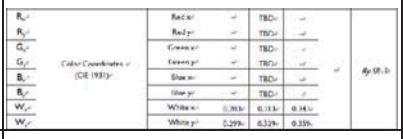
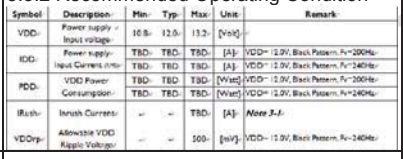
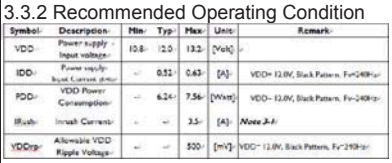
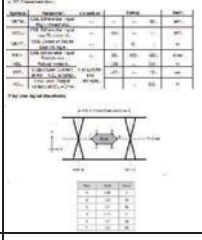
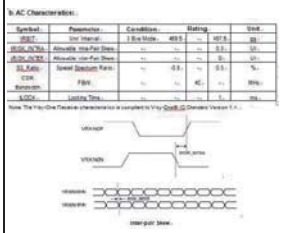
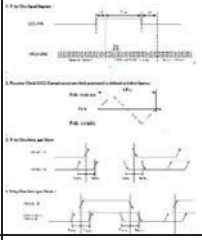
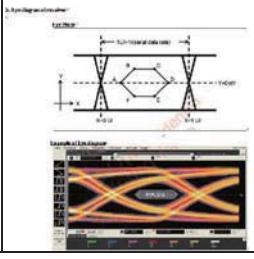
(V) Preliminary Specification
( ) Final Specification

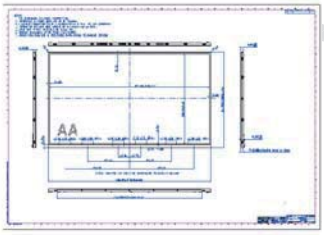
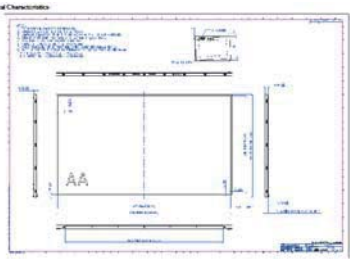
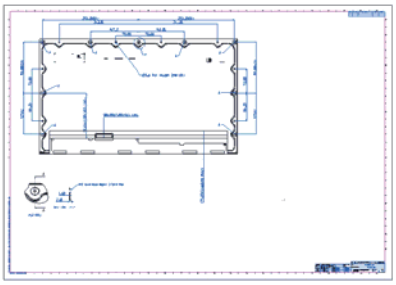
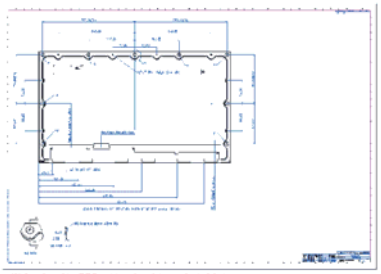
Module	**27" Color TFT-LCD**
Model Name	**M270HTN02.0**

Customer	**Date**	**Approved by**	**Date**
			Aug 01, 2016
Approved by		**Prepared by**	**Date**
			Aug 01, 2016
Note: This Specification is subject to change without notice.		AU Optronics corporation	

Contents

Record of Revision

Version	Date	Page	Old description	New Description	Remark
0.0	2016/6/2	All		New release	
0.1	2016/08/01	All	Document version 0.0	Document version 0.1	
0.1	2016/08/01	6	2.1 Display Characteristics Power Consumption 	2.1 Display Characteristics Power Consumption 	
0.1	2016/08/01	8	Test Condition: 3. VDD=12.0V, Fv=200Hz,Is=100mA,Ta=25℃	Test Condition: 3. VDD=12.0V, Fv=200Hz,Is=80mA,Ta=25℃	
0.1	2016/08/01	8	2.3 Optical Characteristics 	2.3 Optical Characteristics 	
0.1	2016/08/01	17	3.3.2 Recommended Operating Condition 	3.3.2 Recommended Operating Condition 	
0.1	2016/08/01	21	3.4.4 V-by-One Specification 	3.4.4 V-by-One Specification 	
0.1	2016/08/01	22	3.4.4 V-by-One Specification 	3.4.4 V-by-One Specification 	
0.1	2016/08/01	23	3.4.4 V-by-One Specification	3.4.4 V-by-One Specification 	

0.1	2016/08/01	26	3.5 Power ON/OFF Sequence Power Sequence Timing Symbol / Value (Min. / Typ. / Max.) / Unit / Remark T1 0.5 -- 10 [ms] T2 50 130 -- [ms] T3 0 2 -- [ms] Note 3-1. T4 400 -- -- [ms] T5 100 -- -- [ms] T6 0 -- 50 [ms] Note 3-6. Note 3-7. Note 3-8. T7 0 -- 200 [ms] Note 3-8. T8 1000 -- -- [ms]	3.5 Power ON/OFF Sequence Power Sequence Timing Symbol / Value (Min. / Typ. / Max.) / Unit / Remark T1 0.5 -- 10 [ms] T2 0 40 -- [ms] T3 0 2 -- [ms] Note 3-1. T4 400 -- -- [ms] T5 100 -- -- [ms] T6 0 -- 50 [ms] Note 3-6. Note 3-8. T7 0 -- 200 [ms] Note 3-8. Note 3-9. T8 1000 -- -- [ms]	
0.1	2016/08/01	30	4.3.1 Absolute Maximum Rating Permanent damage may occur if exceeding the following maximum rating. (Ta=25℃) Symbol / Description / Min. / Max / Unit / Remark Is LED String Current 0 120 [mA] 100% duty ratio 300 [mA] Duty ratio ≦ 10% Pulse time=10 ms	4.3.1 Absolute Maximum Rating Permanent damage may occur if exceeding the following maximum rating. (Ta=25℃) Symbol / Description / Min / Max / Unit / Remark Is LED String Current 0 150 [mA] 100% duty ratio 300 [mA] Duty ratio ≦ 10% Pulse time=10 ms	
0.1	2016/08/01	30	4.3.2 Recommended Operating Condition (Ta=25℃) Symbol / Description / Min. / Typ. / Max. / Unit / Remark Is LED String Current -- 100 110 [mA] 100% duty ratio of LED chip. Note 4-6. Vs LED String Voltage 50.4 54.9 61.2 [Volt] Is=100mA @ 100% duty ratio: Note 4-1, Note 4-5, Note 4-7. ΔVs Maximum Vs Voltage Deviation of light bar -- -- 3.6 [Volt] Is=100mA @ 100% duty ratio: Note 4-2. Pbar LED Light Bar Power Consumption -- 22.0 24.5 [Watt] Note 4-3. LTadj LED Life Time 30,000 -- -- [Hour] Note 4-4. OVP Over Voltage Protection in system board 110% Vmax -- -- [Volt] Note 4-5.	4.3.2 Recommended Operating Condition (Ta=25℃) Symbol / Description / Min. / Typ. / Max. / Unit / Remark Is LED String Current -- 80 88 [mA] 100% duty ratio of LED chip. Note 4-6. Vs LED String Voltage 48.6 54 59.4 [Volt] Is=80mA @ 100% duty ratio: Note 4-1, Note 4-5, Note 4-7. ΔVs Maximum Vs Voltage Deviation of light bar -- -- 3.6 [Volt] Is=80mA @ 100% duty ratio: Note 4-2. Pbar LED Light Bar Power Consumption -- 17.3 19.0 [Watt] Note 4-3. LTadj LED Life Time 30,000 -- -- [Hour] Note 4-4. OVP Over Voltage Protection in system board 110% Vmax -- -- [Volt] Note 4-5.	
0.1	2016/08/01	31	Note 4-1: Vs (Typ.) = Vf (Typ.) X LED No. (one string): a. Vf: LED chip forward voltage, Vf (Min.)=2.8V, Vf (Typ.)=3.05V, Vf (Max.)=3.4V. b. The same equation to calculate Vs(Min.) & Vs (Max.) for respective Vf (Min.) & Vf (Max.);	Note 4-1: Vs (Typ.) = Vf (Typ.) X LED No. (one string): a. Vf: LED chip forward voltage, Vf (Min.)=2.7V, Vf (Typ.)=3.0V, Vf (Max.)=3.3V. b. The same equation to calculate Vs(Min.) & Vs (Max.) for respective Vf (Min.) & Vf (Max.);	
0.1	2016/08/01	31	Note 4-4: Definition of life time: a. Brightness of LED becomes to 50% of its original value. b. Test condition: Is = 100mA and 25℃ (Room Temperature).	Note 4-4: Definition of life time: a. Brightness of LED becomes to 50% of its original value b. Test condition: Is = 80mA and 25℃ (Room Temperature).	
0.1	2016/08/01	34	Mechanical Characteristics  (1) Avoid touching COF position when doing mechanical design. (2) The user hole depth of the light bar side is different from the other side.	Mechanical Characteristics 	
0.1	2016/08/01	35	Mechanical Characteristics 	Mechanical Characteristics  (1) Avoid touching COF position when doing mechanical design. (2) The user hole depth of the light bar side is different from the other side.	
0.1	2016/08/01	37	8.2 Pallet and shipment information Item / Specification (Q'ty / Dimension / Weight (kg)) / Remark Panel 1 608.8(H)mm x 364.8(V)mm x 11.645(D)mm 3.22 Cushion 1 -- 3.23 Box 1 702(L)mm x 264(W)mm x 456(H)mm 1.2 without Panel & cushion Packing Box 8 pcs/Box 702(L)mm x 264(W)mm x 456(H)mm 26.96 with panel & cushion Pallet 1 1070(L)mm x 740(W)mm x 132(H)mm 14.80 Pallet after Packing 8 boxes/pallet 1070(L)mm x 740(W)mm x 1086(H)mm 230.48	8.2 Pallet and shipment information Item / Specification (Q'ty / Dimension / Weight (kg)) / Remark Panel 1 608.8(H)mm x 364.8(V)mm x 11.645(D)mm 3.15 Cushion 1 -- 3.23 Box 1 702(L)mm x 264(W)mm x 456(H)mm 1.2 without Panel & cushion Packing Box 8 pcs/Box 702(L)mm x 264(W)mm x 456(H)mm 26.83 with panel & cushion & Box Pallet 1 1070(L)mm x 740(W)mm x 132(H)mm 14.80 Pallet after Packing 8 boxes/pallet 1070(L)mm x 740(W)mm x 1086(H)mm 251.84	

1 Handling Precautions

1) Since polarizer is easily damaged, do not touch or press the surface of polorizer with hand.
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 other soft cloth.
5) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface.
6) Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.
7) Do not open or modify the Module Assembly.
8) Do not press the reflector sheet at the back of the module to any directions.
9) In case a TFT-LCD Module has to be put back into the packing container slot after once it was taken out from the container, do not press the center of the LED lightbar edge. Otherwise the TFT-LCD Module may be damaged.
10) Insert or pull out the interface connector, be sure not to rotate nor tilt it of the TFT-LCD Module.
11) Do not twist nor bend the TFT -LCD Module even momentary. It should be taken into consideration that no bending/twisting forces are applied to the TFT-LCD Module from outside. Otherwise the TFT-LCD Module may be damaged.
12) Please avoid touching COF position while you are doing mechanical design.
13) When storing modules as spares for a long time, the following precaution is necessary: Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5℃ and 35℃ at normal humidity.
14) Do not apply the same pattern for a long time, it will enhance relevant defect.

2 General Description

This specification applies to the 27 inch wide Color a-Si TFT-LCD Module M270HTN02.0. The display supports the Full HD - 1920(H) x 1080(V) screen format and 16.7M colors (8bits RGB data input). The input interface is 8 lane V-by-One and this module doesn't contain an driver board for backlight.

2.1 Display Characteristics

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

ITEMS	Unit	SPECIFICATIONS
Screen Diagonal	[mm]	685.65 (27.0")
Active Area	[mm]	597.6 (H) x 336.15 (V)
Pixels H x V	-	1920(x3) x 1080
Pixel Pitch	[um]	311.25 (per one triad) ×311.25
Pixel Arrangement	-	R.G.B. Vertical Stripe
Display Mode	-	TN mode , Normally White
White Luminance (Center)	[cd/m^2]	400 (Typ.)
Contrast Ratio	-	1000 (Typ.)
Response Time	[msec]	5ms (Typ., on/off)
Power Consumption (LCD Module + Backligh unit)	[Watt]	23.54W (Typ.) LCD module : PDD (Typ.)=6.24W@ Black pattern,Fv=240Hz Backlight unit : P_{BLU} (Typ.) =17.3W @ I_{RLED} =80mA
Weight	[Grams]	3220g
Outline Dimension	[mm]	608.8(H) x 354.8(V) x 11.7(D) Typ.
Electrical Interface	-	8 lane V-by-One
Support Color	-	16.7M colors (RGB 8-bits)
Surface Treatment	-	Anti-Glare, 3H
Temperature Range Operating Storage (Shipping)	 [°C] [°C]	 0 to +50 -20 to +60
RoHS Compliance	-	RoHS Compliance
TCO Compliance	-	NA

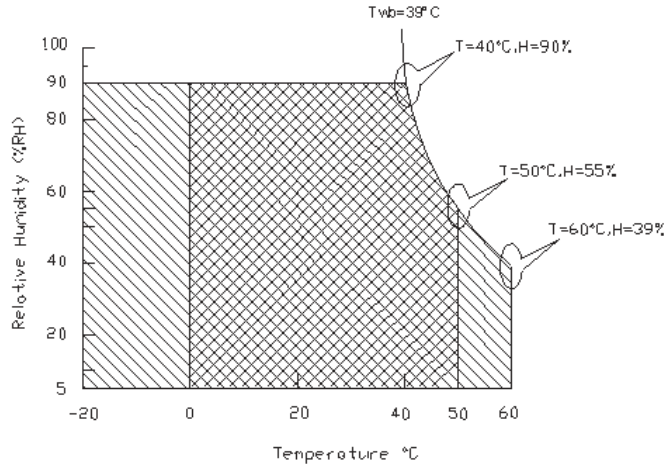
2.2 Absolute Maximum Rating of Environment

Permanent damage may occur if exceeding the following maximum rating.

Symbol	Description	Min.	Max.	Unit	Remark
TOP	Operating Temperature	0	+50	[°C]	***Note 2-1***
TGS	Glass surface temperature (operation)	0	+65	[°C]	***Note 2-1*** *Function judged only*
HOP	Operation Humidity	5	90	[%RH]	***Note 2-1***
TST	Storage Temperature	-20	+60	[°C]	
HST	Storage Humidity	5	90	[%RH]	

Note 2-1: Temperature and relative humidity range are shown as the below figure.

1. 90% RH Max (Ta ≦39℃)
2. Max wet-bulb temperature at 39℃ or less. (Ta ≦39℃)
3. No condensation



Operating Range Storage Range +

2.3 Optical Characteristics

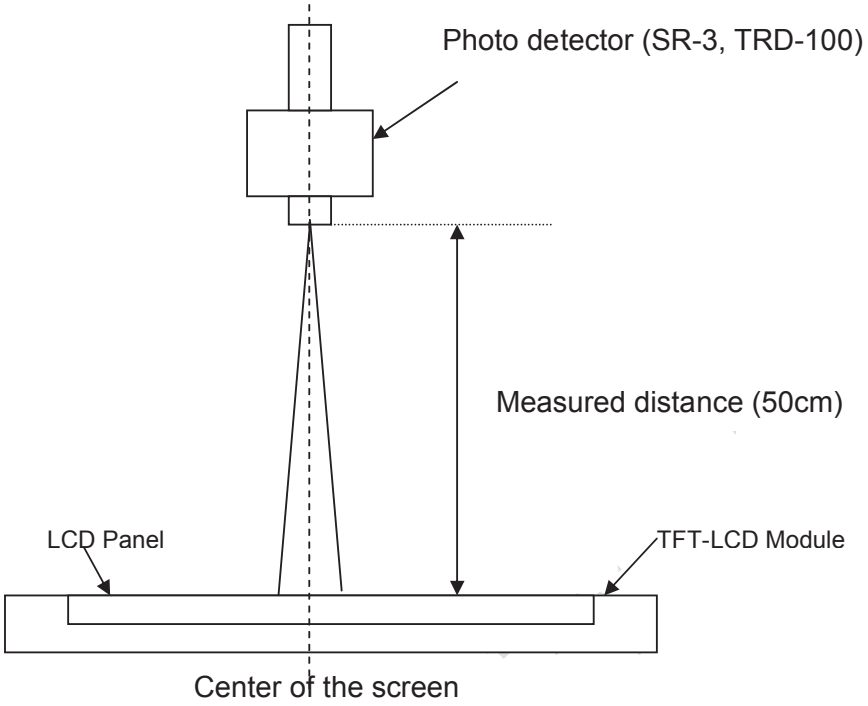
The optical characteristics are measured on the following test condition.

Test Condition:

1. Equipment setup: Please refer to ***Note 2-2***.
2. Panel Lighting time: 30 minutes
3. VDD=12.0V, Fv=200Hz,Is=80mA,Ta=25℃

Symbol	Description		Min.	Typ.	Max.	Unit	Remark
L_W	White Luminance (Center of screen)		320	400	-	[cd/m2]	***Note 2-2*** *By SR-3*
L_{uni}	Luminance Uniformity (9 points)		75	80	-	[%]	***Note 2-3*** *By SR-3*
CR	Contrast Ratio (Center of screen)		600	1000	-	-	***Note 2-4*** *By SR-3*
θ_R	Horizontal Viewing Angle (CR=10)	Right	75	85	-	[degree]	***Note 2-5*** *By SR-3*
θ_L		Left	75	85	-		
Φ_H	Vertical Viewing Angle (CR=10)	Up	70	80	-		
Φ_L		Down	70	80	-		
θ_R	Horizontal Viewing Angle (CR=5)	Right	75	88	-		
θ_L		Left	75	88	-		
Φ_H	Vertical Viewing Angle (CR=5)	Up	70	85	-		
Φ_L		Down	70	85	-		
T_R	Response Time	Rising Time	-	3.8	5.5	[msec]	***Note 2-6*** *By TRD-100*
T_F		Falling Time	-	1.2	2.5		
-		Rising + Falling	-	5	8		
R_x	Color Coordinates (CIE 1931)	Red x	0.618	0.648	0.678	-	*By SR-3*
R_y		Red y	0.302	0.332	0.362		
G_x		Green x	0.296	0.326	0.356		
G_y		Green y	0.594	0.624	0.654		
B_x		Blue x	0.127	0.157	0.187		
B_y		Blue y	0.028	0.058	0.088		
W_x		White x	0.283	0.313	0.343		
W_y		White y	0.299	0.329	0.359		
NTSC coverage ratio				72		[%]	*By SR-3*
CT	Crosstalk		-	-	1.5	[%]	***Note 2-7*** *By SR-3*
F_{dB}	Flicker (Center of screen)		-	-	-20	[dB]	***Note 2-8*** *By SR-3*

Note 2-2: Equipment setup :

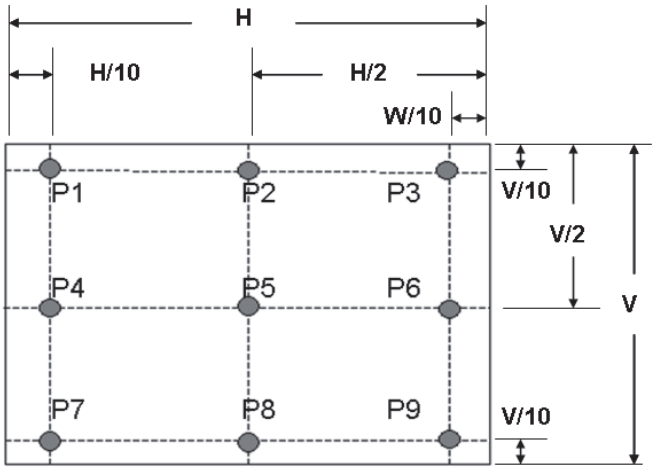


Note 2-3: Luminance Uniformity Measurement

Definition:

$$\text{Luminance Uniformity} = \frac{\text{Minimum Luminance of 9 Points (P1 ~ P9)}}{\text{Maximum Luminance of 9 Points (P1 ~ P9)}}$$

a.Test pattern: White Pattern



Note 2-4: Contrast Ratio Measurement

Definition:

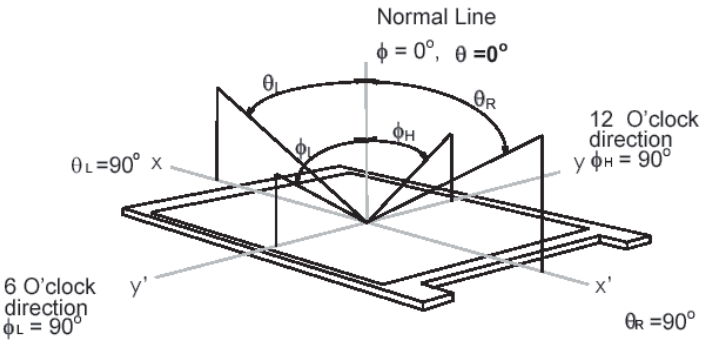
$$\text{Contrast Ratio} = \frac{\text{Luminance of White pattern}}{\text{Luminance of Black pattern}}$$

a. Measured position: Center of screen (P5) & perpendicular to the screen (θ=Φ=0°)

Note 2-5: Viewing angle measurement

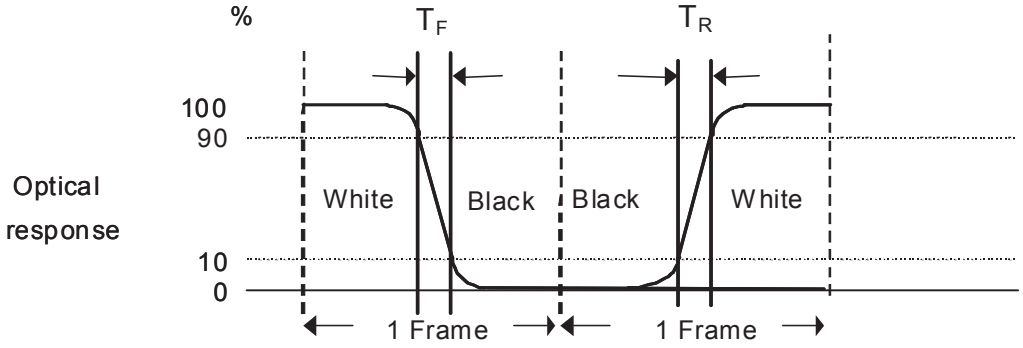
Definition: The angle at which the contrast ratio is greater than 10 & 5 .

a. Horizontal view angle: Divide to left & right (θ_L & θ_R)
Vertical view angle: Divide to up & down (Φ_H &Φ_L)



Note 2-6: Response time measurement

The output signals of photo detector are measured when the input signals are changed from "Black" to "White" (rising time, T_R), and from "White" to "Black" (falling time, T_F), respectively. The response time is interval between the 10% and 90% of optical response. (*Black & White color definition: Please refer section 3.4.3)*



Note 2-7: Crosstalk measurement

Definition:

CT = Max. (CT_H,CT_V);

Where

a.Maximum Horizontal Crosstalk :

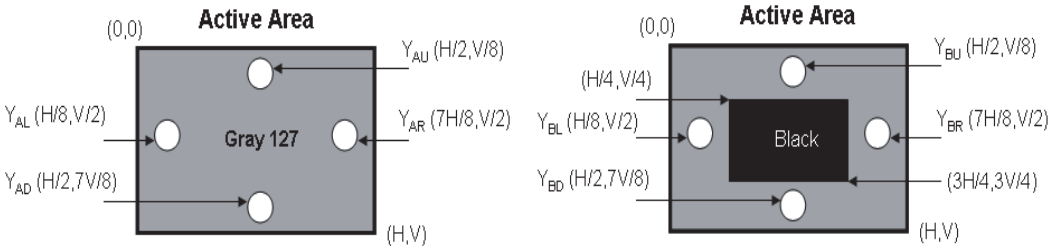
CT_H = Max. (| $Y_{BL} - Y_{AL}$ | / Y_{AL} × 100 %, | $Y_{BR} - Y_{AR}$ | / Y_{AR} × 100 %);

Maximum Vertical Crosstalk:

CT_V = Max. (| $Y_{BU} - Y_{AU}$ | / Y_{AU} × 100 %, | $Y_{BD} - Y_{AD}$ | / Y_{AD} × 100 %);

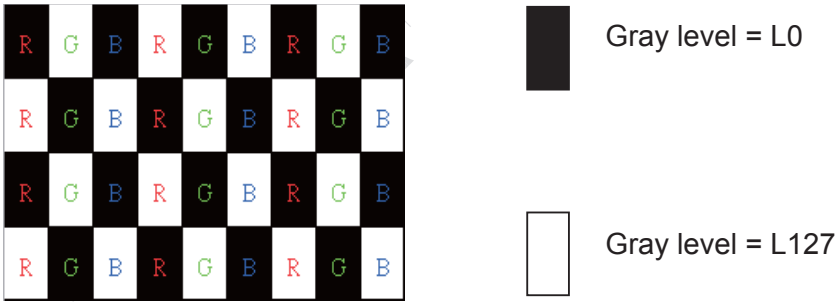
b. Y_{AU}, Y_{AD}, Y_{AL}, Y_{AR} = Luminance of measured location without Black pattern

Y_{BU}, Y_{BD}, Y_{BL}, Y_{BR} = Luminance of measured location with Black pattern



Note 2-8: Flicker measurement

a.Test pattern: It is listed as following.



R: Red, G: Green, B:Blue

b. Measured position: Center of screen (P5) & perpendicular to the screen (θ=Φ=0°)

2.4 Mechanical Characteristics

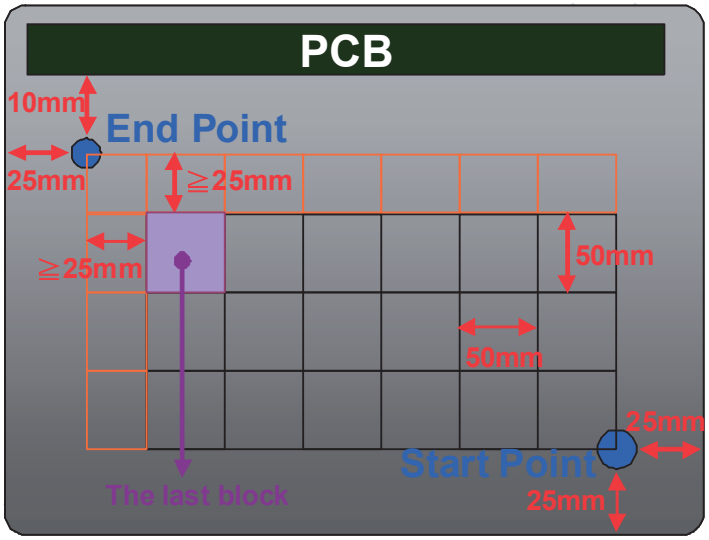
Symbol	Description	Min.	Max.	Unit	Remark
P_{bc}	Backside Compression	2.5	-	[Kgf]	***Note 2-9***

Note 2-9: Test Method:

The point is at a distance from right-downside 25mm x 25mm defined as the Start Point of Measure Points, and the point is at a distance 25mm from left-side & around 10mm from PCB defined as the End Point.

Align 50mm x 50mm block from Start Point on the Bezel Back, and the corners of each block are Measure Points.

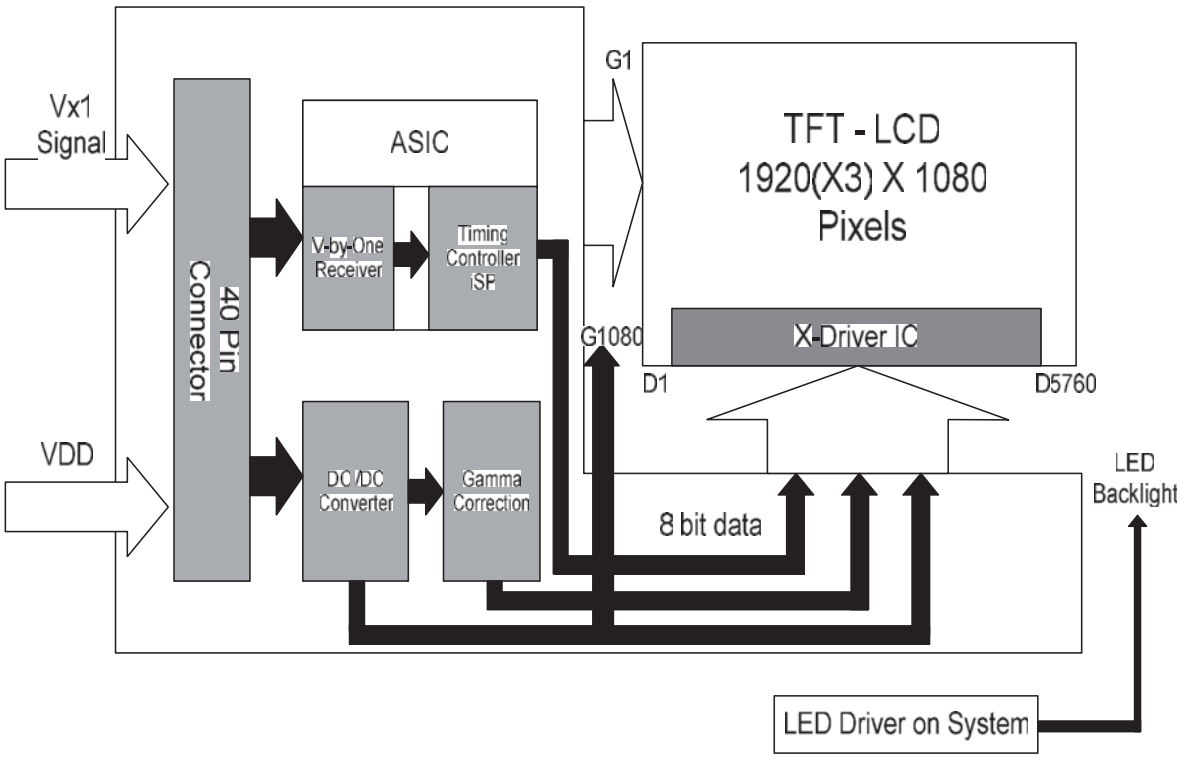
If the distance from the last block to each side of the End Point ≧ 25mm, add other blocks to make sure that most area of Bezel Back can be measured.



3 TFT-LCD Module

3.1 Block Diagram

The following shows the block diagram of the 27 inch Color TFT-LCD Module.



3.2 Interface Connection

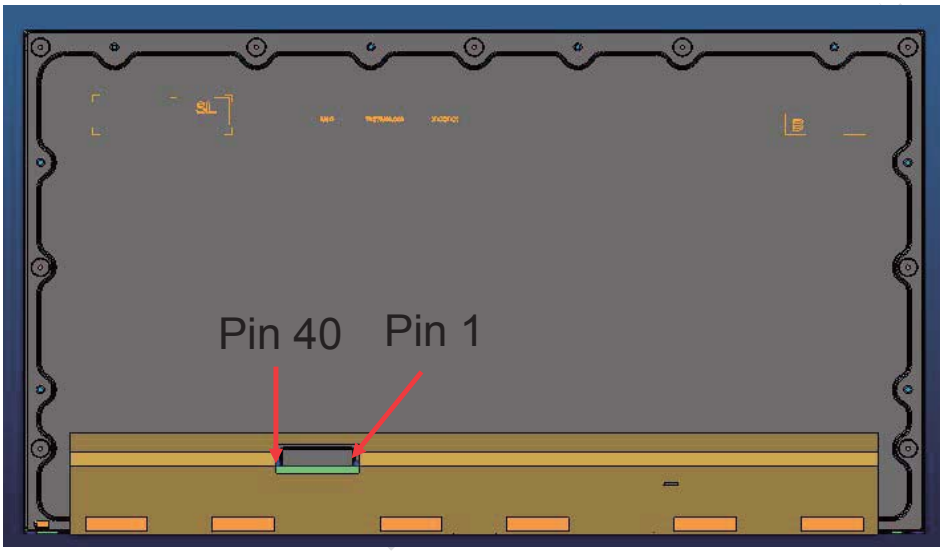
3.2.1 Connector Type

TFT-LCD Connector	Manufacturer	STARCONN
	Part Number	115F40-R000RA-M3
Mating Connector	Manufacturer	JAE
	Part Number	FI-NX40HL (Locked Type)

3.2.2 Connector Pin Assignment

PIN #	Symbol	Description	Remark
1	TxP7	Positive V-by-One lane 7	
2	TxN7	Negative V-by-One lane 7	
3	GND	Ground	
4	TxP6	Positive V-by-One lane 6	
5	TxN6	Negative V-by-One lane 6	
6	GND	Ground	
7	TxP5	Positive V-by-One lane 5	
8	TxN5	Negative V-by-One lane 5	
9	GND	Ground	
10	TxP4	Positive V-by-One lane 4	
11	TxN4	Negative V-by-One lane 4	
12	GND	Ground	
13	TxP3	Positive V-by-One lane 3	
14	TxN3	Negative V-by-One lane 3	
15	GND	Ground	
16	TxP2	Positive V-by-One lane 2	
17	TxN2	Negative V-by-One lane 2	
18	GND	Ground	
19	TxP1	Positive V-by-One lane 1	
20	TxN1	Negative V-by-One lane 1	
21	GND	Ground	
22	TxP0	Positive V-by-One lane 0	
23	TxN0	Negative V-by-One lane 0	
24	GND	Ground	
25	LOCKN	V-by-One LOCKN	
26	HTPDN	V-by-One HTPDN	
27	NC	No Connection (for AUO test only. Do not connect)	
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	NC	No Connection (for AUO test only. Do not connect)	
34	NC	No Connection (for AUO test only. Do not connect)	
35	NC	No Connection (for AUO test only. Do not connect)	
36	VIN	Power Supply Input Voltage	
37	VIN	Power Supply Input Voltage	
38	VIN	Power Supply Input Voltage	
39	VIN	Power Supply Input Voltage	
40	VIN	Power Supply Input Voltage	



3.3 Electrical Characteristics

3.3.1 Absolute Maximum Rating

Permanent damage may occur if exceeding the following maximum rating.

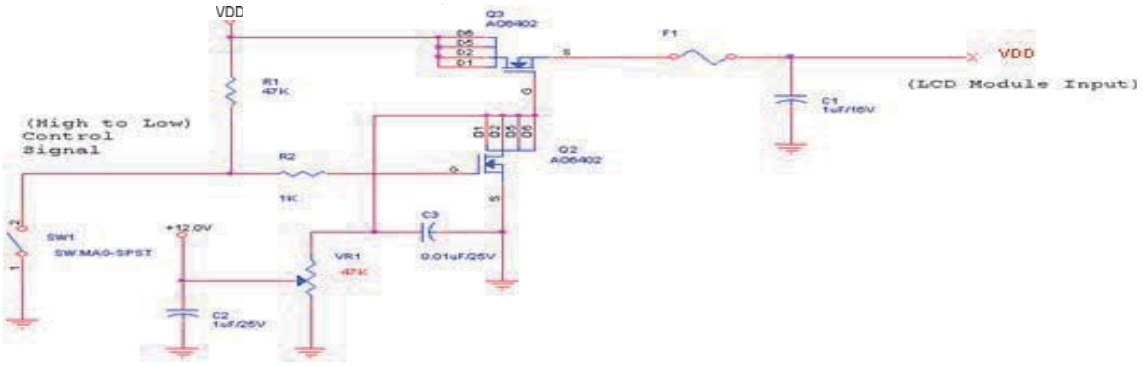
Symbol	Description	Min	Max	Unit	Remark
VDD	Power Supply Input Voltage	GND-0.3	14.0	[Volt]	Ta=25℃

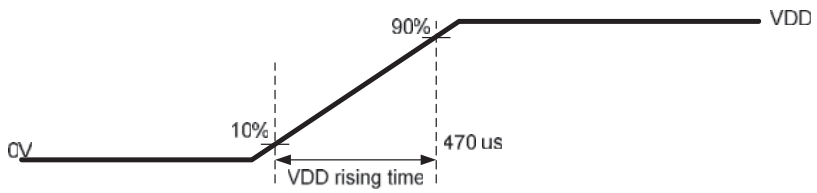
3.3.2 Recommended Operating Condition

Symbol	Description	Min	Typ	Max	Unit	Remark
VDD	Power supply Input voltage	10.8	12.0	13.2	[Volt]	
IDD	Power supply Input Current (RMS)	-	0.52	0.63	[A]	VDD= 12.0V, Black Pattern, Fv=240Hz
PDD	VDD Power Consumption	-	6.24	7.56	[Watt]	VDD= 12.0V, Black Pattern, Fv=240Hz
IRush	Inrush Current	-	-	3.5	[A]	***Note 3-1***
VDDrp	Allowable VDD Ripple Voltage	-	-	500	[mV]	VDD= 12.0V, Black Pattern, Fv=240Hz

Note 3-1: Inrush Current measurement:

Test circuit:

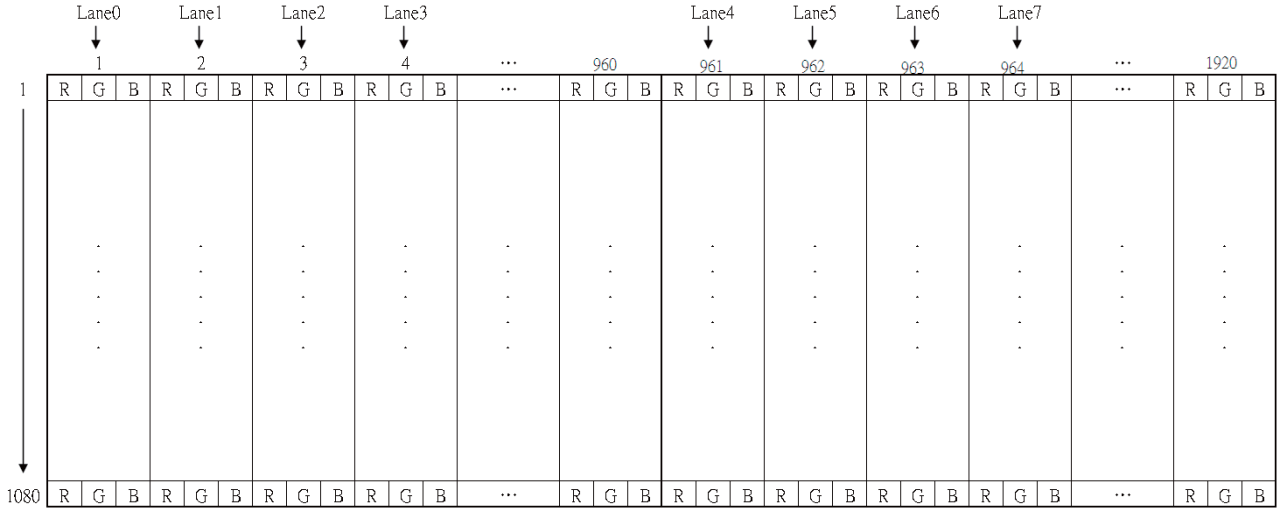




The duration of VDD rising time: 470us.

3.4 Signal Characteristics

3.4.1 LCD Pixel Format



Note 3-2: The module use 8 Lanes V-by-One interface.

Lane0：1+4n pixel
Lane1：2+4n pixel
Lane2：3+4n pixel
Lane3：4+4n pixel
Lane4：961+4n pixel
Lane5：962+4n pixel
Lane6：963+4n pixel
Lane7：964+4n pixel
n=0~239

3.4.2 V-by-One Data Format

Mode	Packer input & Unpacker output		24bpp RGB
3byte mode	Byte0	D[0]	R[0]
		D[1]	R[1]
		D[2]	R[2]
		D[3]	R[3]
		D[4]	R[4]
		D[5]	R[5]
		D[6]	R[6]
		D[7]	R[7]
	Byte1	D[8]	G[0]
		D[9]	G[1]
		D[10]	G[2]
		D[11]	G[3]
		D[12]	G[4]
		D[13]	G[5]
		D[14]	G[6]
		D[15]	G[7]
	Byte2	D[16]	B[0]
		D[17]	B[1]
		D[18]	B[2]
		D[19]	B[3]
		D[20]	B[4]
		D[21]	B[5]
		D[22]	B[6]
		D[23]	B[7]

3.4.3 Color versus Input Data

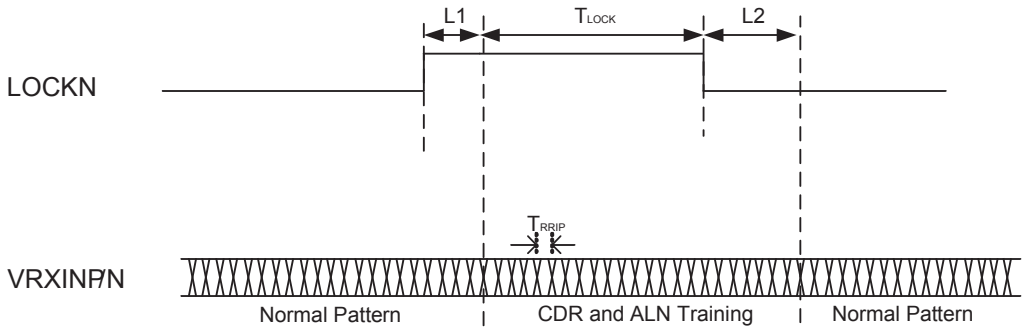
The following table is for color versus input data (8bit). The higher the gray level, the brighter the color.

Color	Gray Level	Color Input Data																								Remark
		RED data (MSB:R7, LSB:R0)								GREEN data (MSB:G7, LSB:G0)								BLUE data (MSB:B7, LSB:B0)								
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0	
Black	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
White	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gray 127	-	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	
Red	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	L255	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Green	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	L255	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	
Blue	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	L255	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	

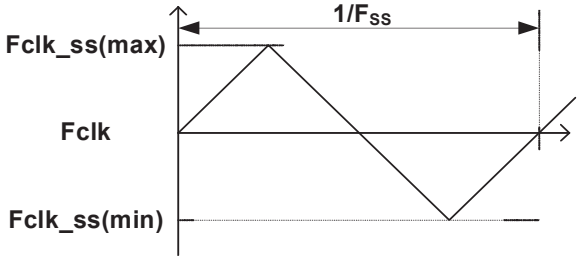
3.4.4 V-by-One Specification

Item		Symbol	Min.	Typ.	Max	Unit	Note
V-by-one Interface	VRXINP/N input each bit Period	T_{RRIP} (UI)	470	--	495	ps	
	Receiver Clock : Spread Spectrum Modulation range	Fclk_ss	Fclk -0.5%	--	Fclk +0.5%	MHz	2
	Receiver Clock : Spread Spectrum Modulation frequency	Fss		30		KHz	2
	CDR training pattern time	T_{LOCK}	--		1	ms	1
	Latency from LOCKN 'HIGH' to clock training pattern	L1	0	--	--	us	1
	Latency from LOCKN 'LOW' to normal 8b10b data	L2	--	--	10	ms	1
	CML Differential Input High Threshold	V_{RTH}	--	--	+50	mV_{DC}	
	CML Differential Input Low Threshold	V_{RTL}	-50	--	--	mV_{DC}	
	CML Common mode Bias Voltage	V_{RCT}		0		V_{DC}	
	Intra-pair skew	T_{INTRA}	--	--	0.3	UI	3
	Inter-pair skew	T_{INTER}	--	--	5	UI	4
	Eye diagram at receiver	A_X	--	0.25	--	UI	5
		A_Y	--	0	--	mV	
		B_X	--	0.3	--	UI	
		B_Y	--	50	--	mV	
		C_X	--	0.7	--	UI	
		C_Y	--	50	--	mV	
		D_X	--	0.75	--	UI	
		D_Y	--	0	--	mV	
		E_X	--	0.7	--	UI	
		E_Y	--	-50	--	mV	
		F_X	--	0.3	--	UI	
		F_Y	--	-50	--	mV	

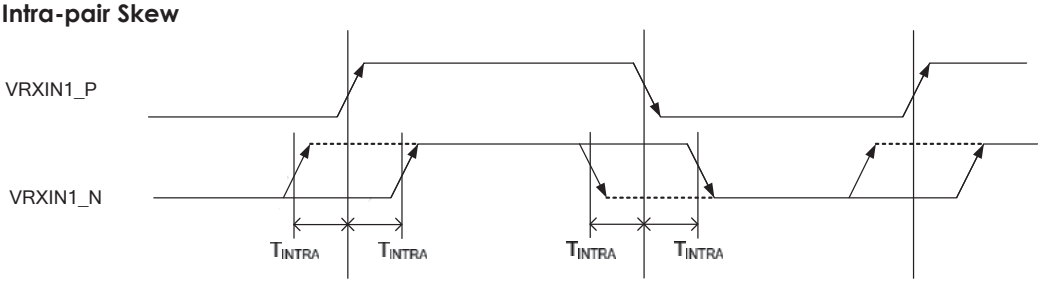
1. V-by-One Signal diagram



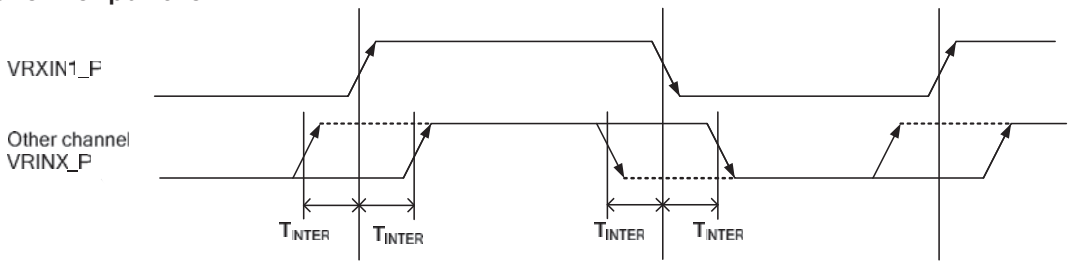
2. Receiver Clock SSCG (Spread spectrum clock generator) is defined as below figures.



3. V-by-One Intra-pair Skew

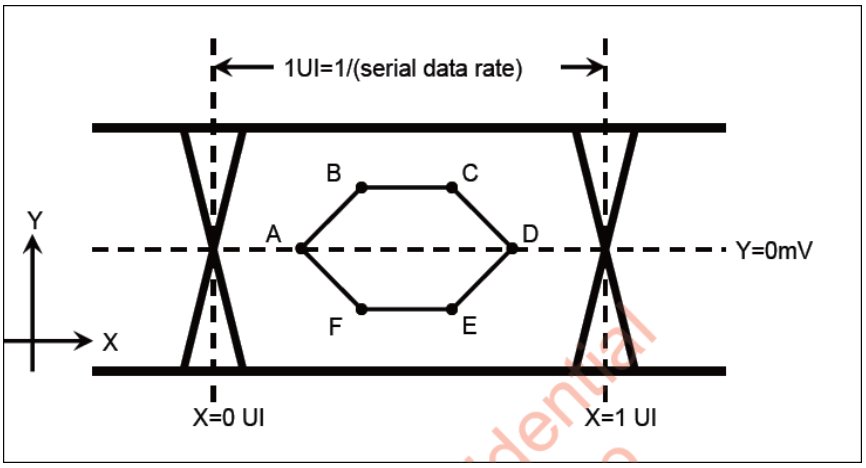


4. **V-by-One Inter-pair Skew**



5. Eye diagram at receiver

Eye Mask



Example of Eye diagram

3.4.5 Input Timing Specification

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	1100	1315	2680	Th	
Tdisp (v)		Active	1080	1080	1080	Th	
Tblk (v)		Blanking	20	235	1600	Th	
Fv		Frequency	60	200	240	Hz	
Th	Horizontal Section	Period	269	270	511	Tclk	
Tdisp (h)		Active	240	240	240	Tclk	
Tblk (h)		Blanking	29	30	271	Tclk	
Fh		Frequency	249.1	263.0	263.0	KHz	***Note 3-3***
Tclk	LVDS Clock	Period	14.1	14.1	14.9	ns	1/Fclk
Fclk		Frequency	67.0	71.0	71.0	MHz	***Note 3-4***

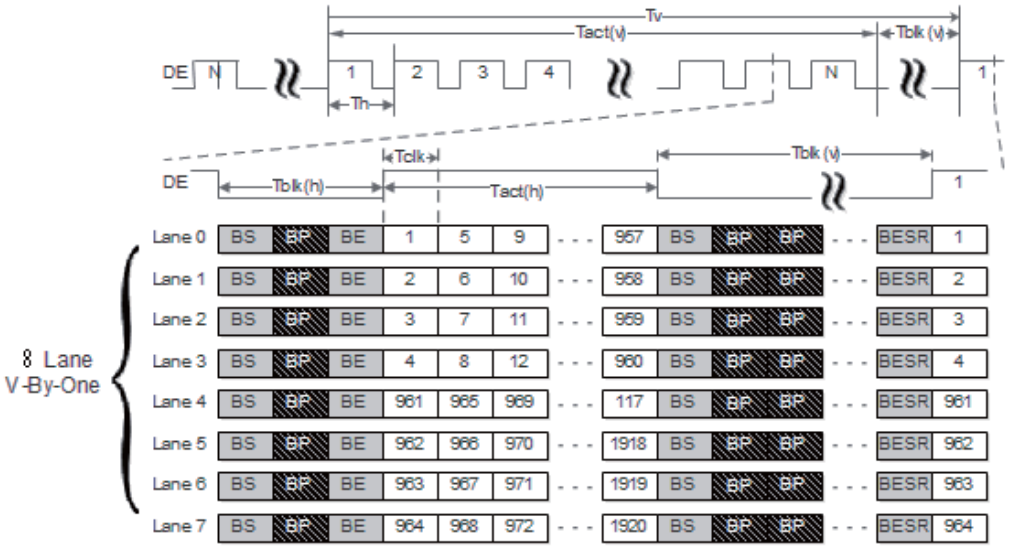
Note 3-3: Please don't exceed the above recommended value.

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

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

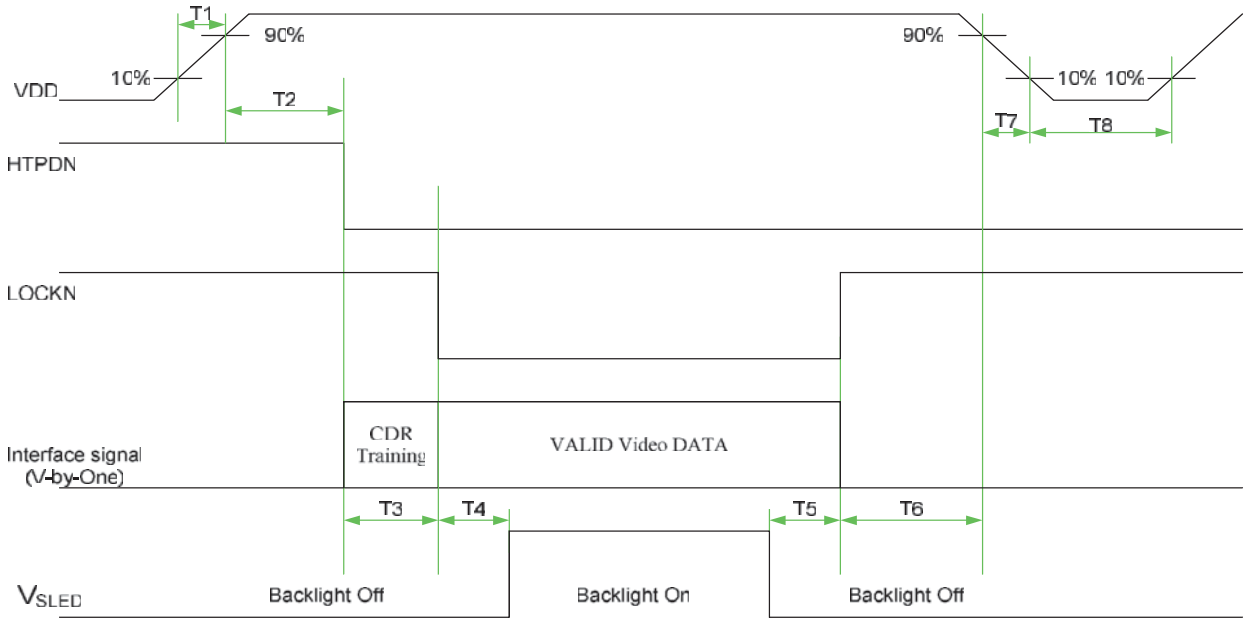
Fclk (Min.) < Fv x Th x Tv < Fclk (Max.)

3.4.6 Input Timing Diagram



3.5 Power ON/OFF Sequence

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



Power Sequence Timing

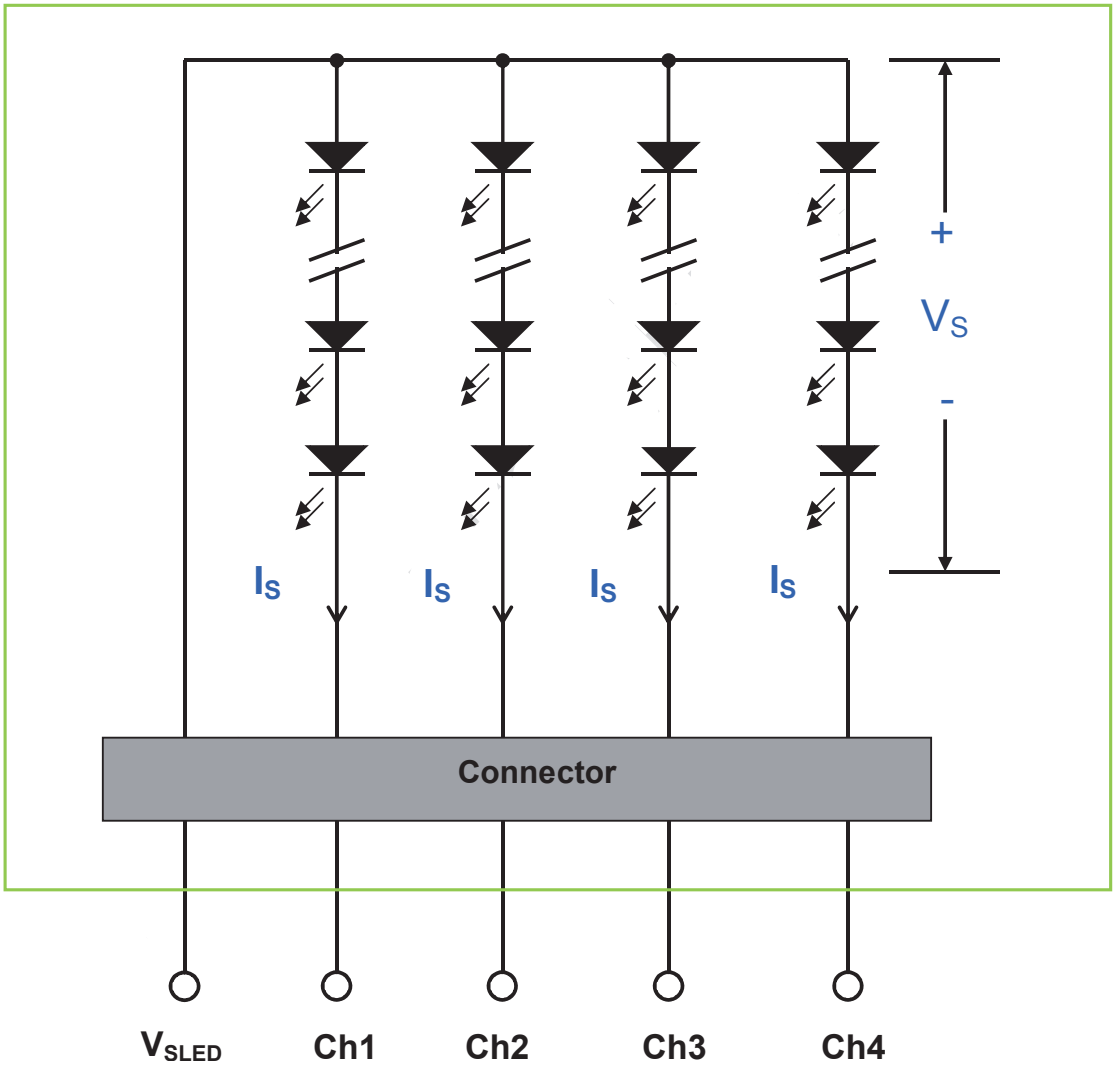
Symbol	Value			Unit	Remark
	Min.	Typ.	Max.		
T1	0.5	-	10	[ms]	
T2	0	40	-	[ms]	
T3	0	2	-	[ms]	***Note 3-5***
T4	600	-	-	[ms]	
T5	100			[ms]	
T6	0	-	50	[ms]	***Note 3-6*** ***Note 3-7***
T7	0	-	200	[ms]	***Note 3-6*** ***Note 3-8***
T8	1000	-	-	[ms]	

Note 3-5 : During T3 period , V-by-One CDR training time by customer's system.
Note 3-6 : During T6 and T7 period , please keep the level of input V-by-One signals with Hi-Z state.
Note 3-7 : Recommend setting T6 = 0ms to avoid electronic noise when VDD is off.
Note 3-8 : Voltage of VDD must decay smoothly after power-off.(customer syster decide this value)

4 Backlight Unit

4.1 Block Diagram

The following shows the block diagram of the 27 inch Backlight Unit. And it includes 72 pcs LED in the LED light bar. (4 strings and 18 pcs LED of one string).



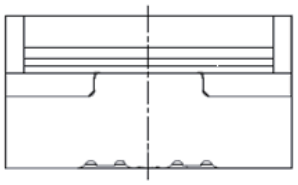
4.2 Interface Connection

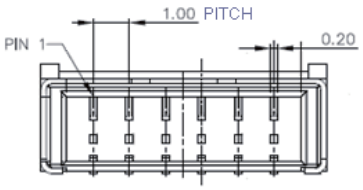
4.2.1 Connector Type

Backlight Connector	Manufacturer	CviLux
	Part Number	CI1406M1VLD-NH
Mating Connector	Manufacturer	CviLux
	Part Number	CI1406SL000-NH(Lock)

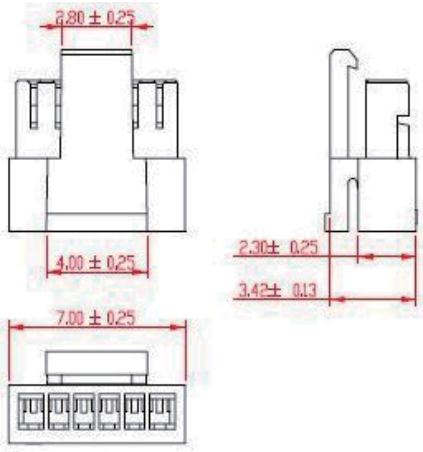
Backlight Connector dimension:

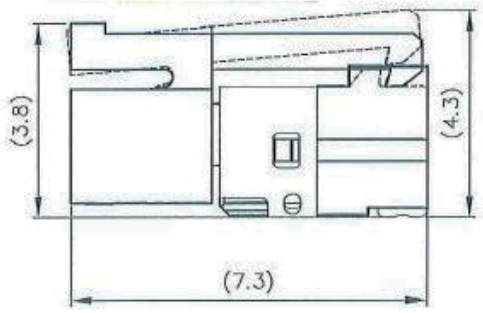
$H \times V \times D = 13.9 \times 3.00 \times 4.25, Pitch = 1.0(unit = mm)$





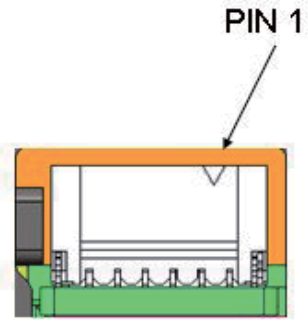
Mating Connector dimension:





4.2.2 Connector Pin Assignment

Pin#	Symbol	Description	Remark
1	Ch1	LED Current Feedback Terminal (Channel 1)	
2	Ch2	LED Current Feedback Terminal (Channel 2)	
3	V_{SLED}	LED Power Supply Voltage Input Terminal	
4	V_{SLED}	LED Power Supply Voltage Input Terminal	
5	Ch3	LED Current Feedback Terminal (Channel 3)	
6	Ch4	LED Current Feedback Terminal (Channel 4)	



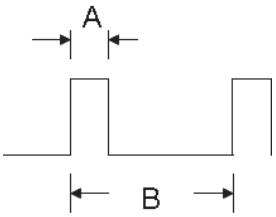
4.3 Electrical Characteristics

4.3.1 Absolute Maximum Rating

Permanent damage may occur if exceeding the following maximum rating.

(Ta=25℃)

Symbol	Description	Min	Max	Unit	Remark
Is	LED String Current	0	150	[mA]	100% duty ratio
			300	[mA]	*Duty ratio≦ 10%* *Pulse time=10 ms*



Duty ratio= (A / B) X 100% ; (A: Pulse time, B: Period)

4.3.2 Recommended Operating Condition

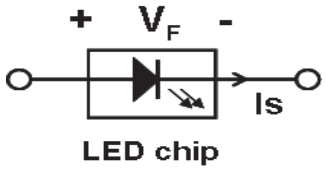
(Ta=25℃)

Symbol	Description	Min.	Typ.	Max.	Unit	Remark
Is	LED String Current		80	88	[mA]	100% duty ratio of LED chip, ***Note 4-6***
Vs	LED String Voltage	48.6	54	59.4	[Volt]	Is=80mA @ 100% duty ratio; ***Note 4-1, Note 4-5, Note 4-7***
ΔVs	Maximum Vs Voltage Deviation of light bar			3.6	[Volt]	Is=80mA @ 100% duty ratio; ***Note 4-2***
P_{BLU}	LED Light Bar Power Consumption		17.3	19.0	[Watt]	***Note 4-3***
LT_{LED}	LED Life Time	30,000	-	-	[Hour]	***Note 4-4***
OVP	Over Voltage Protection in system board	110% Vsmax	-	-	[Volt]	***Note 4-5***

Note 4-1: Vs (Typ.) = V_F (Typ.) X LED No. (one string);

a. V_F: LED chip forward voltage, V_F (Min.)=2.7V, V_F(Typ.)=3.0V, V_F(Max.)=3.3V

b. The same euqation to calculate Vs(Min.) & Vs (Max.) for respective V_F (Min.) & V_F(Max.);



Note 4-2: ΔVs (Max.) = ΔV_F X LED No. (one string);

a. ΔV_F: LED chip forward voltage deviation; (0.2 V , each Bin of LED V_F)

Note 4-3: P_{BLU} (Typ.) = Vs (Typ.) X Is (Typ.) X 4 ; (4 is total String No. of LED Light bar)

P_{BLU} (Max.) = Vs (Max.) X Is (Typ.) X 4 ;

Note 4-4: Definition of life time:

a. Brightness of LED becomes to 50% of its original value

b. Test condition: Is = 80mA and 25℃ (Room Temperature)

Note 4-5: Recommendation for LED driver power design:

Due to there are electrical property deviation in LED & 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.

Note 4-6: AUO strongly recommend "Analog Dimming" method for backlight brightness control for Wavy Noise Free. Otherwise, recommend that Dimming Control Signal (PWM Signal) should be synchronized with Frame Frequency.

Note 4-7: Ensure that the LED light bar is not subjected either forward or reverse voltage while monitor set is on standby mode or not in use.

5 Reliability Test

AUO reliability test items are listed as following table. (*Bare Panel only*)

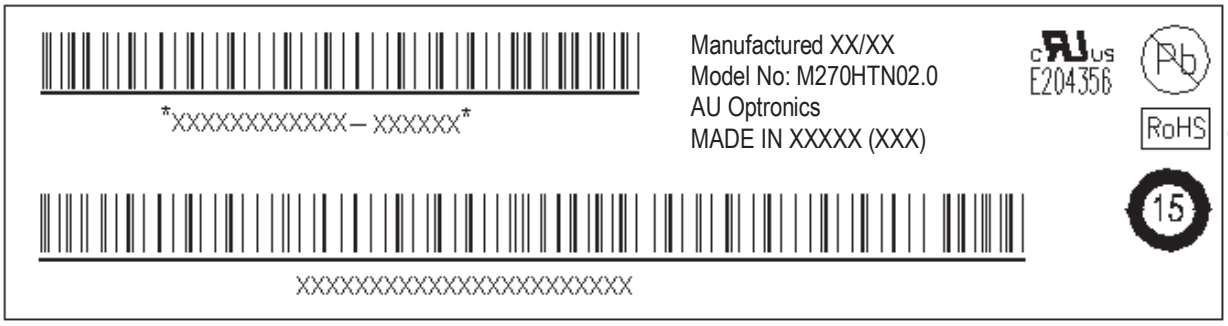
Items	Condition	Remark
Temperature Humidity Bias (THB)	Ta= 50℃, 80%RH, 300hours	
High Temperature Operation (HTO)	Ta= 50℃, 50%RH, 300hours	
Low Temperature Operation	Ta= 0℃, 300hours	
High Temperature Storage (HTS)	Ta= 60℃, 300hours	
Low Temperature Storage (LTS)	Ta= -20℃, 300hours	
Vibration Test (Non-operation)	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)	
Thermal Shock Test (TST)	-20℃/30min, 60℃/30min, 100 cycles	***Note 5-1***
On/Off Test	On/10sec, Off/10sec, 30,000 cycles	
ESD (Electro Static Discharge)	Contact Discharge: ± 15KV, 150pF(330Ω) 1sec, 8 points, 25 times/ point.	***Note 5-2***
	Air Discharge: ± 15KV, 150pF(330Ω) 1sec 8 points, 25 times/ point.	
Altitude Test	Operation:18,000 ft Non-Operation:40,000 ft	

Note 5-1: a. A cycle of rapid temperature change consists of varying the temperature from -20℃ to 60℃, and back again. Power is not applied during the test.
b. After finish temperature cycling, the unit is placed in normal room ambient for at least 4 hours before power on.

Note 5-2: EN61000-4-2, ESD class B: Certain performance degradation allowed
No data lost
Self-recoverable
No hardware failures.

6 Shipping Label

The label is on the panel as shown below:



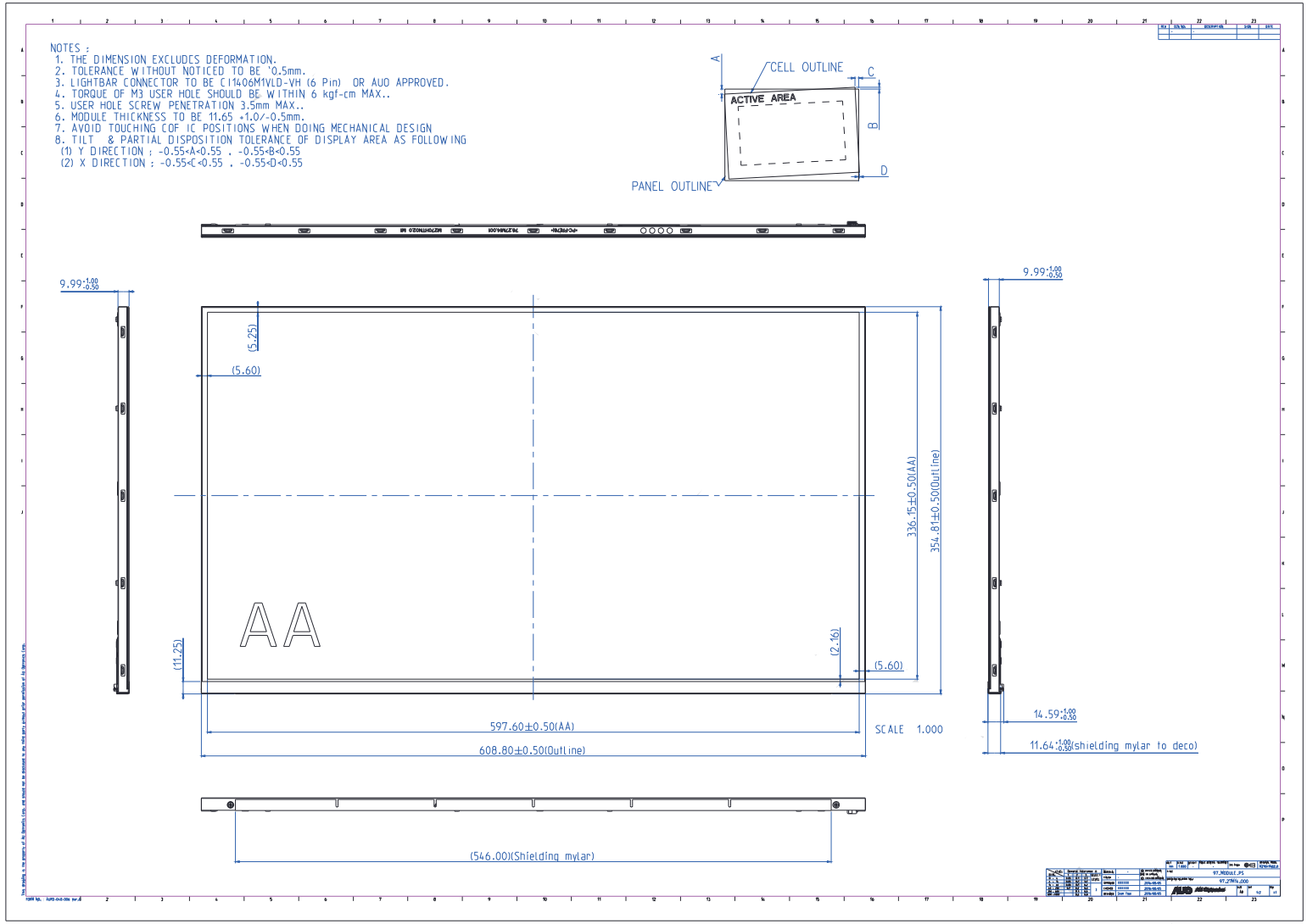
Note 6-1: For Pb Free products, AUO will add for identification.

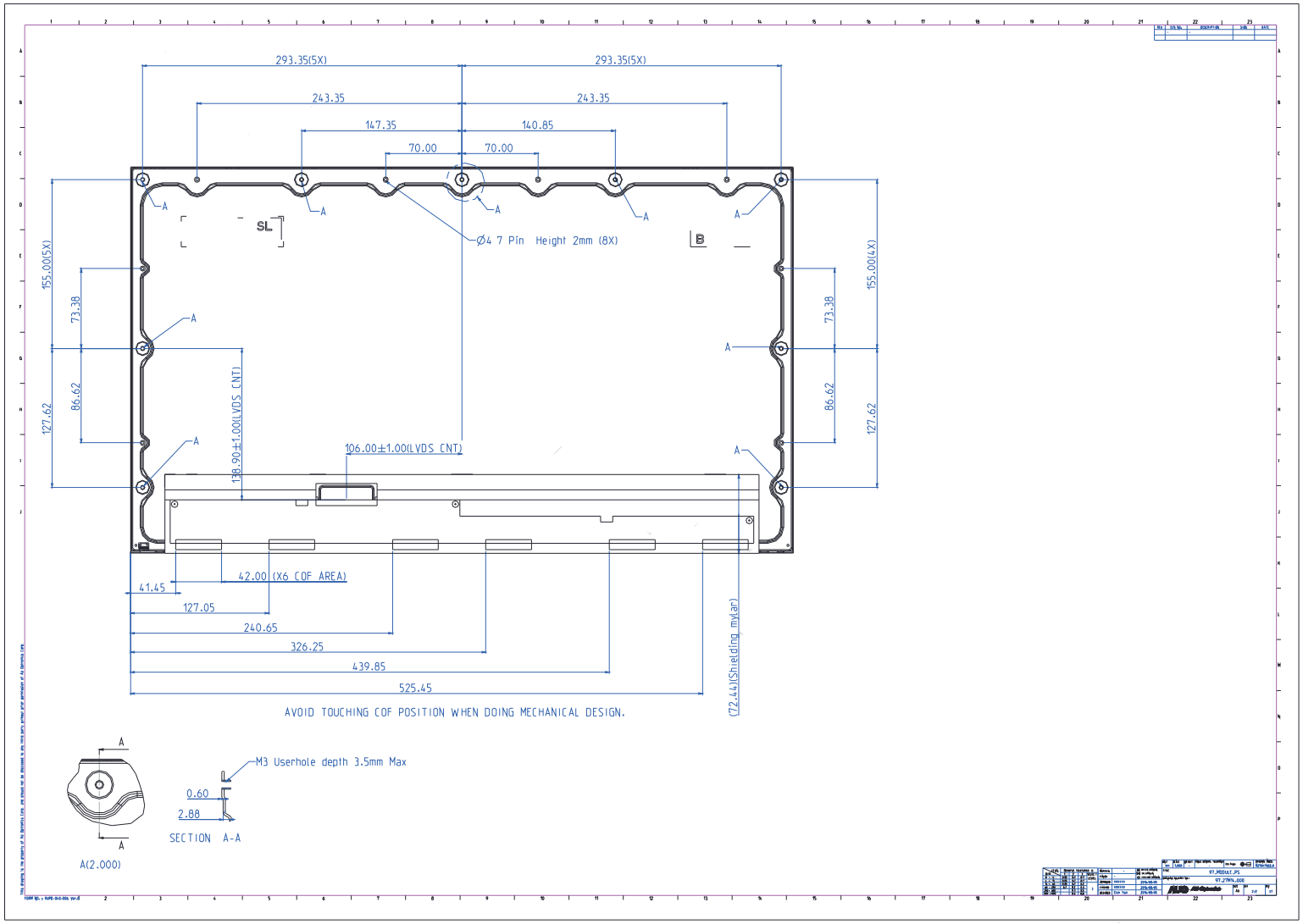
Note 6-2: For RoHS compatible products, AUO will add for identification.

Note 6-3: For China RoHS compatible products, AUO will add for identification.

Note 6-4: The Green Mark will be presented only when the green documents have been ready by AUO Internal Green Team.

7 Mechanical Characteristics



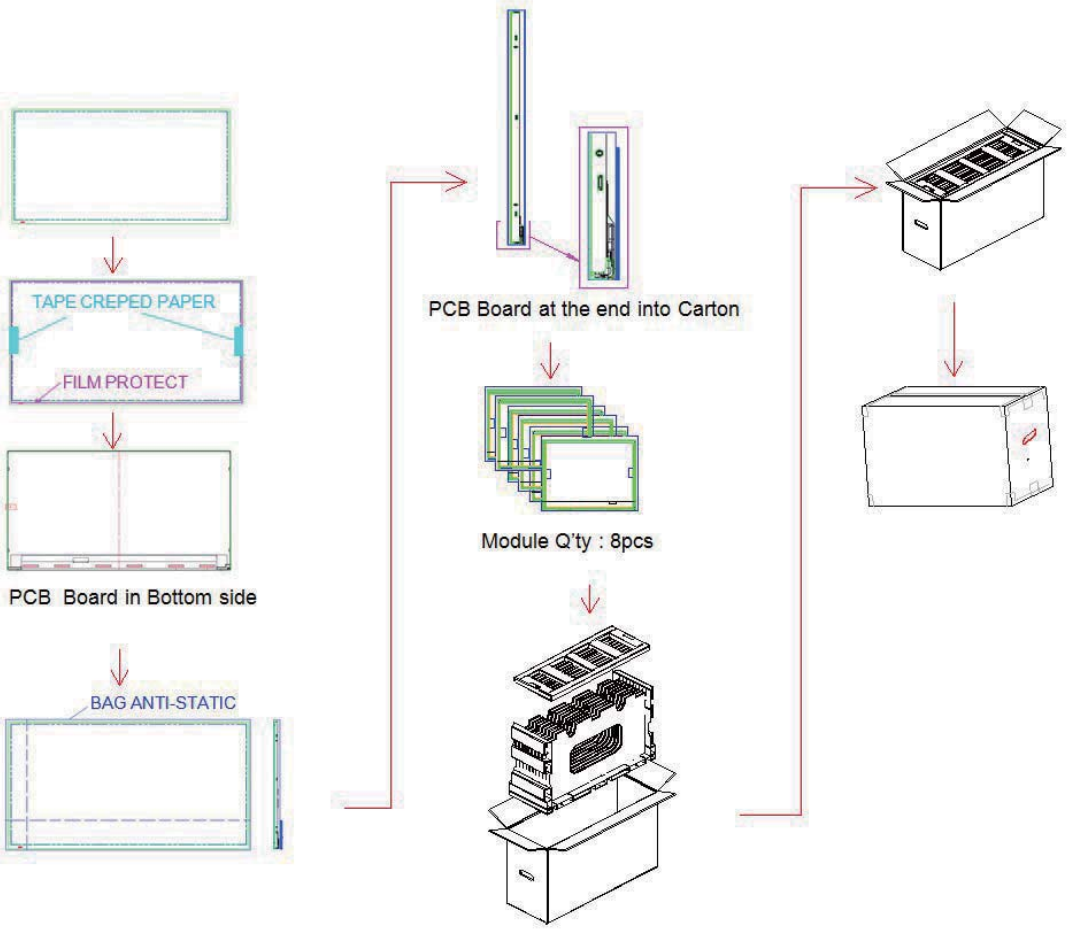


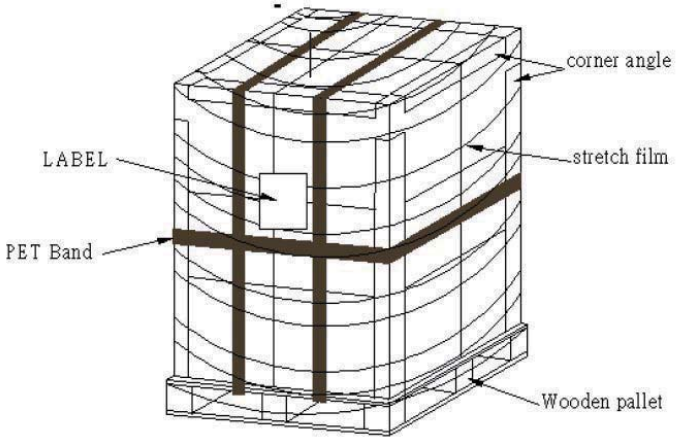
(1) Avoid touching COF position when doing mechanical design

(2) The user hole depth of the light bar side is different from the other side

8 Packing Specification

8.1 Packing Flow





8.2 Pallet and shipment information

Item	Specification			Remark
	Q'ty	Dimension	Weight (kg)	
Panel	1	608.8(H)mm × 354.8(V)mm × 11.645(D)mm	3.15	
Cushion	1	-	3.23	
Box	1	702(L)mm x 264(W)mm x 456(H)mm	1.2	without Panel & cushion
Packing Box	8 pcs/Box	702(L)mm x 264(W)mm x 456(H)mm	26.63	with panel & cushion &
Pallet	1	1070(L)mm x 740(W)mm x 132(H)mm	14.80	
Pallet after Packing	8 boxes/pallet	1070(L)mm x 740(W)mm x 1086(H)mm	251.84	