



# Product Specification

G121SN01 V2

AU OPTRONICS CORPORATION

(V) Preliminary Specifications

( ) Final Specifications

<b>Module</b>	12.1 Inch Color TFT-LCD
<b>Model Name</b>	G121SN01 V2

<b>Customer</b>	<b>Date</b>
<b>Checked &amp; Approved by</b>	
_____	_____
<p>Note: This specification is subject to change without notice.</p>	

<b>Approved by</b>	<b>Date</b>
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## Record of Revision

Version and Date	Page	Old Description	New Description	Remark
0.0 2006/12/19	All	First Draft	All	



## 1. Operating Precautions

- 1) Since front polarizer is easily damaged, please be cautious and 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 soft cloth.
- 5) Since the panel is made of glass, it may be broken or cracked 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 direction.
- 9) In case if a module has to be put back into the packing container slot after 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 (Notebook PC Bezel, for example), 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's recommended to use screen saver or shuffle content periodically if fixed pattern is displayed on the screen.



## 2. General Description

G121SN01 V2 is a Color Active Matrix Liquid Crystal Display composed of a TFT-LCD display, a driver circuit, and a backlight system. The screen format is intended to support SVGA (800(H) x 600(V)) screen and 262K colors (RGB 6-bits). All input signals are LVDS interface compatible. Inverter card of backlight is not included.

G121SN01 V2 is designed for industrial display applications.

### 2.1 Display Characteristics

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

Items	Unit	Specifications
Screen Diagonal	[inch]	12.1
Active Area	[mm]	246.0(H) x 184.5(V)
Pixels H x V		800x3(RGB) x 600
Pixel Pitch	[mm]	0.3075 x 0.3075
Pixel Arrangement		R.G.B. Vertical Stripe
Display Mode		TN, Normally White
Nominal Input Voltage VDD	[Volt]	3.3 typ.
Typical Power Consumption	[Watt]	7.3W (IRCFL=6.0mA)
Weight	[Grams]	660g (typ.)
Physical Size	[mm]	279.0(H)x 209.0(V) x 11.0(D) (typ.)
Electrical Interface		1 channel LVDS
Surface Treatment		Glare, Hardness 3H
Support Color		262K colors
Temperature Range		
Operating	[°C]	-10 to +65
Storage (Non-Operating)	[°C]	-30 to +70
RoHS Compliance		RoHS Compliance



## 2.2 Optical Characteristics

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

Item	Unit	Conditions	Min.	Typ.	Max.	Note
White Luminance	[cd/m <sup>2</sup> ]	IRCFL= 6.0mA (center point)	320	400	-	1
Uniformity		13 Points	-	1.25	1.60	1, 2, 3,
Contrast Ratio		Dark Room	-	600	-	4
Contrast Ratio in Daylight		Sky lamp		10.0		7
		Sun lamp		9.0		7
		Sky lamp+Sun lamp		6.0		7
Response Time	[msec]	Rising	-	10	20	5
	[msec]	Falling	-	25	30	
	[msec]	Rising + Falling	-	35	50	
Viewing Angle	[degree]	Horizontal (Right) CR = 10 (Left)	60	70	-	6
	[degree]		60	70	-	
	[degree]	Vertical (Upper) CR = 10 (Lower)	55	60	-	
	[degree]		45	50	-	
Color / Chromaticity Coordinates (CIE 1931)		Red x	0.590	0.620	0.650	
		Red y	0.310	0.340	0.370	
		Green x	0.275	0.305	0.335	
		Green y	0.555	0.585	0.615	
		Blue x	0.115	0.145	0.175	
		Blue y	0.085	0.115	0.145	
		White x	0.283	0.313	0.343	
		White y	0.299	0.329	0.359	
Color Gamut	%		-	55	-	

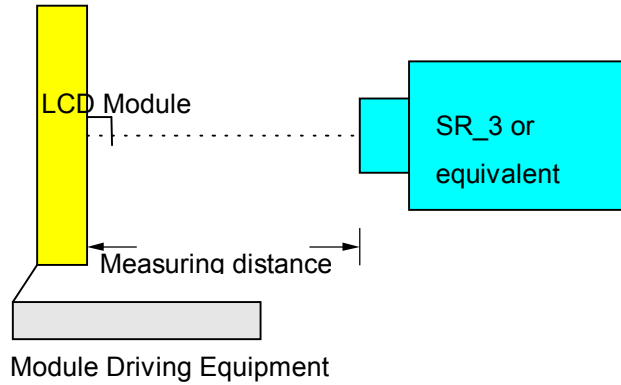
Note 1: Measurement method

Equipment Pattern Generator, Power Supply, Digital Voltmeter, Luminance meter (SR\_3 or equivalent)

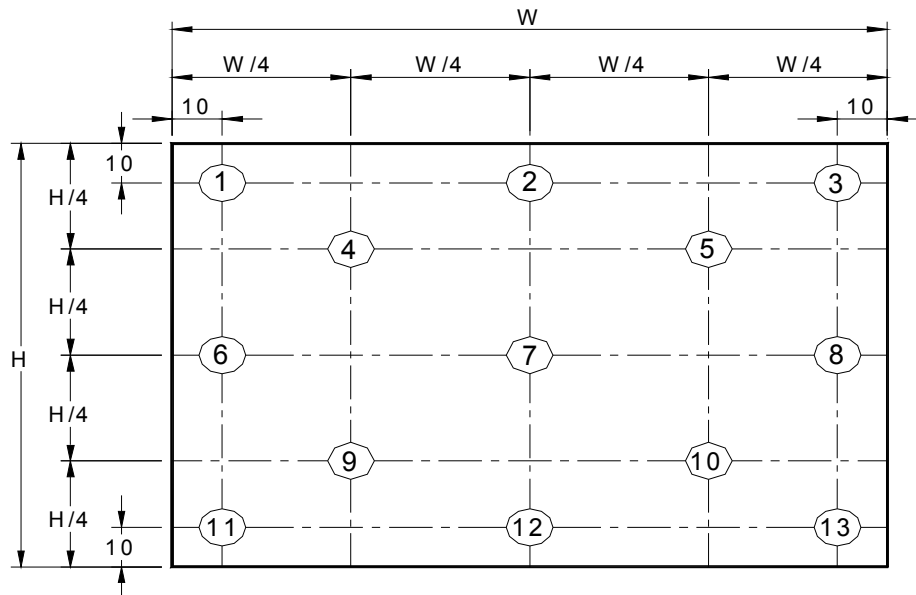
Aperture 1° with 50cm viewing distance

Test Point Center

Environment < 1 lux



Note 2: Definition of 13 points position



Note 3: The luminance uniformity of 13 points is defined by dividing the minimum luminance values by the maximum test point luminance

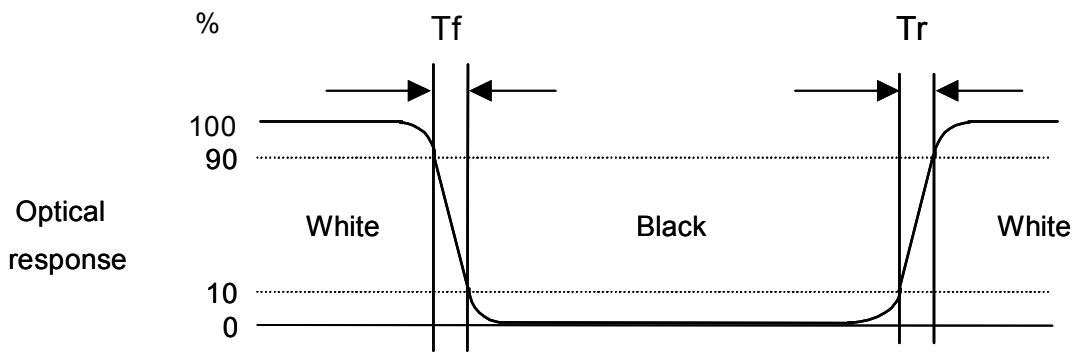
$$\delta_{w13} = \frac{\text{Maximum Brightness of Thirteen Points}}{\text{Minimum Brightness of Thirteen Points}}$$

Note 4: Definition of contrast ratio (CR):

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

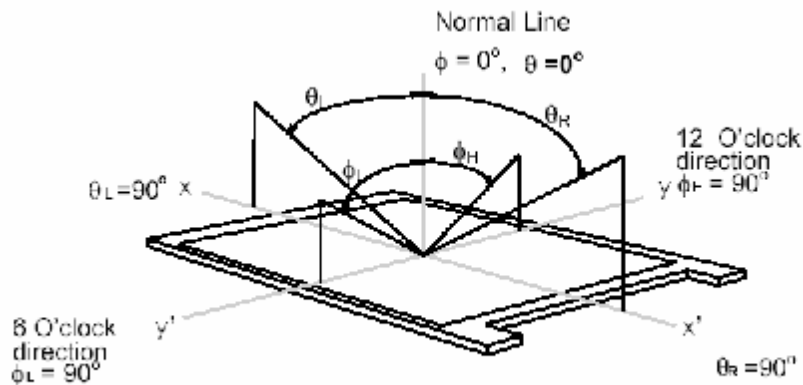
Note 5: Definition of response time:

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 6: Definition of viewing angle

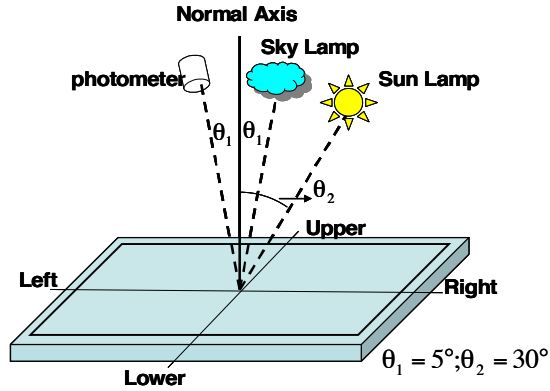
Viewing angle is the measurement of contrast ratio  $\geq 10$ , at the screen center, over a  $180^\circ$  horizontal and  $180^\circ$  vertical range (off-normal viewing angles). The  $180^\circ$  viewing angle range is broken down as below:  $90^\circ$  ( $\theta$ ) horizontal left and right, and  $90^\circ$  ( $\phi$ ) 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.





Note 7: Contrast Ratio in daylight:

Measuring method



Sun lamp: 100,000Lux

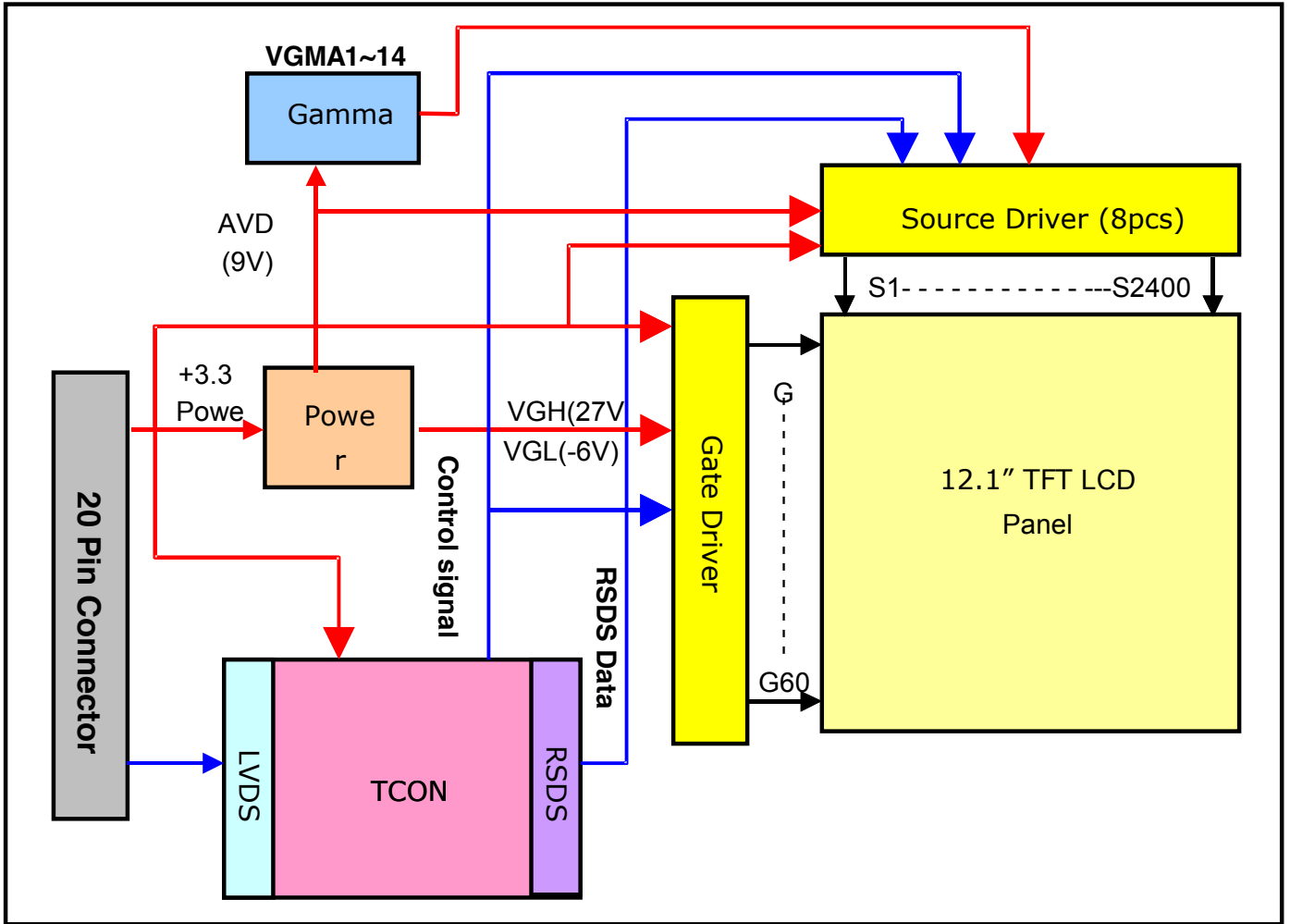
Sky lamp: 2000fL (Foot-lambert) = 6852 nit

Photometer: BM-5A

$$\text{Contrast Ratio in Daylight} = \frac{\text{Luminance of white screen with simulated daylight}}{\text{Luminance of black screen with simulated daylight}}$$

## 3. Functional Block Diagram

The following diagram shows the functional block of the 12.1 inch color TFT/LCD module:



**LVDS Connector:**

JAE FI-SEB20P-HF13E

**Lamp Connector:**

JST BHR-03VS-1

**Mating Type:**

JAE FI-S20S, FI-SE20M or equivalent

**Mating Type:**

SM03(4.0)B-BHS-1-TB

## 4. Absolute Maximum Ratings

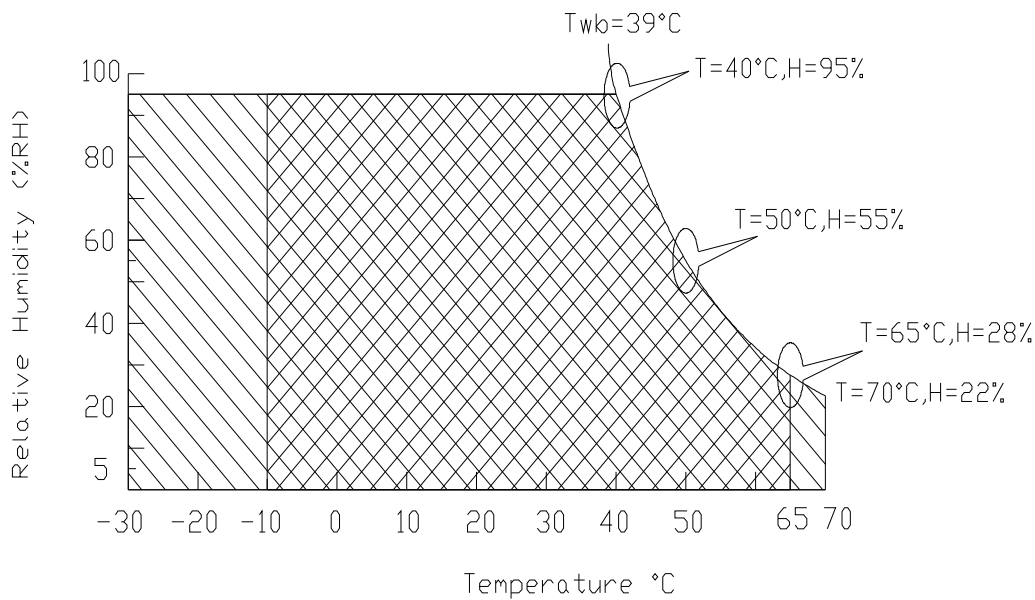
### 4.1 Absolute Ratings of TFT LCD Module

Item	Symbol	Min	Max	Unit
Logic/LCD Drive	Vin	-0.3	+4.0	[Volt]



### 4.2 Absolute Ratings of Environment

Item	Symbol	Min	Max	Unit
Operating Temperature	TOP	-10	+65	[°C]
Operation Humidity	HOP	8	95	[%RH]
Storage Temperature	TST	-30	+70	[°C]
Storage Humidity	HST	5	95	[%RH]

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



Operating Range 

Storage Range  + 

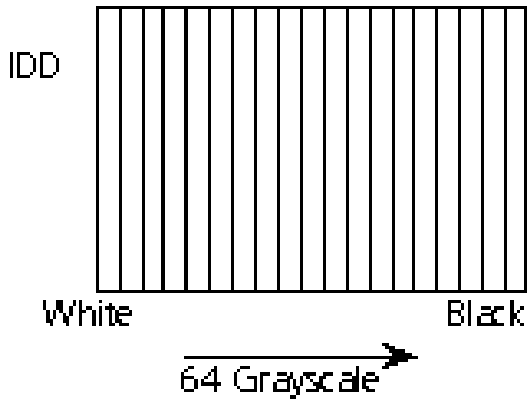
## 5. Electrical Characteristics

### 5.1 TFT LCD Module

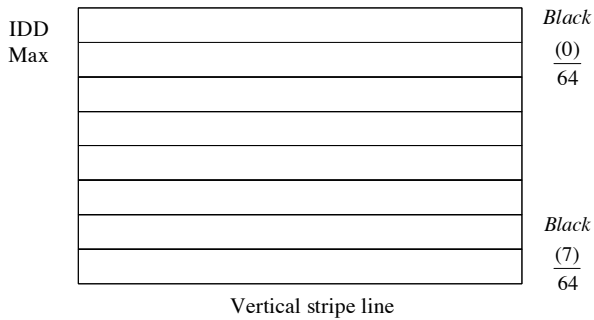
#### 5.1.1 Power Specification

Symbol	Parameter	Min	Typ	Max	Units	Remark
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	Load Capacitance 20uF
IDD	VDD Current	-	235	-	[mA rms]	64 Grayscale Pattern, Note 1
IDD Max	IDD Current max	-	268	-	mA rms	Vertical stripe line Pattern Note 2
Irush	LCD Inrush Current	-	-	1.5	[A]	Note 1
PDD	VDD Power	-	0.86	-	[Watt]	All Black Pattern (VDD=3.3V)
PDD Max	VDD Power max	-	0.88	-	W	Max Pattern Note
VDDrp	Allowable Logic/LCD Drive Ripple Voltage	-	100	-	[mV] p-p	

Note 1: Effective value (mA rms) at  $V_{CC} = 3.3 V/25^{\circ}C$ .



Note 2:



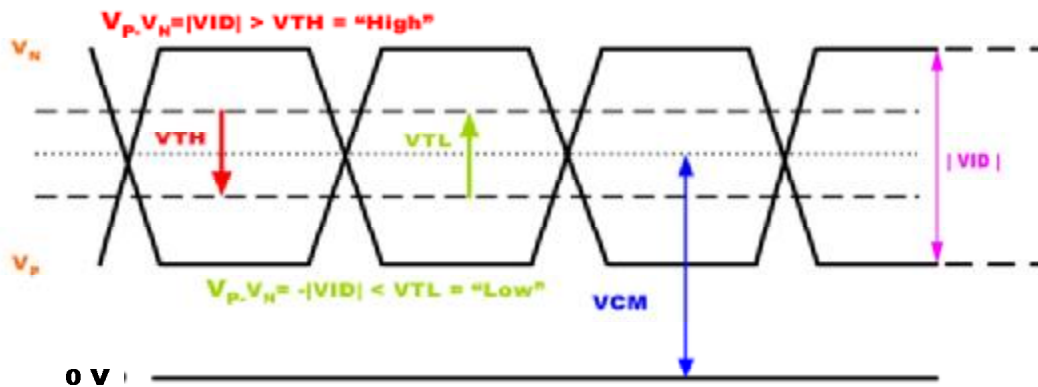
## 5.1.2 Signal Electrical Characteristics

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

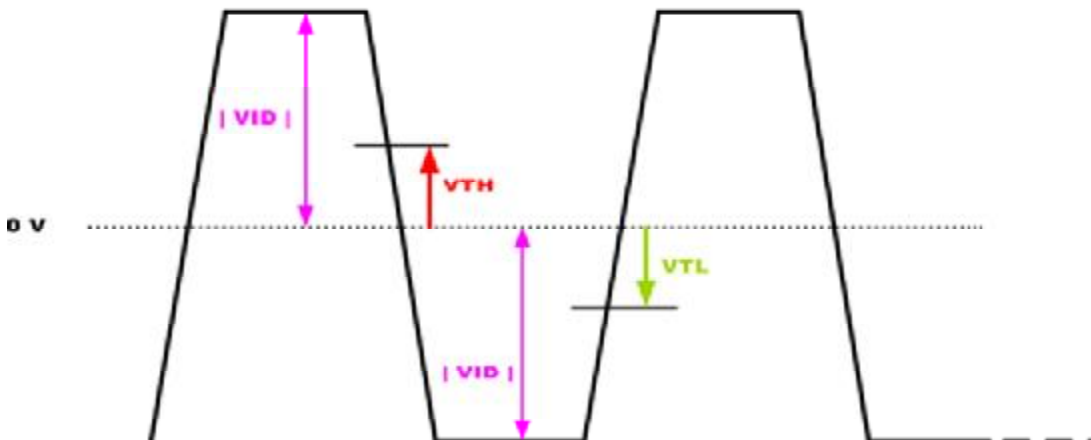
Symbol	Item	Min.	Typ.	Max.	Unit	Remark
VID	Input Differential Voltage	250	350	450	[mV]	
V <sub>ICM</sub>	Differential Input Common Mode Voltage	1.0	1.25	2.0	[V]	
V <sub>TH</sub>	Differential Input High Threshold	-	-	100	[mV]	V <sub>CM</sub> =1.25V
V <sub>TL</sub>	Differential Input Low Threshold	-100	-	-	[mV]	V <sub>CM</sub> =1.25V
CLK	Clock frequency	30	40	50	MHz	

Note: LVDS Signal Waveform.

### Single-end Signal



### Differential Signal



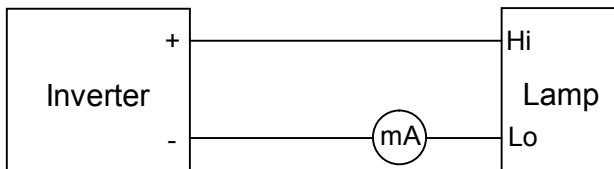
## 5.2 Backlight Unit

### 5.2.1 Parameter guideline for CCFL

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Remark
IRCFL	CCFL operation range	3	6	6.5	[mA] rms	(Ta=25°C) Note 1, 2
FCFL	CCFL Frequency	40	55	65	[KHz]	(Ta=25°C) Note 3
ViCFL 0°C (reference)	CCFL Ignition Voltage	-	-	1,270	[Volt] rms	(Ta= 0°C)
ViCFL 25°C (reference)	CCFL Ignition Voltage	-	-	970	[Volt] rms	(Ta=25°C)
PCFL	CCFL Power consumption (inverter excluded)	3.6	6.5	7.3	[Watt]	(Ta=25°C) Note 4
Lamp Life		-	50,000	-	Hrs	(Ta=25°C) Note 2 IRCFL = 6mA

Note 1: IRCFL is defined as the return current of an inverter. (See 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%.

It is recommended to use the inverter with detection circuit to avoid overvoltage, overcurrent, or mismatching waveform. The purpose is to avoid current flow into only one of the lamps when the other one is not in operation.

Note 2: The definition of lamp life means when any of following conditions happen:

- Luminance falls to 50% or less of the initial value.
- Normal lighting is no more available (flickering, pink lighting, no lighting, etc.)
- Lamp voltage or lighting start voltage exceeds the specified value.

Note 3: 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.

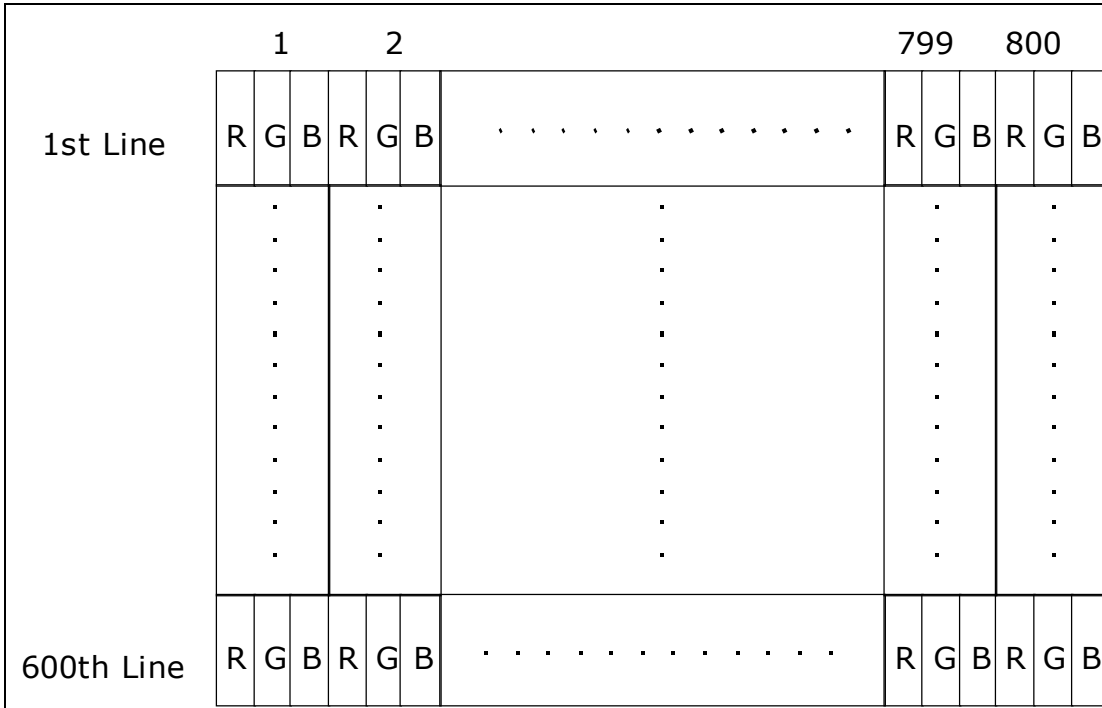
Note 4: Calculator value for reference ( $IRCFL \times VCFL \times 2 = PCFL$ ).

Note 5: The display is with dual lamp 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 between input signal and LCD pixel format.



### 6.2 Scanning Direction

The following figures show the image seen from the front view. The arrow indicates the direction of scan.

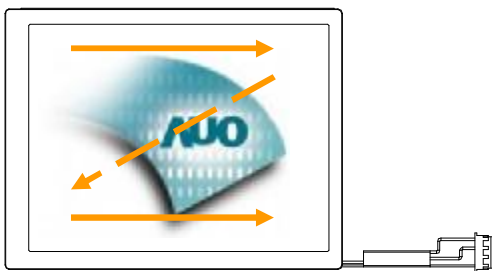


Fig. 1 Normal scan (Pin19 = GND/NC)



Fig. 2 Reverse scan (Pin19 = High)

## 6.3 Signal Description

The module uses a LVDS receiver embedded in AUO's ASIC. LVDS is a differential signal technology for LCD interface and a high-speed data transfer device. Transmitter shall be SN75LVDS84 (negative edge sampling) or compatible.

### Pin Assignment:

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/GND	18	NC/GND
19 (Note1)	Reverse	20	NC/GND

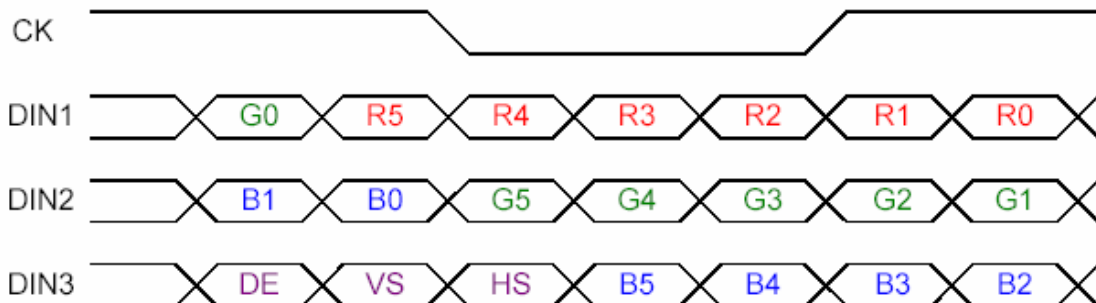
**Note1 :** Pin19 can be used for enabling “reverse scan” function.  
Refer to section 6.1 for scanning direction.

### Signal Description:

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
Reverse	High: Reverse Display; NC/GND: Normal Display
VDD	+3.3V Power Supply
GND	Ground
NC	No Connection

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

### LVDS Signal Format:







## 6.4 The Input Data Format

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.**

## 6.5 Interface Timing

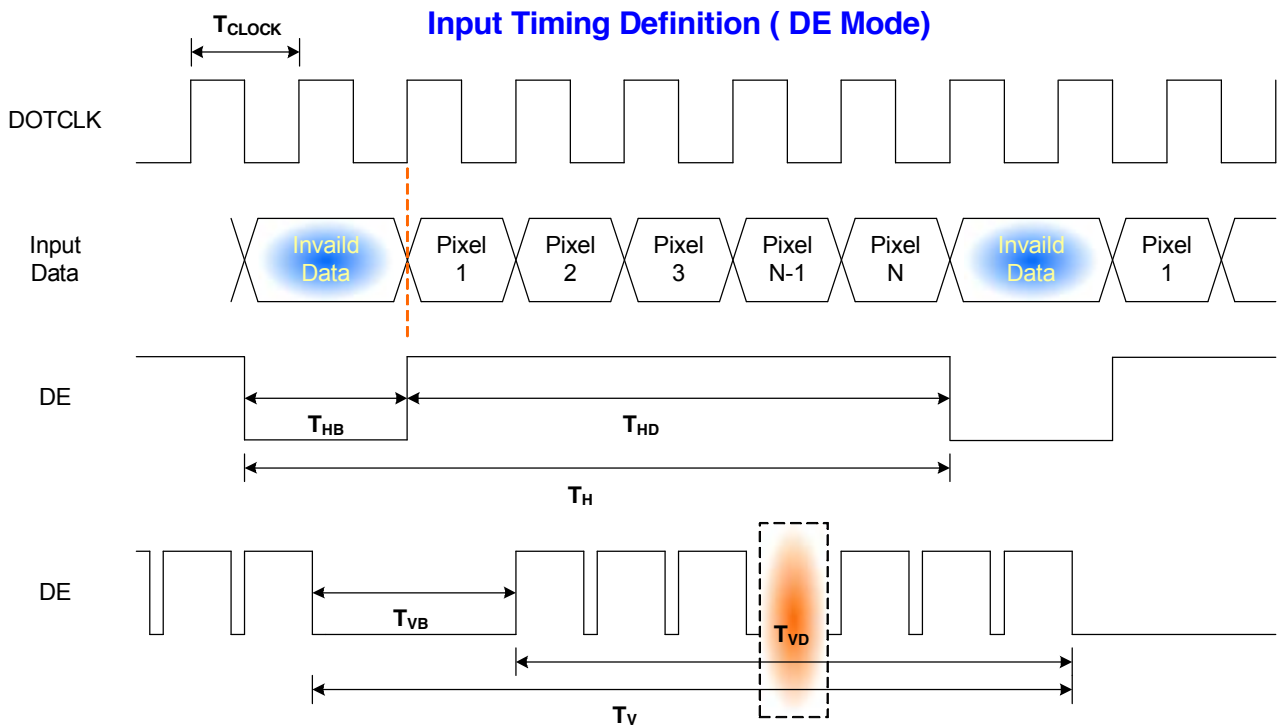
### 6.5.1 Timing Characteristics

#### DE only mode

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Clock frequency	$1/T_{\text{Clock}}$	30	40	50	MHz	
Vertical Section	Period	$T_V$	628	628	628	$T_{\text{Line}}$
	Active	$T_{VD}$	600	600	600	
	Blanking	$T_{VB}$	28	28	28	
Horizontal Section	Period	$T_H$	960	1056	1060	$T_{\text{Clock}}$
	Active	$T_{HD}$	800	800	800	
	Blanking	$T_{HB}$	160	256	260	

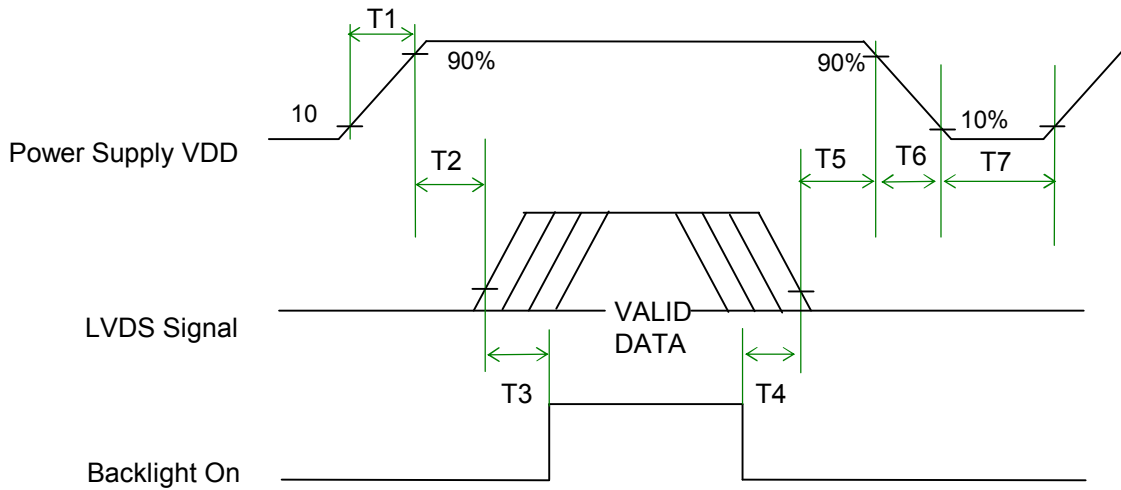
Note: Frame rate is 60 Hz.

### 6.5.2 Input Timing Diagram



## 6.6 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	-	50	ms
T3	180	-	-	ms
T4	180	-	-	ms
T5	0	-	50	ms
T6	0	-	10	ms
T7	500	-	-	Ms

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.

## 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	Signal Connector
Manufacturer	JAE
Connector Model Number	FI-SEB20P-HF13E
Mating Model Number	FI-S20S, FI-SE20M or compatible

### 7.2 Backlight Unit: Lamp Connector

Connector Name / Designation	Lamp Connector
Manufacturer	JST
Connector Model Number	JST BHR-03VS-1 or compatible
Mating Model Number	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



8. Reliability Test Criteria

Items	Required Condition	Note
High Temperature Operation	65°C, 240Hrs (center point of panel surface)	Note 1, 2, 3
Low Temperature Operation	-10°C, 240Hrs	Note 1, 2, 3
Hot Storage	70°C, 240Hrs	Note 1, 2, 3
Cold Storage	-30°C, 240Hrs	Note 1, 2, 3
High temperature & high humidity operation	40°C, 90%RH, 240Hrs (No condensation)	Note 1, 2, 3
Shock Test (Non-Operating)	50G/11ms, ±X, ±Y, ±Z, half-Sin, one time	Note 1, 2, 3
Vibration Test (Non-Operating)	1.5G, 10Hz ~ 200Hz ~ 10Hz 30 minutes for each Axis (X, Y, Z)	Note 1, 2, 3
ESD	Contact Discharge: Max±8KV, 150pF(330Ω) 1sec, 8 points, 25 times/point.	Note 3, 4
	Air Discharge: Max ±15KV, 150pF(330Ω) 1sec, 8 points, 25 times/point	
Thermal shock (non-operation)	1. -20°C±3°C...30minutes 60°C±3°C...30minutes 2. 100 cycles 3. Temperature transition time within 5 minutes	Note 1, 2, 3
Attitude Test	Operation:10,000ft / 8hrs Non-Operation: 40,000ft / 24hrs	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: 1. Function OK 2. No serious image quality degradation

Note 4: According to EN61000-4-2 , ESD class B: Some performance degradation allowed. No data lost, self-recoverable. No hardware failures.

## 9. Mechanical Characteristics

### 9.1 LCM Outline Dimension (Front View)

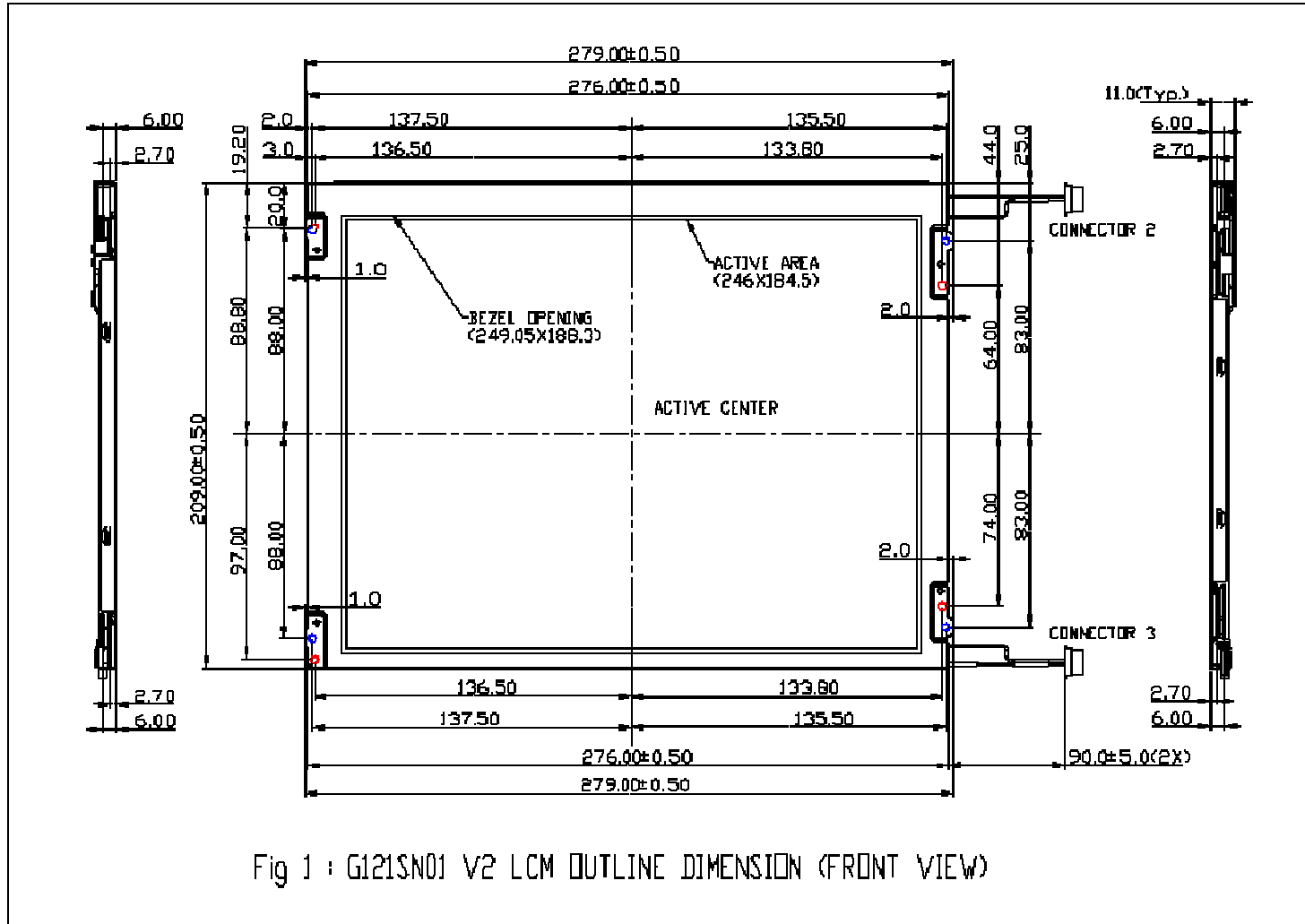
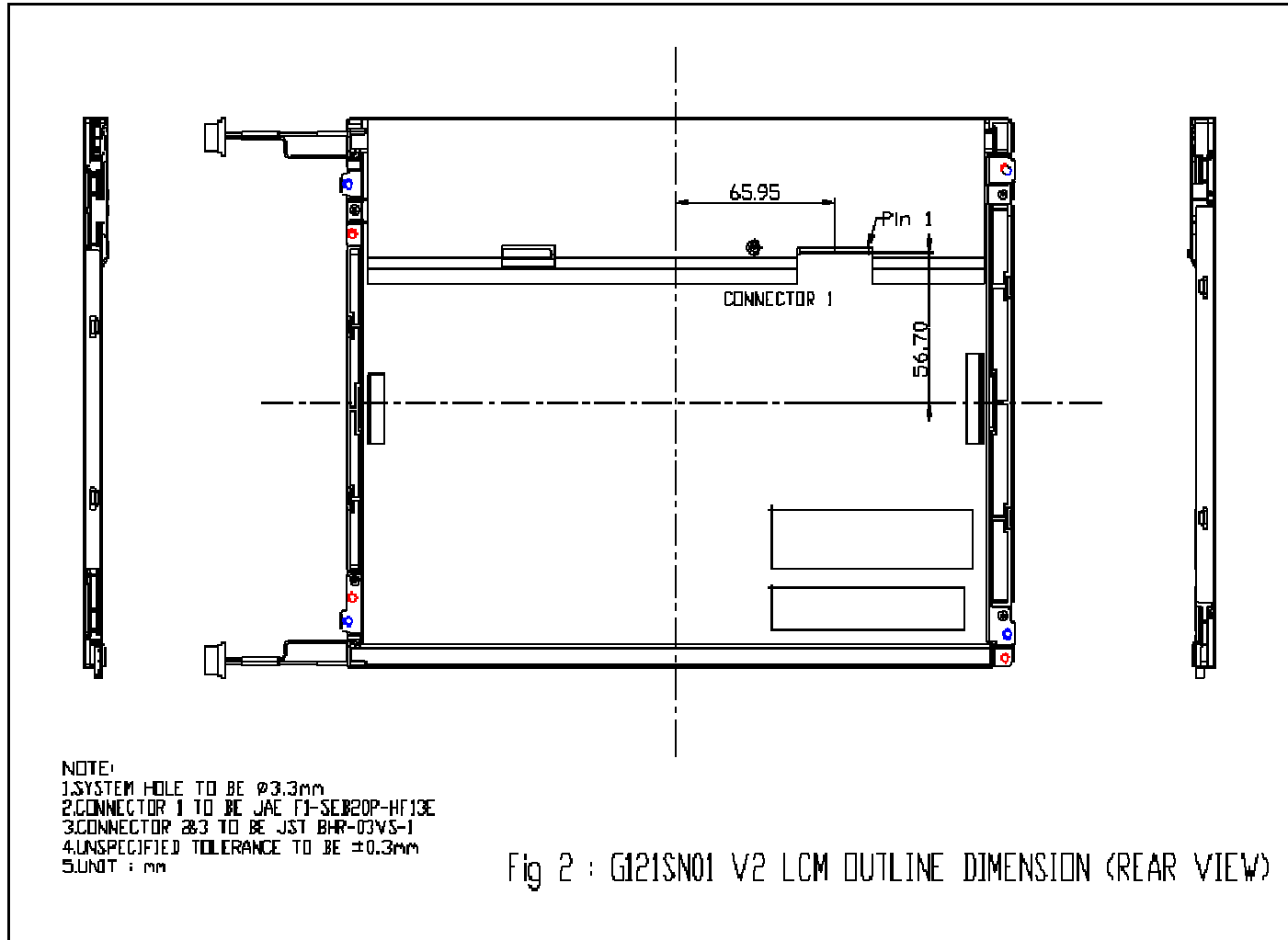


Fig 1 : G121SN01 V2 LCM OUTLINE DIMENSION (FRONT VIEW)

**9.2 LCM Outline Dimension (Rear View)**



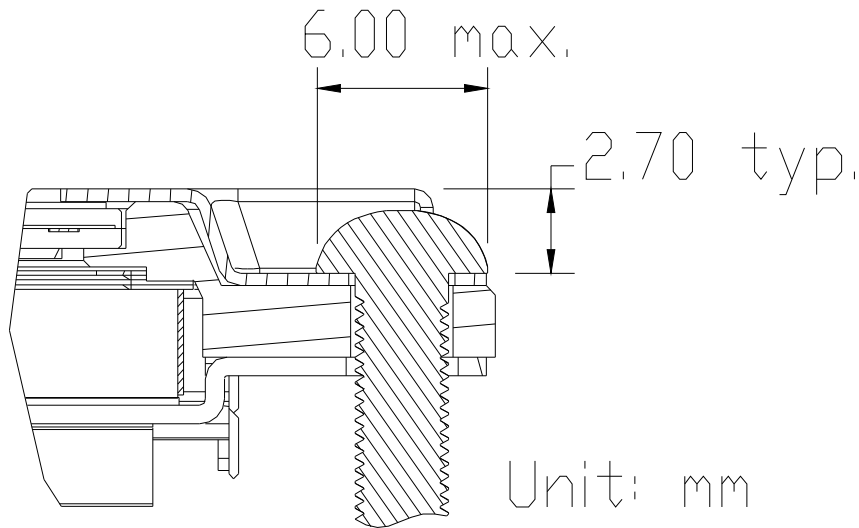
## 9.3 Screw Hole Depth and Center Position

Screw type: M3 screw

Screw hole minimum depth, from side surface =2.7mm (See drawing)

The Max. Diameter of the mounting screw head is 6.0mm

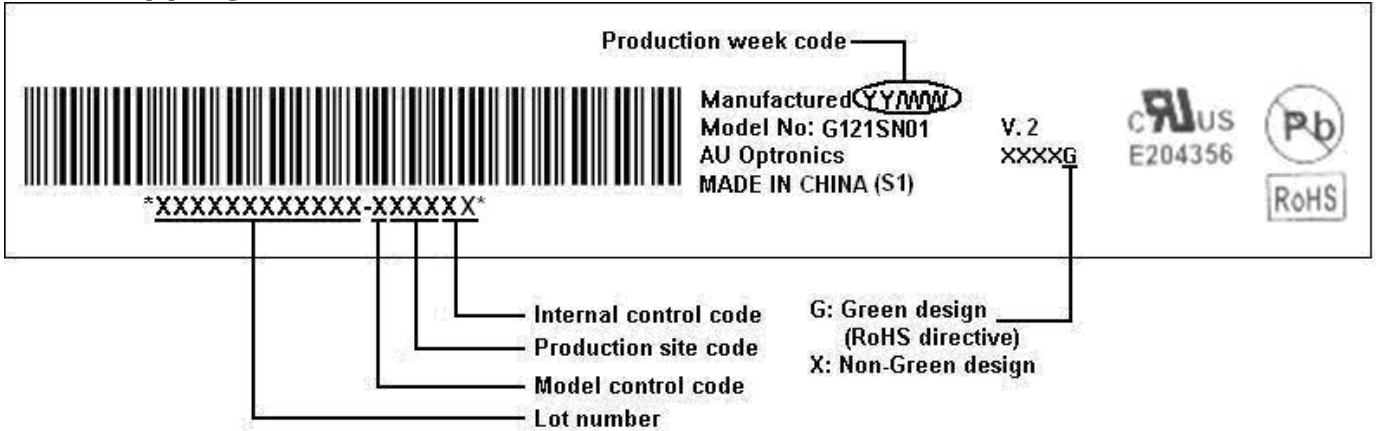
Screw Torque: Maximum 6.0 kgf-cm





## 10. Label and Packaging

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

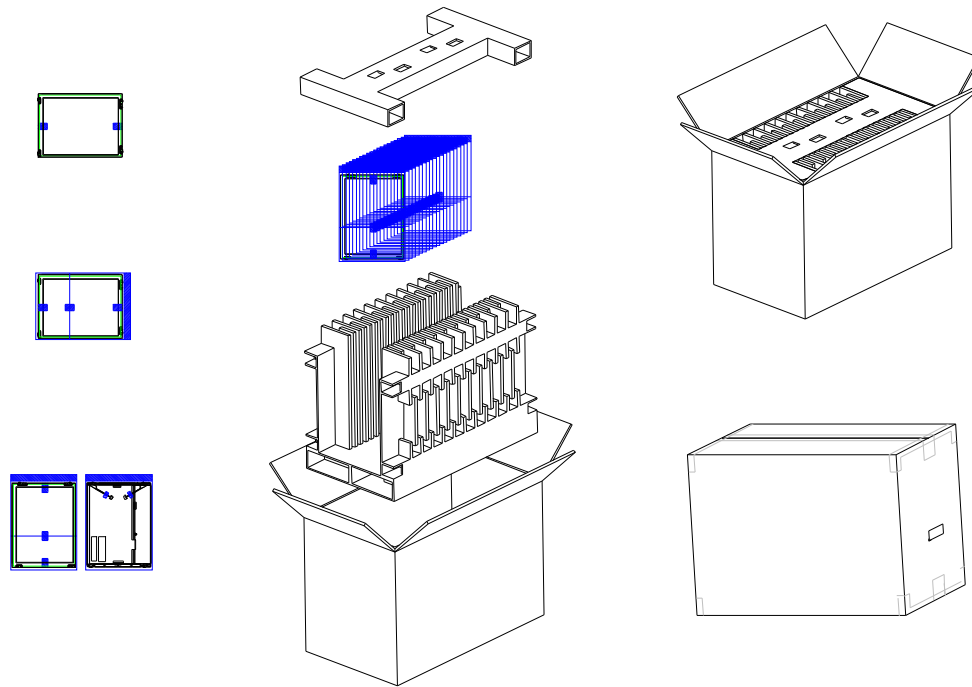


### 10.2 Carton Package

Max capacity: 20 TFT-LCD modules per carton.

Max weight: 17 kg per carton

Outside dimension of carton: 576(L) mm x 326(L) mm x 420(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**

#### **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.

### **11.3 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 60950

U.S.A. Information Technology Equipment