Product Specification

AU OPTRONICS CORPORATION

( ) Preliminary Specifications
(V) Final Specifications

Module	10.1 Inch Color TFT-LCD
Model Name	G101STN01.A

Customer	**Date**	**Approved by**	**Date**
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Note: This Specification is subject to change without notice.		General Display Business Division / AU Optronics corporation	

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Record of Revision

Version and Date	Page	Old description	New Description
0.0 Nov. 27, 2017	All	First draft specification	-
1.0 Mar. 20, 2018	22		
1.1 Apr. 11, 2018	12	VCM：Min 1.15 ; Typ 1.2 ; Max 1.45	VCM：Min 1.125 ; Typ - ; Max 1.375

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) To avoid ESD (Electro Static Discharde) damage, be sure to ground yourself before handling TFT-LCD Module.
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 LED light bar edge. Instead, press at the far ends of the LED light bar 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) TFT-LCD Module is not allowed to be twisted & bent even force is added on module in a very short time. Please design your display product well to avoid external force applying to module by end-user directly.
12) 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.
13) Severe temperature condition may result in different luminance, response time and lamp ignition voltage.
14) Continuous operating TFT-LCD display under low temperature environment may accelerate lamp exhaustion and reduce luminance dramatically.
15) The data on this specification sheet is applicable when LCD module is placed in landscape position.
16) 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

This specification applies to the Color Active Matrix Liquid Crystal Display G101STN01.A composed of a TFT-LCD display, a driver and power supply circuit, and a LED backlight system. The screen format is intended to support Wide SVGA (1024(H) x 600(V)) screen and 262k/16.7M colors (LVDS 6/8-bits). And LED driving circuit for backlight unit is included in G101STN01.A.

All input signals are LVDS interface.

G101STN01.A designed with wide viewing angle; wide temperature and long life LED backlight (20K hrs) is well suited for industial applications.

G101STN01.A is a RoHS product.

2.1 Display Characteristics

The following items are characteristics summary on the table under 25 ^{o}C condition:

Items	Unit	Specifications
Screen Diagonal	[inch]	10.1
Active Area	[mm]	222.72(H) x 125.28(V)
Pixels H x V		1024 (RGB)x 600
Pixel Pitch	[mm]	0.2175(H)×0.2088(V)
Pixel Arrangement		R. G. B. Stripe
Display Mode		TN, Normally White
Nominal Input Voltage VCCS	[Volt]	3.3 (typ.)
Typical Power Consumption	[Watt]	3.15W (max.)
Weight	[Grams]	184.5 (typ.)
Physical Size	[mm]	235(H)x143(V)x6.3(T) (typ.)
Electrical Interface		LVDS
Surface Treatment		AG, (3H)
Color Gamut	%	45
Support Color		262K/16.7M colors
Temperature Range Operating Storage (Non-Operating)	 [^{o}C] [^{o}C]	 -10 to +60 -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/m2]	ILED= 30 mA (center point)	250	300	-	1
Uniformity	%	5 points	80	-	-	2,3
Contrast Ratio			400	500	-	4
Response Time	[msec]	Rising	-	7	10	5
	[msec]	Falling	-	9	18	
	[msec]	Rising + Falling	-	16	28	
Viewing Angle	[degree] [degree]	Horizontal (Right) CR = 10 (Left)	60 60	70 70	-	6
	[degree] [degree]	Vertical (Upper) CR = 10 (Lower)	50 50	60 60	-	
Color / Chromaticity Coordinates (CIE 1931)	-	Red x	0.524	0.574	0.624	-
		Red y	0.285	0.335	0.385	
		Green x	0.280	0.330	0.380	
		Green y	0.525	0.575	0.625	
		Blue x	0.108	0.158	0.208	
		Blue y	0.09	0.140	0.190	
		White x	0.263	0.313	0.363	
		White y	0.279	0.329	0.379	

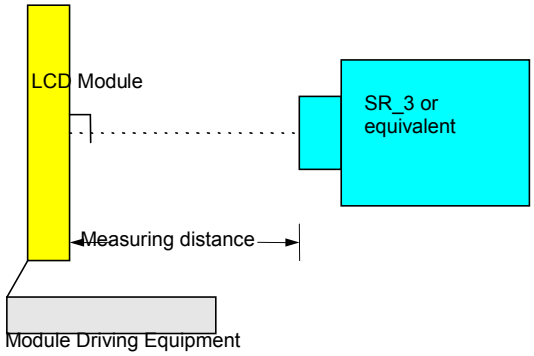
Note 1: Measurement method

Equipment Pattern Generator, Power Supply, Digital Voltmeter, Luminance meter (SR_3 or equivalent)

Aperture 1° with 50cm viewing distance

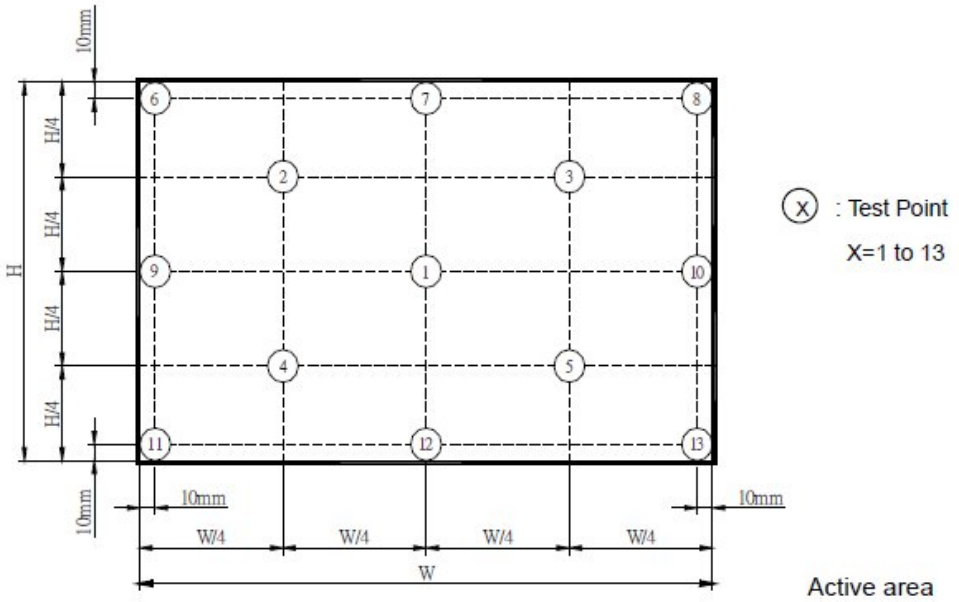
Test Point Center

Environment *< 1 lux*



Note 2: Definition of 5 points position (Display active area: 222.72(H) x 125.28(V))
Measure the luminance of gray level 63 at 5 points

δW_{5p} = {Minimum [L (1) ~ L (5)] / Maximum [L (1) ~ L (5)]}*100%



Note 3: The luminance uniformity of 5 points is defined by dividing the minimum luminance values by the maximum test point luminance

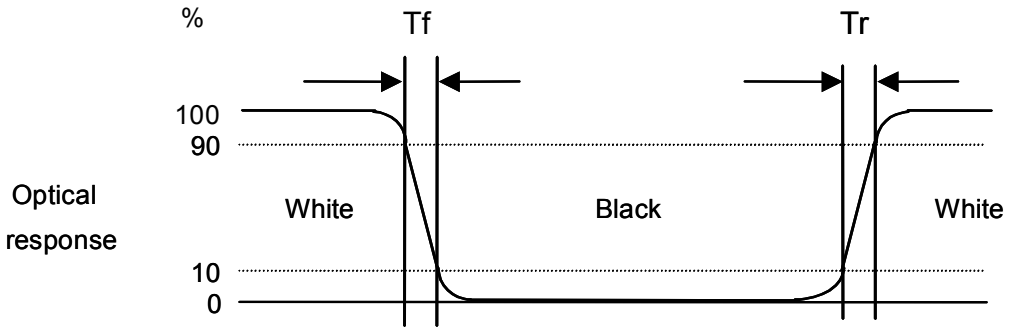
$$\delta_{W5} = \frac{\text{Minimum Brightness of five points}}{\text{Maximum Brightness of five points}}$$

Note 4: Definition of contrast ratio (CR):

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

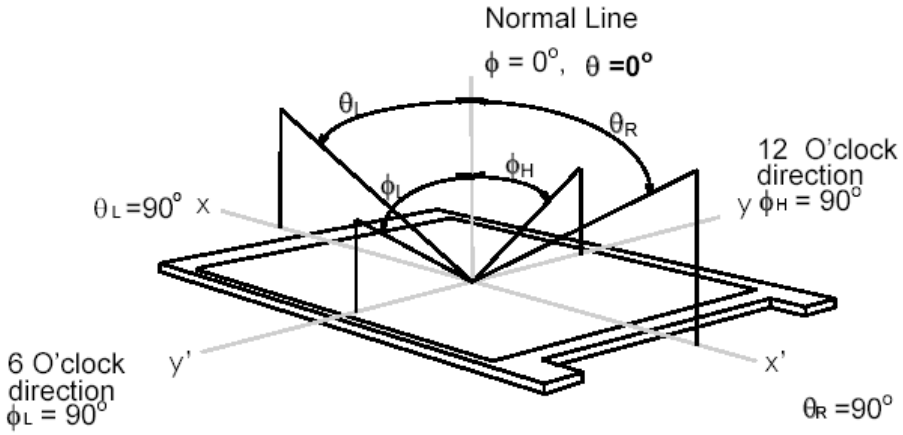
Note 5: Definition of response time:

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.



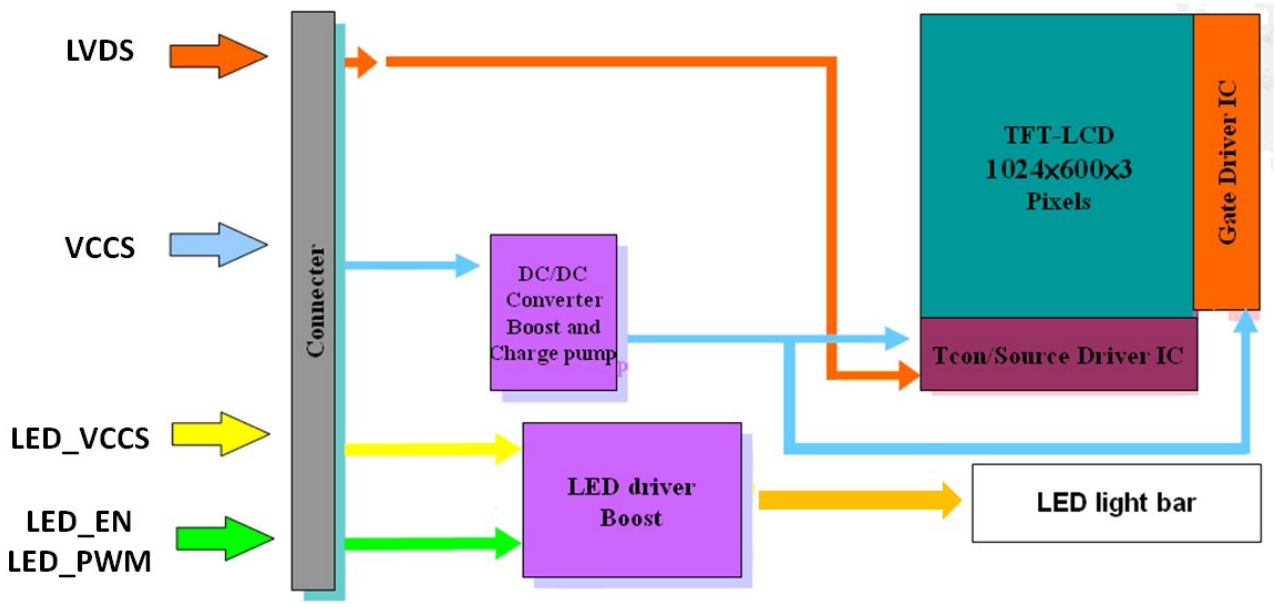
Note 6: Definition of viewing angle

Viewing angle is the measurement of contrast ratio ≧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 10.1 inch color TFT/LCD module:



4. Absolute Maximum Ratings

4.1 Absolute Ratings of TFT LCD Module

Item	Symbol	Min	Max	Unit
Logic/LCD drive Voltage	VCCS	-0.3	4	[Volt]
EDID drive Voltage	VEDID	-0.3	4	[Volt]
Converter Input Voltage	LED_VCCS	-0.3	9	[Volt]
Converter Control Signal Voltage	LED_PWM	-0.3	LED_VCCS	[Volt]
Converter Control Signal Voltage	LED_EN	-0.3	LED_VCCS	[Volt]

4.2 Absolute Ratings of Environment

Item	Symbol	Min	Max	Unit
Operating Temperature	TOP	-10	60	[^{o}C]
Storage Temperature	TST	-30	70	[^{o}C]

Note: Maximum Wet-Bulb should be 39 ^{o}C and no condensation.

5. Electrical Characteristics

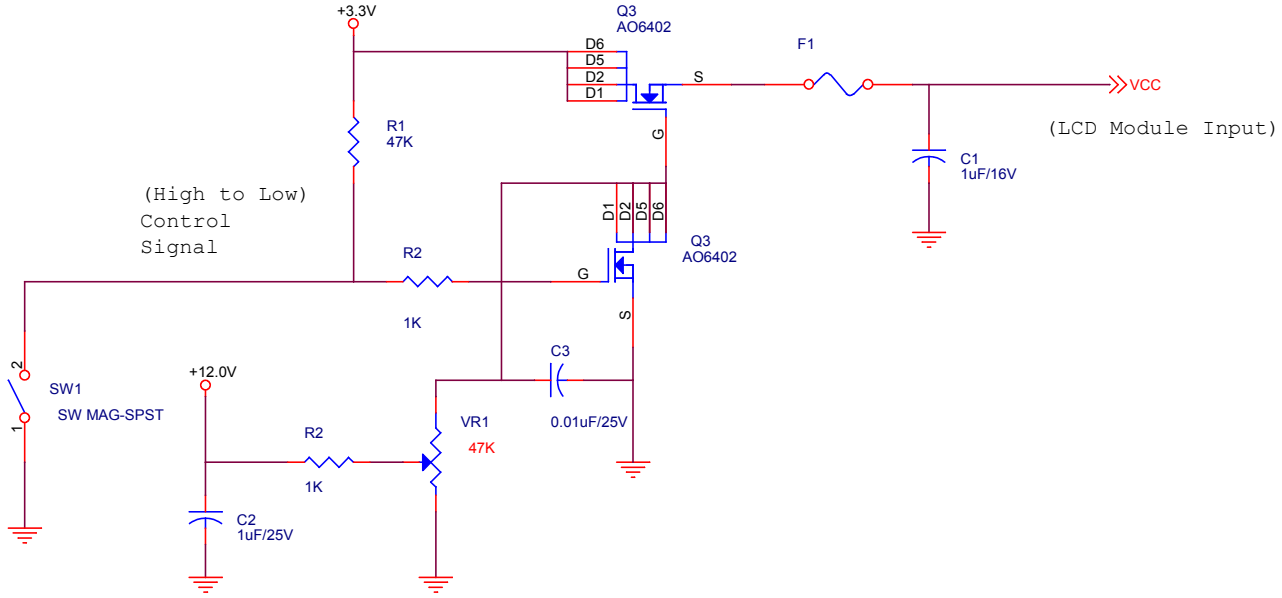
5.1 TFT LCD Module

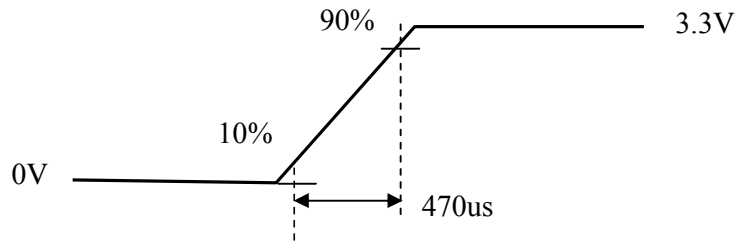
5.1.1 Power Specification

Input power specifications are shown as follows;

Symbol	Parameter	Min	Typ	Max	Units	Remark
VCCS	Logic/LCD Drive Voltage	3	3.3	3.6	[Volt]	
I_{VCCS}	VCCS Current	-	140	168	[mA]	Black Pattern (VCCS=3.3V, at 60Hz)
Irush	LCD Inrush Current	-	-	1.5	[A]	Note 1
P_{VCCS}	VCCS Power	-	-	0.55	[Watt]	Black Pattern (VCCS=3.3V, at 60Hz)
VCCSrp	Allowable Logic/LCD Drive Ripple Voltage			100	[mV] p-p	

Note 1: Measurement condition:





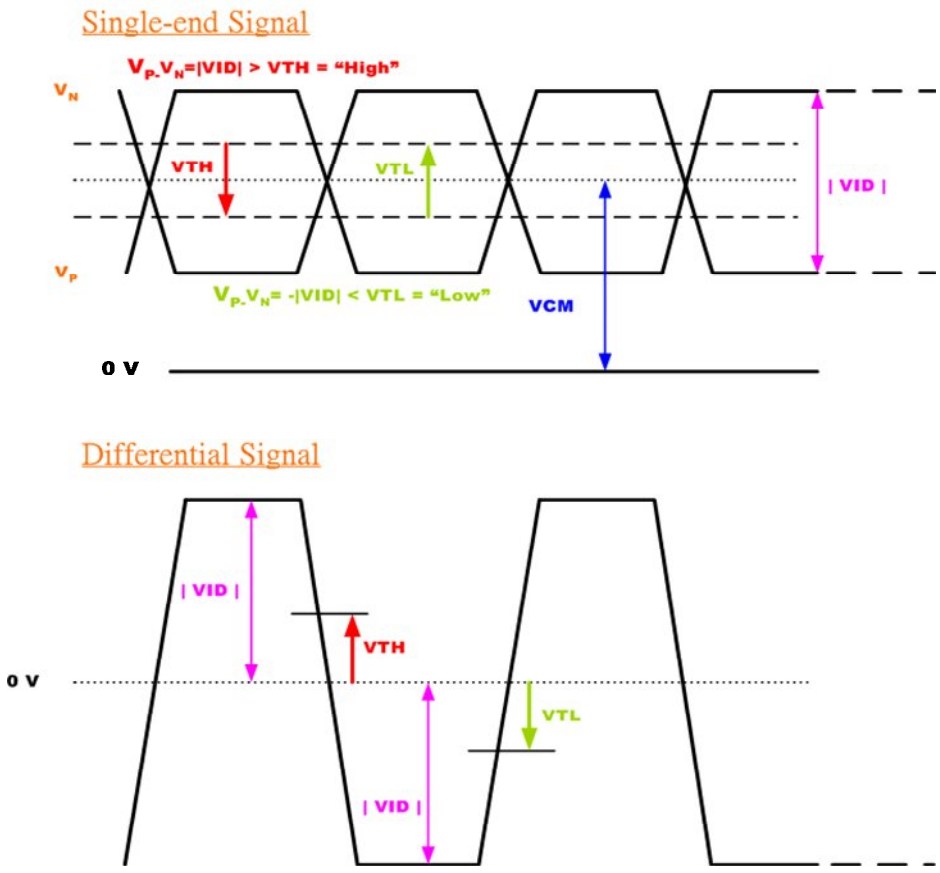
VCCS rising time

5.1.2 LVDS DC Electrical Characteristics

Input signals shall be low or Hi-Z state when VCCS 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]	
VCM	Differential Input Common Mode Voltage	1.125	-	1.375	[V]	VTH/VTL=±100mV

Note: LVDS Signal Waveform.



5.2 Backlight Unit

5.2.1 Parameter guideline for LED

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

Symbol	Parameter		Min.	Typ.	Max.	Unit	Remark
LED_VCCS	Input Voltage		4	5	7	[Volt]	
$I_{LEDRUSH}$	Inrush Current		-	-	1.5	[A]	
I_{LED}	Input Current		-	415	520	[mA]	Note 2
P_{LED}	Power Consumption		-	-	2.6	[Watt]	Note 2
LED_EN	EN Control Level	BL On	2.3	-	7	[Volt]	
		BL Off	0	-	0.5		
F_{PWM}	PWM Control Frequency		190	-	2000	[Hz]	PWM Control
D_{PWM}	PWM Control Duty Ratio		10	-	100	[%]	
V_{PWM}	PWM Control Level	High Level	2.3	-	7	[Volt]	
		Low Level	0	-	0.5		
I_F	LED Forward Current		**-**	30	**-**	[mA]	Ta = 25°C
V_F	LED Forward Voltage		-	12.8	14.4	[Volt]	I_F=30mA,Ta = 25°C
P_{LED}	LED Power Consumption		-	0.384	0.432	[Watt]	I_F= 30mA,Ta = 25°C LED per string Power
Operation Life			20,000	-	-	Hrs	I_F=30mA, Ta = 25°C

Note 1: Ta means ambient temperature of TFT-LCD module.

Note 2: $I_{LEDRUSH}$, I_{LED}, P_{LED} are defined for LED backlight and tested when LED_VCCS = 5V and 100% duty of PWM dimming.

Note 3: I_F, V_F are defined for one channel LED. There are five LED channel in back light unit.

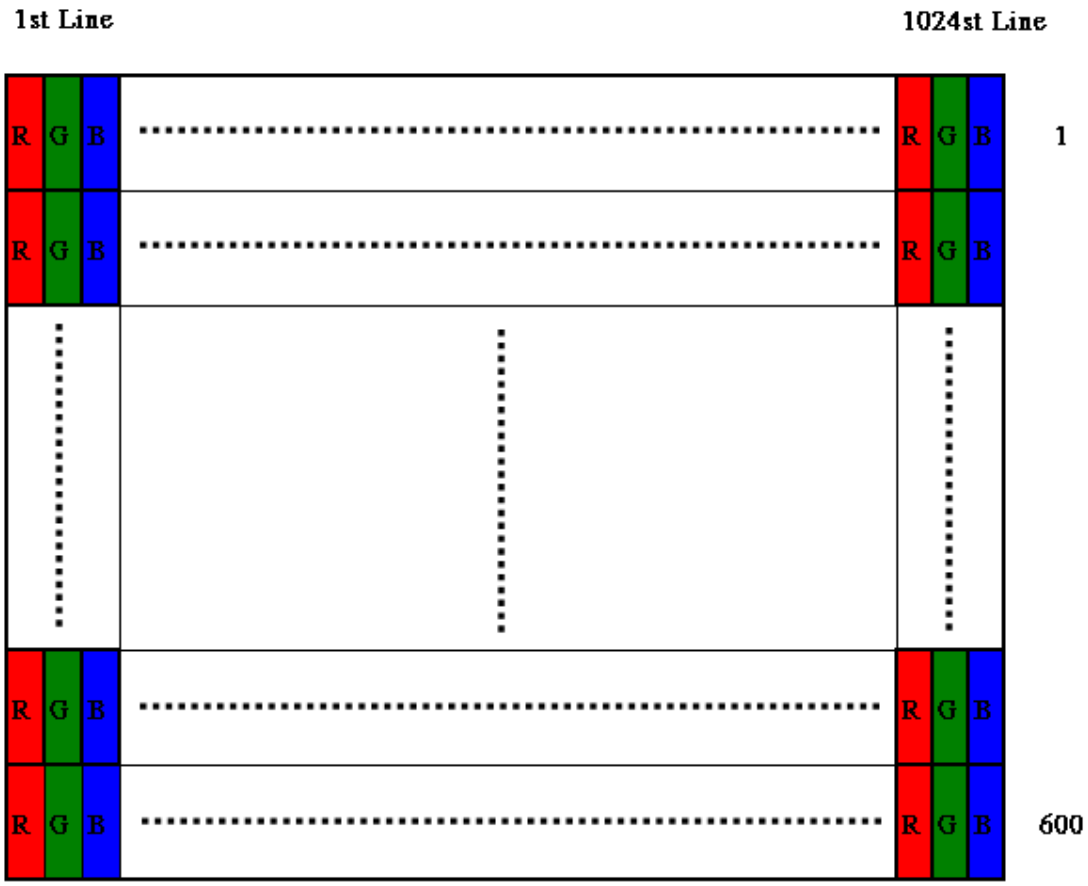
Note 4: If G101STN01.A module is driven by high current or at high ambient temperature & humidity condition. The operating life will be reduced.

Note 5: Operating life means brightness goes down to 50% initial brightness. Minimum operating life time is estimated data.

6. Signal Characteristic

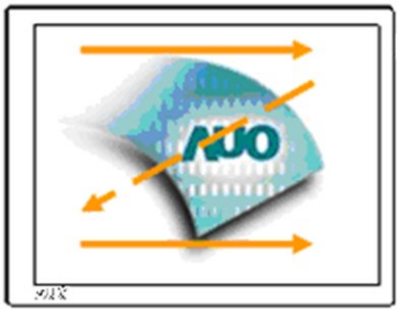
6.1 Pixel Format Image

Following figure shows the relationship between input signal and LCD pixel format.

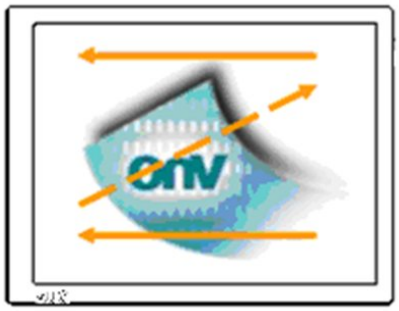


6.2 Scanning Direction

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



REV=L or NC



REV=H

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.

Pin no	Symbol	Function	Remark
1	LED_VCCS	LED Power Supply (5V typ.)	
2	LED_VCCS	LED Power Supply (5V typ.)	
3	LED_VCCS	LED Power Supply (5V typ.)	
4	NC	No Connection (Reserve)	
5	LED_EN	Enable Control Signal of LED Converter	
6	LED_PWM	PWM Control Signal of LED Converter	
7	NC	No Connection (Reserve)	
8	LED_GND	LED Ground	
9	LED_GND	LED Ground	
10	LED_GND	LED Ground	
11	NC	No Connection (Reserve)	
12	REV	Scanning direction selection. REV ="H": inversion / REV="L" or "NC" : normal	
13	VSS	Ground	
14	SEL68	6/8bits LVDS data input selection SEL_68 = "H" : 8bit / SEL_68 = "L" or NC : 6bit	
15	Order_SEL	LVDS format selection. Order_SEL = "H" : JEIDA / Order_SEL = "L" or NC : NS-Like	
16	VSS	Ground	
17	NC	No Connection (Reserved for AUO test)	
18	NC	No Connection (Reserved for AUO test)	
19	VSS	Ground	
20	Rxin3+	LVDS receiver signal channel 3 pin20 & pin21 connect to GND or NC for 6bit LVDS Input	
21	Rxin3-		
22	VSS	Ground	
23	RxCLK+	LVDS differential clock input	
24	RxCLK-		
25	VSS	Ground	
26	Rxin2+	LVDS Differential Data Input	
27	Rxin2-		
28	VSS	Ground	
29	Rxin1+	LVDS Differential Data Input	
30	Rxin1-		
31	VSS	Ground	
32	Rxin0+	LVDS Differential Data Input	
33	Rxin0-		
34	NC	No Connection (Reserve)	

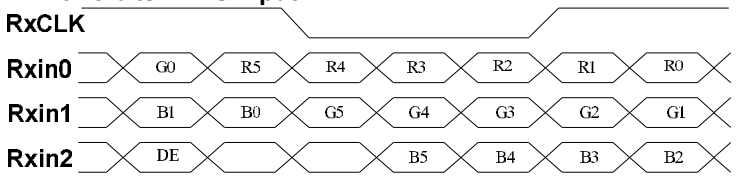
35	NC	No Connection (Reserve)	
36	NC	No Connection (Reserve)	
37	NC	No Connection (Reserve)	
38	VCCS	Power Supply (3.3V typ.)	
39	VCCS	Power Supply (3.3V typ.)	
40	NC	No Connection (Reserve)	

Note 1: Input Signals shall be in low status when VCCS is off.
Note 2: High stands for “3.3V”, Low stands for “0V”, NC means “No Connection”.

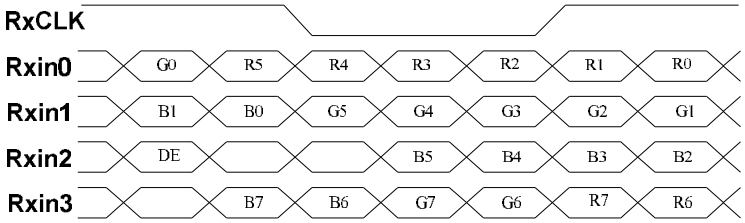
6.4 The Input Data Format

6.4.1 SEL68 and Order_SEL

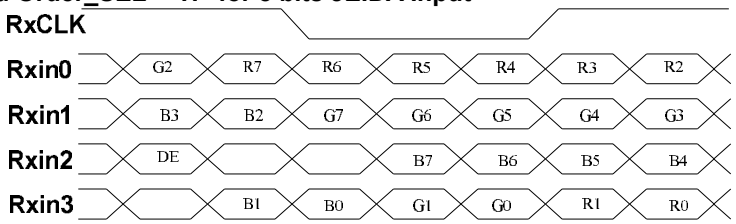
SEL68 =“Low” or “NC” for 6 bits LVDS Input



SEL68 = “High” and Order_SEL =“Low” or “NC” for 8 bits NS-Like Input



SEL68 = “High” and Order_SEL =“H” for 8 bits JEIDA Input



Signal Name	Description	Remark
R7 R6 R5 R4 R3 R2 R1 R0	Red Data 7 Red Data 6 Red Data 5 Red Data 4 Red Data 3 Red Data 2 Red Data 1 Red Data 0	Red-pixel Data For 8Bits LVDS input MSB: R7 ; LSB: R0 For 6Bits LVDS input MSB: R5 ; LSB: R0
G7 G6 G5 G4 G3 G2 G1 G0	Green Data 7 Green Data 6 Green Data 5 Green Data 4 Green Data 3 Green Data 2 Green Data 1 Green Data 0	Green-pixel Data For 8Bits LVDS input MSB: G7 ; LSB: G0 For 6Bits LVDS input MSB: G5 ; LSB: G0
B7 B6 B5 B4 B3 B2 B1 B0	Blue Data 7 Blue Data 6 Blue Data 5 Blue Data 4 Blue Data 3 Blue Data 2 Blue Data 1 Blue Data 0	Blue-pixel Data For 8Bits LVDS input MSB: B7 ; LSB: B0 For 6Bits LVDS input MSB: B5 ; LSB: B0
RxCLKIN	LVDS Data Clock	
DE	Data Enable Signal	When the signal is high, the pixel data shall be valid to be displayed.

Note1: Please follow PSWG.
Note2: Output signals from any system shall be low or Hi-Z state when VCCS is off.

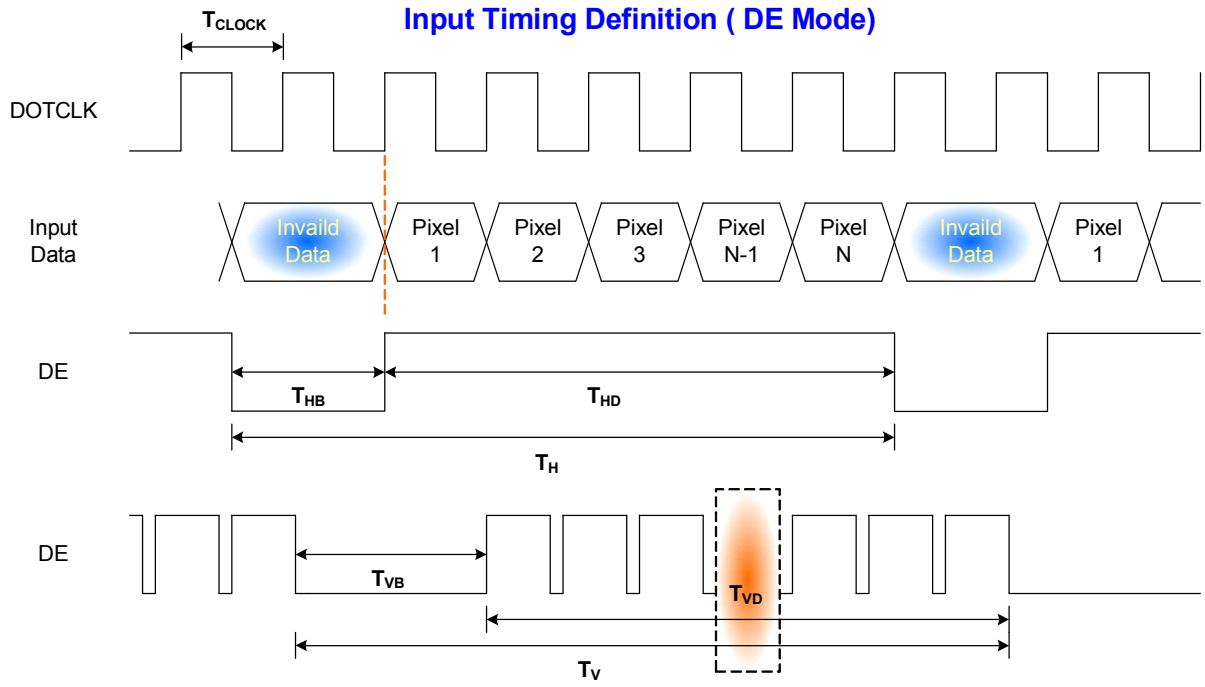
6.5 Interface Timing

6.5.1 Timing Characteristics

Signal		Symbol	Min.	Typ.	Max.	Unit
Clock Frequency		Tdclk	40.8	51.2	67.2	MHz
Vertical Section	Period	T_V	610	635	800	T_{Line}
	Active	T_{VD}	600	600	600	
	Blanking	T_{VB}	10	35	200	
Horizontal Section	Period	T_H	1114	1344	1400	T_{dclk}
	Active	T_{HD}	1024	1024	1024	
	Blanking	T_{HB}	90	320	376	
Frame Rate		F	50	60	70	Hz

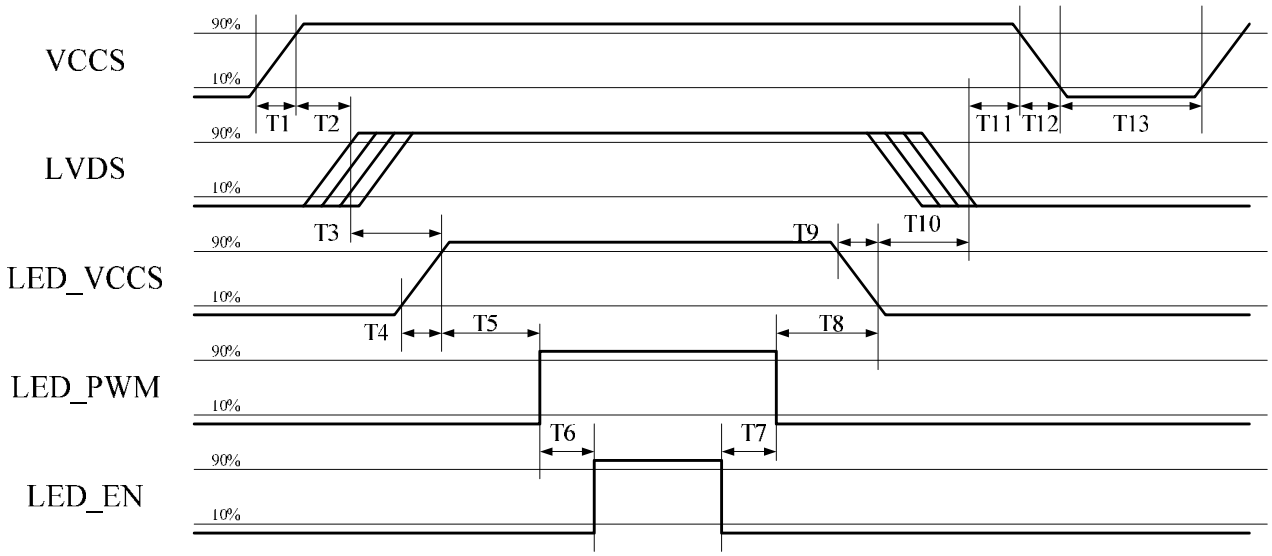
Note : DE mode.

6.5.2 Input Timing Diagram



6.6 Power ON/OFF Sequence

VCCS 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 VCCS 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	0.5	-	10	Ms
T5	10	-	-	ms
T6	10	-	-	ms
T7	10	-	-	ms
T8	10	-	-	ms
T9	0	-	10	ms
T10	180	-	-	ms
T11	0	-	50	ms
T12	0.5	-	10	ms
T13	500	-	-	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	Signal Connector
Manufacturer	Hirose or compatible
Connector Model Number	Hirose FH41-40S-0.5SH(05) or compatible

Pin No.	Symbol	Pin No.	Symbol
1	LED_VCCS	21	Rxin3-
2	LED_VCCS	22	VSS
3	LED_VCCS	23	RxCLK+
4	NC	24	RxCLK-
5	LED_EN	25	VSS
6	LED_PWM	26	Rxin2+
7	NC	27	Rxin2-
8	LED_GND	28	VSS
9	LED_GND	29	Rxin1+
10	LED_GND	30	Rxin1-
11	NC	31	VSS
12	REV	32	Rxin0+
13	VSS	33	Rxin0-
14	SEL68	34	NC
15	Order_SEL	35	NC
16	VSS	36	NC
17	NC	37	NC
18	NC	38	VCCS
19	VSS	39	VCCS
20	Rxin3+	40	NC

8. Reliability Test Criteria

Items	Required Condition	Note
Temperature Humidity Bias	40 °C /90%,300Hr	
High Temperature Operation	60 °C, 300Hr	
Low Temperature Operation	-10 °C, 300Hr	
Hot Storage	70 °C, 300 hours	
Cold Storage	-30 °C, 300 hours	
Thermal Shock Test	-30 °C /30 min ,70 °C /30 min ,100cycles	
Shock Test (Non-Operating)	50G,20ms,Half-sine wave,(+-X,+-Y,+-Z)	
Vibration Test (Non-Operating)	1.5G, 10~200~10Hz, Sine wave 30mins/axis, 3 direction (X, Y, Z)	

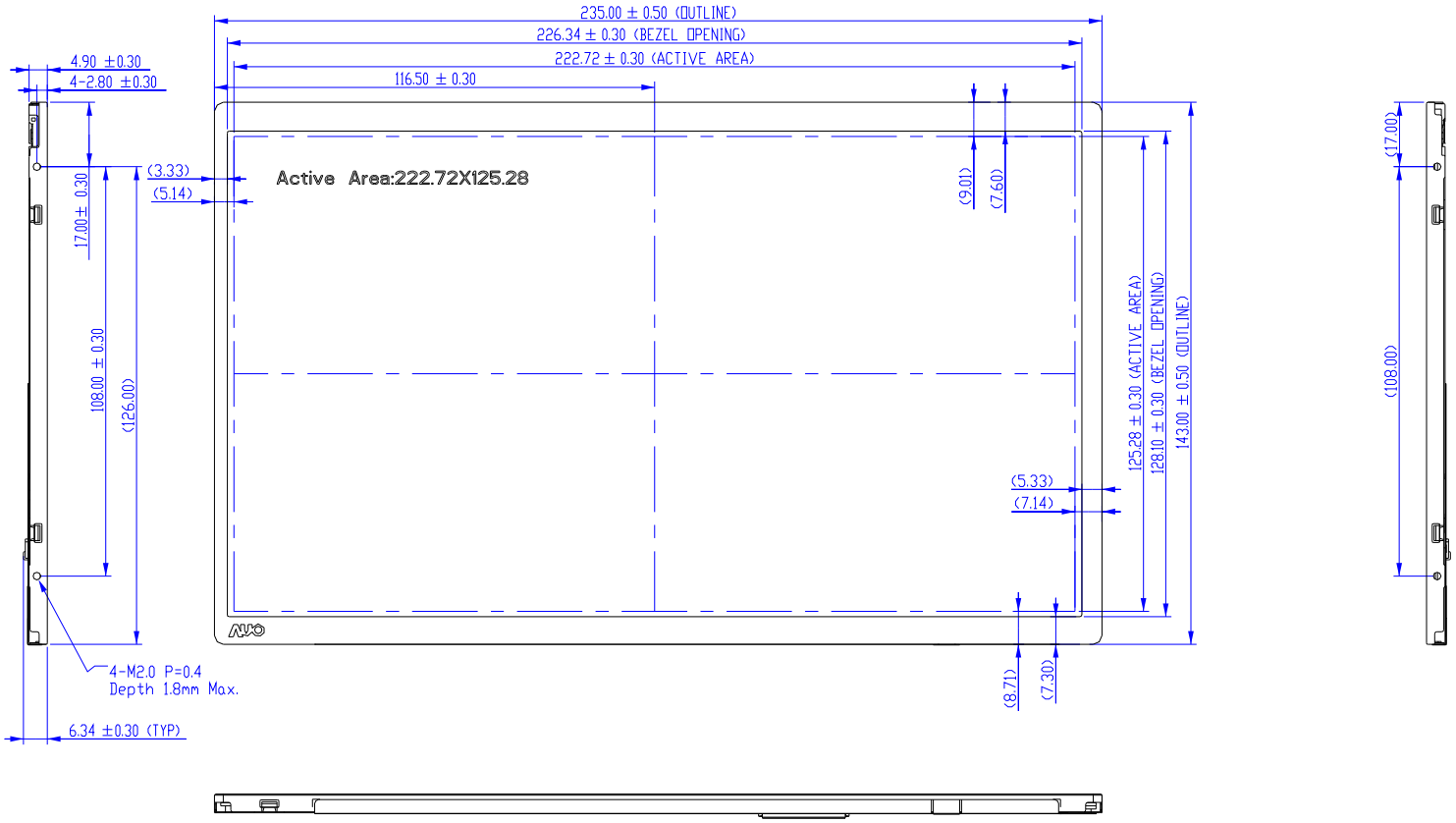
Note 1: After reliability test, it is no function defect and occurrence of any new defective shall not be allowed.

Note 2:

- Water condensation is not allowed for each test items.
- Each test is done by new TFT-LCD module. Don't use the same TFT-LCD module repeatedly for reliability test.
- The reliability test is performed only to examine the TFT-LCD module capability.
- To inspect TFT-LCD module after reliability test, please store it at room temperature and room humidity for 24 hours at least in advance.

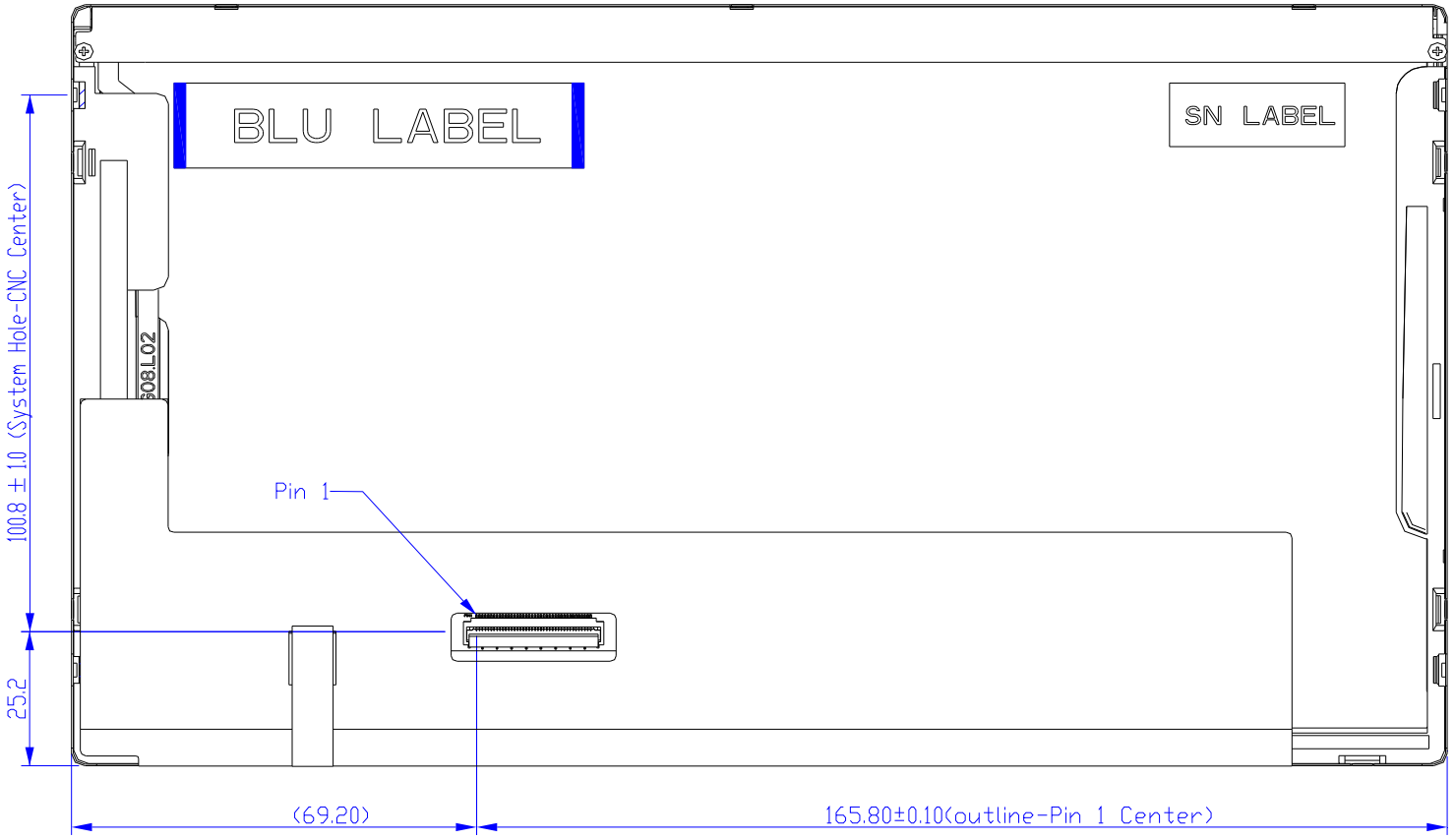
9. Mechanical Characteristics

9.1 LCM Outline Dimension (Front View)



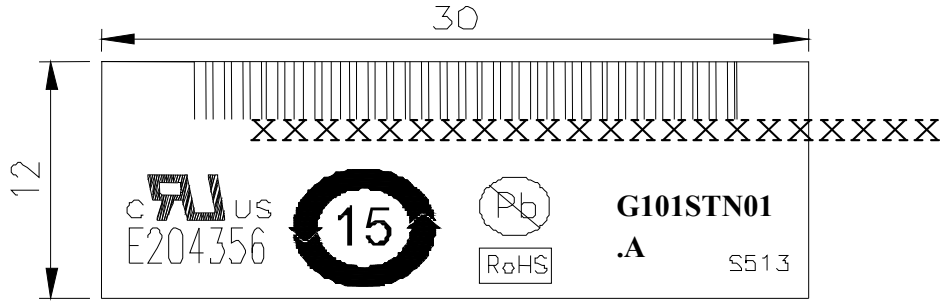
Notes:
1.General tolerance is ± 0.5mm

9.2 LCM Outline Dimension (Rear View)

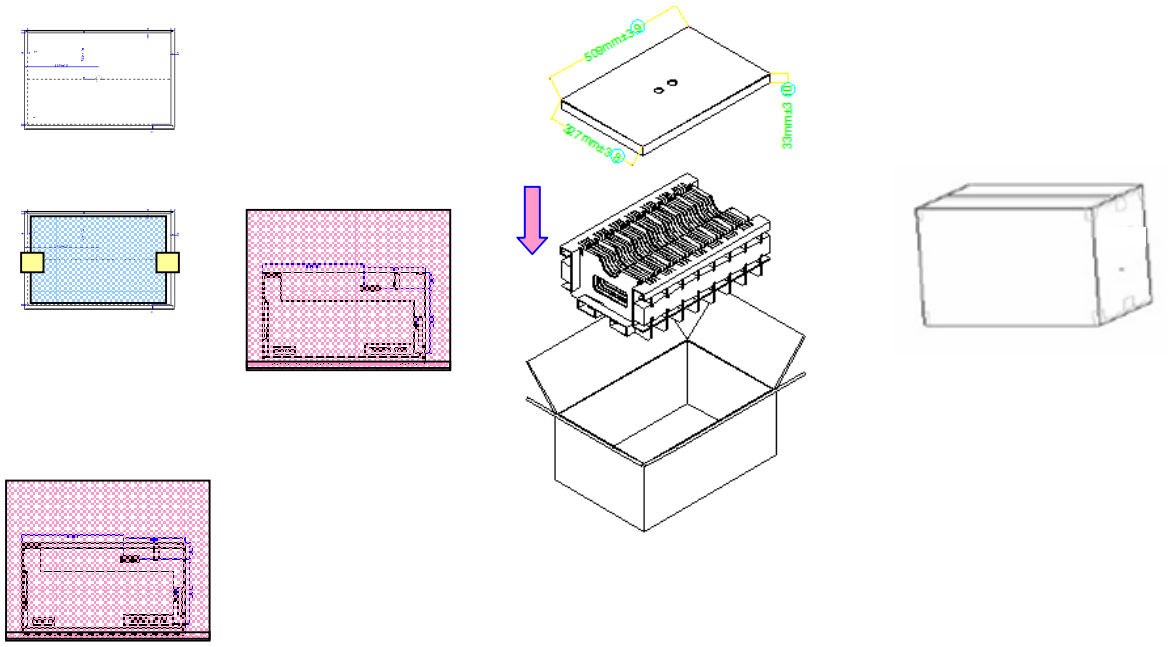


10. Label and Packaging

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



10.2 Carton Package



Max capacity：35 TFT-LCD module per carton
Max weight: 9.0 kg per carton
Outside dimension of carton: 484(L)*328(W)*257(H)mm
Pallet size：1,150mm*980mm*138mm
Box stacked_Max
Module by air：(2 *3) *5 layers，one pallet put 30 boxes，total 1,050 pcs module
Module by sea：(2 *3) *5 layers + (2 *3) *2 layers , two pallet put 42 boxes，total 1,470 pcs module
Module by sea_HQ：(2 *3) *5 layers+(2 *3) *3 layers, two pallet put 48 boxes, total 1,680 pcs module

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 60950-1 second edition	U.S.A. Information Technology Equipment