

() Preliminary Specifications

(V) Final Specifications

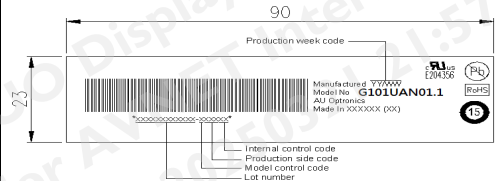
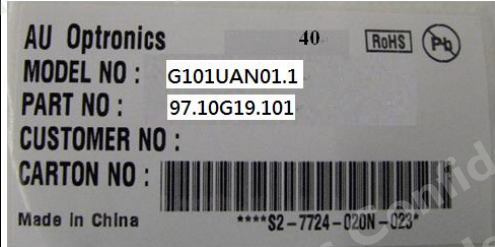
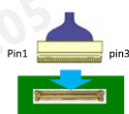
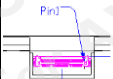
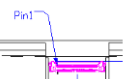
Module	10.1" WUXGA Color TFT-LCD with LED Backlight design
Model Name	G101UAN01.1

Customer Date Checked & Approved by	Approved by Date <u>LeaDer Feng</u> <u>2023/09/25</u> Prepared by <u>Jon Tseng</u> <u>2023/09/25</u>
	General Display Business Division / AUO Display Plus Corporation

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Record of Revision

Version and Date	Page	Old description	New Description																																																																																				
0.0 2022/04/29	All	-	First draft specification																																																																																				
0.1 2022/06/29	27	Pallet size : 1000mm*820mm*320mm	Pallet size : 1000mm*820mm*132mm																																																																																				
1.0 2022/09/26	5	Power Consumption TBD W	Power Consumption : 5.45 W																																																																																				
	5	Physical Size TBD Max (PCBA side)	Physical Size 5.05 Max (PCBA side)																																																																																				
	11	<table><thead><tr><th>Symbol</th><th>Parameter</th><th>Min</th><th>Typ</th><th>Max</th><th>Units</th><th>Remark</th></tr></thead><tbody><tr><td>VDD</td><td>Logic/LCD Drive Voltage</td><td>3.0</td><td>3.3</td><td>3.6</td><td>[Volt]</td><td>-</td></tr><tr><td>IDD</td><td>IDD Current</td><td>-</td><td>TBD</td><td>TBD</td><td>[mA]</td><td>Note 1</td></tr><tr><td>IRush</td><td>Inrush Current</td><td>-</td><td>-</td><td>1500</td><td>[mA]</td><td>Note 2</td></tr><tr><td>PDD</td><td>VDD Power</td><td>-</td><td>TBD</td><td>TBD</td><td>[mW]</td><td>Note 1</td></tr><tr><td>VDDrp</td><td>Allowable Logic/LCD Drive Ripple Voltage</td><td>-</td><td>-</td><td>100</td><td>[mV] p-p</td><td>-</td></tr></tbody></table> Note 1 : Maximum Measurement Condition : White Pattern at 3.3V driving voltage. (P_{DD}=V_{DD} × I_{DD})	Symbol	Parameter	Min	Typ	Max	Units	Remark	VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	-	IDD	IDD Current	-	TBD	TBD	[mA]	Note 1	IRush	Inrush Current	-	-	1500	[mA]	Note 2	PDD	VDD Power	-	TBD	TBD	[mW]	Note 1	VDDrp	Allowable Logic/LCD Drive Ripple Voltage	-	-	100	[mV] p-p	-	<table><thead><tr><th>Symbol</th><th>Parameter</th><th>Min</th><th>Typ</th><th>Max</th><th>Units</th><th>Remark</th></tr></thead><tbody><tr><td>VDD</td><td>Logic/LCD Drive Voltage</td><td>3.0</td><td>3.3</td><td>3.6</td><td>[Volt]</td><td>-</td></tr><tr><td>IDD</td><td>IDD Current</td><td>-</td><td>0.206</td><td>0.348</td><td>[A]</td><td>Note 1</td></tr><tr><td>IRush</td><td>Inrush Current</td><td>-</td><td>-</td><td>1500</td><td>[mA]</td><td>Note 2</td></tr><tr><td>PDD</td><td>VDD Power</td><td>-</td><td>0.68</td><td>1.15</td><td>[W]</td><td>Note 1</td></tr><tr><td>VDDrp</td><td>Allowable Logic/LCD Drive Ripple Voltage</td><td>-</td><td>-</td><td>100</td><td>[mV] p-p</td><td>-</td></tr></tbody></table> Note 1 : Typical Measurement Condition : White Pattern at 3.3V driving voltage. (P_{DD}=V_{DD} × I_{DD}) Maximum Measurement Condition : R/G/B Pattern at 3.3V driving voltage. (P_{DD}=V_{DD} × I_{DD})	Symbol	Parameter	Min	Typ	Max	Units	Remark	VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	-	IDD	IDD Current	-	0.206	0.348	[A]	Note 1	IRush	Inrush Current	-	-	1500	[mA]	Note 2	PDD	VDD Power	-	0.68	1.15	[W]	Note 1	VDDrp	Allowable Logic/LCD Drive Ripple Voltage	-	-	100	[mV] p-p	-
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1.1 2023/09/25	19	Note 1: Start from right side.	Note 1: eDP cable install as following. 																																																																																				
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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 Discharge) 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

G101UAN01.1 is a Color Active Matrix Liquid Crystal Display composed of a TFT LCD panel, a driver circuit, and LED backlight system. The screen format is intended to support the 16:10 WUXGA, 1920(H) x1200(V) screen and 16.7M colors (RGB 6-bits + Hi FRC) with LED backlight driving circuit. All input signals are eDP interface compatible.

2.1 Display Characteristics

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

Items	Unit	Specifications
Screen Diagonal	[inch]	10.1"
Active Area	[mm]	216.81(H) x 135.5(V)
Pixels H x V		1920 x 3(RGB) x 1200
Pixel Pitch	[mm]	0.11292 X 0.11292
Pixel Arrangement		R.G.B. Vertical Stripe
Display Mode		AHVA, Normally Black
Nominal Input Voltage VDD	[Volt]	+3.3 Typ
Power Consumption	[Watt]	5.45 (with LED driver)
Weight	[Grams]	170 Max
Physical Size	[mm]	229.9 x 150.5 x 2.9 Max (Panel side) 5.05 Max (PCBA side)
Electrical Interface		2 Lane eDP 1.2
Surface Treatment		HC
Support Color		16.7M colors (RGB 6-bit + Hi-FRC)
Temperature Range Operating Storage (Non-Operating)	[°C] [°C]	-10 to +60 -20 to +60
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 ²]	I _{LED} = 17.9mA (5p average)	600	800		
Uniformity	%	5 points	70%			
Contrast Ratio			600	800	-	
Response Time	[msec]	Rising + Falling	---	25	35	
Viewing Angle	[degree]	Horizontal (Right) CR = 10 (Left)	80	89	---	
	[degree]		80	89	---	
	[degree]	Vertical (Upper) CR = 10 (Lower)	80	89	---	
	[degree]		80	89	---	
Color / Chromaticity Coordinates (CIE 1931)		Red x	0.543	0.593	0.643	
		Red y	0.291	0.341	0.391	
		Green x	0.274	0.324	0.374	
		Green y	0.539	0.589	0.639	
		Blue x	0.104	0.154	0.204	
		Blue y	0.073	0.123	0.173	
		White x	0.263	0.313	0.363	
		White y	0.279	0.329	0.379	
Color Gamut	%		-	50	-	

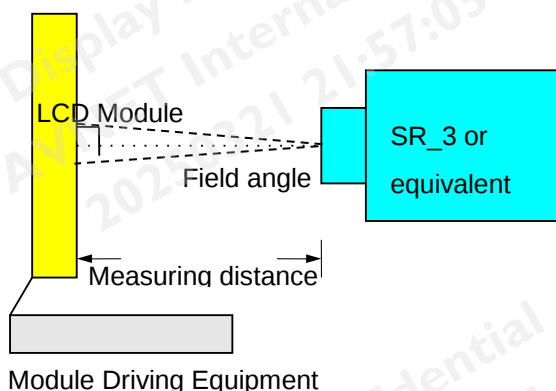
Note 1: Measurement method

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

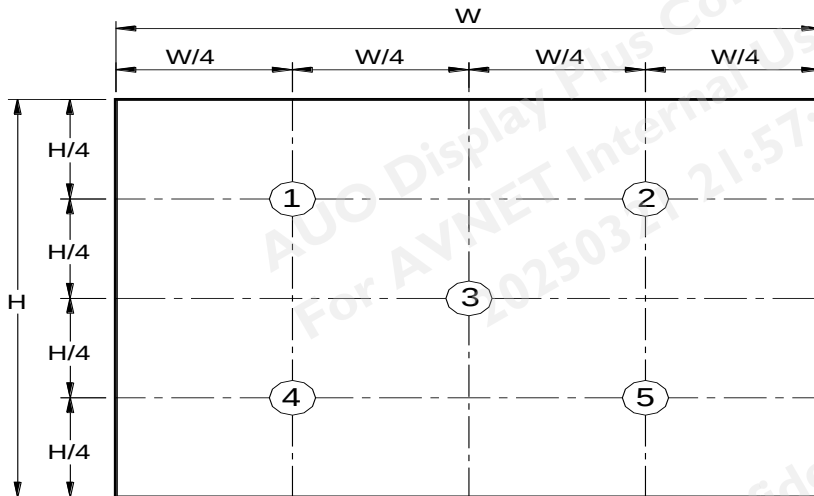
Aperture Field angle 2° with 50cm measuring distance

Test Point Follow Note 2 position

Environment < 1 lux



Note 2: Definition of 5 points position



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

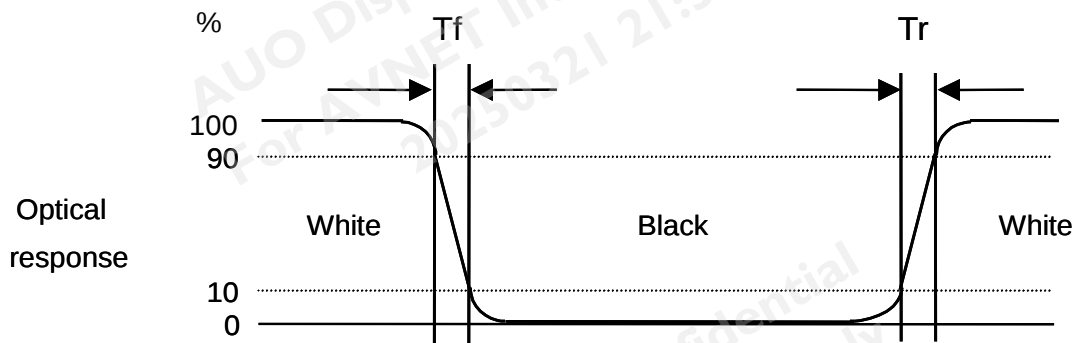
$$\delta w_9 = \frac{\text{Minimum Brightness of five points}}{\text{Maximum Brightness of five points}}$$

Note 4: Definition of contrast ratio (CR):

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

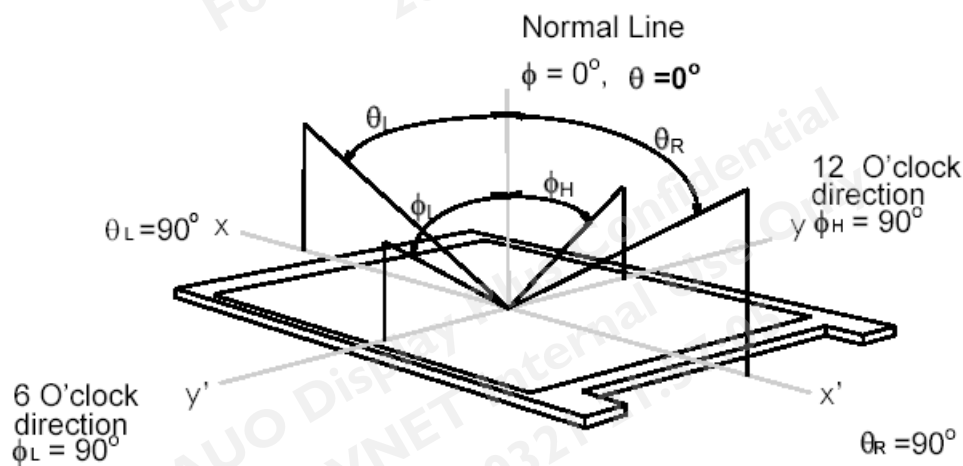
Note 5: Definition of response time:

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.



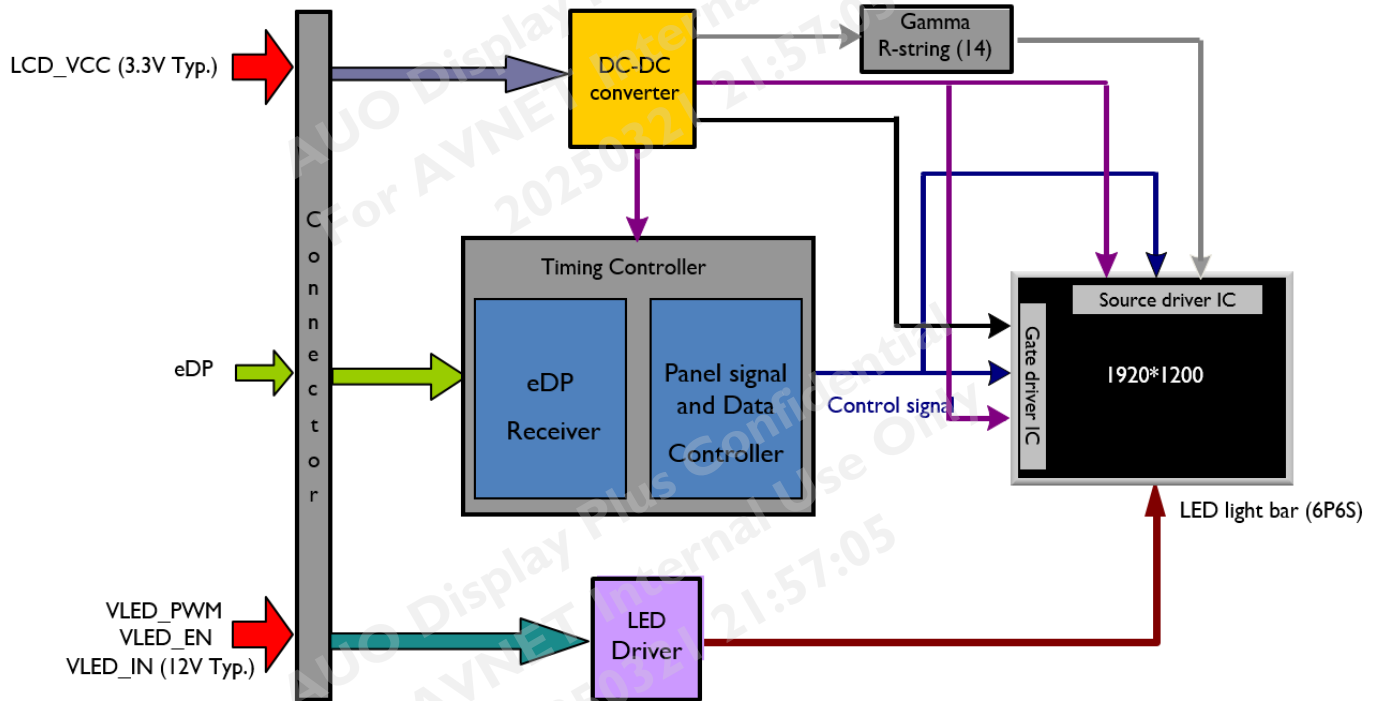
Note 6: Definition of viewing angle

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

An absolute maximum rating of the module is as following:

4.1 Absolute Ratings of TFT LCD Module

Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD drive Voltage	VDD	-0.3	+4.0	[Volt]	Note 1,2

4.2 Absolute Ratings of Environment

Item	Symbol	Min	Max	Unit
Operating Temperature	TOP	-10	+60	[°C]
Operation Humidity	HOP	5	90	[%RH]
Storage Temperature	TST	-20	+60	[°C]
Storage Humidity	HST	5	90	[%RH]

Note 1: At Ta (25°C)

Note 2: Permanent damage to the device may occur if exceed maximum values

Note 3: Maximum wet-bulb temperature is less than 39°C and no condensation

5. Electrical Characteristics

5.1 TFT LCD Module

5.1.1 Power Specification

Input power specifications are as follows;

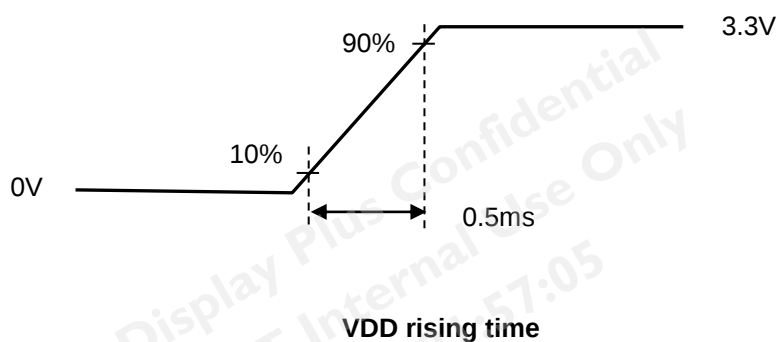
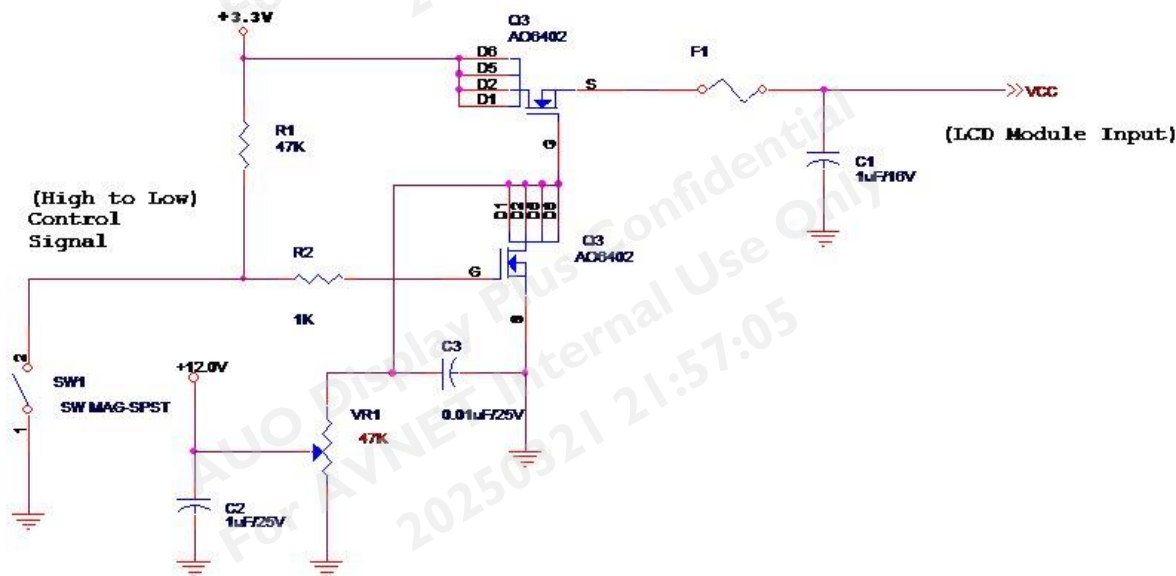
The power specification are measured under 25°C and frame frequency under 60Hz

Symbol	Parameter	Min	Typ	Max	Units	Remark
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	
IDD	IDD Current	-	0.206	0.348	[A]	Note 1
IRush	Inrush Current	-	-	1500	[mA]	Note 2
PDD	VDD Power	-	0.68	1.15	[W]	Note 1
VDDrp	Allowable Logic/LCD Drive Ripple Voltage	-	-	100	[mV] p-p	

Note 1 : Typical Measurement Condition : White Pattern at 3.3V driving voltage. ($P_{typ} = V_{3.3} \times I_{white}$)

Maximum Measurement Condition : R/G/B Pattern at 3.3V driving voltage. ($P_{\max} = V_{3.3} \times I_{R/G/B}$)

Note 2 : Measure Condition



5.1.2 Signal Electrical Characteristics

Input signals shall be low or High-impedance state when VDD is off.

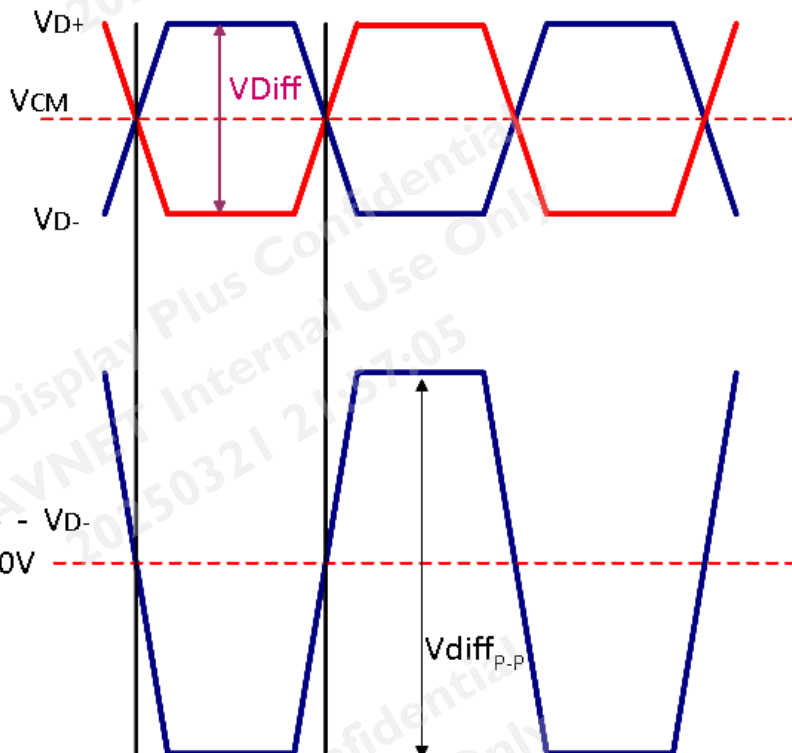
Signal electrical characteristics are as follows;

Display Port main link signal:

Differential pair VD+ , VD-
Which is one Display port
Main link

VCM of Display port
Main link

$$V_{diffP-P} = [(VD+) - (VD-)] \times 2$$

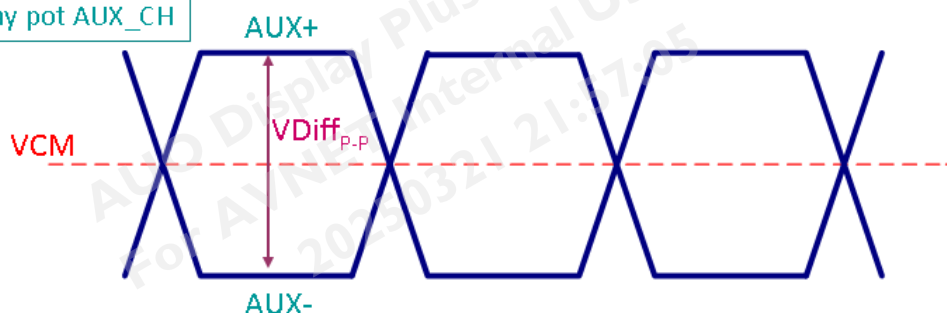


Display port main link					
		Min	Typ	Max	unit
VCM	RX input DC Common Mode Voltage	--	0	--	V
VDiffP-P	Peak-to-peak Voltage at a receiving Device	150	--	1320	mV

Follow as VESA display port standard V1.1a

Display Port AUX_CH signal:

Differential AUX+ , AUX-
Which is Display port AUX_CH



Display port AUX_CH					
		Min	Typ	Max	unit
VCM	AUX DC Common Mode Voltage	-	0	-	V
VDiff _{p-p}	AUX Peak-to-peak Voltage at a receiving Device	0.4	0.6	0.8	V

Follow as VESA display port standard V1.1a

Display Port VHPD signal:

Display port VHPD					
		Min	Typ	Max	unit
VHPD	HPD Voltage	2.25	-	2.75	V

Follow as VESA display port standard V1.1a



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5.2 Backlight Unit

5.2.1 LED characteristics

Parameter	Symbol	Min	Typ	Max	Units	Condition
Backlight Power Consumption	PLED	-	4.1	4.3	[Watt]	(Ta=25°C @ Max. VLED_PWM duty)
LED Life-Time	N/A	15,000	-	-	Hour	(Ta=25°C @ 800 nits) Note1.
LED Forward Voltage	VF	-	5.65	5.8	[Volt]	(Ta=25°C)
LED Forward Voltage of every LED string	VF-string	-	33.9	34.8	[Volt]	(Ta=25°C) Note2.
LED Forward Current	IF	-	17.9	-	[mA]	(Ta=25°C)

Note 1. The LED life-time define as the estimated time to 50% degradation of initial luminous.

Note 2. LED Array 6 parallel * 6 series



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5.2.2 Backlight input signal characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Remark
LED Power Supply	VLED_IN	10.8	12	13.2	[Volt]	Define as Connector Interface (Ta=25°C) Note1, 2
LED Enable Input High Level	VLED_EN	2.5	-	5.5	[Volt]	
LED Enable Input Low Level		-	-	0.8	[Volt]	
PWM Logic Input High Level	VLED_PWM	2.5	-	5.5	[Volt]	
PWM Logic Input Low Level		-	-	0.8	[Volt]	
PWM Input Frequency	FPWM	200	-	20K	Hz	
PWM Duty Ratio	Duty	10		100	%	

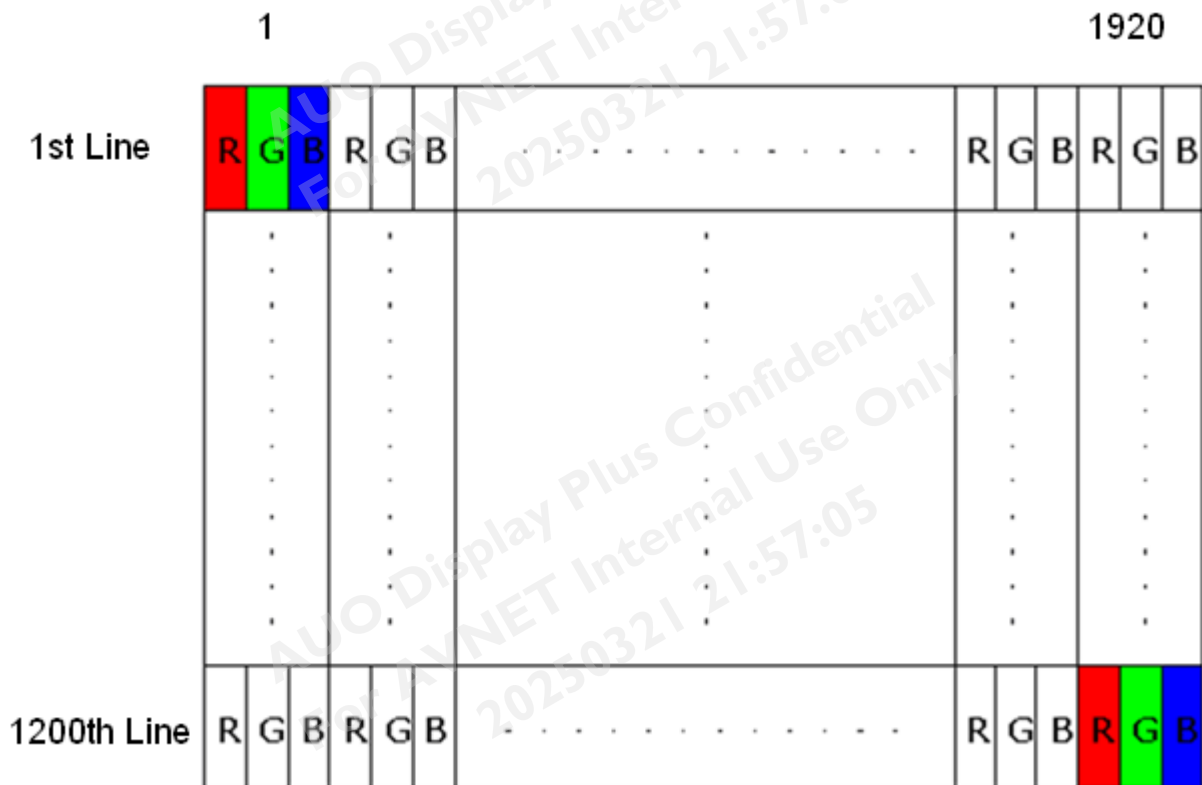
Note 1: The signal is measured in panel.

Note 2: The LED PWM Logic Input Low Level Voltage must have output impedance close to 0 ohm in front of input connector.

6. Signal Interface Characteristic

6.1 Pixel Format Image

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





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6.2 The Input Data Format

Lane 0	Lane 1
R0-7:0	R1-7:0
G0-7:0	G1-7:0
B0-7:0	B1-7:0
R2-7:0	R3-7:0
G2-7:0	G3-7:0
B2-7:0	B3-7:0
R4-7:0	R5-7:0
G4-7:0	G5-7:0
B4-7:0	B5-7:0

8bit RGB 2-Lane Main-Link

6.3 Integration Interface Requirement

6.3.1 Connector Description

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	IPEX or compatible
Type / Part Number	IPEX 20765-030E-11A
Mating Housing/Part Number	IPEX 20704-030-## or compatible

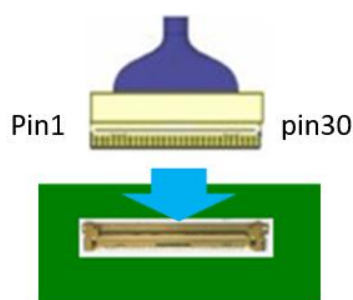
6.3.2 Pin Assignment

eDP 2lane is a differential signal technology for LCD interface and high speed data transfer device.

Pin No.	Symbol	Function
1	NC	NO Connect
2	H_GND	High Speed Ground
3	Lane1_N	Comp Signal Link Lane 1
4	Lane1_P	True Signal Link Lane 1
5	H_GND	High Speed Ground
6	Lane0_N	Comp Signal Link Lane 0
7	Lane0_P	True Signal Link Lane 0
8	H_GND	High Speed Ground
9	AUX_CH_P	True Signal Auxiliary Ch.
10	AUX_CH_N	Comp Signal Auxiliary Ch.
11	H_GND	High Speed Ground
12	LCD_VCC	LCD logic and driver power
13	LCD_VCC	LCD logic and driver power
14	LCD_Self_Test	LCD Panel Self Test Enable
15	LCD_GND	LCD logic and driver ground
16	LCD_GND	LCD logic and driver ground
17	HPD	HPD signal pin
18	BL_GND	Backlight ground
19	BL_GND	Backlight ground
20	BL_GND	Backlight ground
21	BL_GND	Backlight ground
22	VLED_EN	Backlight On / Off

23	VLED_PWM	System PWM signal Input
24	NC	No connect
25	NC	No connect
26	VLED_IN	Backlight power
27	VLED_IN	Backlight power
28	VLED_IN	Backlight power
29	VLED_IN	Backlight power
30	NC	No connect

Note 1: eDP cable install as following.



Note 2: Input signals shall be low or High-impedance state when VDD is off. Internal circuit of eDP inputs are as following.

Note 3: The impedance of the eDP differential lines (LaneX_N/P) on AUO PCB side is 100 ohm.

6.4 Interface Timing

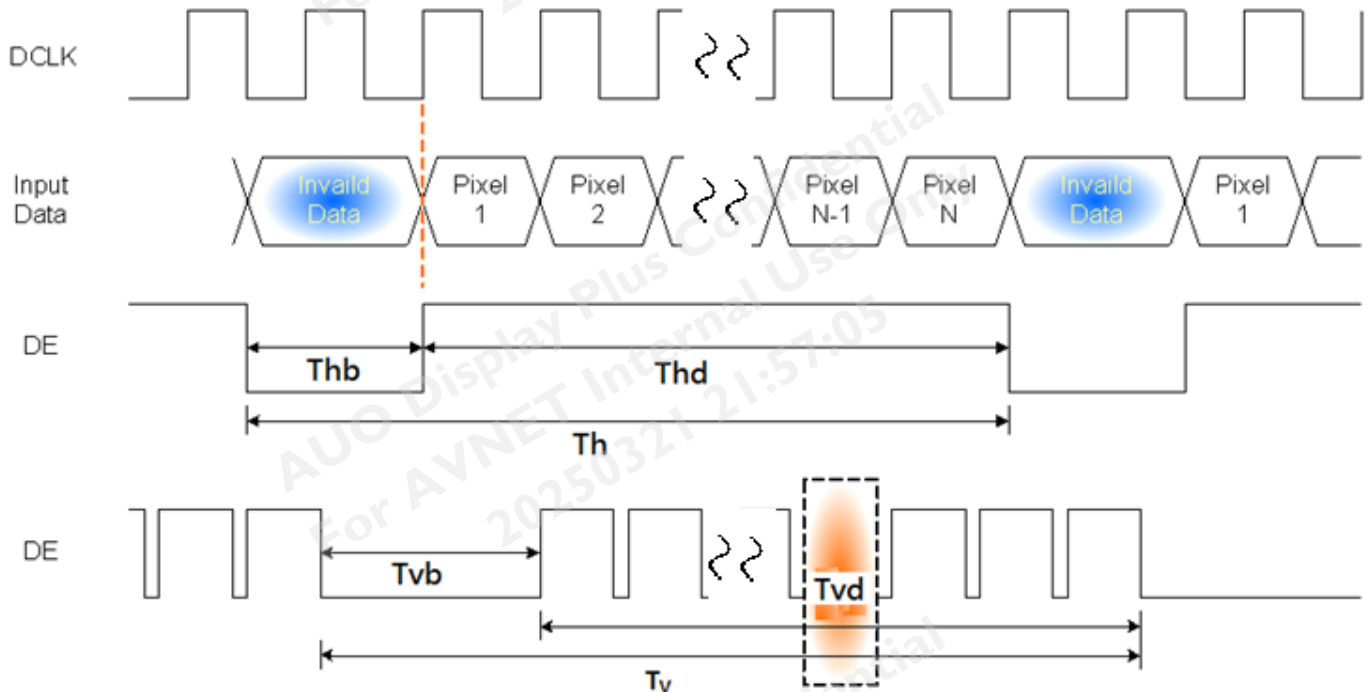
6.4.1 Timing Characteristics

Basically, interface timings should match the 1920x1200 /60Hz manufacturing guide line timing.

Parameter		Symbol	Min.	Typ.	Max.	Unit
Frame Rate		---	---	60	---	Hz
Clock frequency		$1/ T_{\text{Clock}}$	148.04	149.9	151.27	MHz
Vertical Section	Period	T_V	1206	1212	1218	T_{Line}
	Active	T_{VD}	1200			
	Blanking	T_{VB}	6	12	18	
Horizontal Section	Period	T_H	2046	2058	2070	T_{Clock}
	Active	T_{HD}	1920			
	Blanking	T_{HB}	126	138	150	

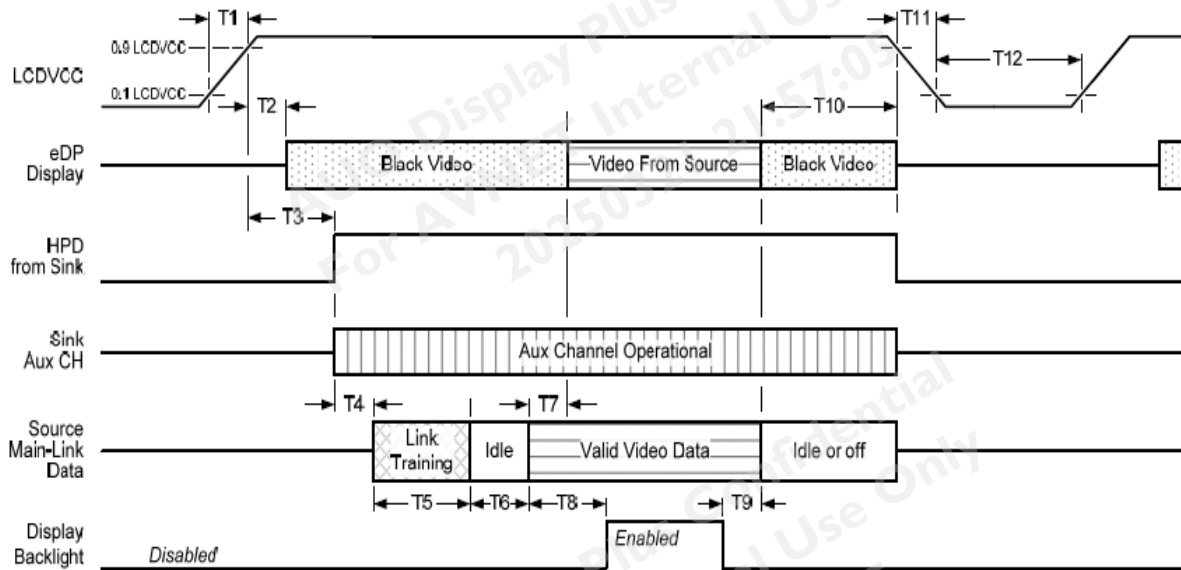
Note : DE mode only

6.4.2 Timing diagram



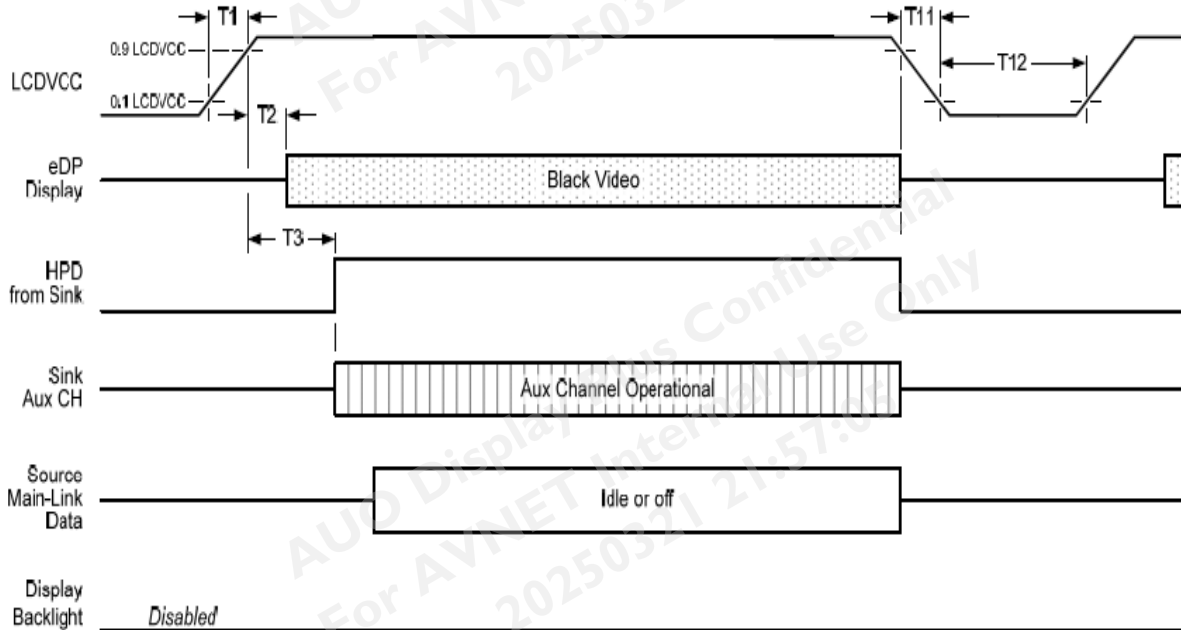
6.5 Power ON/OFF Sequence

Display Port Panel Power Sequence:



Display port interface power up/down sequence, normal system operation

Display Port AUX_CH Transaction Only:



Display port interface power up/down sequence, AUX_CH transaction only

Display Port Panel Power Sequence Timing Parameter:

Timing Parameter	Description	Reqd. by	Limits			Notes
			Min.	Typ.	Max.	
T1	Power rail rise time, 10% to 90%	source	0.5ms		10ms	
T2	Display from LCD_VCC to black video generation	sink	0ms		200ms	Prevents display noise until valid video data is received from source
T3	Display from LCD_VCC to HPD high	sink	0ms		200ms	Sink AUX_CH must be operational upon HPD high.
T4	Display from HPD high to link training initialization	source				Allows for source to read link capability and initialize.
T5	Link training duration	source				Dependant on source link to read training protocol.
T6	Link idle	source				Min accounts for required BS-Idle pattern. Max allows for source frame synchronization
T7	Delay from valid video data from source to video on display	sink	0ms		50ms	Max allows sink validate video data and timing
T8	Delay from valid video data from source to backlight enable	source				Source must assure display video is stable
T9	Delay from backlight disable to end of valid video data	source				Source must assure backlight is no longer illuminated
T10	Delay from end of valid video data from source to power off	source	0ms		500ms	
T11	Power rail fall time, 90% to 10%	source			10ms	
T12	Power off time	source	1500ms			

Note1: The sink must include the ability to generate black video autonomously. The sink must automatically enable black video under the following conditions:

- upon LCD_VCC power on (with in T2 max)-when the "Novideostream_Flag" (VB-ID Bit 3) is received from the source (at the end of T9).
- when no main link data, or invalid video data, is received from the source. Black video must be displayed within 64ms (typ) from the start of either condition. Video data can be deemed invalid based on MSA and timing information, for example.

Note 2: The sink may implement the ability to disable the black video function, as described in Note 1, above, for system development and debugging purpose.

Note 3: The sink must support AUX_CH polling by the source immediately following LCD_VCC power on without causing damage to the sink device (the source can re-try if the sink is not ready). The sink must be able to respond to an AUX_CH transaction with the time specified within T3 max.

7. 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	60 °C, 300Hr	
Cold Storage	-20 °C, 300Hr	
Thermal Shock Test	-10 °C /30 min , 60 °C /30 min , 20cycles	
Hot Start Test	60 °C /1 Hr min. power on/off per 5 minutes, 5 times	
Cold Start Test	-10 °C /1 Hr min. power on/off per 5 minutes, 5 times	
On/off test	On/10 sec, Off/10 sec, 30,000 cycles	
Shock Test	Acceleration: 220 G Half sine wave Active time: 2 ms Pulse: X,Y,Z .one time for each side Test method: Non-Operation	
Vibration Test	Acceleration: 1.5 G Frequency: 10 - 500Hz Random Sweep: 30 Minutes each Axis (X, Y, Z) Test method: Non-Operation	
ESD	Contact : ± 8KV/ operation, Class B Air : ± 15KV / operation, Class B	Note 1

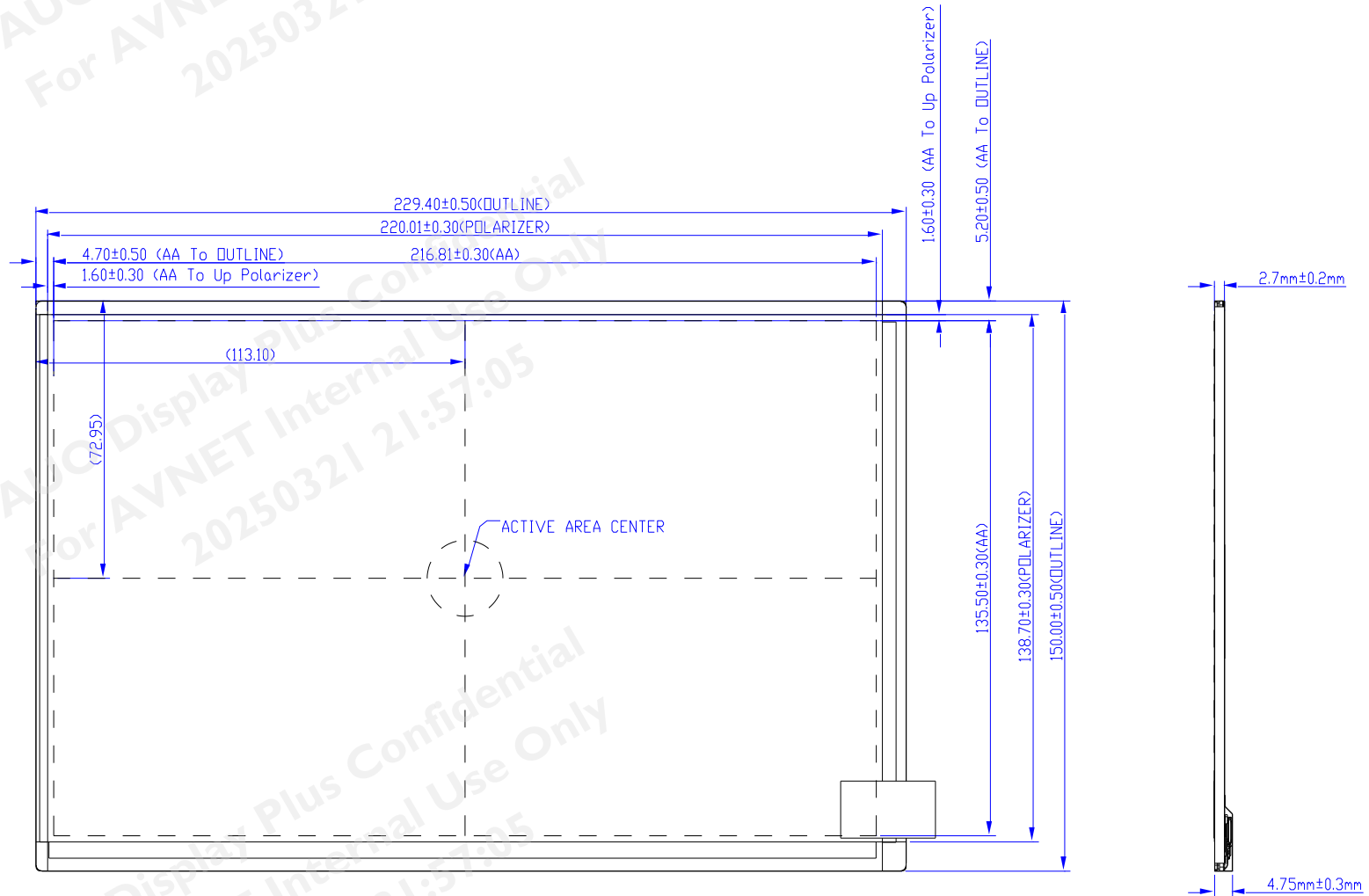
Note1: According to EN61000-4-2 , ESD class B: Some performance degradation allowed. No data lost
. Self-recoverable. No hardware failures.

Note2:

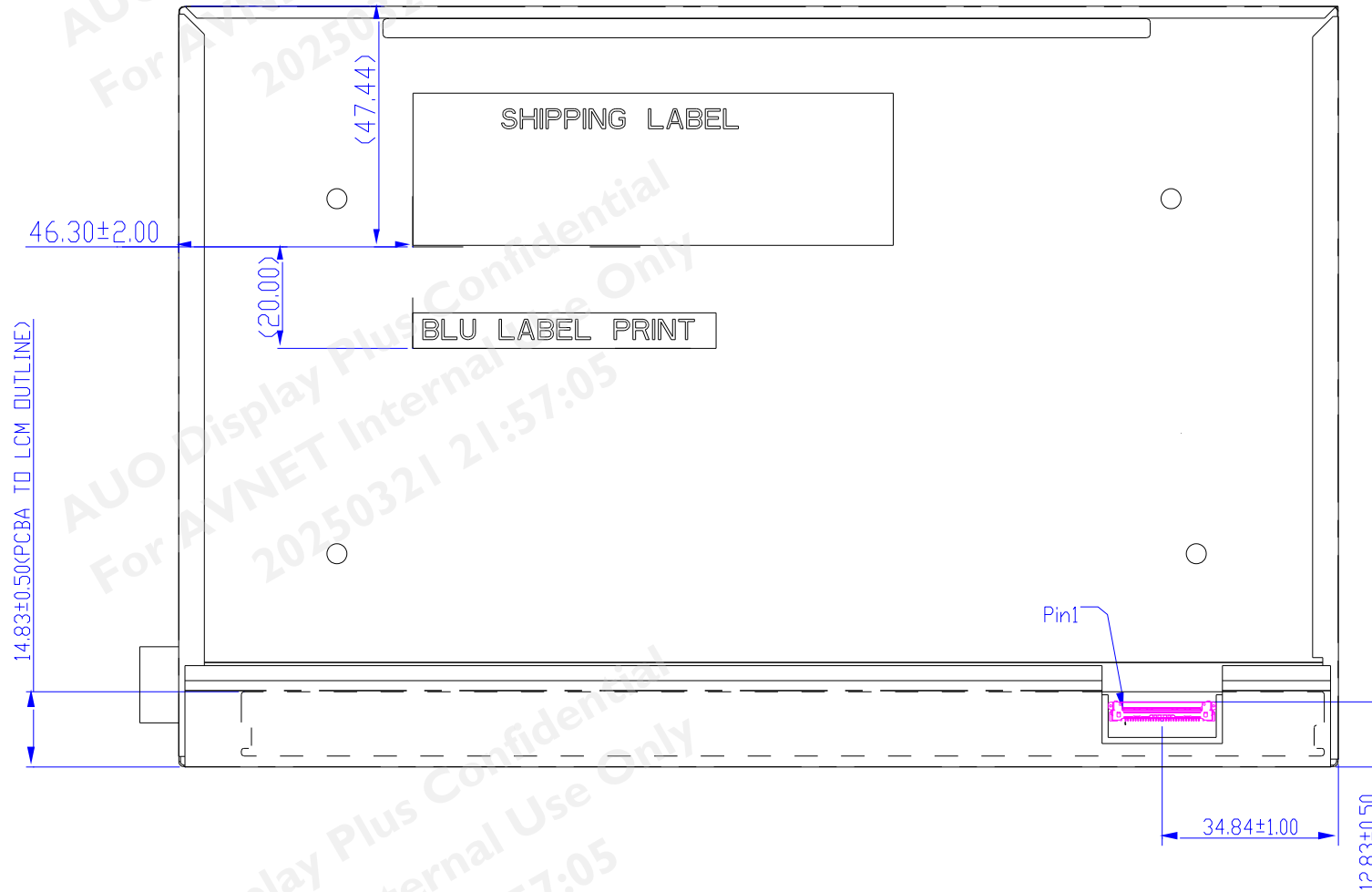
- Water condensation is not allowed for each test items.
- Each test is done by new TFT-LCD module. Don't use the same TFT-LCD module repeatedly for reliability test.
- The reliability test is performed only to examine the TFT-LCD module capability.
- To inspect TFT-LCD module after reliability test,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

8. Mechanical Characteristics

8.1 LCM Outline Dimension (Front View)

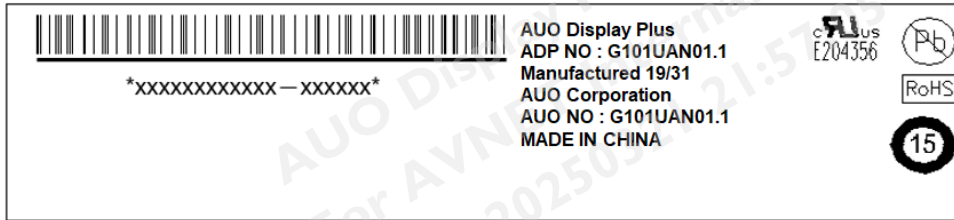


8.2 LCM Outline Dimension (Rear View)

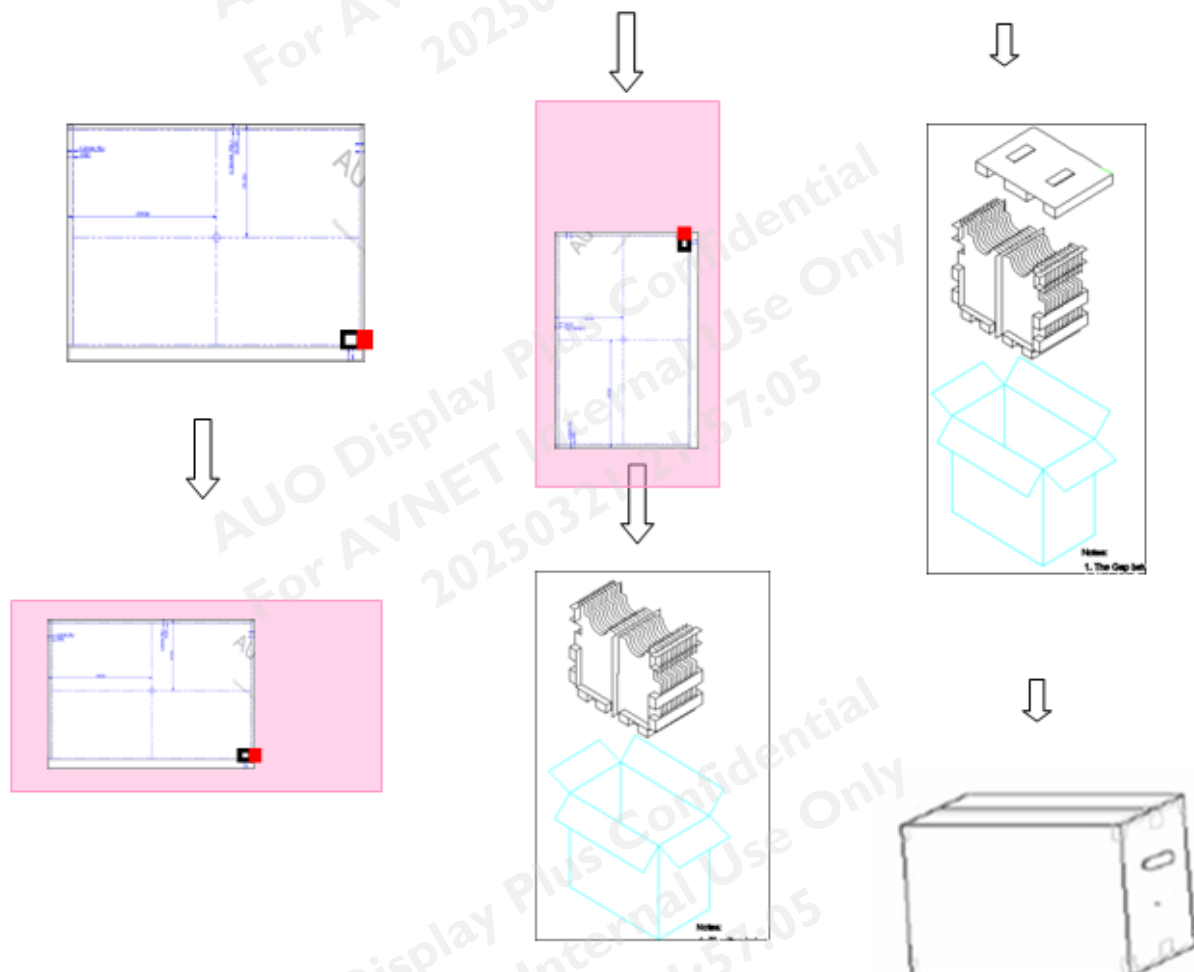


9. Label and Packaging

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



9.2 Carton/Pallet Label and Package





AUO Display+

Product Specification

G101UAN01.1

AUO Display Plus Corporation

Max capacity : 40 pcs TFT-LCD module per carton

Outside dimension of carton: 387mm(H)*387mm(W)*320mm(H)

Pallet size : 1000mm*820mm*132mm

Pallet layer : 4 layers

Box stacked

Module by air : (2 *2) *4 layers , one pallet put 16 boxes , total 640pcs module

Module by sea : (2 *2) *4 layers , one pallet put 16 boxes , total 640pcs module

Module by sea_ HQ : (2 *2) *4 layers , one pallet put 16 boxes , total 640pcs module

10. Safety

10.1 Sharp Edge Requirements

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

10.2 Materials

10.2.1 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.

10.2.2 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.

10.3 Capacitors

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

10.4 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