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AU OPTRONICS CORPORATION

Product Functional Specifications

12.1" SVGA Color TFT-LCD Module

Model Name: G0121SN01 V.0

| | |
|-------------------|--------------------|
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12.1 inch SVGA Color TFT LCD Module
Model Name: G121SN01 V.0

Preliminary Specification
 Final Specification

Note: This Specification is subject to change without notice.



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II. Record of Revision

| Version and Date | Page | Old Description | New Description | Remark |
|------------------|------|-----------------|-----------------|--------|
| 0. 2004/10/27 | All | First Draft | All | |



1.0 Handling 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 disconnection 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 nor 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 CFL 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 should be supplied by power complied with requirements of Limited Power Source, or be applied exemption.
- 14) The LCD module is designed so that the CCFL in it is supplied by Limited Current Circuit. Do not connect the CFL in Hazardous Voltage Circuit.



2.0 General Description

This specification applies to the 12.1 inch Color TFT LCD Module G121SN01 V.0.

This module is designed for display units of Industrial Applications.

The screen format is intended to support the SVGA (800(H) x 600(V)) screen and 262k colors (RGB 6-bits data driver).

All input signals are LVDS interface compatible.

The module does not contain an inverter card for backlight.

2.1 Display Characteristics

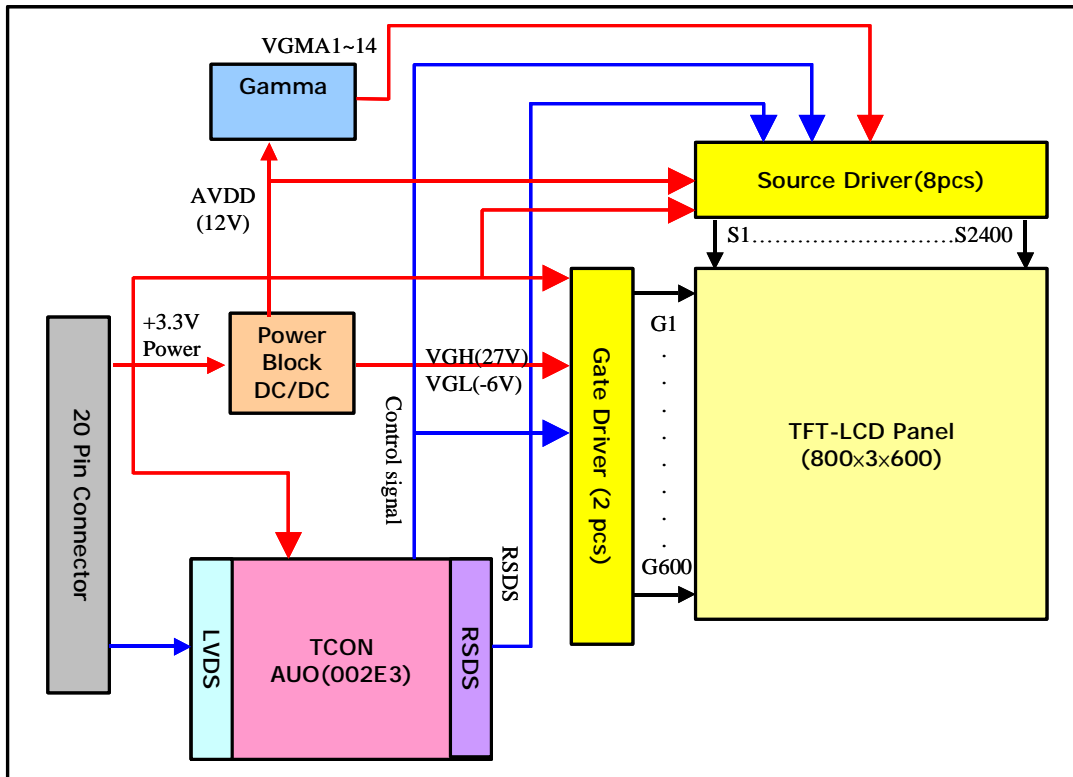
The following items are characteristics summary on the table under 25°C condition :

| Items | Unit | Specifications |
|---|----------------------|---------------------------------------|
| Screen Diagonal | [mm] | 310 (12.1") |
| Active Area | [mm] | 246.0(H) x 184.5(V) |
| Pixel H x V | | 800(x3) x 600 |
| Pixel Pitch | [mm] | 0.3075(H) x 0.3075(V) |
| Pixel Arrangement | | R.G.B. Vertical Stripe |
| Display Mode | | Normally White |
| Typical White Luminance (ICFL=6 mA) | [cd/m ²] | 400 Typ. (center) |
| Contrast Ratio | | 500 : 1 Typ. |
| Optical Rise Time/Fall Time | [msec] | 10/25 Typ. |
| Nominal Input Voltage VDD | [Volt] | +3.3 Typ. |
| Typical Power Consumption (VDD line + VCFL line) | [Watt] | 7.8 Typ |
| Weight | [Grams] | 660 ±10 |
| Physical Size | [mm] | 279.0(W) x 209.0(H) x 11(D) |
| Electrical Interface | | LVDS |
| Support Color | | Native 262K colors (RGB 6-bit driver) |
| Temperature Range | | |
| Operating | [°C] | -10 to +65 |
| Storage(Shipping) | [°C] | -30 to +70 |



2.2 Functional Block Diagram

The following diagram shows the functional block of the 12.1 inch Color TFT LCD Module :





3.0 Absolute Maximum Ratings

Absolute maximum ratings of the module is as follows :

| Item | Symbol | Min | Max | Unit | Conditions |
|-------------------------|--------|------|---------|----------|------------|
| Logic/LCD Drive Voltage | VDD | -0.3 | +4.0 | [Volt] | |
| Input Voltage of Signal | Vin | -0.3 | VDD+0.3 | [Volt] | |
| CCFL Current | ICFL | 4 | 7 | [mA] rms | |
| CCFL Ignition Voltage | Vs | - | 690 | Vrms | 25°C |
| | | | 890 | | 0°C |
| Operating Temperature | TOP | -10 | +65 | [°C] | Note1 |
| Operating Humidity | HOP | 8 | 95 | [%RH] | Note1 |
| Storage Temperature | TST | -30 | +70 | [°C] | Note1 |
| Storage Humidity | HST | 5 | 95 | [%RH] | Note1 |

Note1 : Maximum Wet-Bulb should be 39°C and no condensation.

TBD



4.0 Optical Characteristics

The optical characteristics are measured under stable conditions as follows under 25°C condition :

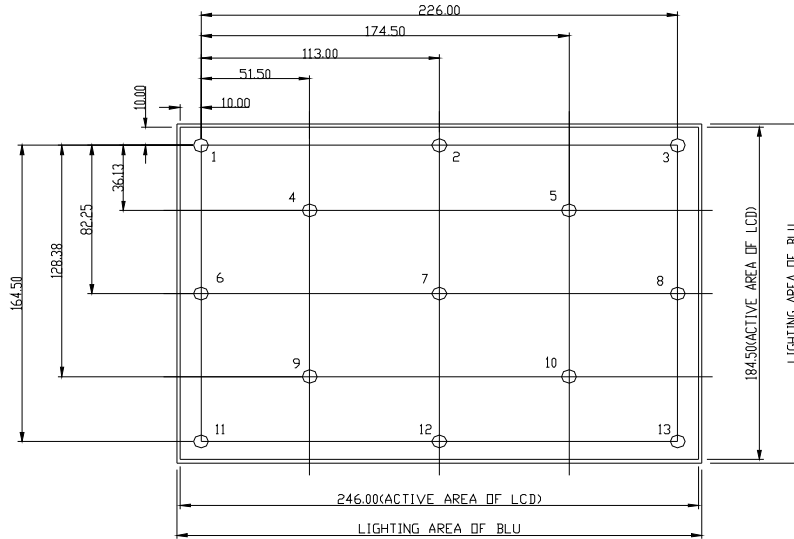
| Item | Unit | Conditions | Min. | Typ. | Max. |
|---|----------------------|--------------------|-------|-------|-------|
| Viewing Angle | [degree] | Horizontal (Right) | — | 70 | — |
| | [degree] | K = 10 (Left) | | 70 | |
| K : Contrast ratio | [degree] | Vertical (Upper) | — | 50 | — |
| | [degree] | K = 10 (Lower) | | 60 | |
| White Uniformity | | 13 Points | — | — | 1.6 |
| Contrast ratio | | $\theta = 0^\circ$ | 400 | 500 | — |
| Response Time (Room Temp) | [msec] | Rising | — | 10 | 20 |
| | [msec] | Falling | — | 25 | 30 |
| Color Chromaticity Coordinates(CIE) | | Red x | TBD | TBD | TBD |
| | | Red y | TBD | TBD | TBD |
| | | Green x | TBD | TBD | TBD |
| | | Green y | TBD | TBD | TBD |
| | | Blue x | TBD | TBD | TBD |
| | | Blue y | TBD | TBD | TBD |
| | | White x | 0.283 | 0.313 | 0.343 |
| | | White y | 0.299 | 0.329 | 0.359 |
| White Luminance (ICFL 6mA) | [cd/m ²] | $\theta = 0^\circ$ | 320 | 400 | — |



Note 1: Definition of white uniformity:

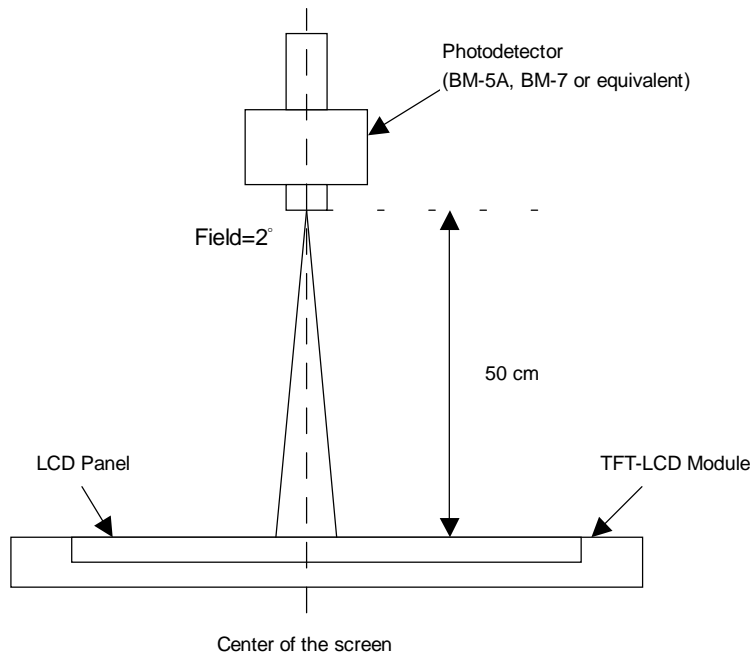
White uniformity is calculated with the following formula.
Luminance are measured at the following nine points (1~13).

$$\delta_w = \frac{\text{Maximum Brightness of thirteen points}}{\text{Minimum Brightness of thirteen points}}$$



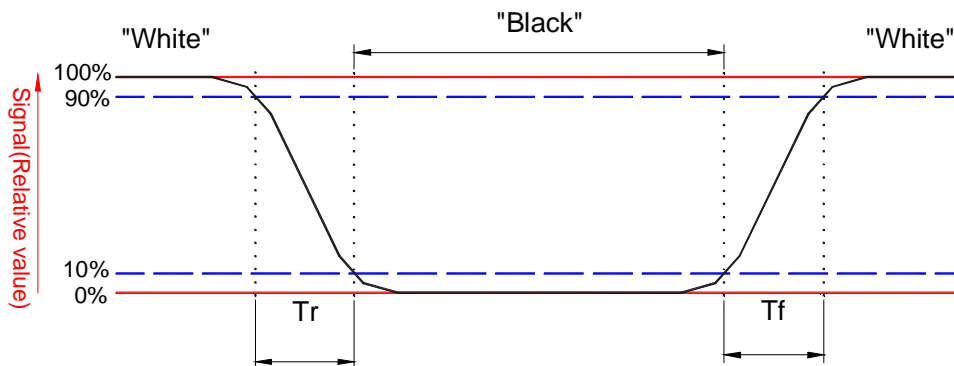
Note 2: Measurement method

The LCD module should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a stable, windless and dark room.



Note 3: Definition of response time

The output signals of BM-7 or equivalent 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.



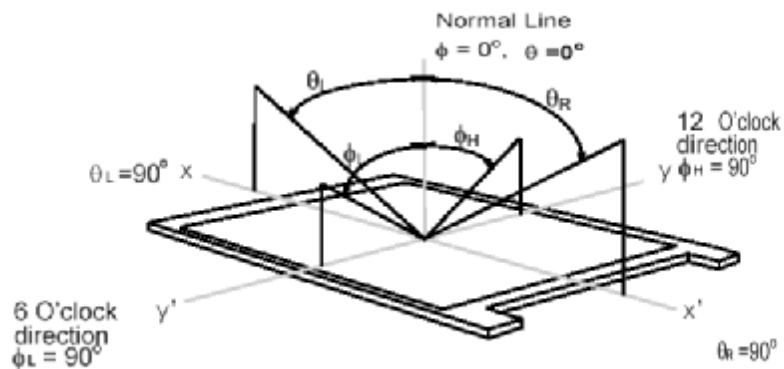
Note 4: Definition of contrast ration

Contrast ratio is calculated with the following formula.

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

Note 5: Definition of viewing angle

Viewing angle is the measurement of contrast ratio ≥ 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 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.





5.0 Signal Interface

5.1 Connectors

Physical interface is described as for the connector on module.

These connectors are capable of accommodating the following signals and will be following components.

| | |
|--------------------------------|------------------------|
| Connector Name / Designation | For Signal Connector |
| Manufacturer | JAE |
| Type / Part Number | FI-SE20M or compatible |
| Mating Connector / Part Number | TBD |

| | |
|--------------------------------|------------------------------|
| Connector Name / Designation | For Lamp Connector |
| Manufacturer | JST |
| Type / Part Number | JST BHR-03VS-1 or compatible |
| Mating Connector / Part Number | JST SM03(4.0)B-BHS-1-TB |

5.2 Signal Pin

| Pin No. | Signal Name | Pin No. | Signal Name |
|---------|-------------|---------|-------------|
| 1 | VDD | 2 | VDD |
| 3 | GND | 4 | GND |
| 5 | RxIN0- | 6 | RxIN0+ |
| 7 | GND | 8 | RxIN1- |
| 9 | RxIN1+ | 10 | GND |
| 11 | RxIN2- | 12 | RxIN2+ |
| 13 | GND | 14 | CKIN- |
| 15 | CKIN+ | 16 | GND |
| 17 | NC | 18 | NC |
| 19 | NC | 20 | NC |

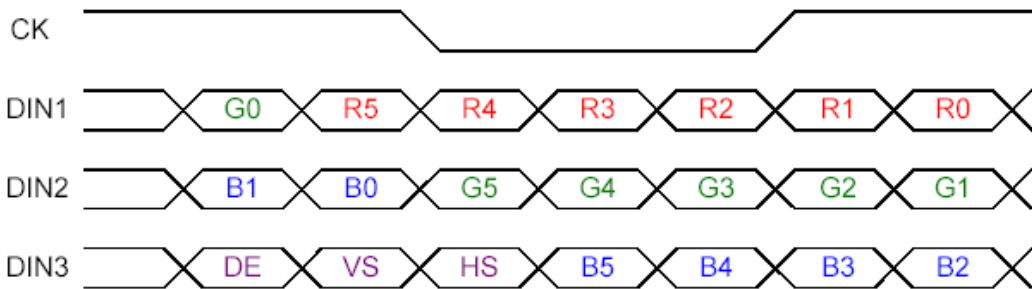


5.3 Signal Description

The module using a LVDS receiver. LVDS is a differential signal technology for LCD interface and high speed data transfer device. Transmitter shall be SN75LVDS84 (negative edge sampling) or compatible.

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

| Signal Name | Description |
|----------------|--|
| RxIN0-, RxIN0+ | LVDS differential data input (Red0-Red5, Green0) |
| RxIN1-, RxIN1+ | LVDS differential data input (Green1-Green5, Blue0-Blue1) |
| RxIN2-, RxIN2+ | LVDS differential data input (Blue2-Blue5, Hsync, Vsync, DE) |
| CKIN-, CKIN+ | LVDS differential clock input |
| VDD | +3.3V Power Supply |
| GND | Ground |
| NC | No Connection |





| Signal Name | Description | |
|--|--|--|
| +RED5 +RED4 +RED3 +RED2 +RED1 +RED0 | Red Data 5 (MSB) Red Data 4 Red Data 3 Red Data 2 Red Data 1 Red Data 0 (LSB) Red-pixel Data | Red-pixel Data Each red pixel's brightness data consists of these 6 bits pixel data. |
| +GREEN5 +GREEN4 +GREEN3 +GREEN2 +GREEN1 +GREEN0 | Green Data 5 (MSB) Green Data 4 Green Data 3 Green Data 2 Green Data 1 Green Data 0 (LSB) Green-pixel Data | Green-pixel Data Each green pixel's brightness data consists of these 6 bits pixel data. |
| +BLUE5 +BLUE4 +BLUE3 +BLUE2 +BLUE1 +BLUE0 | Blue Data 5 (MSB) Blue Data 4 Blue Data 3 Blue Data 2 Blue Data 1 Blue Data 0 (LSB) Blue-pixel Data | Blue-pixel Data Each blue pixel's brightness data consists of these 6 bits pixel data. |
| CLK | Data Clock | The typical frequency is 40MHz. The signal is used to strobe the pixel data and DE signals. All pixel data shall be valid at the falling edge when the DE signal is high. |
| DE | Display Timing | This signal is strobed at the falling edge of CLK. When the signal is high, the pixel data shall be valid to be displayed. |
| VSYNC | Vertical Sync | The signal is synchronized to CLK. |
| HSYNC | Horizontal Sync | The signal is synchronized to CLK. |

Note : Output signals from any system shall be low or Hi-Z state when VDD is off.

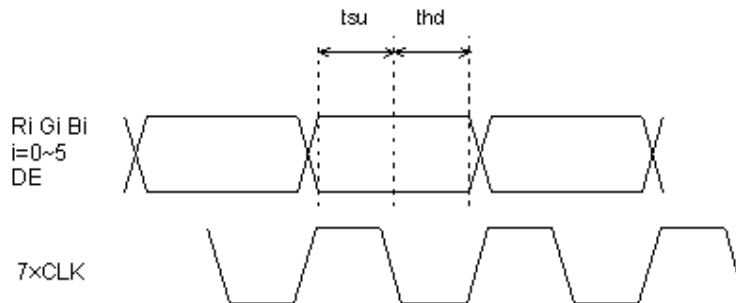
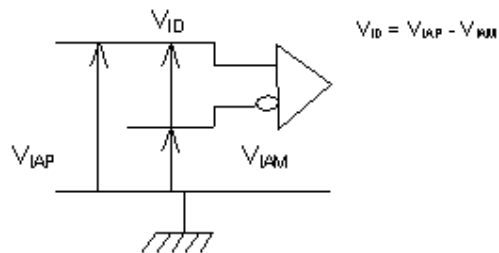
5.4 Signal Electrical Characteristics

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

It is recommended to refer the specifications of SN75LVDS86(Texas Instruments) in detail.

Signal electrical characteristics are as follows :

| Item | Symbol | Min. | Typ. | Max. | Unit |
|-------------------------------|------------------|-------|------|-------|------|
| The differential level | VID | 0.25 | 0.35 | 0.45 | V |
| The common mode input voltage | VIC | 1.125 | 1.25 | 1.375 | V |
| The input setup time | tsu | -0.6 | - | 0.6 | ns |
| The input hold time | thd | 11.74 | - | 50 | ns |
| High-level input voltage | V _{IAP} | 2.0 | | | V |
| Low-level input voltage | V _{IAM} | | | 0.8 | V |
| Clock frequency | CLK | 20 | | 85 | MHz |





5.5 Signal for Lamp connector

Note: CN2 connector (backlight): JST BHR-03VS-1

Mating connector: JST SM03(4.0)B-BHS-1-TB

| Pin no. | Symbol | Function | Remark |
|---------|--------|--------------------------|--------------------|
| 1 | H | CCFL power supply (H.V.) | Cable color: Pink |
| 2 | NC | No connection | |
| 3 | L | CCFL power supply (GND) | Cable color: White |

6.0 Pixel Format Image

Following figure shows the relationship of the input signals and LCD pixel format :

| | 1 | | 2 | | ... | | | | | | | | | | 799 | | 800 | | | | | |
|------------|---|---|---|---|-----|---|-------|--|--|--|--|--|--|--|-----|--|-----|---|---|---|---|---|
| 1st Line | R | G | B | R | G | B | | | | | | | | | | | R | G | B | R | G | B |
| | . | . | . | . | . | . | | | | | | | | | | | . | . | . | . | . | . |
| | . | . | . | . | . | . | | | | | | | | | | | . | . | . | . | . | . |
| | . | . | . | . | . | . | | | | | | | | | | | . | . | . | . | . | . |
| | . | . | . | . | . | . | | | | | | | | | | | . | . | . | . | . | . |
| | . | . | . | . | . | . | | | | | | | | | | | . | . | . | . | . | . |
| | . | . | . | . | . | . | | | | | | | | | | | . | . | . | . | . | . |
| | . | . | . | . | . | . | | | | | | | | | | | . | . | . | . | . | . |
| | . | . | . | . | . | . | | | | | | | | | | | . | . | . | . | . | . |
| 600th Line | R | G | B | R | G | B | | | | | | | | | | | R | G | B | R | G | B |



7.0 Parameter guide line for CCFL inverter

| Parameter | Min | Typ | Max | Units | Condition |
|-----------------------------------|-----|--------|-----|-------------------|-------------|
| White Luminance | 320 | 400 | - | Cd/m ² | At 6mA ICFL |
| CCFL current (ICFL) | TBD | 6 | TBD | mArms | Note1 |
| CCFL Frequency (FCFL) | 40 | 55 | 80 | KHz | Note4 |
| CCFL Ignition Voltage (Vs) | - | - | 690 | Vrms | Note1 |
| | | | 890 | | Note3 |
| CFL Voltage (Reference) (VCFL) | TBD | 530 | TBD | Vrms | Note1 |
| CCFL Power consumption (PCFL) | TBD | 3.2 | TBD | W | Note2 |
| Lamp Life Time | - | 50,000 | - | Hr | Note1, 5 |

Note1 : T=25°C

Note2 : Inverter should be designed with the characteristic of lamp. When you are designing the inverter, the output voltage of the inverter should comply with the following conditions.

(1) The area under the positive and negative cycles of the waveform of the lamp current and lamp voltage should be area symmetric (the symmetric ratio should be larger than 90%).

(2) There should not be any spikes in the waveform.

(3) The waveform should be sine wave as possible.

(4) Lamp current should not exceed the maximum value within the operating temperature (It is prohibited to over the maximum lamp current even if operated in the non-guaranteed temperature). When lamp current is over the maximum value for a long time, it may cause fire. Therefore, it is recommend that the inverter should have the current limit circuit.

Note3 : The inverter open voltage should be designed larger than the lamp starting voltage at T=0°C, otherwise backlight may be blinking for a moment after turning on or not be able to turn on. The open voltage should be measured after ballast capacitor. If an inverter has shutdown function it should keep its open voltage for longer than 1 second even if lamp connector is open.

Note4 : Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency shall be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

Note5 : Brightness (ICFL=6mA) to be decreased to the 50% of the initial value.



8.0 Interface Timings

Basically, interface timing should match the VESA 800x600 /60Hz(VG901101) manufacturing guide line timing.

8.1 Timing Characteristics

(a) DE mode

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---------------------|--------|------|------|------|------|--------|
| Clock frequency | Fck | 30 | 40 | 50 | MHz | |
| Horizontal blanking | Thb1 | 160 | 256 | 260 | Clk | |
| Vertical blanking | Tvb1 | 28 | 28 | 28 | Th | |

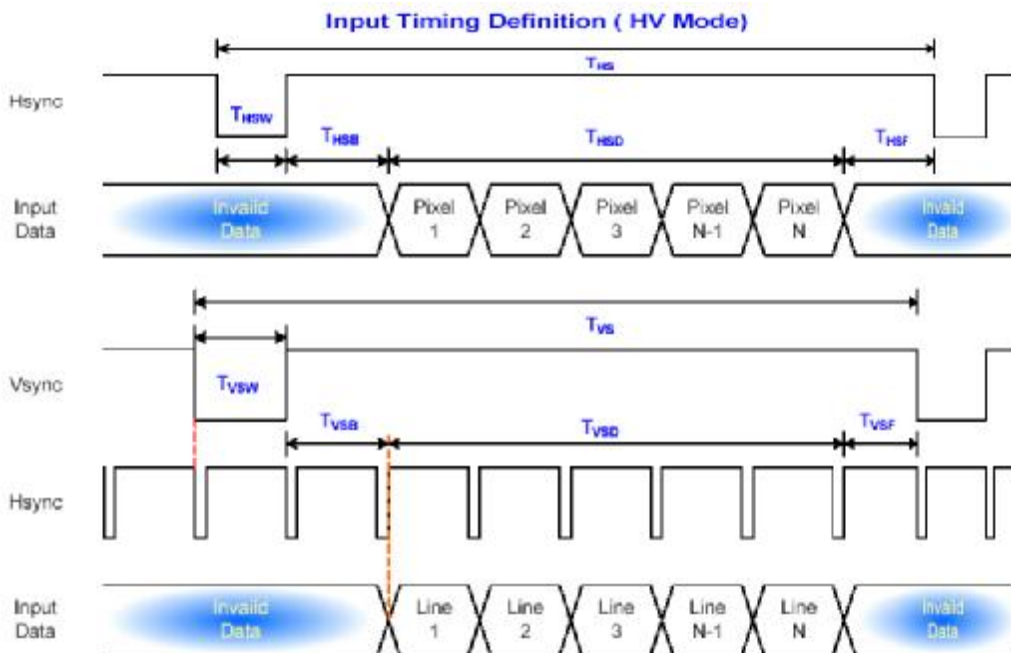
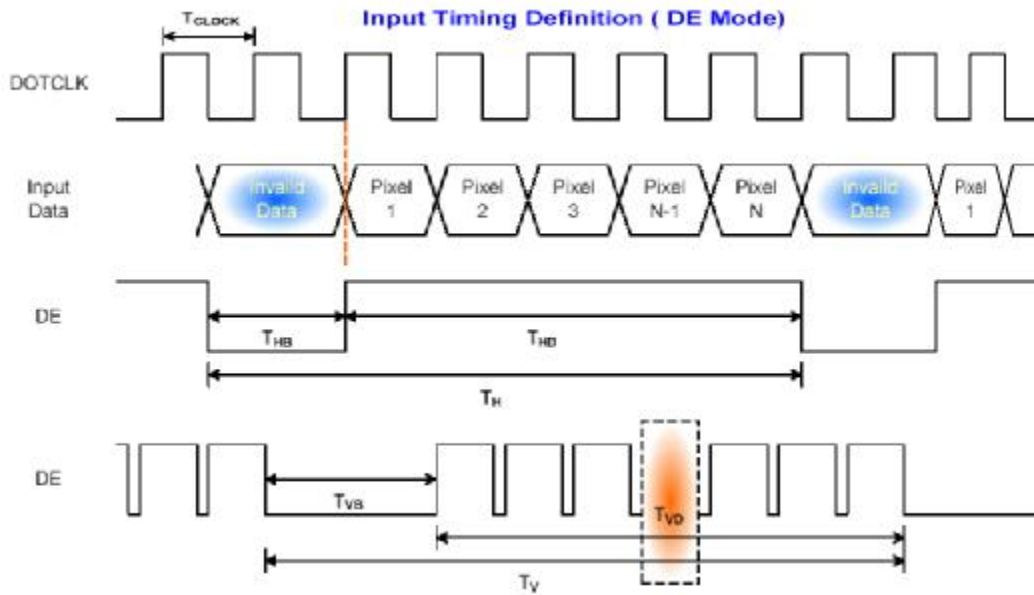
(b) HV mode

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|--------------------------------|-----------|------|------|------|------|--------|
| Clock frequency | Fck | 30 | 40 | 50 | MHz | |
| Hsync period | Th | 960 | 1056 | 1060 | Clk | |
| Hsync active | Thsd | 800 | | | Clk | |
| Hsync front porch | Thf | 114 | 210 | 214 | Clk | |
| Hsync pulse width + back porch | Thw + Thb | 46 | 46 | 46 | Clk | |
| Hsync blanking | Thb1 | 160 | 256 | 260 | Clk | |
| Vsync period | Tv | 628 | 628 | 628 | Th | |
| Vsync active | Tvsd | 600 | | | Th | |
| Vsync front porch | Tvf | 1 | 1 | 1 | Th | |
| Vsync pulse width + back porch | Tvw + Tvb | 27 | 27 | 27 | Th | |
| Hsync/Vsync phase shift | Ths | 2 | | | Th | |



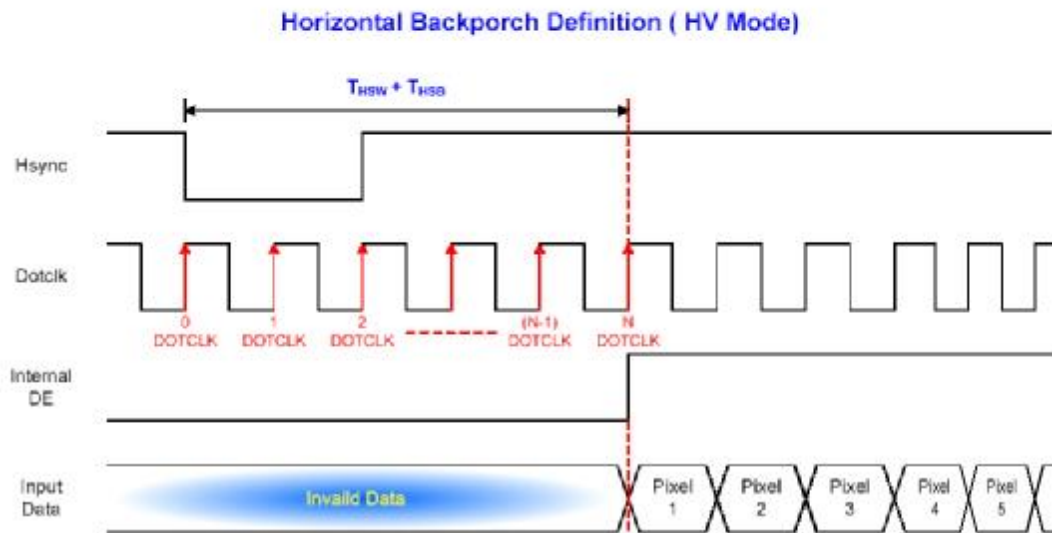
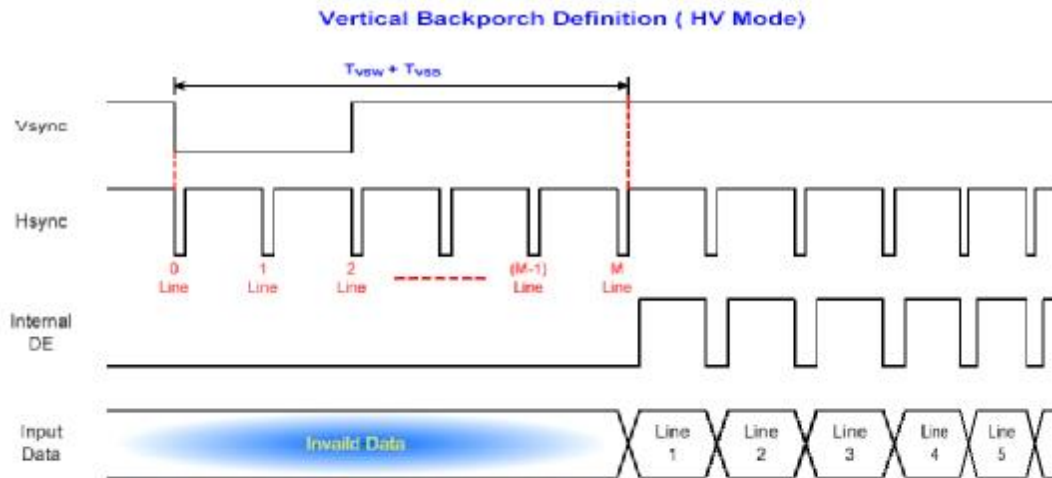
| Item | Symbol | Value | Unit | Description |
|--------------------------|--------|-------|------|--|
| Horizontal display start | The | 46 | Clk | After falling edge of Hsync, counting 218clk, then getting valid data from 219th clk's data. |
| Vertical display start | Tve | 1 | Th | After falling edge of Vsync, counting 25th, then getting 26th Th's data. |

8.2 Timing Definition





8.3 Timing Chart



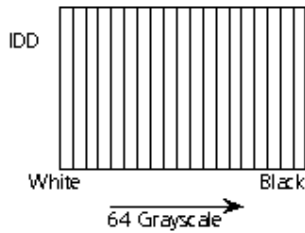


9.0 Power Consumption

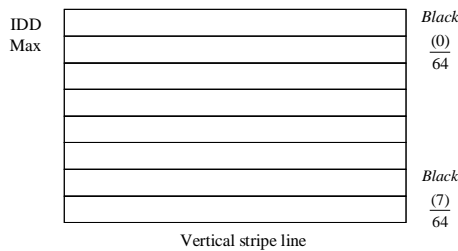
Input power specifications are as follows :

| Symbol | Parameter | Min | Typ | Max | Units | Condition |
|-------------------------------|--------------------------|---|------|-----|--------|-------------------------------------|
| Module | | | | | | |
| VDD | Logic/LCD Drive Voltage | 3.0 | 3.3 | 3.6 | V | Load Capacitance 20uF |
| PDD | VDD Power | - | 1.4 | - | W | All Black Pattern |
| PDD Max | VDD Power max | - | 1.56 | - | W | Max Pattern Note |
| IDD | IDD Current | - | 424 | - | mArms | 64 Grayscale Pattern Note 1 |
| IDD Max | IDD Current max | - | 473 | - | mArms | Vertical stripe line Pattern Note 2 |
| V _{RP} | Power Ripple Voltage | - | 100 | - | mVp-p | |
| I _{RUSH} | Inrush Current | - | 1500 | - | mApeak | |
| Lamp | | | | | | |
| ICFL | CCFL current | - | 6 | - | mArms | Ta=25°C |
| VCFL | CCFL Voltage (Reference) | - | 530 | - | V | |
| PCFL | CCFL Power consumption | - | 3.2 | - | W | |
| Total Power consumptio | | 7.8 Watt (w/o Inverter, All black pattern) @ LCM circuit 1.4 W (typ.), B/L input 6.4W (typ.) | | | | |

Note 1: Effective value (mArms) at V_{CC} = 3.3 V/25°C.

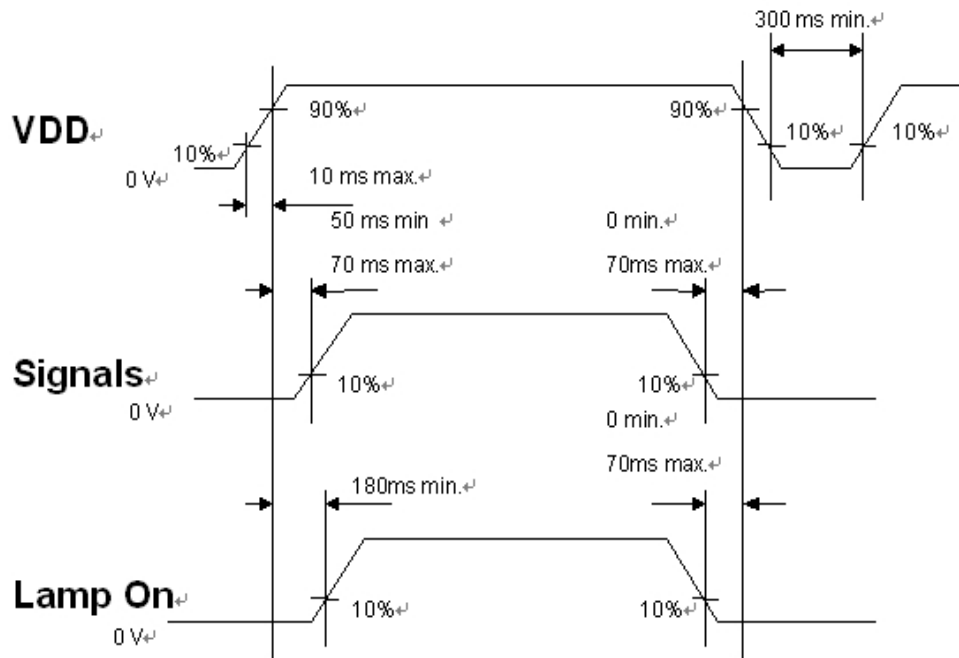


Note 2:





10.0 Power ON/OFF Sequence



VDD power and lamp on/off sequence is as follows.

Interface signals are also shown in the chart.

Signals from any system shall be Hi-Z state or low level when VDD is off.



11.0 Reliability / Safety Requirement

11.1 Reliability Test Conditions

| Test tem | Test Condition | Remark |
|--|--|--------------|
| High temperature storage | 70°C, 240Hrs | Note 1, 2, 3 |
| Low temperature storage | -30°C, 240Hrs | Note 1, 2, 3 |
| High temperature & high humidity operation | 40°C, 90%RH, 240Hrs (No condensation) | Note 1, 2, 3 |
| High temperature operation | 65°C, 240Hrs | Note 1, 2, 3 |
| Low temperature operation | -10°C, 240Hrs | Note 1, 2, 3 |
| Electrostatic discharge (non-operation) | 150 pF, 150Ω, 10kV, 1 second, 9 position on the panel, 10 times each place | Note 3 |
| Vibration (non-operation) | Sinusoidal vibration, 1.5 G zero-to-peak, 50 to 500 Hz, 0.5 octave/minute. The test duration shall be one sweep from 50 to 500 to 50 Hz in each of three mutually perpendicular axes | Note 1, 2, 3 |
| Mechanical shock (non-operation) | 50G/11ms, ±X, ±Y, ±Z, half-Sin, one time | Note 1, 2, 3 |
| Thermal shock (non-operation) | 1. -30°C±3°C...30minutes 70°C±3°C...30minutes 2. 100 cycles 3. Temperature transition time within 5 minutes | Note 1, 2, 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: Judgement: 1. Function OK 2. No serious image quality degradation



11.2 Safety

UL

11.3 Green



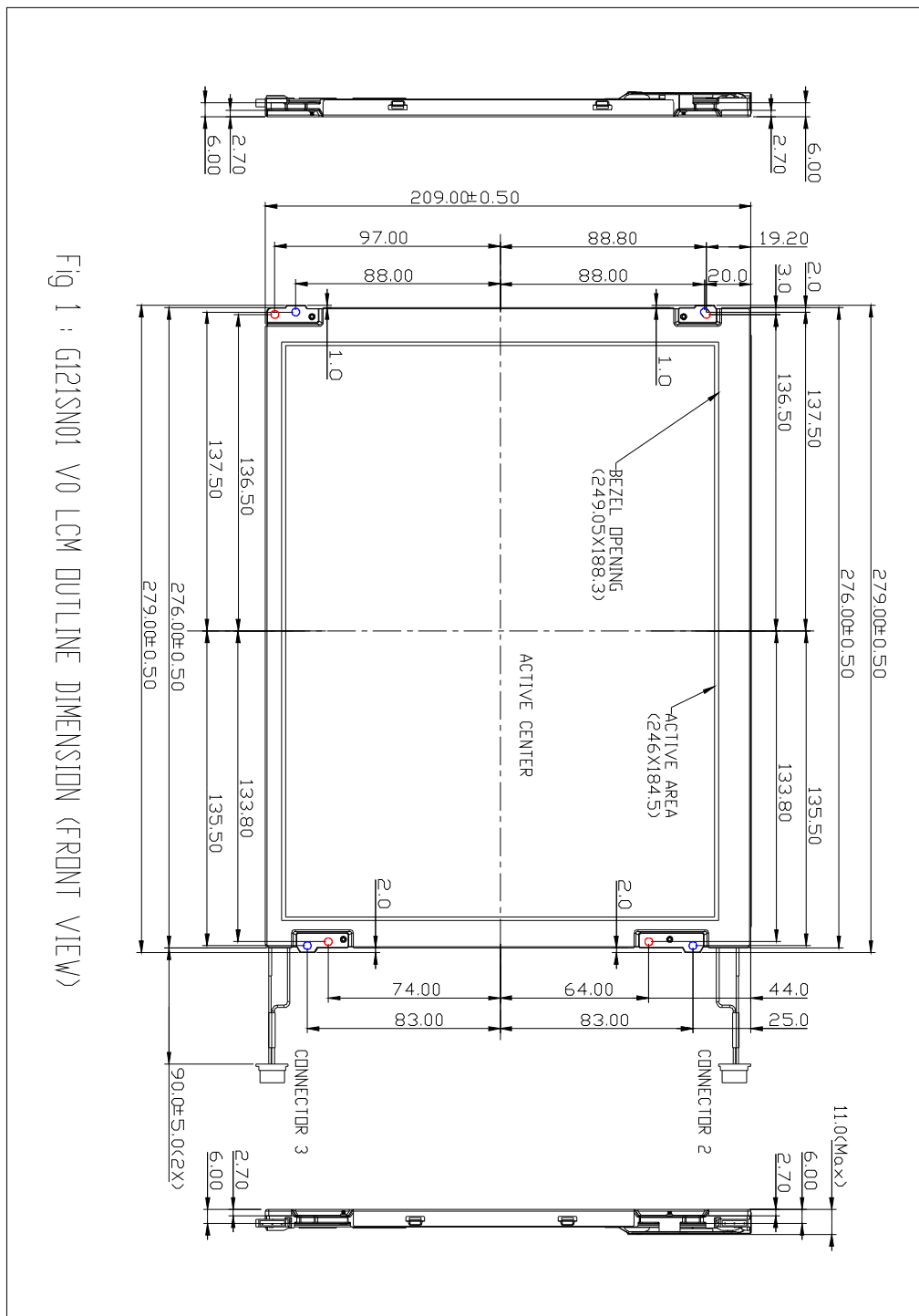
Lead (Pb) free & RoHs in Taiwan and in Europe

12.0 Packing Dimension:

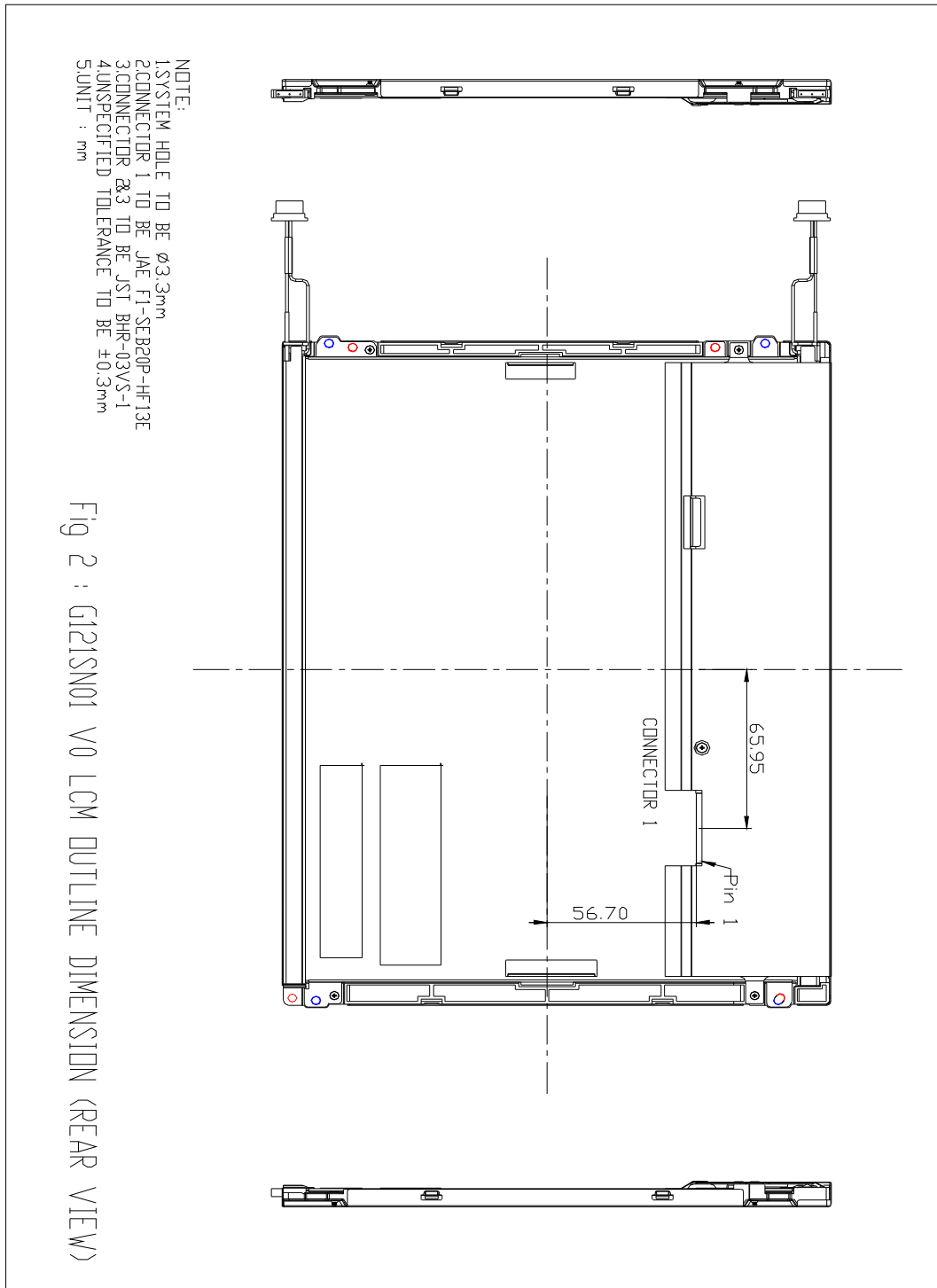
1. Max. Capacity: 20pcs LCD Modules / per carton
2. Max. Weight: TBD kg / per carton
3. The outside dimension of carton is TBD

13.0 Mechanical Characteristics

13.1 LCM Outline dimension (Front View)



13.2 LCM Outline dimension (Rear View)





13.3 Screw Note
TBD