = 10 (Lower) | 75 75 | 89 89 | - - | |
| Color / Chromaticity Coordinates (CIE 1931) | | Red x | 0.616 | 0.646 | 0.676 | |
| | | Red y | 0.309 | 0.339 | 0.369 | |
| | | Green x | 0.260 | 0.290 | 0.320 | |
| | | Green y | 0.573 | 0.603 | 0.633 | |
| | | Blue x | 0.115 | 0.145 | 0.175 | |
| | | Blue y | 0.040 | 0.070 | 0.100 | |
| | | White x | 0.283 | 0.313 | 0.343 | |
| | | White y | 0.299 | 0.329 | 0.359 | |
| Color Gamut | % | | | 72 | - | |

Note 1: Measurement method

Equipment Pattern Generator, Power Supply, Digital Voltmeter, Luminance meter (SR_3 or equivalent)
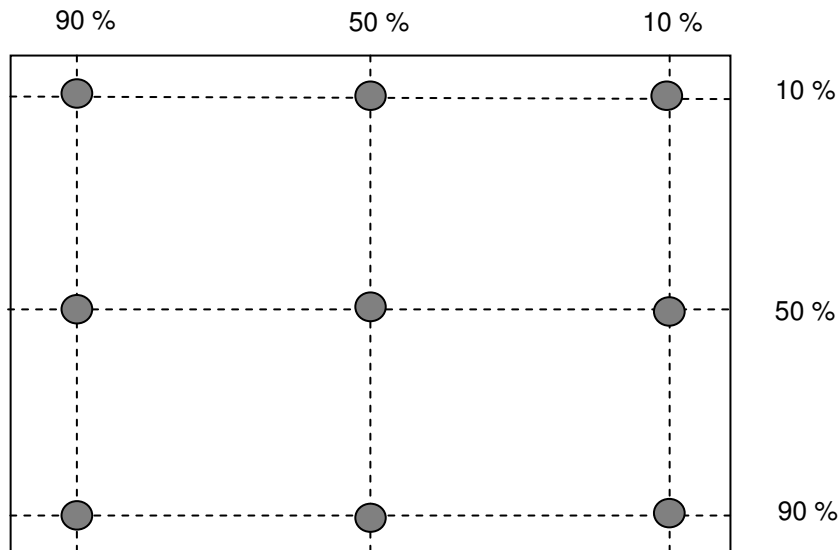
Aperture        1° with 50cm viewing distance

Test Point      Center

Environment     < 1 lux
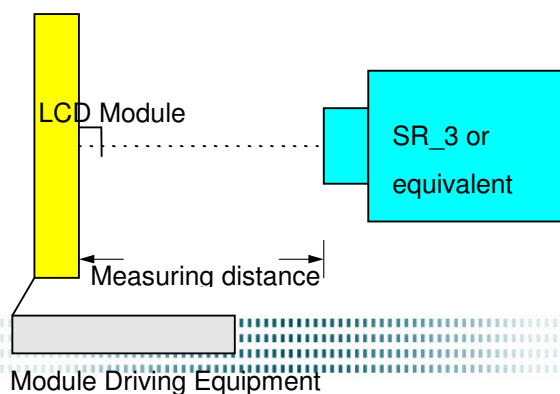
Note 2: Definition of 9 points position (Display active area : 304.128(H) x 228.096(V))

90 %          50 %          10 %

10 %

50 %

90 %

Note 3: The luminance uniformity of 9 points is defined by dividing the minimum luminance values by the maximum test point luminance

$$\delta_{W9} = \frac{\text{Minimum Brightness of nine points}}{\text{Maximum Brightness of nine points}}$$

Note 4 : Definition of contrast ratio (CR):

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "White" state}}{\text{Brightness on the "Black" state}}$$
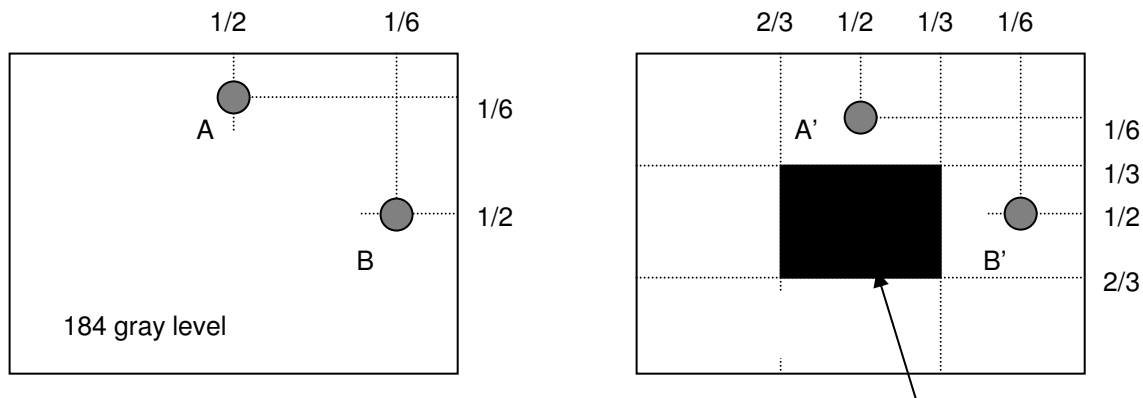
Note 5 : Definition of cross talk (CT)

CT = | YB – YA | / YA × 100 (%)
Where
YA = Luminance of measured location without gray level 0 pattern (cd/m2)
YB = Luminance of measured location with gray level 0 pattern (cd/m2)

1/2          1/6                          2/3    1/2    1/3    1/6

1/6                                                        1/6

A                                       A'                    1/3

1/2                                                        1/2

B                                       B'                    2/3

184 gray level

Note 6: Definition of response time:

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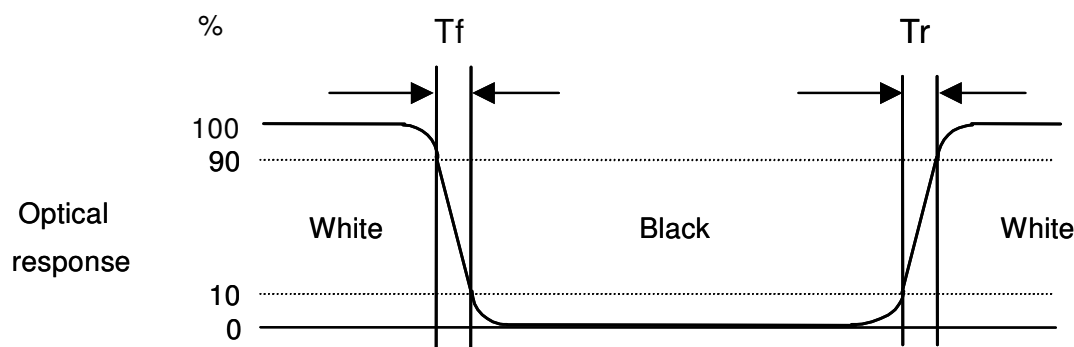


Note 7: Definition of viewing angle

Viewing angle is the measurement of contrast ratio $\geqq 10$, 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 below: 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 to its center to develop the desired measurement viewing angle.
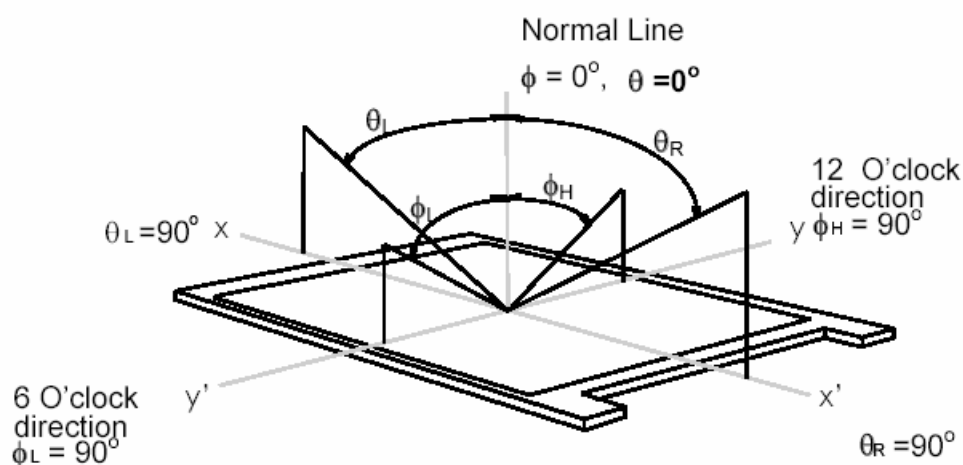
## 3. Functional Block Diagram

The following diagram shows the functional block of the 22 inches wide Color TFT-LCD Module:
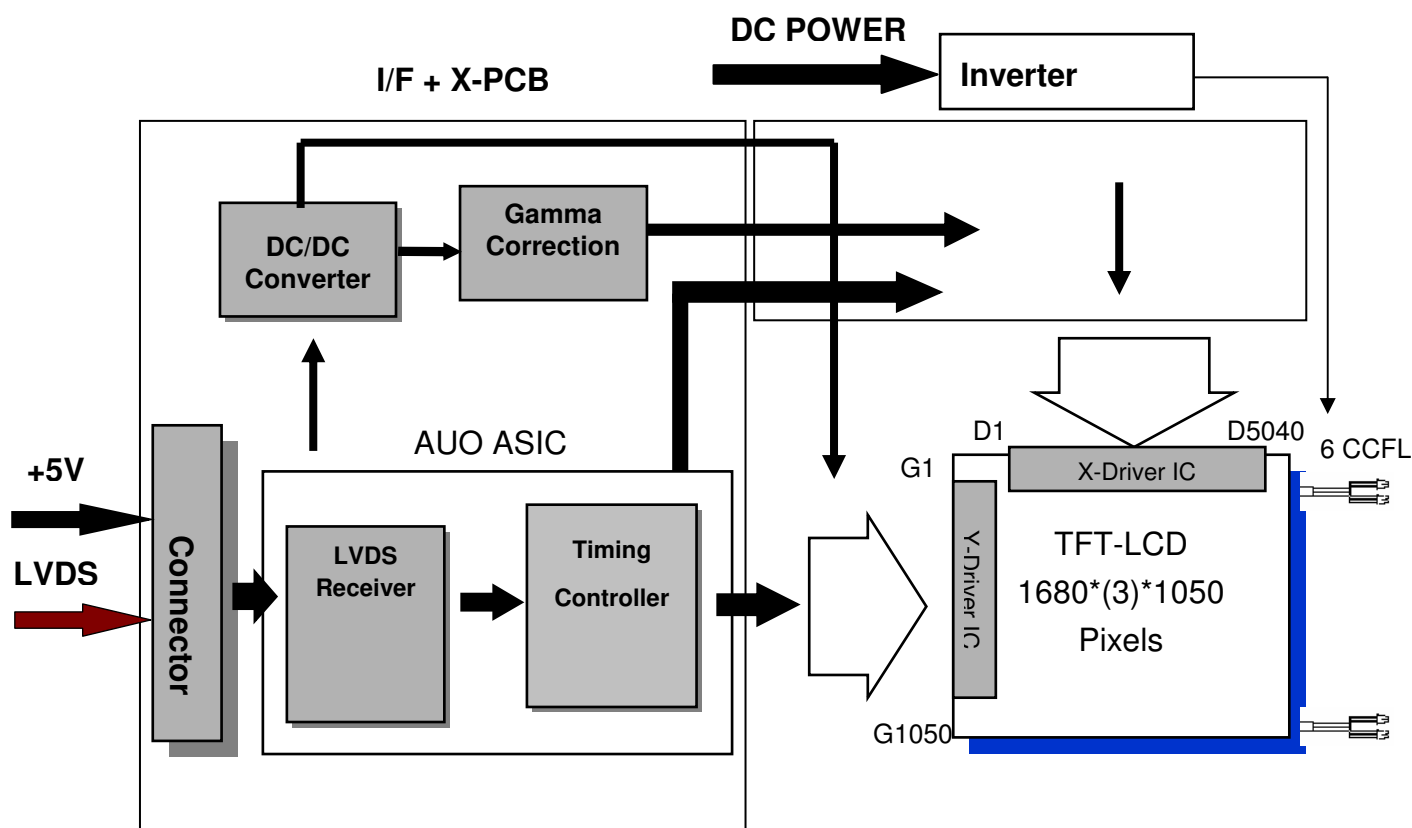


LVDS Connector:  JAE (FI-XB30SRL-HF11) or equivalent.
Lamp Connector:  Socket type (YEONHO 3500IHS-02L) or equivalent.

# 4. Absolute Maximum Ratings

## 4.1 Absolute Ratings of TFT LCD Module

| Item | Symbol | Min | Max | Unit |
|------|--------|-----|-----|------|
| Logic/LCD Drive Voltage | VDD | -0.3 | +5.5 | [Volt] |

## 4.2 Absolute Ratings of Environment

| Item | Symbol | Min | Max | Unit |
|------|--------|-----|-----|------|
| Operating Temperature | TOP | 0 | +50 | [$^{o}$C] |
| Operation Humidity | HOP | 5 | 90 | [%RH] |
| Storage Temperature | TST | -20 | +60 | [$^{o}$C] |
| Storage Humidity | HST | 8 | 90 | [%RH] |

Note: Maximum Wet-Bulb should be 39℃ and no condensation.
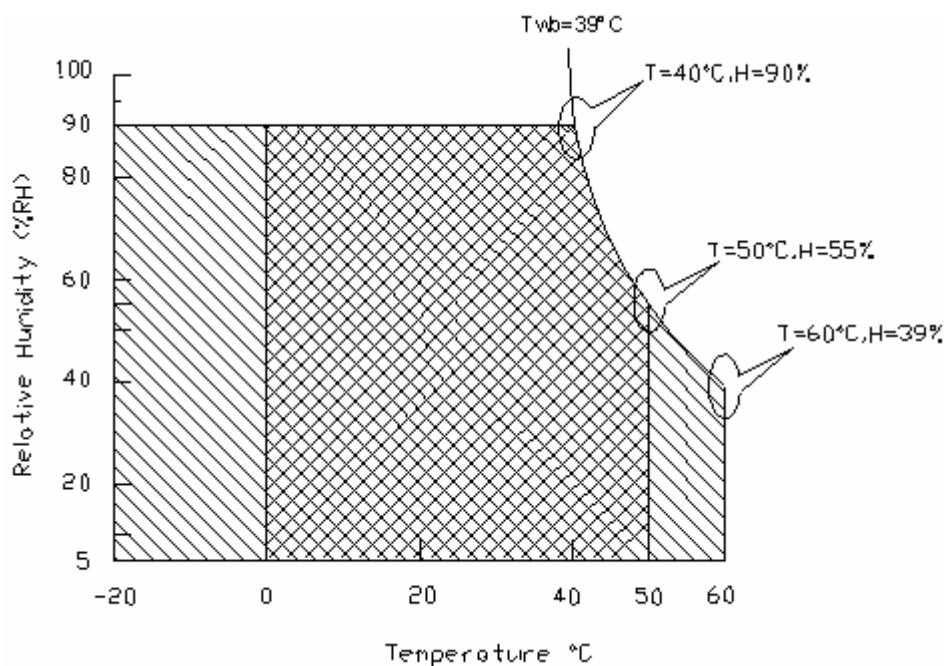


Operating Range     Storage Range

# 5. Electrical Characteristics

## 5.1 TFT LCD Module

### 5.1.1 Power Specification

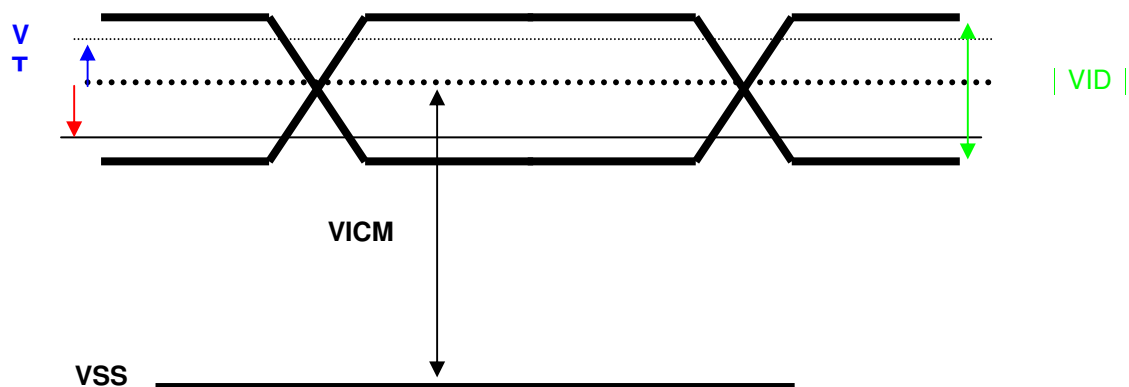| Symbol | Parameter | Min | Typ | Max | Units | Remark |
|--------|-----------|-----|-----|-----|-------|--------|
| VDD | Logic/LCD Drive Voltage | 4.5 | 5.0 | 5.5 | [Volt] | ±10% |
| IDD | VDD Current | - | 1300 | TBD | [mA] | VDD= 5.0V, All White Pattern At 60Hz |
| Irush | LCD Inrush Current | - | - | 3 | [A] | Note 1 |
| PDD | VDD Power | - | 6.5 | TBD | [Watt] | VDD= 5.0V, All Black Pattern At 60Hz |

Note 1: Measurement condition:

## 5.1.2 Signal Electrical Characteristics

Input signals shall be low or Hi-Z state when VDD is off.

| Symbol | Item | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| VTH | Differential Input High Threshold | - | - | 100 | [mV] | VCM=1.2V |
| VTL | Differential Input Low Threshold | -100 | - | - | [mV] | VCM=1.2V |
| \|VID\| | Input Differential Voltage | 100 | 400 | 600 | [mV] | |
| VICM | Differential Input Common Mode Voltage | 0.3 | - | 1.25 | [V] | VTH/VTL=±100mV |

Note: LVDS Signal Waveform.

## 5.2 Backlight Unit

### 5.2.1 Parameter guideline for CCFL

Following characteristics are measured under a stable condition using an inverter at 25℃ (Room Temperature):

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Remark |
|--------|-----------|------|------|------|------|--------|
| IRCFL | CCFL Operation Current | 3 | 6.5 | - | [mA] rms | (Ta=25$^{o}$C) Note 1 |
| FCFL | CCFL Frequency | 40 | 50 | 60 | [KHz] | (Ta=25$^{o}$C) Note 2 |
| ViCFL (0$^{o}$C) (reference) | CCFL Ignition Voltage | - | 1440 | 1730 | [Volt] rms | (Ta= 0$^{o}$C) |
| ViCFL (25$^{o}$C) (reference) | CCFL Ignition Voltage | - | 1200 | 1440 | [Volt] rms | (Ta=25$^{o}$C) |
| VCFL | CCFL Operation Voltage | 747 | 830 | 913 | [Volt] rms | (Ta=25$^{o}$C) IRCFL=6.5mA VCFL = Typ±10% |
| PCFL | CCFL Power consumption (inverter excluded) | - | 32.4 | - | [Watt] | (Ta=25$^{o}$C) Note 3, 5 IRCFL=6.5mA |
| Lamp Life | | 40,000 | 50,000 | | Hrs | (Ta=25$^{o}$C) Note 4 IRCFL = 6.5mA |

Note 1: IRCFL is defined as the return current of an inverter. (In Figure. 1)
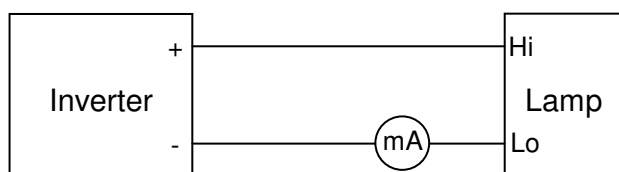


(Figure. 1: Measurement of return current)

A stable IRCFL is a current without flicker or biasing waveform provided by inverter that ensures the backlight perform to its specification. The ideal sine waveform should be symmetric in positive and negative polarities and the asymmetry rate of the inverter waveform should be below 10%.



(Note) Ip: Positive peak value
I-p: Negative peak value
Irms: Effective value
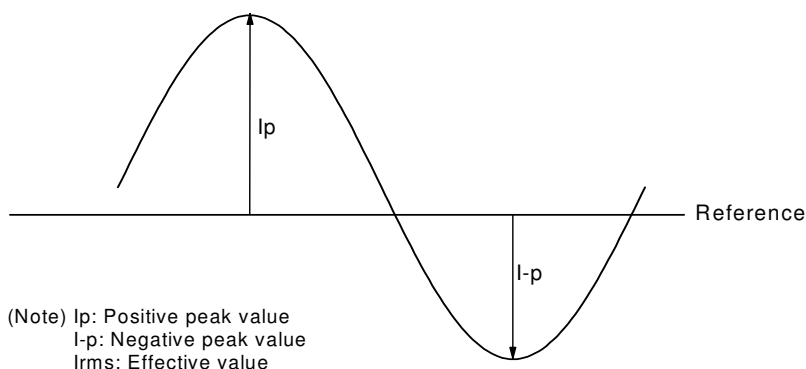
DC Bias = (| Ip – I-p| / Irms ) x 100 % <10%

Crest Factor = Ip or (I-p) / Irms should have the range within 1.414 $\pm$ 10%


It is recommended to use the inverter with detection circuit ( ie: balance and protection circuit) to avoid overvoltage, overcurrent, or mismatching waveform.


Note 2: CCFL frequency should be carefully determined to avoid interference between inverter and TFT LCD. Higher frequency will induce higher leakage current and further impact lamp life.

Note 3: Calculation value for reference (IRCFLxVCFLx6=PCFL).

Note 4: The definition of lamp life means when any of following conditions happen:

   a)   Luminance falls to 50% or less of the initial value.

   b)   Normal lighting is no more available (flickering, pink lighting, no lighting, etc.)

   c)   Lamp voltage or lighting start voltage exceeds the specified value.


   Lamp life time shortens according to

   a)   Placing methodology: mercury is unevenly distributed in portrait mounting

   b)   Environmental condition: low temperature reduces the presence of mercury vapor, which results in approximately lamp life of 1,000 hours

   c)   CCFL surface temperature: Presence of gradient in lamp surface temperature causes uneven mercury migration

   d)   Inverter design: its resonance capacitor should be fine-tuned with the impedance of CCFL

   e)   Over driving current ( > TBD mA) shortens lamp life time dramatically.


Note 5: The display is with 6 lamps design, and the CCFL current in above table refers to each lamp.

# 6. Signal Characteristic

## 6.1 Pixel Format Image

Following figure shows the relationship of the input signals and LCD pixel format.
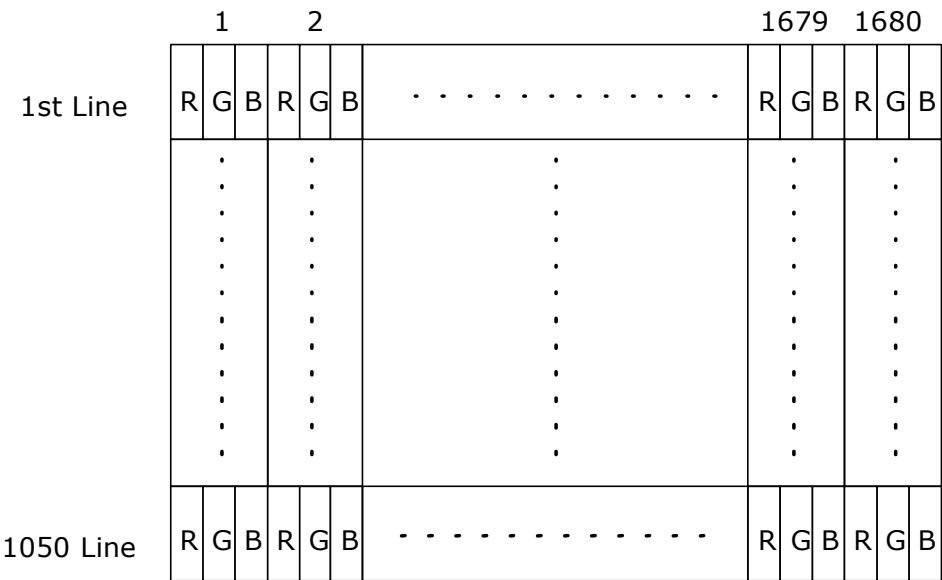
## 6.2 Signal Description

The module using a pair of LVDS receiver SN75LVDS82(Texas Instruments) or compatible. LVDS is a differential signal technology for LCD interface and high speed data transfer device. Transmitter shall be SN75LVDS83(negative edge sampling) or compatible**.** The first LVDS port(RxOxxx) transmits odd pixels while the second LVDS port(RxExxx) transmits even pixels.

| PIN # | SIGNAL NAME | DESCRIPTION |
|---|---|---|
| 1 | RxOIN0- | Negative LVDS differential data input (Odd data) |
| 2 | RxOIN0+ | Positive LVDS differential data input (Odd data) |
| 3 | RxOIN1- | Negative LVDS differential data input (Odd data) |
| 4 | RxOIN1+ | Positive LVDS differential data input (Odd data) |
| 5 | RxOIN2- | Negative LVDS differential data input (Odd data, H-Sync, V-Sync, DSPTMG) |
| 6 | RxOIN2+ | Positive LVDS differential data input (Odd data, H-Sync, V-Sync, DSPTMG) |
| 7 | GND | Power Ground |
| 8 | RxOCLKIN- | Negative LVDS differential clock input (Odd clock) |
| 9 | RxOCLKIN+ | Positive LVDS differential clock input (Odd clock) |
| 10 | RxOIN3- | Negative LVDS differential data input (Odd data) |
| 11 | RxOIN3+ | Positive LVDS differential data input (Odd data) |
| 12 | RxEIN0- | Negative LVDS differential data input (Even data) |
| 13 | RxEIN0+ | Positive LVDS differential data input (Even data) |
| 14 | GND | Power Ground |
| 15 | RxEIN1- | Positive LVDS differential data input (Even data) |
| 16 | RxEIN1+ | Negative LVDS differential data input (Even data) |
| 17 | GND | Power Ground |
| 18 | RxEIN2- | Negative LVDS differential data input (Even data) |
| 19 | RxEIN2+ | Positive LVDS differential data input (Even data) |
| 20 | RxECLKIN- | Negative LVDS differential clock input (Even clock) |
| 21 | RxECLKIN+ | Positive LVDS differential clock input (Even clock) |
| 22 | RxEIN3- | Negative LVDS differential data input (Even data) |
| 23 | RxEIN3+ | Positive LVDS differential data input (Even data) |
| 24 | GND | Power Ground |
| 25 | NC | No contact (For AUO test only) |
| 26 | NC | No contact (For AUO test only) |
| 27 | NC | No contact (For AUO test only) |
| 28 | VCC | +5.0V Power Supply |
| 29 | VCC | +5.0V Power Supply |
| 30 | VCC | +5.0V Power Supply |

Note1: Start from left side

Connector

1    30

RxOIN0-

VCC
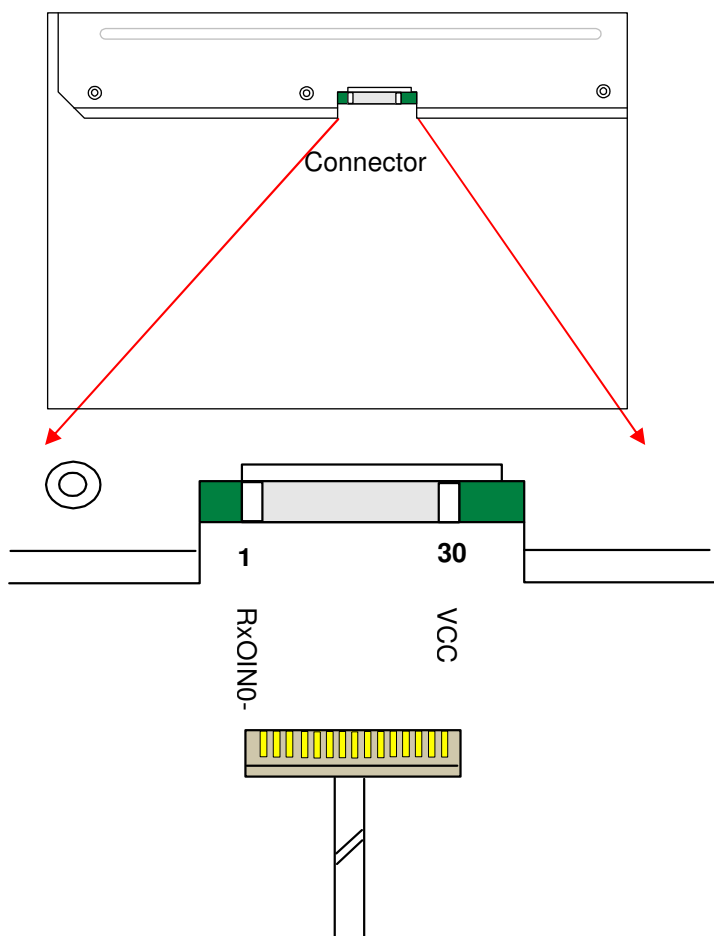
Note2: Input signals of odd and even clock shall be the same timing.

## 6.3 The Input Data Format
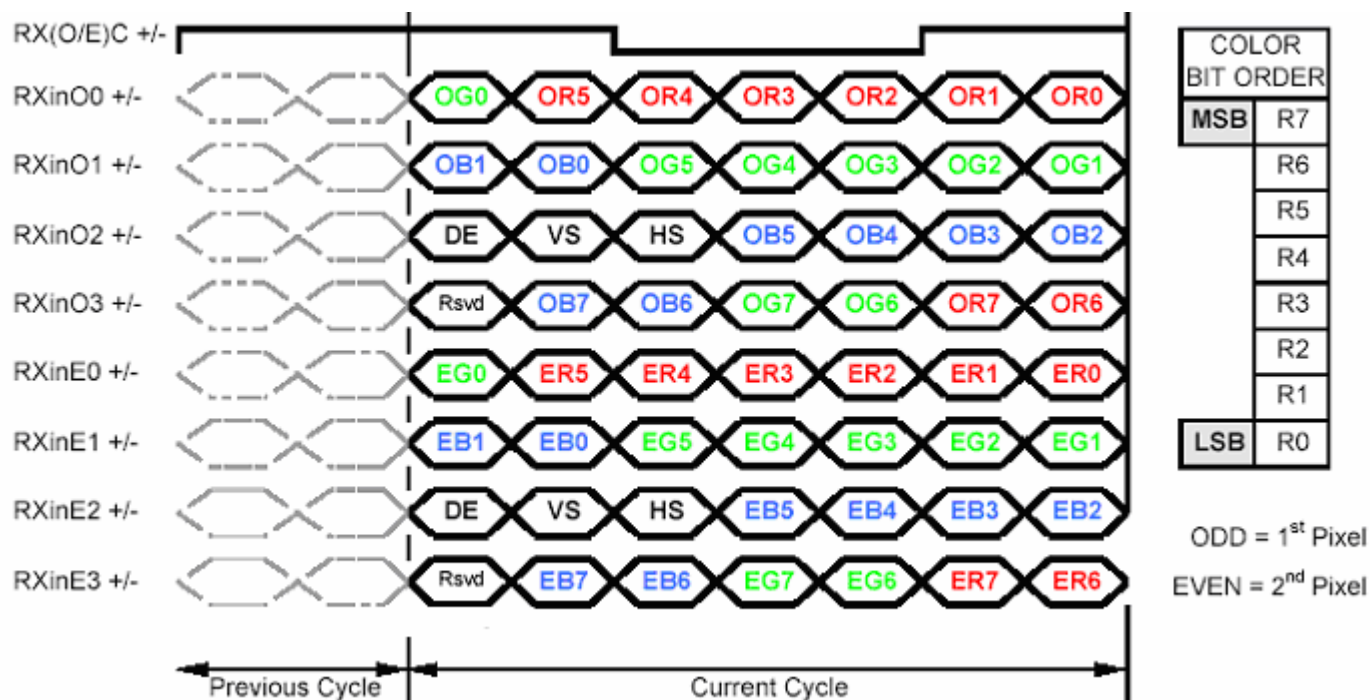


Note1: 8-bits signal input.
Note2: L:NS alike H:Thine alike
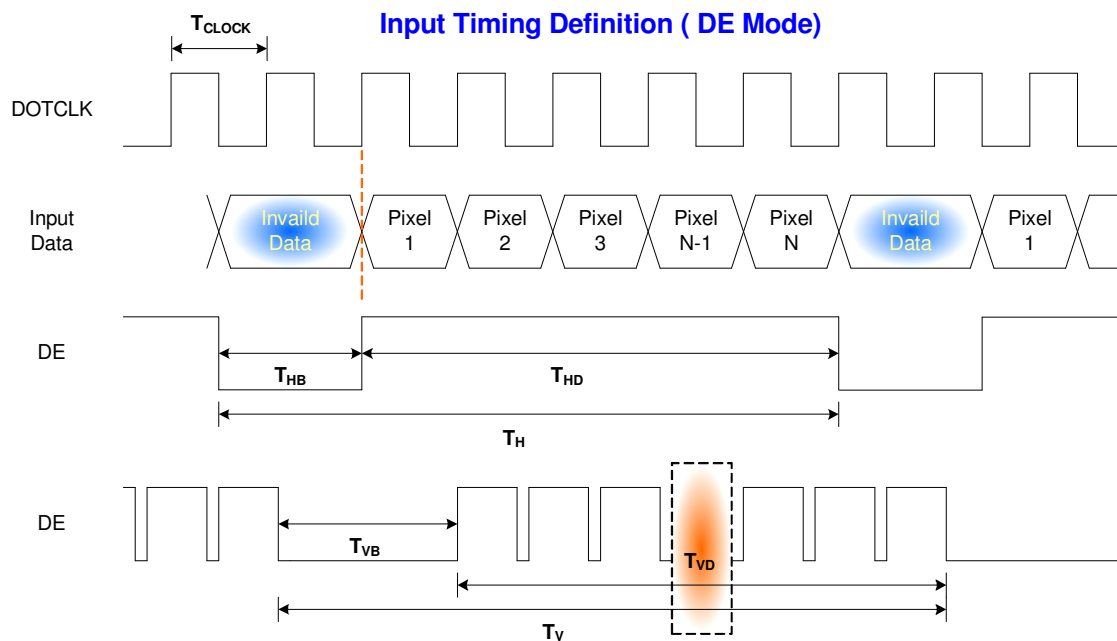
## 6.4 Interface Timing

### 6.4.1 Timing Characteristics

| Signal | Item | Symbol | Min | Typ | Max | Unit |
|--------|------|--------|-----|-----|-----|------|
| Clock | Frequency | 1/ $T_{Clock}$ | 60 | 72.1 | 85 | MHz |
| Vertical Section | Period | $T_V$ | 1058 | 1066 | 2047 | T_line |
| | Active | $T_{VD}$ | 1050 | 1050 | 1050 | |
| | Blanking | $T_{VB}$ | 8 | 16 | 997 | |
| Horizontal Section | Period | $T_H$ | 870 | 1128 | 2047 | T_clock |
| | Active | $T_{HD}$ | 840 | 840 | 840 | |
| | Blanking | $T_{HB}$ | 30 | 288 | 1207 | |

Note: Frame rate is 60 Hz.
Note: DE mode only.
Note : Typical value refer to VESA STANDARD

### 6.4.2 Input Timing Diagram

## 6.5 Power ON/OFF Sequence

VDD power and lamp on/off sequence is as below. Interface signals are also shown in the chart. Signals from any system shall be Hi-Z state or low level when VDD is off.
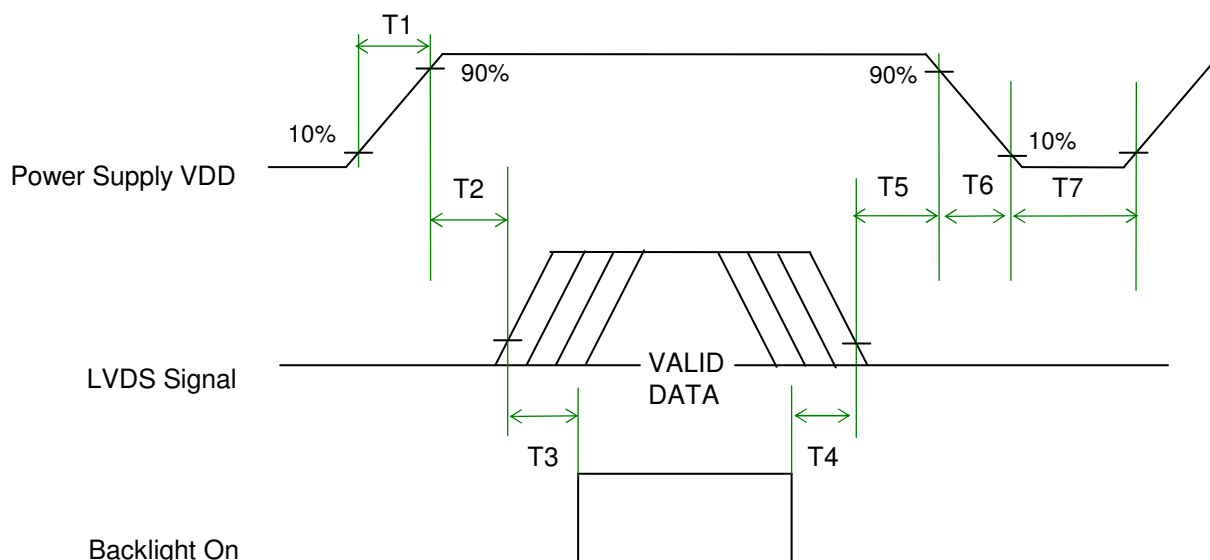


### Power ON/OFF sequence timing

| Parameter | Value | | | Units |
|:---:|:---:|:---:|:---:|:---:|
| | Min. | Typ. | Max. | |
| T1 | 0.5 | - | 10 | [ms] |
| T2 | 0 | 40 | 50 | [ms] |
| T3 | 200 | - | - | [ms] |
| T4 | 200 | - | - | [ms] |
| T5 | 0.5 | 16 | 50 | [ms] |
| T6 | - | - | 100 | [ms] |
| T7 | 1000 | - | - | [ms] |

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

# 7. Connector & Pin Assignment

Physical interface is described as for the connector on module. These connectors are capable of accommodating the following signals and will be following components.

## 7.1 TFT LCD Module: LVDS Connector

| Connector Name / Designation | Interface Connector / Interface card |
|---|---|
| Manufacturer | LVDS: JAE or compatible |
| Type Part Number | LVDS : JAE (FI-XB30SRL-HF11) or equivalent. |
| Mating Housing Part Number | FI-X30H (JAE) or compatible |

| Pin# | Signal Name | Pin# | Signal Name |
|---|---|---|---|
| 1 | RxOIN0- | 2 | RxOIN0+ |
| 3 | RxOIN1- | 4 | RxOIN1+ |
| 5 | RxOIN2- | 6 | RxOIN2+ |
| 7 | GND | 8 | RxOCLKIN- |
| 9 | RxOCLKIN+ | 10 | RxOIN3- |
| 11 | RxOIN3+ | 12 | RxEIN0- |
| 13 | RxEIN0+ | 14 | GND |
| 15 | RxEIN1- | 16 | RxEIN1+ |
| 17 | GND | 18 | RxEIN2- |
| 19 | RxEIN2+ | 20 | RxECLKIN- |
| 21 | RxECLKIN+ | 22 | RxEIN3- |
| 23 | RxEIN3+ | 24 | GND |
| 25 | NC | 26 | NC |
| 27 | NC | 28 | VCC |
| 29 | VCC | 30 | VCC |

## 7.1.1 Connector Illustration
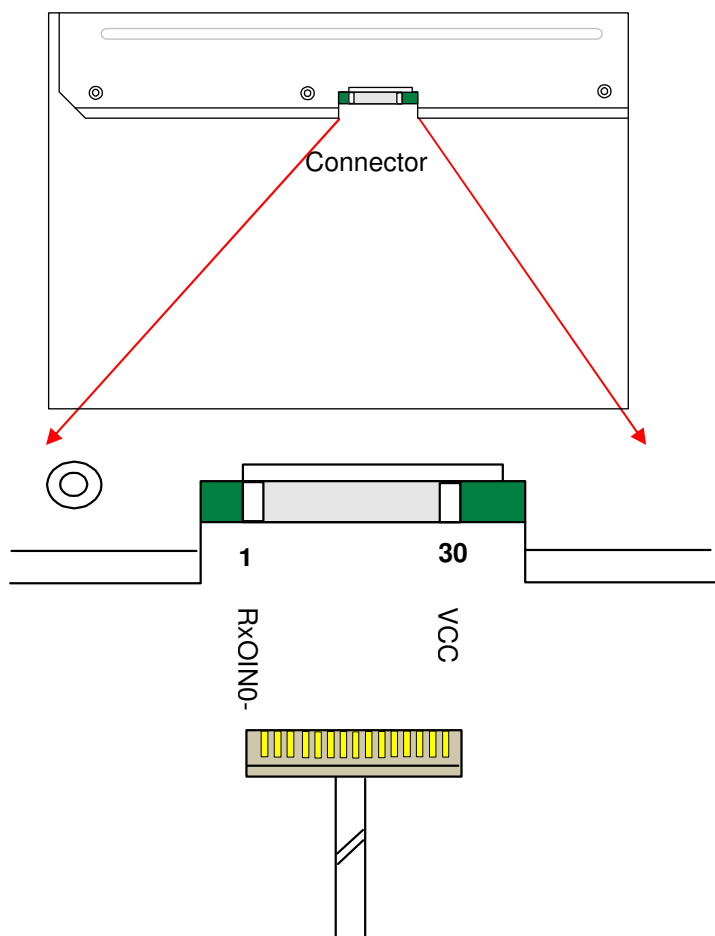
## 7.2 Backlight Unit: Lamp Connector

| Connector Name / Designation | Lamp Connector |
|---|---|
| Manufacturer | YEONHO or compatible |
| Connector Model Number | YEONHO 3500IHS-02L or compatible |
| Mating Model Number | TBD |

| | Connector No. | Pin No. | Color | Function |
|---|---|---|---|---|
| Upper | CN1 | 1 | Sky Blue | High Voltage |
| | | 2 | Black | Ground |
| | CN2 | 1 | Pink | High Voltage |
| | | 2 | White | Ground |
| | CN3 | 1 | White | High Voltage |
| | | 2 | Gray | Ground |

| | Connector No. | Pin No. | Color | Function |
|---|---|---|---|---|
| Lower | CN4 | 1 | Sky Blue | High Voltage |
| | | 2 | Black | Ground |
| | CN5 | 1 | Pink | High Voltage |
| | | 2 | White | Ground |
| | CN6 | 1 | White | High Voltage |
| | | 2 | Gray | Ground |

◆ Cable length: 170 ± 10 mm

## 8. Reliability Test

Environment test conditions are listed as following table.

| Items | Required Condition | Note |
|---|---|---|
| Temperature Humidity Bias | Ta= 50℃, 80%RH, 300hours | |
| High Temperature Operation | Ta= 50℃, 300hours | |
| Low Temperature Operation | Ta= 0℃, 300hours | |
| High Temperature Storage | Ta= 60℃, 300hours | |
| Low Temperature Storage | Ta= -20℃, 300hours | |
| Thermal Shock Test | -20℃/30min, 60℃/30min, 100 cycles | |
| Shock Test (Non-Operating) | 50G,20ms,Half-sine wave,( ±X, ±Y, ±Z) | |
| Vibration Test (Non-Operating) | 1.5G, (10~200Hz, P-P) <br> 30 mins/axis (X, Y, Z) | |
| On/off test | On/10 sec, Off/10 sec, 30,000 cycles | |
| ESD | Contact Discharge: ± 8KV, 150pF(330Ω ) 1sec, <br> 8 points, 25 times/ point. | Note 1 |
| | Air Discharge: ± 15KV, 150pF(330Ω ) 1sec <br> 8 points, 25 times/ point. | |

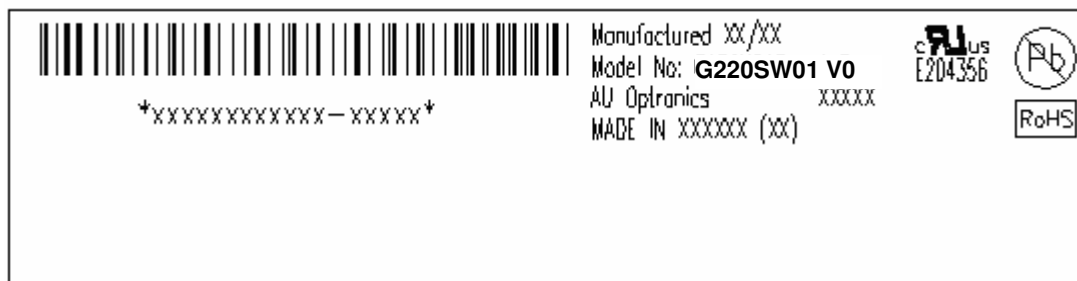Note1: According to EN61000-4-2, ESD class B: Some performance degradation allowed. No data lost

. Self-recoverable. No hardware failures.

# 9. Mechanical Characteristics

Cable Length > 170mm

G220SW01 V0
MI-0
Date Code

48±5

71.77±10

117.45±10

BL    S

Module Assembly G220SW01 V0
9722G01.000
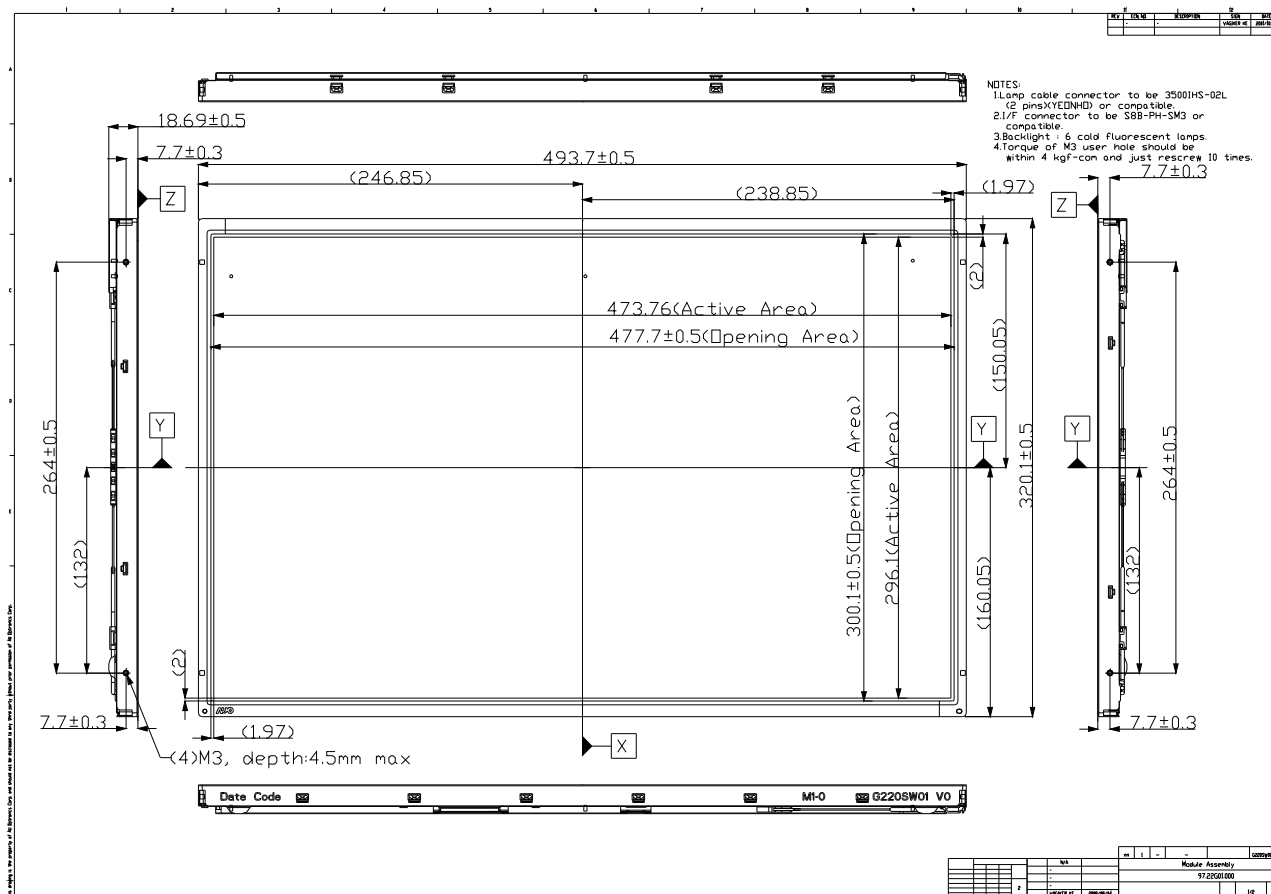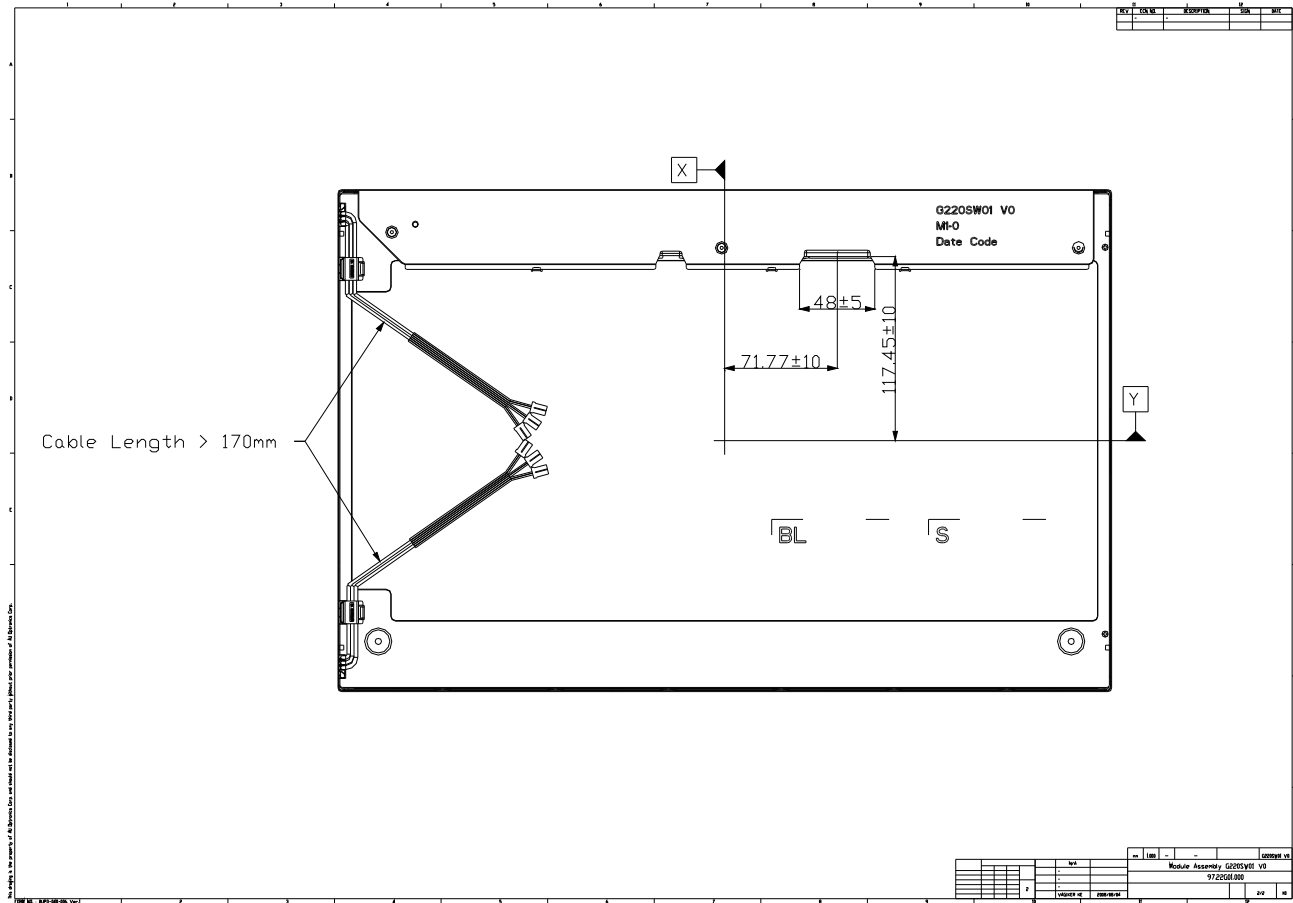
## 10. Label and Packaging

### 10.1 Shipping Label (on the rear side of TFT-LCD display)

Manufactured XX/XX
Model No: G220SW01 V0
AU Optronics          XXXXX
MADE IN XXXXXX (XX)
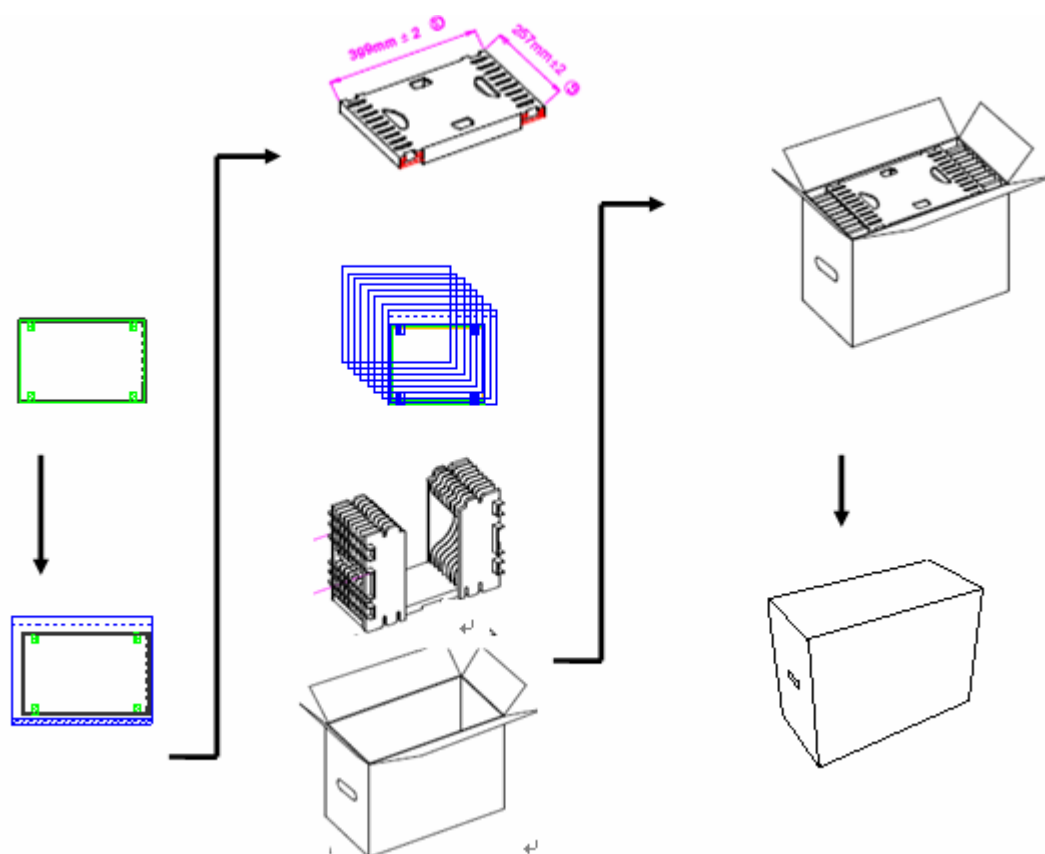
*xxxxxxxxxxxx—xxxxx*

E204356

RoHS

### 10.2 Carton Package

Max capacity: 22 TFT-LCD module per carton (8pcs * 1 layers)
Max weight: 26 kg per carton
Outside dimension of carton: 562(L)mm* 275(W)mm* 426(H)mm

# 11. Safety

## 11.1 Sharp Edge Requirements

There will be no sharp edges or comers on the display assembly that could cause injury.

## 11.2 Materials

### 11.2.1 Toxicity

There will be no carcinogenic materials used anywhere in the display module. If toxic materials are used, they will be reviewed and approved by the responsible AUO toxicologist.

### 11.2.2 Flammability

All components including electrical components that do not meet the flammability grade UL94-V1 in the module will complete the flammability rating exception approval process.

The printed circuit board will be made from material rated 94-V1 or better. The actual UL flammability rating will be printed on the printed circuit board.

## 11.3 Capacitors

If any polarized capacitors are used in the display assembly, provisions will be made to keep them from being inserted backwards.

## 11.4 National Test Lab Requirement

The display module will satisfy all requirements for compliance to:

**UL 1950, First Edition**           U.S.A. Information Technology Equipment