( ) Preliminary Specifications
(v) Final Specifications

Module	27 Inch Color TFT-LCD
Model Name	G270QAN02.0 (97.27G05.001)

Customer	**Date**	**Approved by**	**Date**
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Record of Revision

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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 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 27 inch wide color a-Si TFT-LCD Module. The screen format is intended to support the QHD (2560(H) x 1440(V) screen and 16.7M colors. All input signals are 4-channel LVDS and this module dosen't contain a driver board for backlight.

2.1 Display Characteristics

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

Items	Unit	Specifications
Screen Diagonal	[inch]	27"
Active Area	[mm]	596.74(H) x 335.66(V)
Resolution		2560(x3) x 1440
Pixel Pitch	[mm]	0.2331 x 0.2331
Pixel Arrangement		R.G.B. Vertical Stripe
Display Mode		AHVA
Nominal Input Voltage VDD	[Volt]	5
Power Consumption	[Watt]	Total: 15.6W (typ.) LCD = 3.7W @Full-White pattern, FV=60Hz BLU= 11.9W
Weight	[Grams]	3500g (Typ)
Physical Size	[mm]	608.74 (H) x 355.3 (V) x 14.53 (D) (Typ)
Electrical Interface		4 channel LVDS (8bits RGB data input)
Surface Treatment		Anti-Glare
Support Color		16.7 M Colors ,True 8 Bit (RGB)
Temperature Range Operating Storage (Non-Operating)	 [°C] [°C]	 0 to +50 -20 to +60
RoHS Compliance		RoHS Compliance
TCO Compliance		TCO 8.0

2.2 Optical Characteristics

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

Test Condition:

1.Equipment setup:Please refer to Note 1

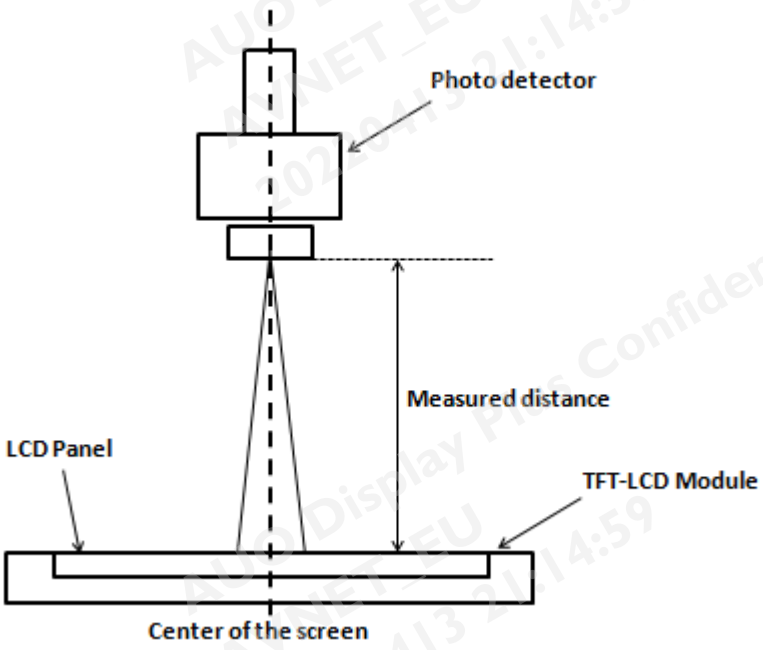
2.Panel Lighting: 30 minutes

3.VDD=5.0V , Fv=60Hz, Is = 60mA

Item	Unit	Conditions		Min.	Typ.	Max.	Note
White Luminance	cd/m^2	ILED=60mA(center point)		280	350		
Uniformity	%	9 points		75	80		2
Contrast Ratio	--			600	1000		3
Response Time	msec	Rising			8	16	4
		Falling			8	16	
		Rising + Falling			16	32	
Viewing Angle	degree	Horizontal CR >= 10	(Right)	75	89		5
			(Left)	75	89		
		Vertical CR >= 10	(Upper)	75	89		
			(Lower)	75	89		
Color / Chromaticity Coordinates (CIE 1931)	--	Red x		0.619	0.649	0.679	6
		Red y		0.308	0.338	0.368	
		Green x		0.274	0.304	0.334	
		Green y		0.606	0.636	0.666	
		Blue x		0.120	0.150	0.180	
		Blue y		0.027	0.057	0.087	
		White x		0.283	0.313	0.343	
		White y		0.299	0.329	0.359	
Color Gamut	%	SRGB			99		

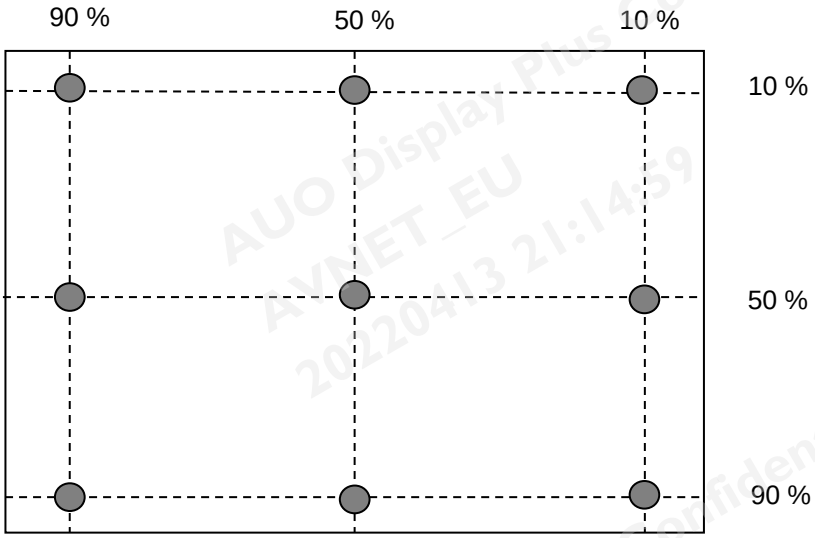
Note 1: Measurement method

The LCD module should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring (at surface 35℃). 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 2: Luminance uniformity of these 9 points is defined as below and measured by SR-3

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



$$\text{Uniformity} = \frac{\text{Minimum Luminance in 9 points (1-9)}}{\text{Maximum Luminance in 9 Points (1-9)}}$$

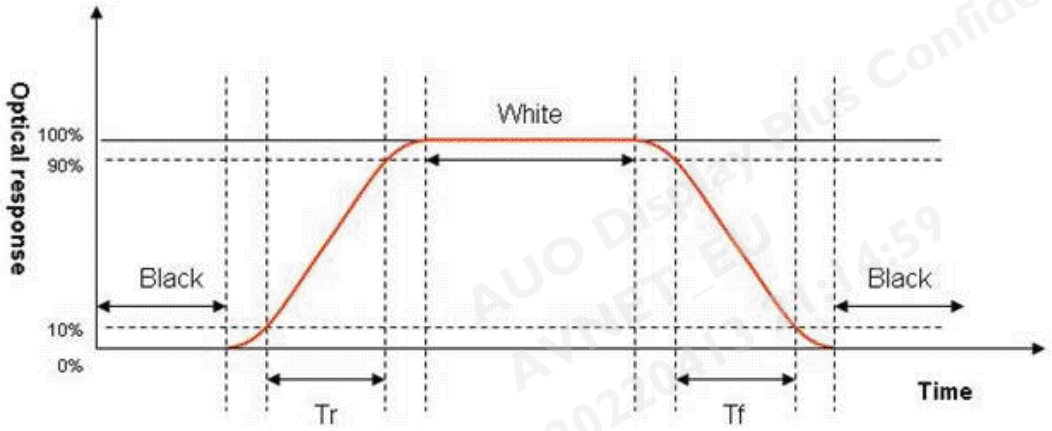
Note 3: Contrast ratio is measured by SR-3

Definition of contrast ratio (CR):

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

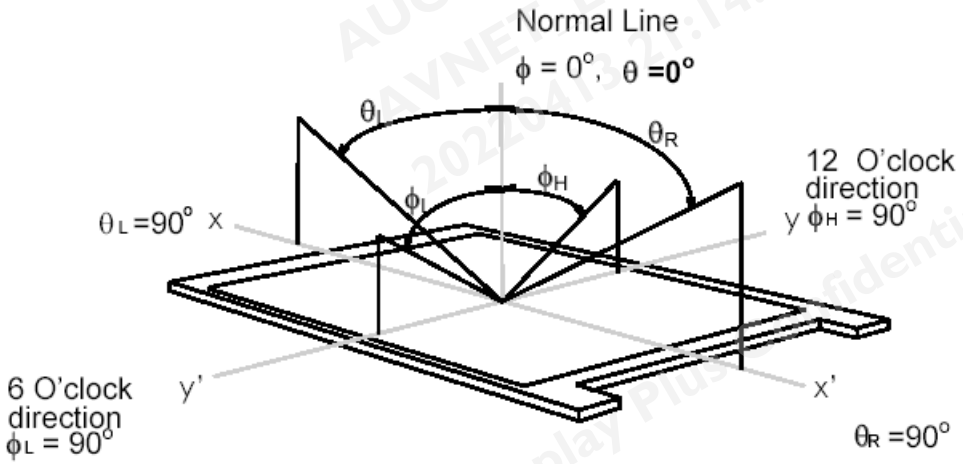
Note 4: Definition of Response time

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 5: Definition of viewing angle measured by ELDIM

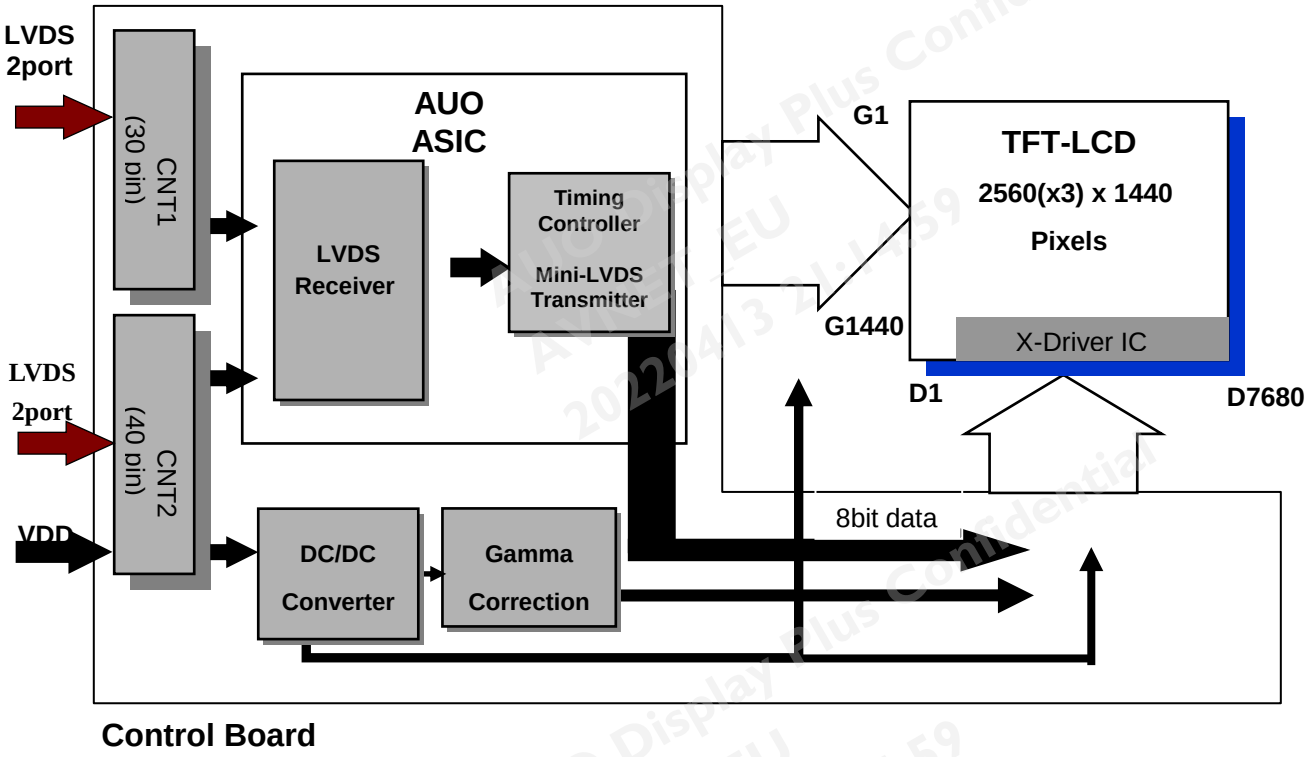
Viewing angle is the measurement of contrast ratio ≧ 10, at the screen center, over a 180° horizontal and 180° vertical range (off-normal viewing angles). The 180° viewing angle range is broken down as below: 90° (θ) horizontal left and right, and 90° (Φ) vertical high (up) and low (down). The measurement direction is typically perpendicular to the display surface with the screen rotated to its center to develop the desired measurement viewing angle.



Note 6: Color chromaticity and coordinates (CIE) is measured by SR-3

3. Functional Block Diagram

The following diagram shows the functional block of the 27 inch color TFT/LCD module:



4. Absolute Maximum Ratings

4.1 Absolute Ratings of TFT LCD Module

Permanent damage may occur if exceeding the following maximum rating.

Symbol	Description	Min	Max	Unit	Remark
VDD	Power Supply Input Voltage	GND-0.3	6.0	[Volt]	Ta=25℃

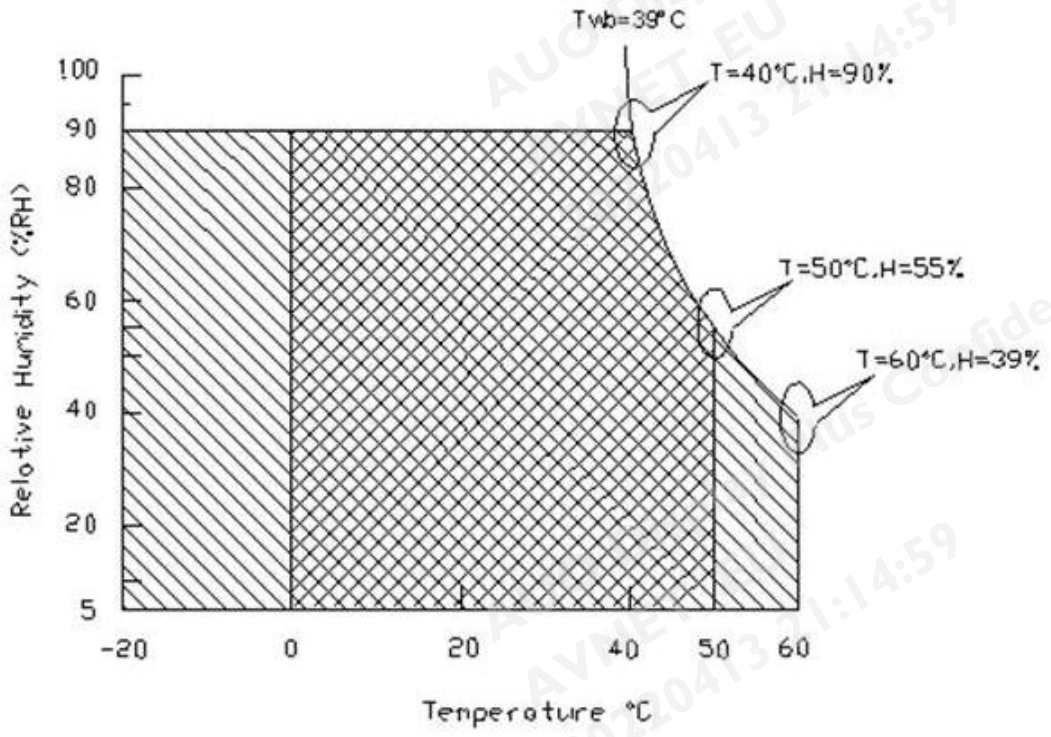
4.2 Absolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit	Conditions
Operating	TOP	0	+50	[°C]	Note
Operation Humidity	HOP	5	90	[%RH]	
Storage	TST	-20	+60	[°C]	
Storage Humidity	HST	5	90	[%RH]	

Note 1: Within Ta= 25℃

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

Note 3: For quality performance, please refer to AUO IIS (Incoming Inspection Standard).



5. Electrical Characteristics

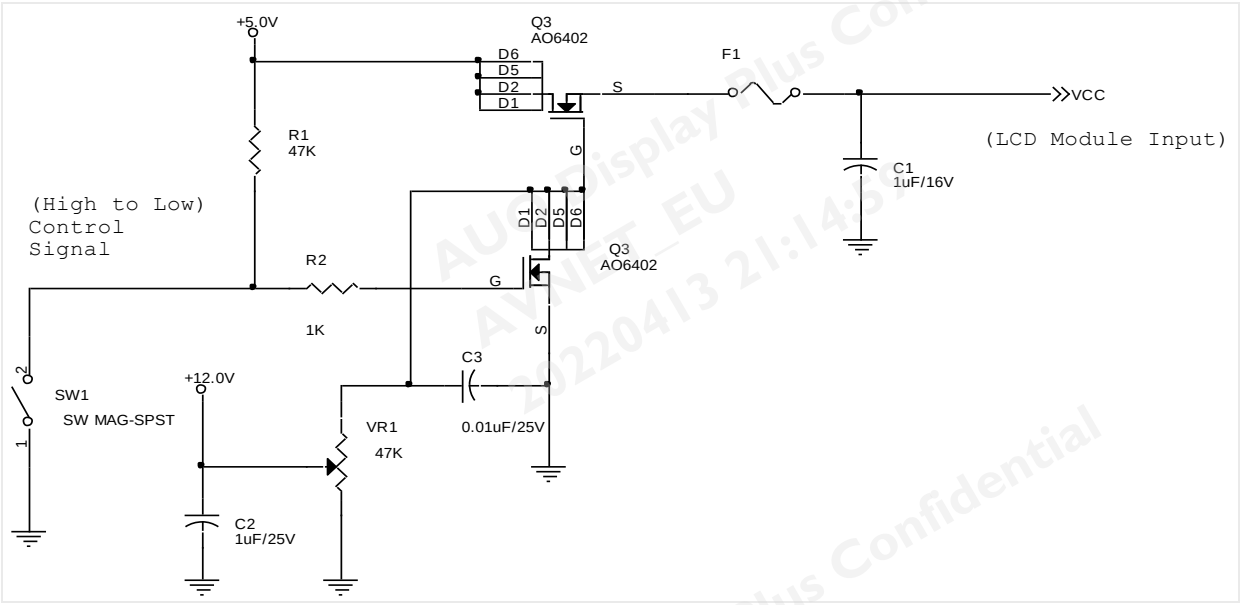
5.1 TFT LCD Module

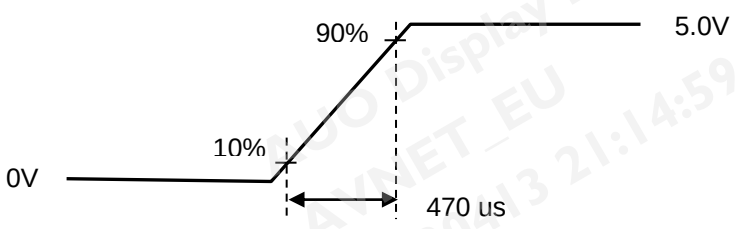
5.1.1 Power Specification

Input power specifications are shown as follows:

Symbol	Parameter	Min	Typ	Max	Units	Remark
VDD	Logic/LCD Drive Voltage	4.5	5	5.5	[Volt]	±10%
IDD	VDD Current	-	0.74	0.89	[A]	Vin=5V, White Pattern, at 60Hz
Irush	LCD Inrush Current	-	-	5	[A]	Note 1
PDD	VDD Power	-	3.7	4.5	[Watt]	Vin=5V, White Pattern, at 60Hz
VDDrp	Allowable Logic/LCD Drive Ripple Voltage	-	-	500	[mV] p-p	With panel loading

Note 1: Measurement condition:





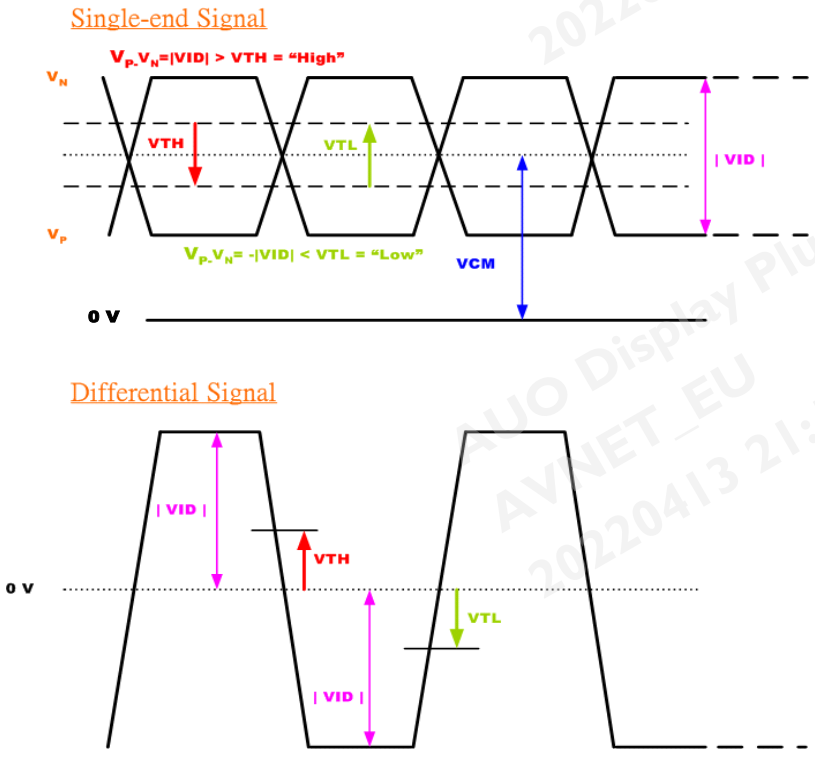
VDD rising time

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	-	600	[mV]	
VICM	Differential Input Common Mode Voltage	+1.0	+1.2	+1.5	[V]	VTH/VTL=+-200mV

5.1.2 LVDS DC Signal Electrical Characteristics

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

Note: LVDS Signal Waveform.

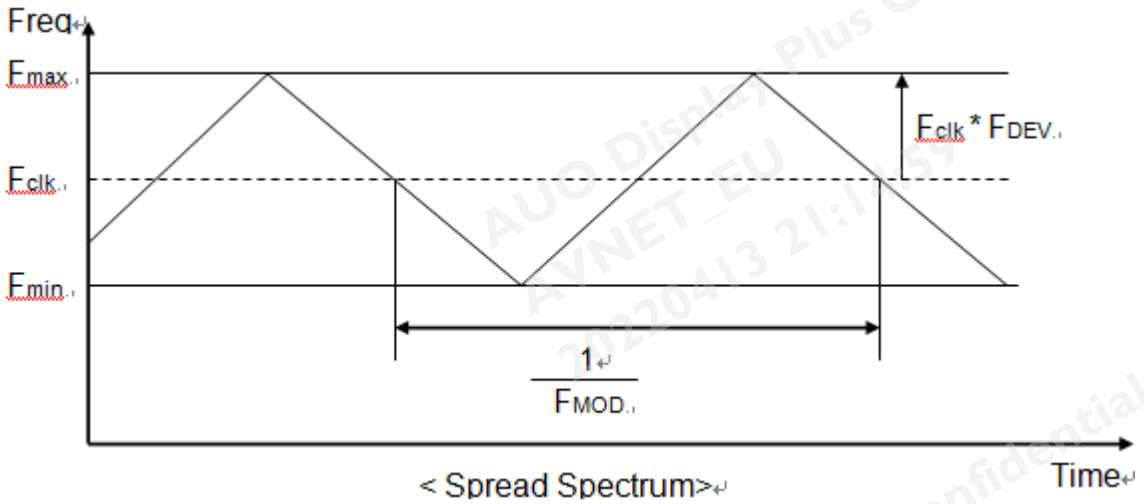


Note: AC Characteristics

Symbol	Description	Min	Max	Unit	Remark
F_{DEV}	Maximum deviation of input clock frequency during Spread Spectrum	-	± 3	%	

F_{MOD}	Maximum modulation frequency of input clock during Spread Spectrum	-	200	KHz	

Note: Fclk- LVDS Clock Frequency.



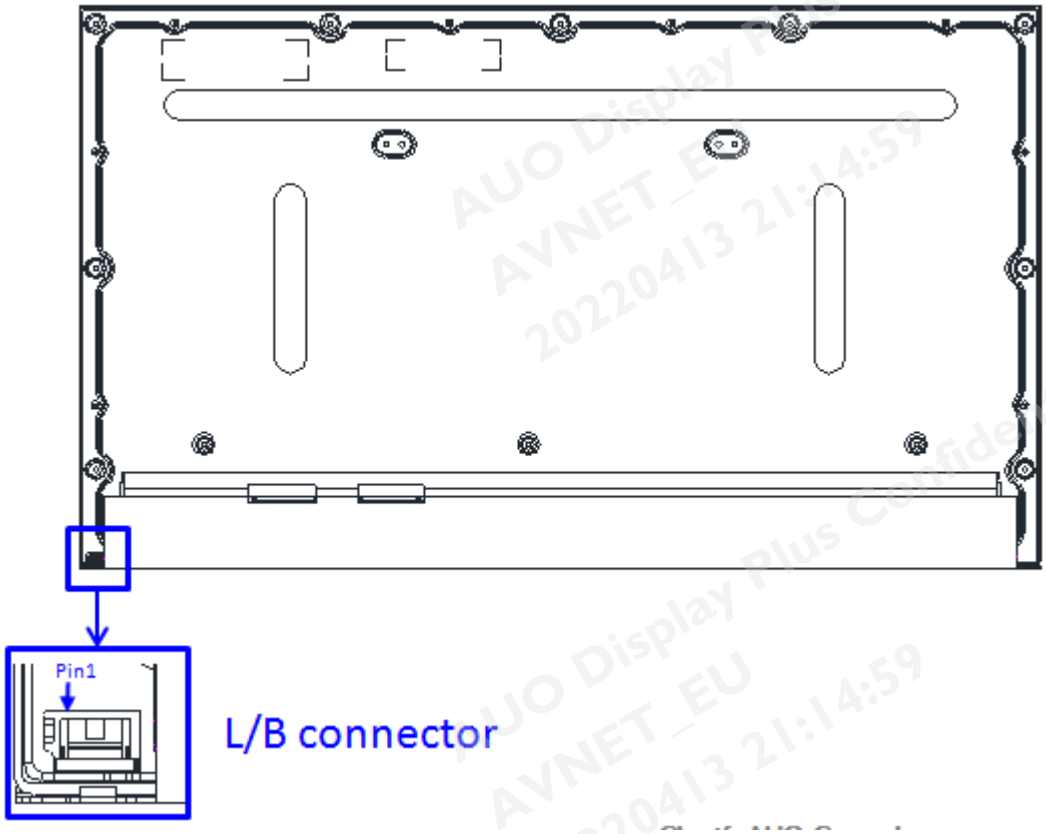
5.2 Backlight Unit

5.2.1 LED Backlight Unit

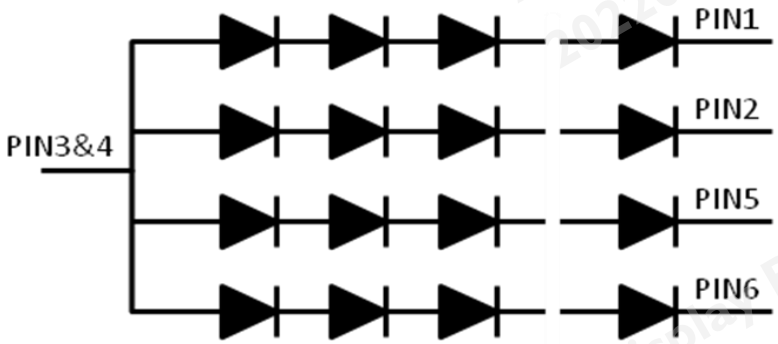
Connector Name / Designation	Lamp Connector
Manufacturer	ENTERY
Backlight connector	3709K-Q06C-04L 6PIN
Mating connector	H112K-D06N-31,33B

5.2.2 Pin Assignment

Pin #	Symbol	Description
1	Ch1	IRLED (current out)
2	Ch2	IRLED (current out)
3	V_{SLED}	VLED (voltage in))
4	V_{SLED}	VLED (voltage in)
5	Ch3	IRLED (current out)
6	Ch4	IRLED (current out)



The following shows the block diagram of 27 inch Backlight Unit.



5.2.3 Parameter guideline for LED

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

LED characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Remark
I_L	LED Supply Current	-	60	66	[mA]	Ta = 25°C, Note 2
V_L	LED Supply Voltage	-	49.5	59.04	[Volt]	I_F = 60mA, Ta = 25°C Note 2⁄3
P_{LED}	LED Power Consumption	-	11.9	14.2	[Watt]	I_F = 60mA, Ta = 25°C Note 3⁄4⁄5
L_L	LED Life Time	30,000	-	-	Hrs	I_F=60mA, Ta = 25°C, Note 6, Note 7

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

Note 2: I_L, V_L are defined for one channel LED. There are 4 LED channel in back light unit.

Note 3: LED backlight is 72 LEDs (4 strings, 18pcs for each string)

Note 4: The LED supply power is for 4 string of LED

Note 5: The voltage capacity of LED driver IC must be over max. of LED Voltage.

Note 6: Definition of life time: Brightness becomes to 50% of its original value.

Note 7: If G270QAN02.001 module is driven by high current or at high ambient temperature & humidity condition. The operating life will reduce.

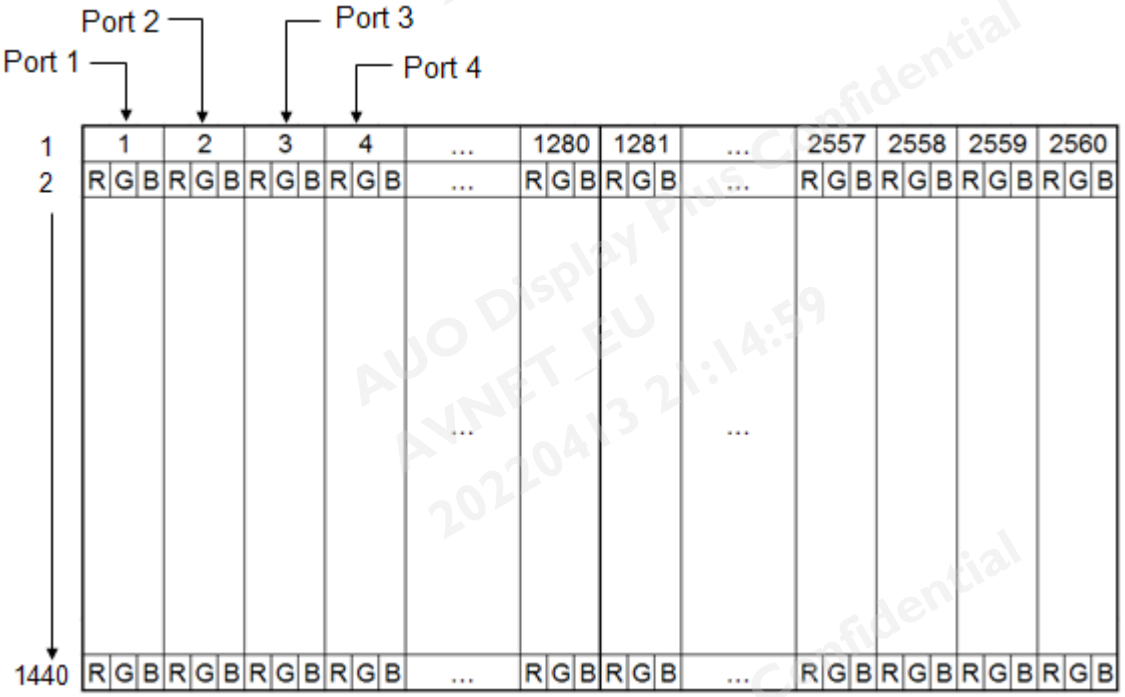
Note 8: Recommendation for LED driver power design – Due to there are electrical property deviation in LED and monitor set system component after long time operation, AUO strongly recommend the design value of LED driver board OVP (Over Voltage Protection) should be 10% higher than max

value of LED string voltage (Vs) at least.

6. Signal Characteristic

6.1 Pixel Format Image

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



Note 1: The module use 4port-LVDS interface.

Port 1： 4N+1 (1, 5.. 2557 pixel)

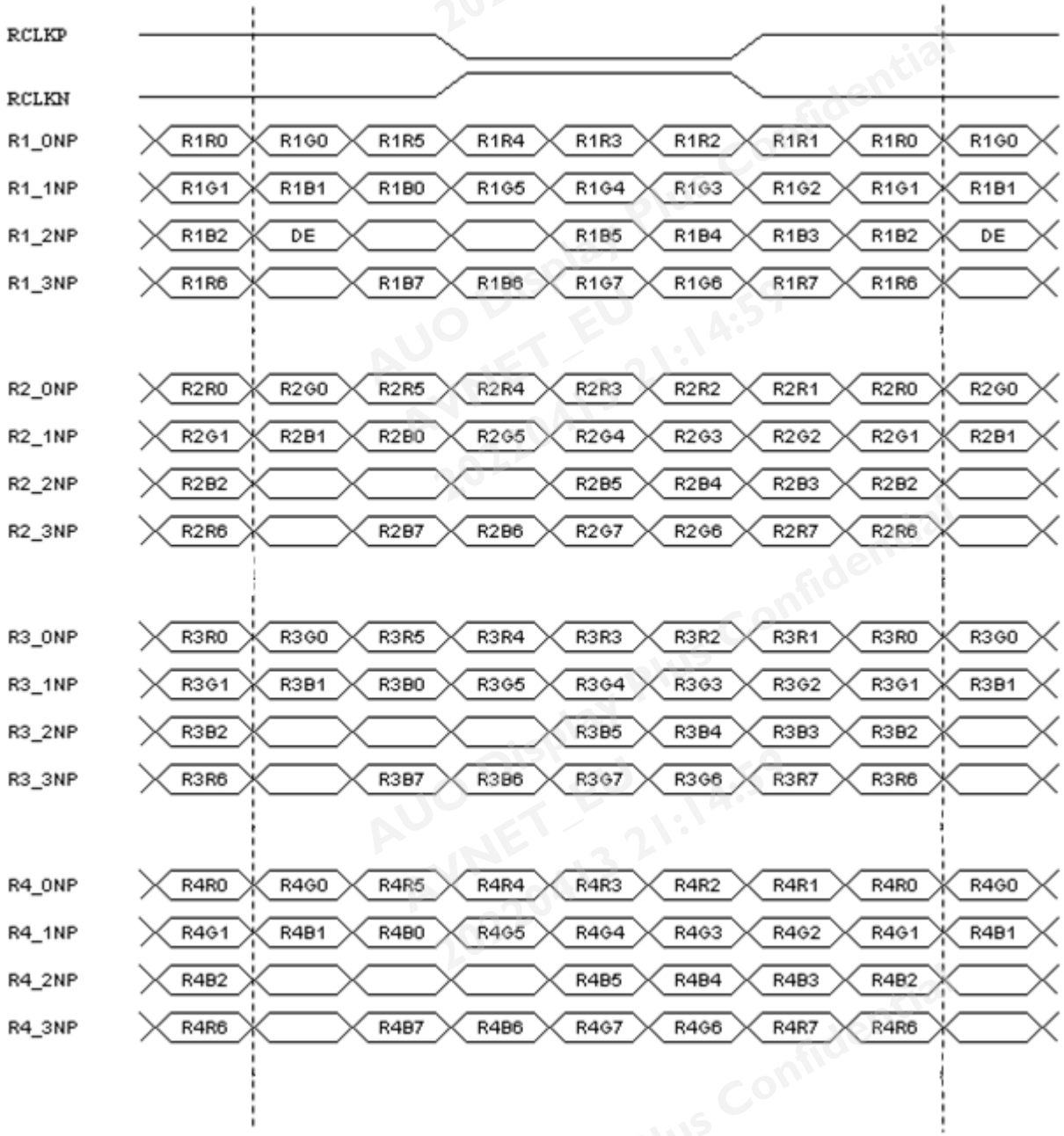
Port 2： 4N+2 (2, 6.. 2558 pixel)

Port 3： 4N+3 (3, 7.. 2559 pixel)

Port 4： 4N+4 (4, 8.. 2560 pixel)

N = 0, 1 ~639

6.2 LVDS Data Format



6.3 Signal Description

6.3.1 TFT LCD Module: LVDS Connector

TFT-LCD Connector (CNT1)	Manufacturer	P-TWO	
	Part Number	AL230F-A0G1D-P	
TFT-LCD Connector (CNT2)	Manufacturer	Starconn	
	Part Number	115F40-R000RA-M3	
Mating Connector (CNT1)	Manufacturer	JAE	STM
	Part Number	JAE_FI-X30HL	STM_ PFSKX10001N30A
Mating Connector (CNT2)	Manufacturer	Starconn	
	Part Number	115H40-0000TA-00-R	

6.3.2 Connector Pin Assignment

■ **LVDS CN1**

PIN #	Symbol	Description	Remark
1	R1_0N	FIRST_ Negative LVDS differential data input	
2	R1_0P	FIRST_ Positive LVDS differential data input	
3	R1_1N	FIRST_ Negative LVDS differential data input	
4	R1_1P	FIRST_ Positive LVDS differential data input	
5	R1_2N	FIRST_ Negative LVDS differential data input	
6	R1_2P	FIRST_ Positive LVDS differential data input	
7	GND	Power Ground	
8	R1_CLKN	FIRST_ Negative LVDS differential clock input	
9	R1_CLKP	FIRST_ Positive LVDS differential clock input	
10	GND	Power Ground	
11	R1_3N	FIRST_ Negative LVDS differential data input	
12	R1_3P	FIRST_ Positive LVDS differential data input	
13	NC	No connection (for AUO test only. Do not connect)	
14	NC	No connection (for AUO test only. Do not connect)	
15	GND	Power Ground	
16	R2_0N	SECOND_ Negative LVDS differential data input	
17	R2_0P	SECOND_ Positive LVDS differential data input	
18	R2_1N	SECOND_ Negative LVDS differential data input	

19	R2_1P	SECOND_ Positive LVDS differential data input	
20	R2_2N	SECOND_ Negative LVDS differential data input	
21	R2_2P	SECOND_ Positive LVDS differential data input	
22	GND	Power Ground	
23	R2_CLKN	SECOND_ Negative LVDS differential clock input	
24	R2_CLKP	SECOND_ Positive LVDS differential clock input	
25	GND	Power Ground	
26	R2_3N	SECOND_ Negative LVDS differential data input	
27	R2_3P	SECOND_ Positive LVDS differential data input	
28	NC	No connection (for AUO test only. Do not connect)	
29	NC	No connection (for AUO test only. Do not connect)	
30	NC	No connection (for AUO test only. Do not connect)	

■ **LVDS CN2**

PIN #	Symbol	Description	Remark
1	R3_0N	THIRD_ Negative LVDS differential data input	
2	R3_0P	THIRD_ Positive LVDS differential data input	
3	R3_1N	THIRD_ Negative LVDS differential data input	
4	R3_1P	THIRD_ Positive LVDS differential data input	
5	R3_2N	THIRD_ Negative LVDS differential data input	
6	R3_2P	THIRD_ Positive LVDS differential data input	
7	GND	Power Ground	
8	R3_CLKN	THIRD_ Negative LVDS differential clock input	
9	R3_CLKP	THIRD_ Positive LVDS differential clock input	
10	GND	Power Ground	
11	R3_3N	THIRD_ Negative LVDS differential data input	
12	R3_3P	THIRD_ Positive LVDS differential data input	
13	NC	No connection (for AUO test only. Do not connect)	
14	NC	No connection (for AUO test only. Do not connect)	
15	GND	Power Ground	
16	R4_0N	FOURTH_ Negative LVDS differential data input	
17	R4_0P	FOURTH_ Positive LVDS differential data input	

18	R4_1N	FOURTH_ Negative LVDS differential data input	
19	R4_1P	FOURTH_ Positive LVDS differential data input	
20	R4_2N	FOURTH_ Negative LVDS differential data input	
21	R4_2P	FOURTH_ Positive LVDS differential data input	
22	GND	Power Ground	
23	R4_CLKN	FOURTH_ Negative LVDS differential clock input	
24	R4_CLKP	FOURTH_ Positive LVDS differential clock input	
25	GND	Power Ground	
26	R4_3N	FOURTH_ Negative LVDS differential data input	
27	R4_3P	FOURTH_ Positive LVDS differential data input	
28	NC	No connection (for AUO test only. Do not connect)	
29	NC	No connection (for AUO test only. Do not connect)	
30	NC	No connection (for AUO test only. Do not connect)	
31	NC	No connection (for AUO test only. Do not connect)	
32	NC	No connection (for AUO test only. Do not connect)	
33	GND	Power Ground	
34	GND	Power Ground	
35	GND	Power Ground	
36	VDD	Power +5V	
37	VDD	Power +5V	
38	VDD	Power +5V	
39	VDD	Power +5V	
40	VDD	Power +5V	

6.4 Interface Timing

6.4.1 Timing Characteristics

It only support DE mode and the input timing are shown as the following table.

Symbol	Description		Min.	Typ.	Max.	Unit	Remark
Tv	Vertical Section	Period	1452	1481	2299	Th	
Tdisp (v)		Active	1440	1440	1440	Th	
Tblk (v)		Blanking	12	41	859	Th	
Fv		Frequency	49	60	76	Hz	
Th	Horizontal Section	Period	679	680	1023	Tclk	
Tdisp (h)		Active	640	640	640	Tclk	
Tblk (h)		Blanking	39	40	383	Tclk	
Fh		Frequency	71.3	88.8	112.6	KHz	***Note 3-3***
Tclk	LVDS Clock	Period	13.1	16.6	20.6	ns	1/Fclk
Fclk		Frequency	48.4	60.4	76.5	MHz	***Note 3-4***

Note 3-3: The equation is listed as following. Please don't exceed the above recommended value.

Fh (Min.) = Fclk (Min.) / Th (Min.);
Fh (Typ.) = Fclk (Typ.) / Th (Typ.);
Fh (Max.)= Fclk (Max.) / Th (Min.);

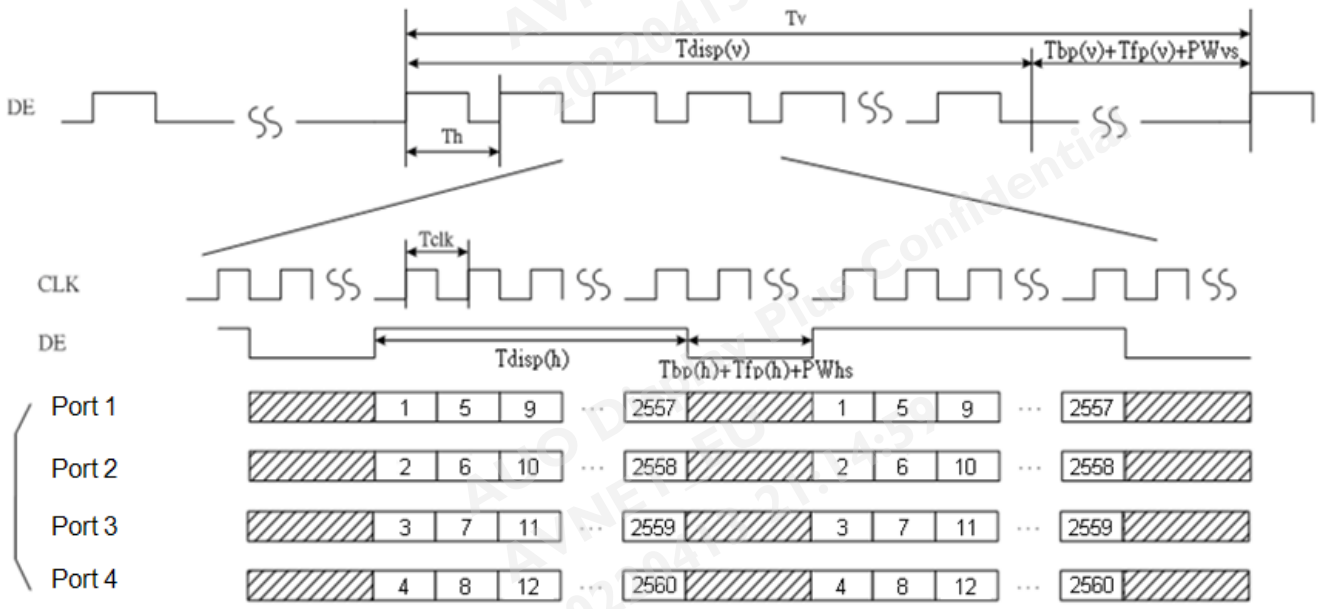
Note 3-4: The equation is listed as following. Please don't exceed the above recommended value.

Fclk (Min.) = Fv (Min.) x Th (Min.) x Tv (Min.);

Fclk (Typ.) = Fv (Typ.) x Th (Typ.) x Tv (Typ.);

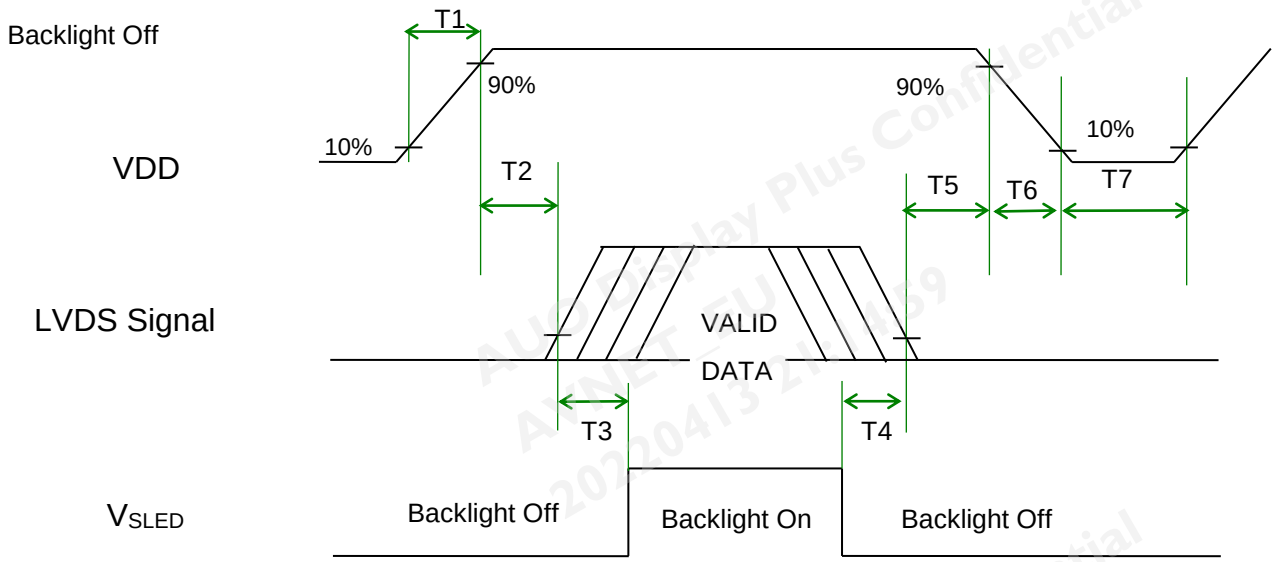
Fclk (Max.) = Fv (Max.) x Th (Typ.) x Tv (Typ.);

6.4.2 Input Timing Diagram



6.5 Power ON/OFF Sequence

VDD power,LVDS signal and backlight on/off sequence are as following. LVDS signals from any system shall be Hi-Z state when VDD is off.



Power Sequence Timing

Symbol	Value			Unit	Remark
	Min.	Typ.	Max.		
T1	0.5	-	10	[ms]	
T2	0	-	50	[ms]	
T3	500	-	-	[ms]	
T4	100	-	-	[ms]	
T5	0		50	[ms]	***Note 3-5***
T6	0	-	200	[ms]	***Note 3-6***
T7	1000	-	-	[ms]	

Note 3-5 : Recommend setting T5 = 0ms to avoid electronic noise when VDD is off.

Note 3-6: Voltage of VDO must decay smoothly after power-off. (Customer system decide this value)

7. Reliability Test Criteria

Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta= 50°C, 80%RH, 300hours	
High Temperature Operation (HTO)	Ta= 50°C, 300hours	
Low Temperature Operation (LTO)	Ta= 0°C, 300hours	
High Temperature Storage (HTS)	Ta= 60°C, 300hours	
Low Temperature Storage (LTS)	Ta= -20°C, 300hours	
Vibration Test (Non-operation)	Acceleration: 1.5 Grms Wave: Random Frequency: 10 - 200 Hz Sweep: 30 Minutes each Axis (X, Y, Z)	
Shock Test (Non-operation)	Acceleration: 50 G Wave: Half-sine Active Time: 20 ms Direction: ±X, ±Y, ±Z (one time for each Axis)	
Drop Test	Height: 60 cm, package test	
Thermal Shock Test (TST)	-20 °C /30min, 60/ °C 30min, 100 cycles	1
On/Off Test	On/10sec, Off/10sec, 30,000 cycles	
ESD (Electrostatic Discharge)	Contact Discharge: ± 8KV, 150pF(330Ω) 1sec, 9 points, 25 times/ point.	2
	Air Discharge: ± 15KV, 150pF(330Ω) 1sec 9 points, 25 times/ point.	
Altitude Test	Operation:10,000 ft Non-Operation:30,000 ft	

Note 1: The TFT-LCD module will not sustain damage after being subjected to 100 cycles of rapid temperature change. A cycle of rapid temperature change consists of varying the temperature from -20°C to 50°C, and back again. Power is not applied during the test. After temperature cycling, the unit is placed in normal room ambient for at least 4 hours before power on.

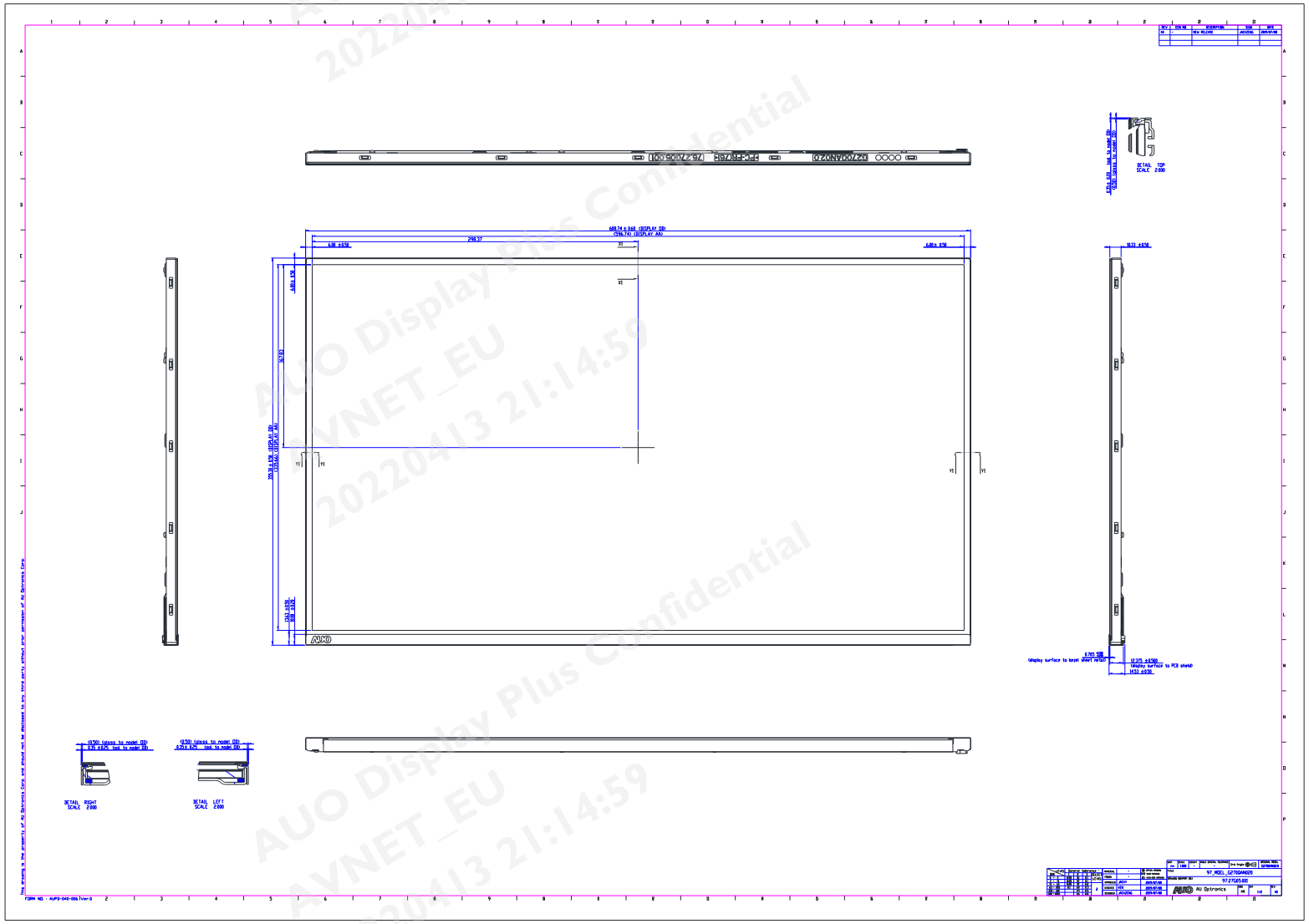
Note 2: According to EN61000-4-2 , ESD class B: Some performance degradation allowed. No data lost. Self-recoverable. No hardware failures.

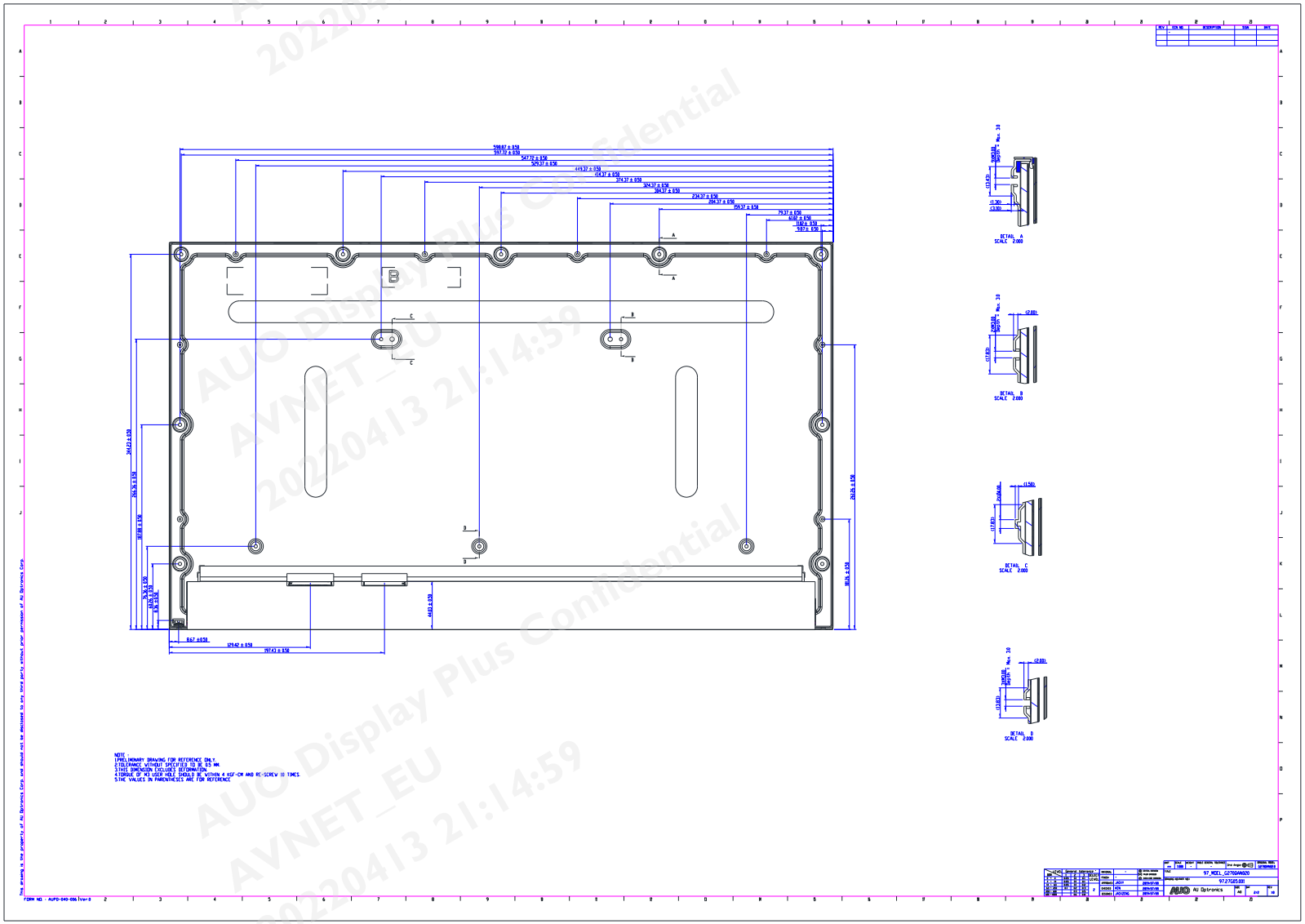
Note 3:

- 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.
- No function failure occurs.

8. Mechanical Characteristics

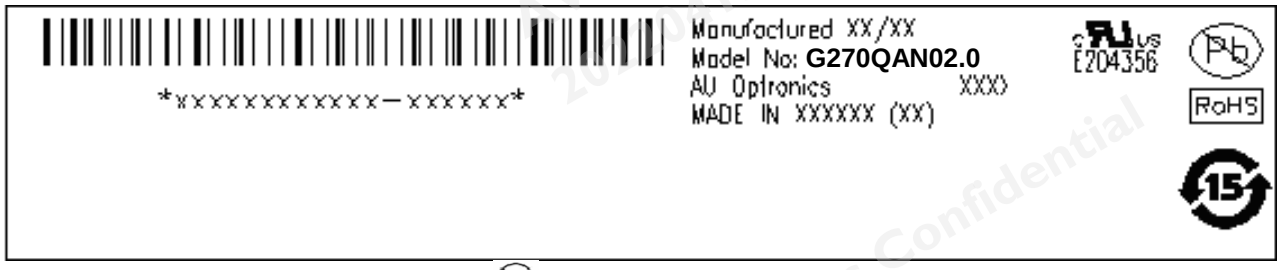
8.1 LCM Outline Dimension





9. Label and Packaging

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



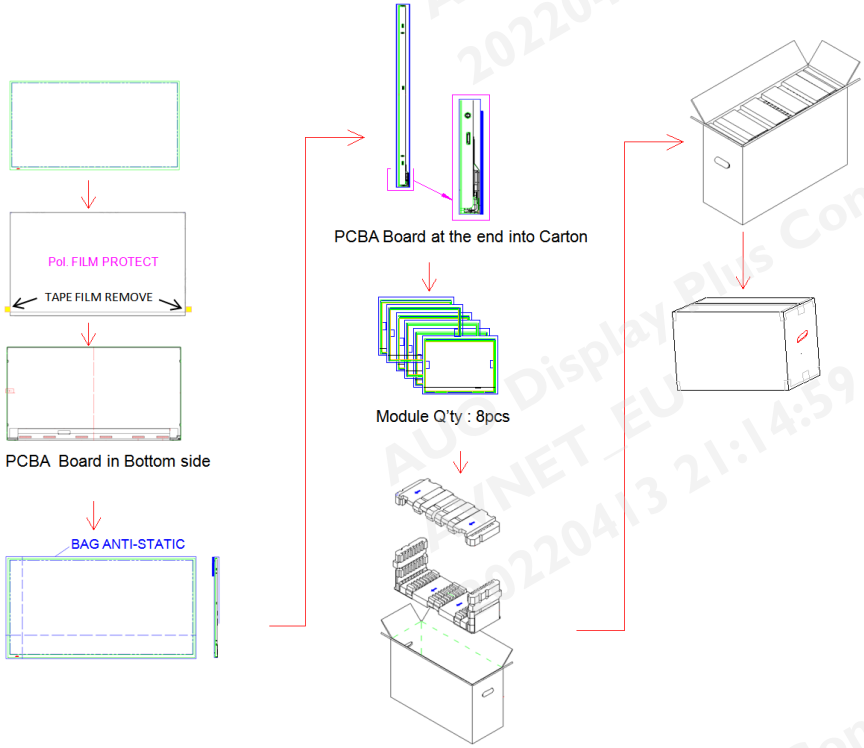
Note 1: For Pb Free products, AUO will add for identification.

Note 2: For RoHS compatible products, AUO will add for identification.

Note 3: For China RoHS compatible products, AUO will add for identification.

Note 4: The Green Mark will be presented only when the green documents have been ready by AUO Internal Green Team.

9.2 Carton Package



Max capacity：8 PCS TFT-LCD module per carton

Max weight：28.6 kg per carton

Outside dimension of carton：702mm(L)* 264mm(W)*456mm(H)

Pallet size： 1070 mm * 740 mm * 132mm

Box stacked

Module by air_Max：(1 *4) *2 layers，one pallet put 8 boxes，total 64pcs module

Module by sea_Max：(1*4) *2 layers + (1 *4) *2 layers , two pallet put 16 boxes，total 128pcs module

Module by sea_HQ_Max：(1*4) *2 layers+(1*4) *2 layers, two pallet put 16 boxes, total 128pcs module

10 Safety

10.1 Sharp Edge Requirements

There will be no sharp edges or comers 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