DATA MODUL

AUO
AUO Display+

Specification

G156HAN02.001

15.6" - 1920x1080 – eDP

Spec Revision: 1.0
Revision Date: 18.07.2024

Note: This specification is subject to change without prior notice

Passion Displayed

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☐ **Preliminary Specification**
■ **Final Specification**

Module	15.6 Inch Color TFT-LCD
Model Name	G156HAN02.0 (001)
Note	Support portrait used

Company		Approved by	Date
		LeaDer Feng	2024/07/18
Checked & Approved by	Date	Prepared by	Date
		BinJou Huang	2024/07/18
		General Display Business Unit / AUO Display Plus Corporation	

G156HAN02.0 ver. 0.0

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Record of Revision

Version	Date	Page	Old description	New Description
0.0	2024/03/08	All	Preliminary Specification	
1.0	2024/07/18	All	Final Specification	

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1. Operating Precautions

1) Display area (Polarizer) of TFT-LCD Module is easily to be damaged, please be cautious and not to scratch it.

2) Be sure to power off your machine before connecting or disconnecting your signal cable to TFT-LCD Module.

3) Wipe off water drop on display area 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) Display area (Glass) of TFT-LCD Module may be broken or cracked if bump Module against hard object.

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 TFT-LCD module assembly.

8) Do not press the reflector sheet at the back of the module to any direction.

9) In case if TFT-LCD 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 Reflector edge. Instead, press at the far ends of the LED Reflector edge softly. Otherwise the TFT-LCD Module may be damaged.

10) When inserting or removing of your signal cable to TFT-LCD Module, be sure not to apply abnormal force (rotate, tilt…etc.) to the Connector of the TFT-LCD 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 without flammability grade are used in the TFT-LCD module. The TFT-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.

14) Continuous operating TFT-LCD Module under high temperature environment may accelerate LED light bar exhaustion and reduce luminance dramatically.

15) The data on this specification sheet is applicable when TFT-LCD module is placed in landscape position.

16) Continuous displaying fixed pattern may induce image sticking. It's recommended to use screen saver or moving content periodically if fixed pattern is displayed on the screen.

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2. General Description

G156HAN02.0 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 16:9 FHD, 1920(H) x 1080(V) screen and 16.2M colors (RGB 6-bits + FRC)with LED backlight driving circuit. All input signals are eDP(Embedded DisplayPort) interface compatible.

G156HAN02.0 is designed for a display unit of notebook style personal computer and industrial machine.

2.1 Display Characteristics

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

Items	Unit	Specifications
Screen Diagonal	[inch]	15.6
Active Area	[mm]	344.16 (H) x 193.59 (V)
Resolution	-	1920 x 3(RGB) x 1080
Pixel Pitch	[mm]	0.17925 x 0.17925
Pixel Arrangement	-	R.G.B. Vertical Stripe
Display Mode	-	AHVA, Normally Black
Nominal Input Voltage VDD	[Volt]	+3.3 (typ.)
LCD Power Consumption	[Watt]	0.98 W (Max.)
Backlight Power Consumption	[Watt]	10.44 W (Max.)
Weight	[Grams]	660 (Max.)
Physical Size	[mm]	363.8(H) x 215.9 (V) x 8.8(D) (typ.)
Electrical Interface	-	2 Lane eDP
Surface Treatment		Anti-glare, 3H
Support Color	-	16.2M colors (RGB 6-bits+FRC)
Temperature Range (LCD Module only) Operating Storage (Non-Operating)	[^{o}C]	-20 to +70 (+70 ^{o}C as panel surface temperature) -20 to +70
RoHS Compliance		RoHS Compliance

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2.2 Optical Characteristics

The optical characteristics of LCM panel are measured under stable conditions at 25 ℃.

| Item	Unit	Conditions		Min.	Typ.	Max.	Note
White Luminance	cd/m²	I_{LED}=58mA (center point)		400	500		1
Luminance Uniformity	%	9 points		75	80	-	2,3
Contrast ratio	--			700	1000	-	4
Response Time	msec	Rising (Tr)+ Falling (Tf)		-	25	35	5
Viewing Angle	[degree]	Horizontal CR >= 10	(Right)	80	89	-	6
			(Left)	80	89	-	
		Vertical CR >= 10	(Upper)	80	89	-	
			(Lower)	80	89	-	
Color / Chromaticity Coordinate (CIE 1931)	--	Red x		0.600	0.650	0.700	
		Red y		0.283	0.333	0.383	
		Green x		0.246	0.296	0.346	
		Green y		0.558	0.608	0.658	
		Blue x		0.097	0.147	0.197	
		Blue y		0.008	0.058	0.108	
		White x		0.263	0.313	0.363	
		White y		0.279	0.329	0.379	
Color Gamut	%	CIE 1931		-	72	-	

Note 1: Measurement method

Equipment Pattern Generator, Power Supply, Digital Voltmeter, Luminance meter (SR_3 or equivalent)
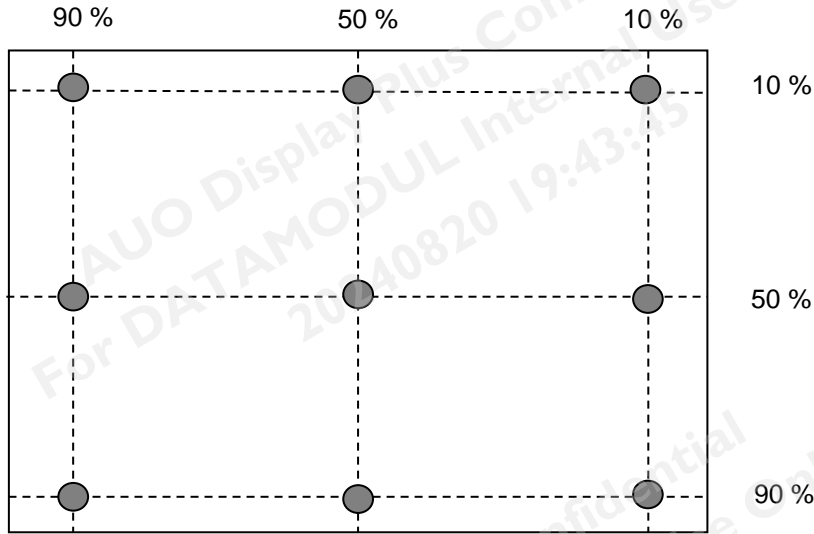Aperture   1∘ with 50cm viewing distance
Test Point   Center
Environment   *< 1 lux*
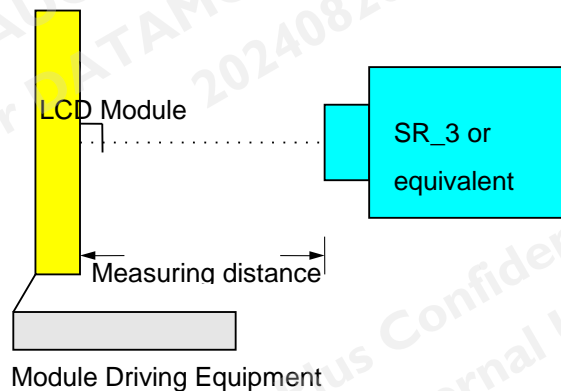
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Note 2: Definition of 9 points position

Note 3: The luminance uniformity of 9 points is defined by dividing the minimum luminance values by the maximum test point luminance

$$\delta_{W9} = \frac{\text{Minimum Brightness of 9 points}}{\text{Maximum Brightness of 9 points}}$$

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.


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For DATAMODUL internal use only - provided by sisihu on 2024/08/20
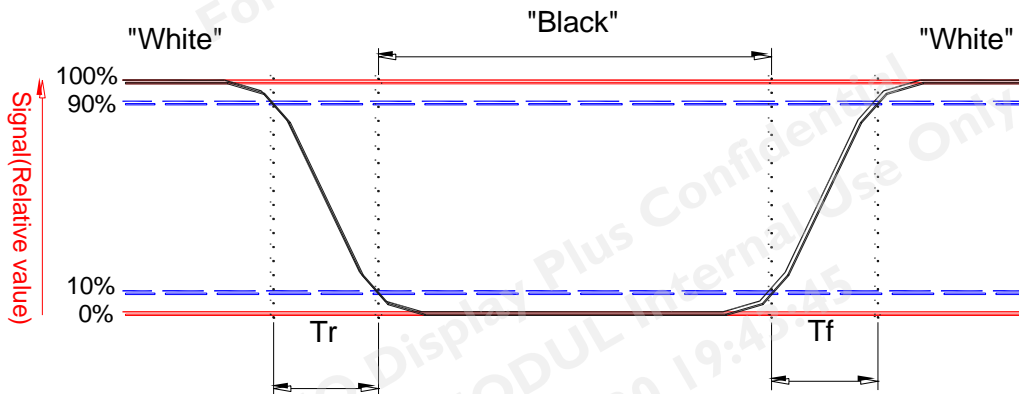
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**Note 6:** Definition of viewing angle

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.
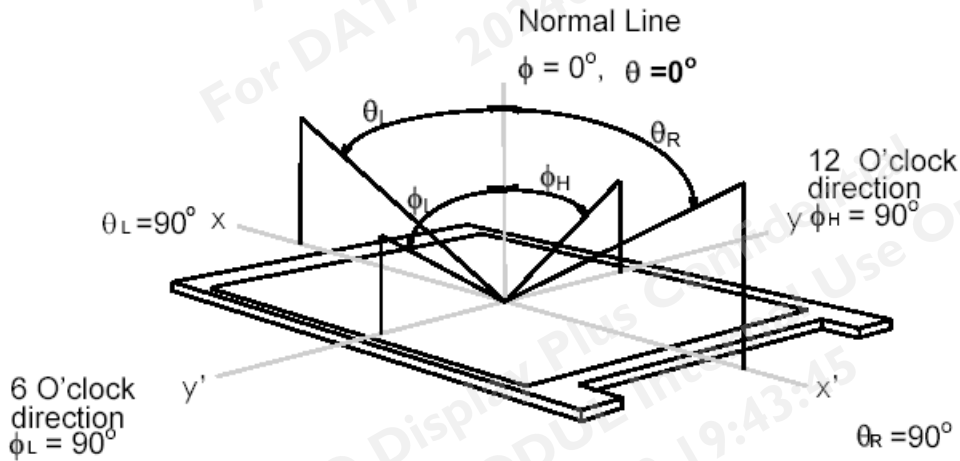
3. Functional Block Diagram

The following diagram shows the functional block of the 15.6 inch color TFT/LCD module:
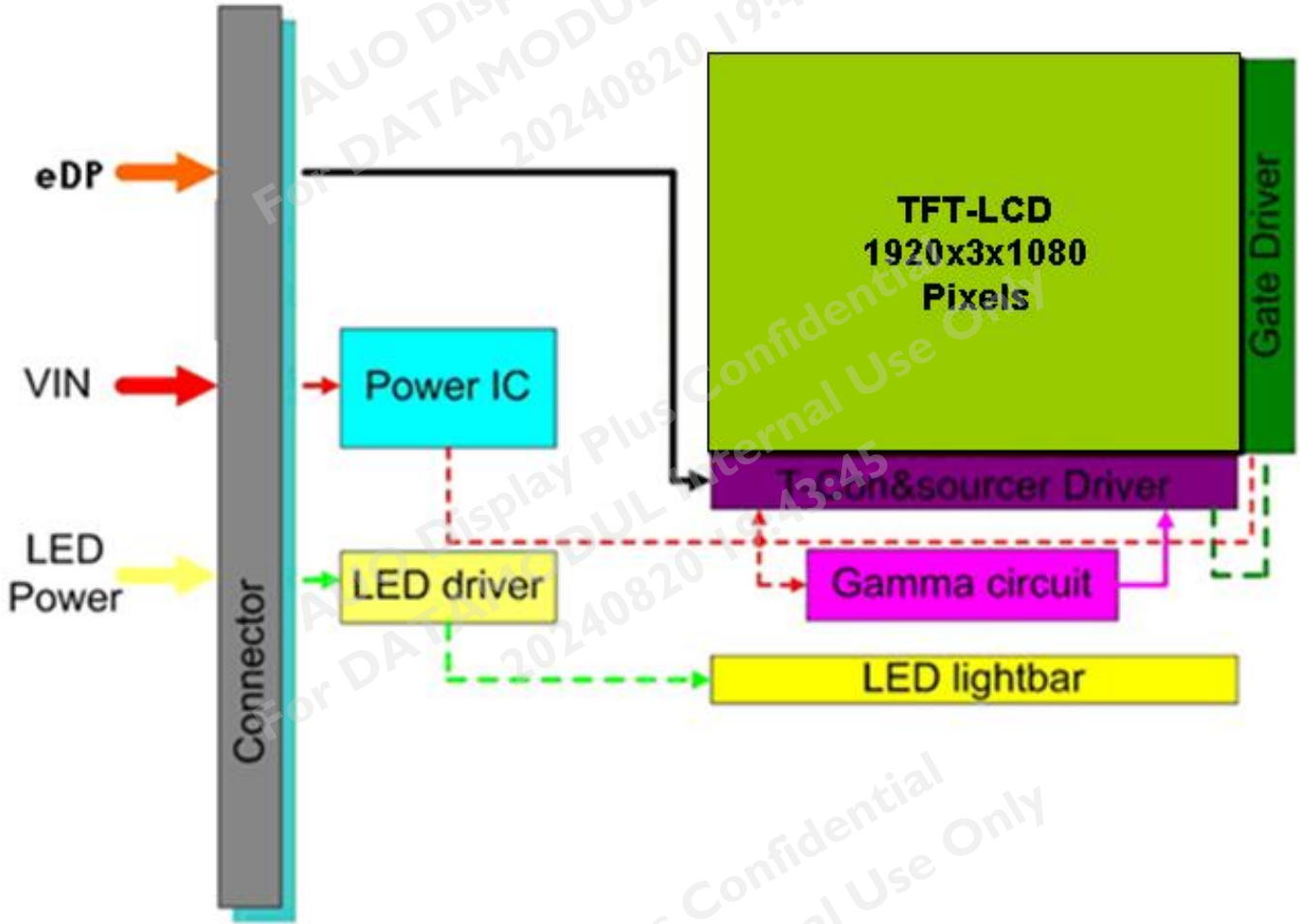
4. Absolute Maximum Ratings
4.1 Absolute Ratings of TFT LCD Module

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

4.2 Absolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit
Operating Temperature	TOP	-20	+70	[°C]
Operation Humidity	HOP	5	95	[%RH]
Storage Temperature	TST	-20	+70	[°C]
Storage Humidity	HST	5	95	[%RH]

Note: Maximum Wet-Bulb should be 39 °C and no condensation.
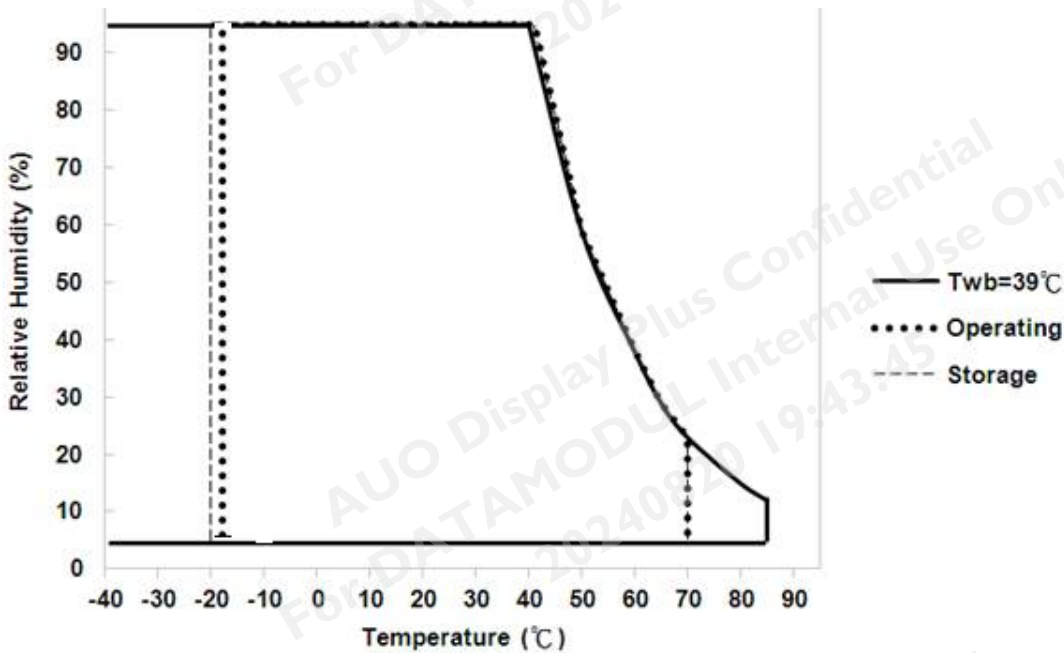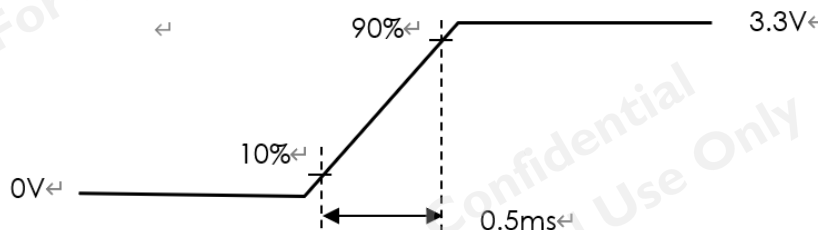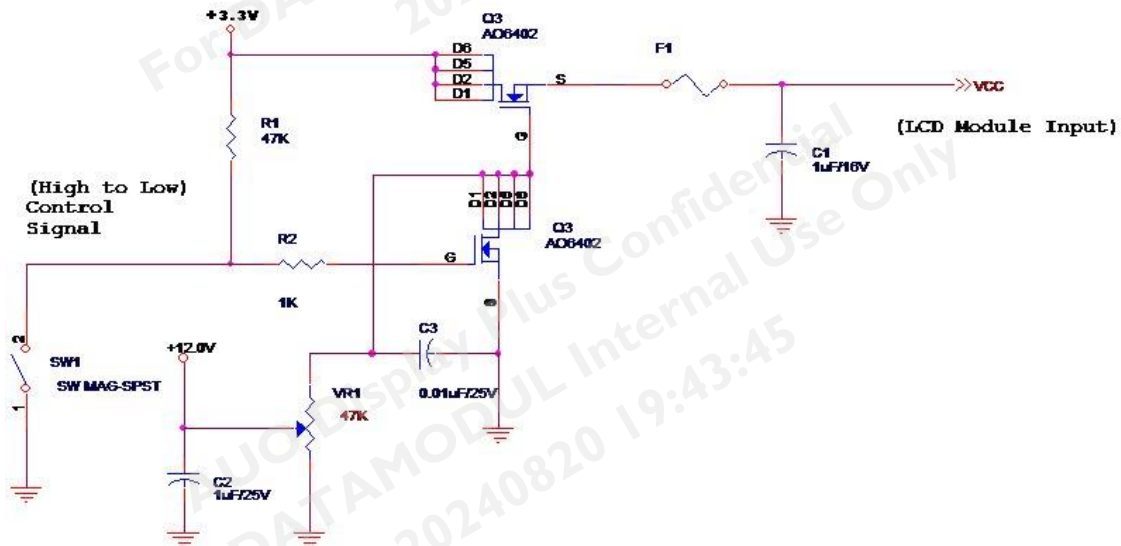
5. Electrical characteristics

5.1 TFT LCD Module

5.1.1 Power Specification

Input power specifications are as following:

Symbol	Parameter	Min	Typ	Max	Unit	Remark
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	
IDD	VDD Current ,Input Current	-	0.24	0.29	[A]	VDD= 3.3V, All Black Pattern At 60Hz *Note 1
IRush	LCD Inrush Current	-	-	2.0	[A]	*Note 2
PDD	VDD Power	-	0.79	0.98	[Watt]	VDD= 3.3V, All Black Pattern At 60Hz
VDDrp	Allowable Logic/LCD Drive Ripple Voltage	-	-	100	[mV] p-p	VDD= 3.3V, All Black Pattern At 60Hz

Note 1*:* Current fuse is built in a module. Current capacity of power supply for VDD should be larger than 2A design value, so that the fuse can be opened at the trouble of electrical circuit of module.

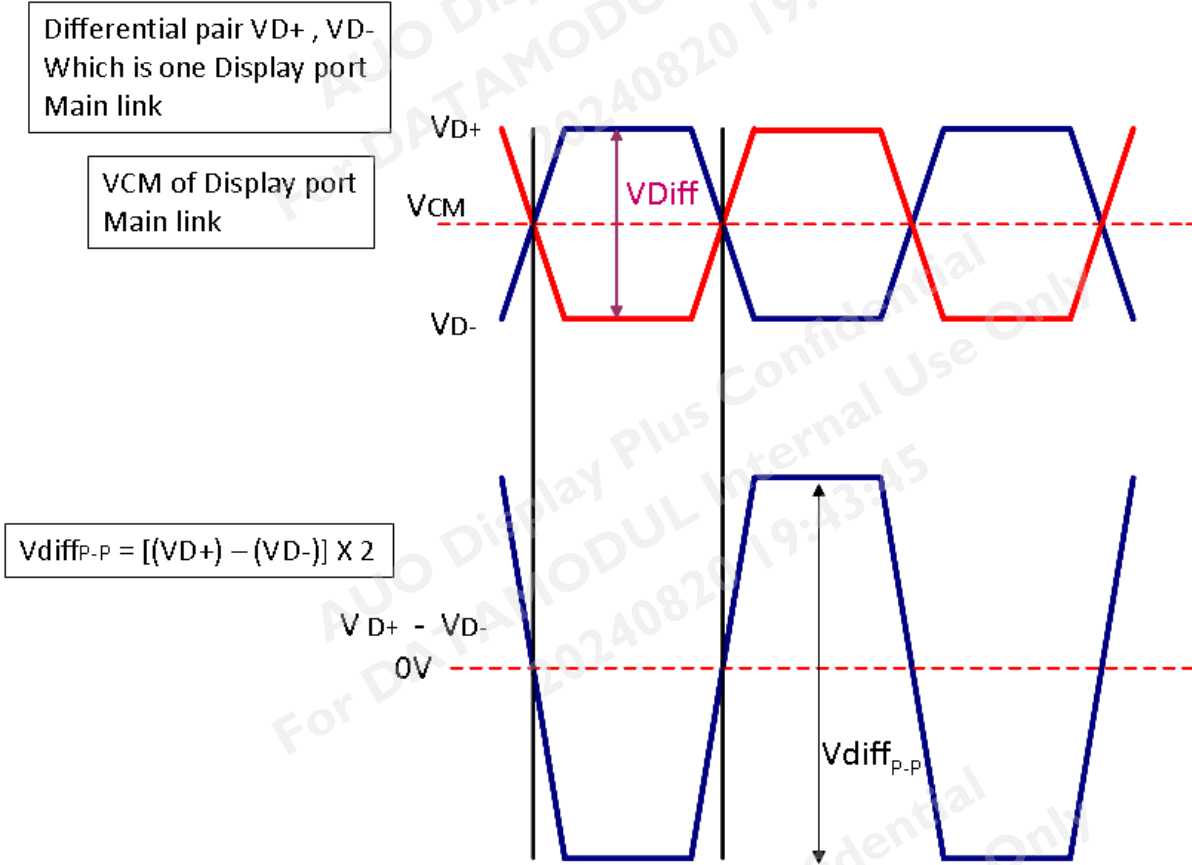**Note 2***:* Measurement conditions:

· **Vin rising time**

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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;
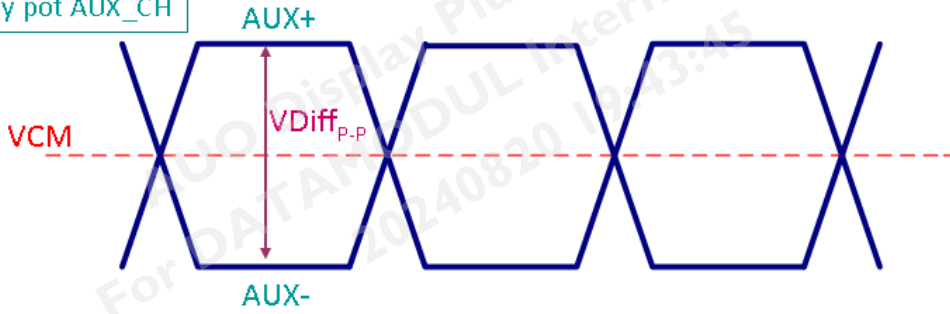
Display Port main link signal:

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

VCM of Display port
Main link

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

Display port main link		Min	Typ	Max	unit
VCM	RX input DC Common Mode Voltage		0		V
VDiff$_{P-P}$	Peak-to-peak Voltage at a receiving Device	100		1320	mV

Fallow as VESA display port standard V1.1a

Display Port AUX_CH signal:

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

Fallow as VESA display port standard V1.1a.

Display Port V$_{HPD}$ signal:

Display port VHPD		Min	Typ	Max	unit
VHPD	HPD Voltage	2.25		3.6	V

Fallow as VESA display port standard V1.1a.

5.2 Backlight Unit

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5.2.1 LED characteristics

Parameter	Symbol	Min	Typ	Max	Units	Condition
LED Power Consumption	PLED	-	7.83	8.35	[Watt]	(Ta=25℃), Note 1 Vin =12V
LED Life-Time	N/A	50,000	-	-	Hour	(Ta=25℃), Note 2,3

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

Note 2: If G156HAN02.0 module is driven at high ambient temperature & humidity condition. The operating life will be reduced.

Note 3: Operating life means brightness goes down to 50% initial brightness. Min. operating life time is estimated data.

5.2.2 Backlight input signal characteristics

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

Backlight input signal characteristics

| Symbol	Parameter	Min	Typ	Max	Units	Remark
VCC	Backlight input Voltage	10.8	12	13.2	[Volt]	
IVCC	Backlight input Current		0.82	0.87	[A]	VCC=12V, 100% PWM Duty
PVCC	Backlight input Consumption		9.84	10.44	[Watt]	VCC=12V,100% PWM Duty
F_{PWM}	Dimming Frequency	200		20K	[Hz]	Define as Connector Interface (Ta=25℃)
	Swing Voltage	3	3.3	5	[Volt]	
	High Voltage	3	3.3	5	[Volt]	
	Low Voltage			0.8	[Volt]	
	Dimming Duty 200Hz~5KHZ	5		100	%	
	Dimming Duty 5KHz~20KHZ	15		100	%	

Note 1 : Recommanded system pull up/down resistor no bigger than 10kohm.

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6. Signal Characteristic

6.1 Pixel Format Image

Following figure shows the relationship of the input signals and LCD pixel format.
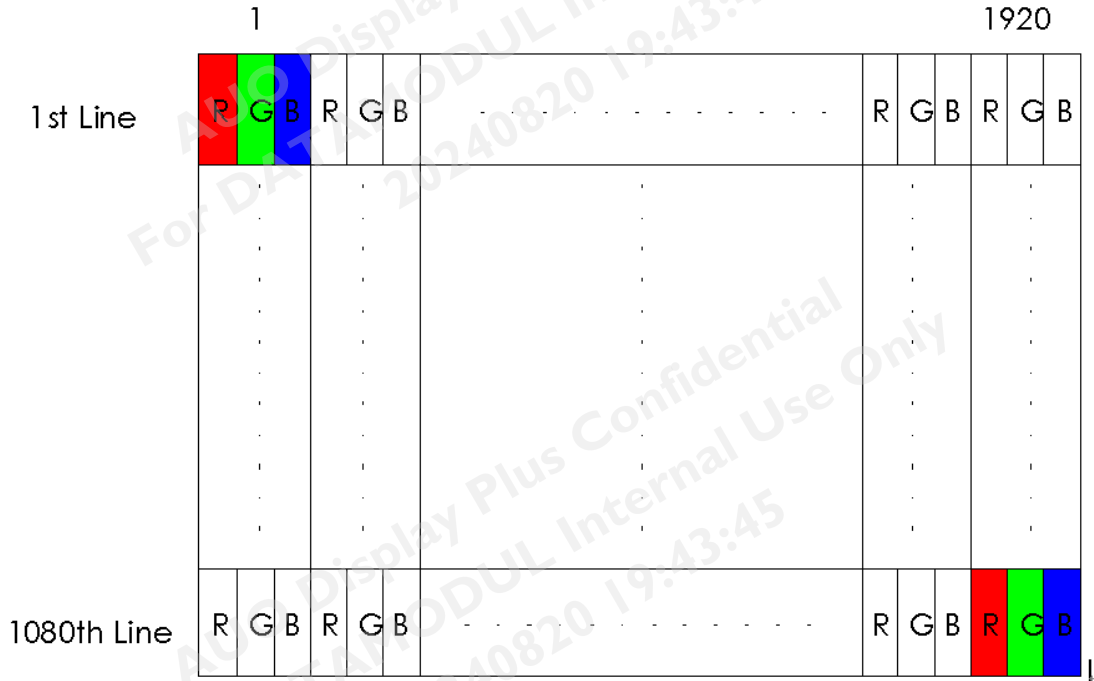
6.2 Integration Interface Requirement

6.2.1 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 20455-030E-76B or compatible
Mating Housing/Part Number	IPEX 20453-030T-11 or compatible

6.2.2 Pin Assignment (2 Lane)

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

PIN No	Symbol	Function
1	NC	Reverse for AUO TEST only
2	H_GND	High Speed Ground
3	Lane1_N	Comp Signal 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_VDD	LCD logic and driver power
13	LCD_VDD	LCD logic and driver power
14	LCD_Self_Test or NC	LCD Panel Self Test Enable (Optional)
15	LCD GND	LCD logic and driver ground
16	LCD GND	LCD logic and driver ground
17	HPD	HPD signale pin
18	BL_GND	Backlight_ground
19	BL_GND	Backlight_ground
20	BL_GND	Backlight_ground
21	BL_GND	Backlight_ground
22	BL_Enable	Backlight On / Off
23	BL PWM DIM	System PWM signal Input
24	NC	Reverse for AUO TEST only
25	NC	Reverse for AUO TEST only
26	VCC	Backlight power (5V~21V)
27	VCC	Backlight power (5V~21V)
28	VCC	Backlight power (5V~21V)
29	VCC	Backlight power (5V~21V)
30	NC	No Connect (Reserved for CM)

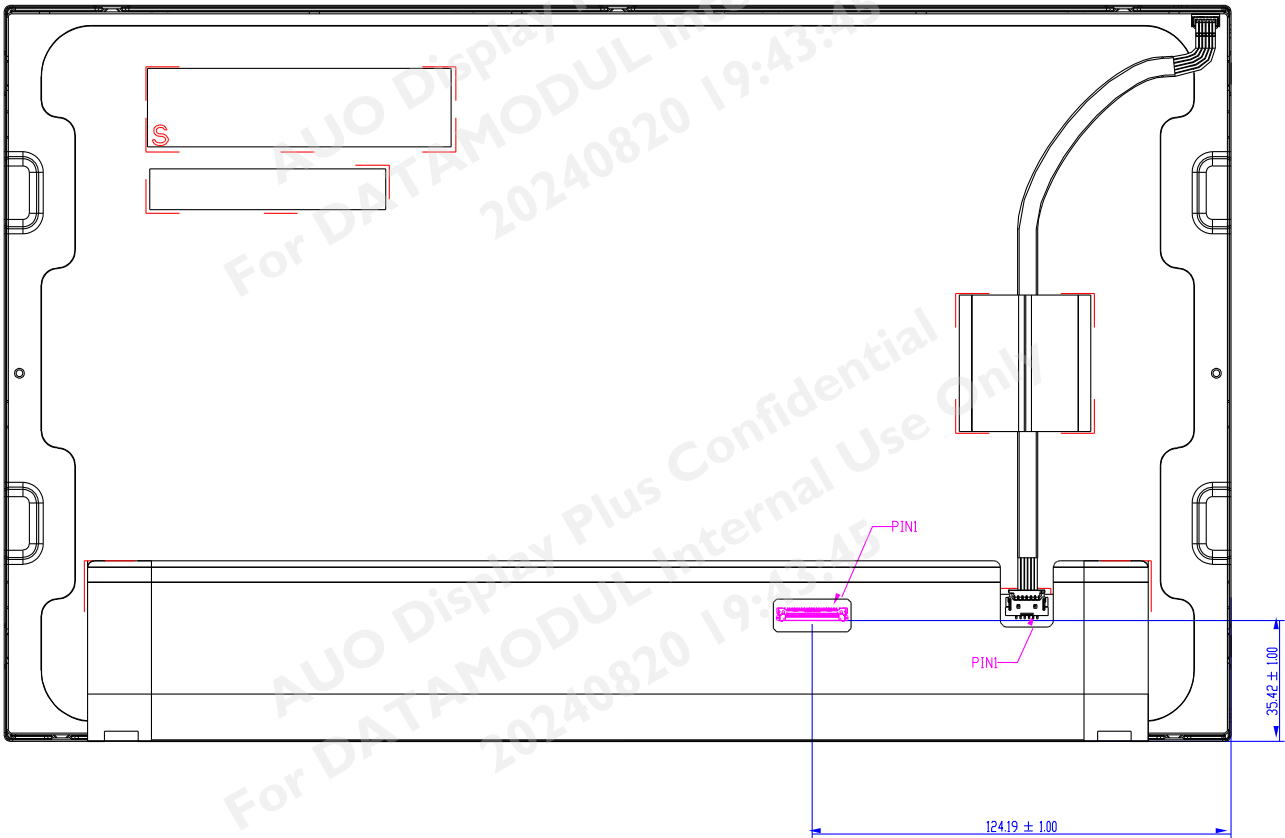**Note1**：Start from right side refer to next page illustration.

Note2：Input signals shall be low or High-impedance state when VDD is off.
Internal circuit of **eDP inputs** are as following.

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TCON Display Port Rx

6. Lane0-
7. Lane0+

9. AUX+
10. AUX-

17. HPD
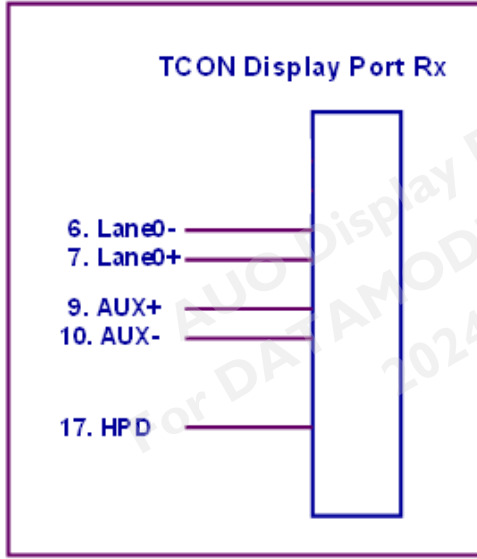
Note3：Connector Illustration

6.3 Interface Timing

6.3.1 Timing Characteristics

Basically, interface timings should match the 1920x1080 /60Hz manufacturing guide line timing.

| Parameter		Symbol	Min.	Typ.	Max.	Unit
Frame Rate		-	-	60	-	**Hz**
Clock frequency		1/ T_{Clock}	-	141	-	**MHz**
Vertical Section	**Period**	T_V	1090	1116	1880	T_{Line}
	Active	T_{VD}		1080		
	Blanking	T_{VB}	10	36	800	
Horizontal Section	**Period**	T_H	2080	2104	2320	T_{Clock}
	Active	T_{HD}		1920		
	Blanking	T_{HB}	160	184	400	

Note 1 : DE mode only
Note 2 : The maximum clock frequency = (960+B)*(1080+A)*60 < 80MHz

6.4 Power ON/OFF Sequence

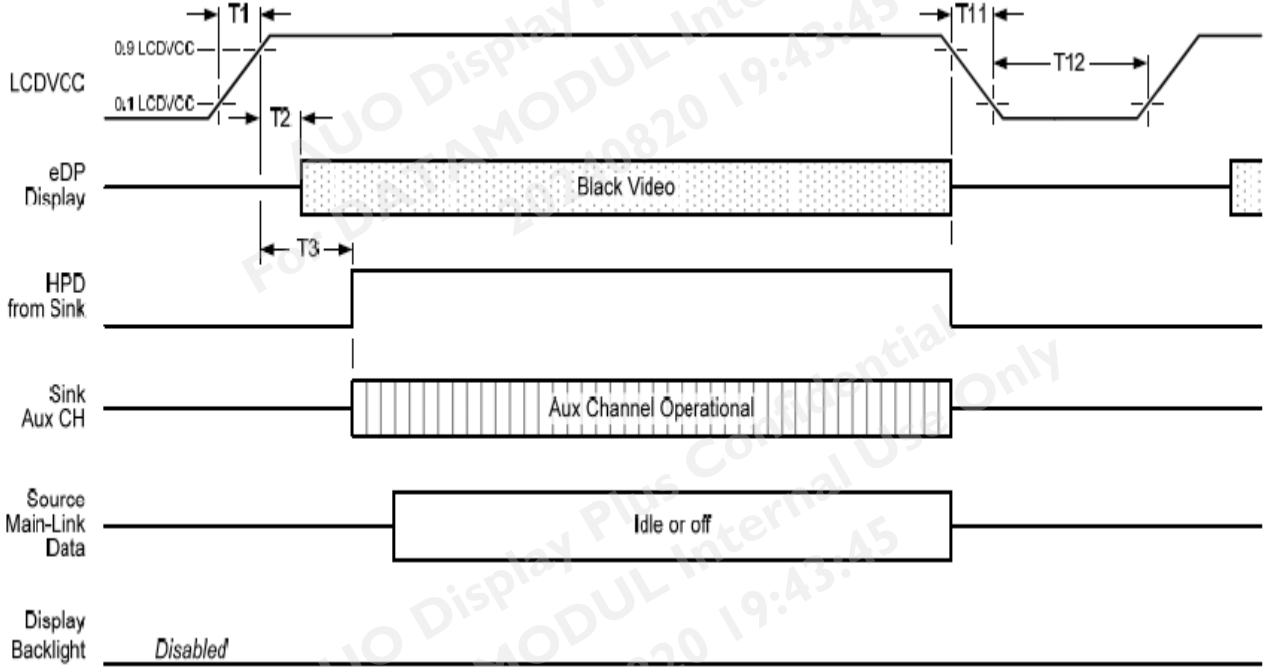Power on/off sequence is as follows. Interface signals and LED on/off sequence are also shown in the chart.

Signals from any system shall be Hi-Z state or low level when VDD is off

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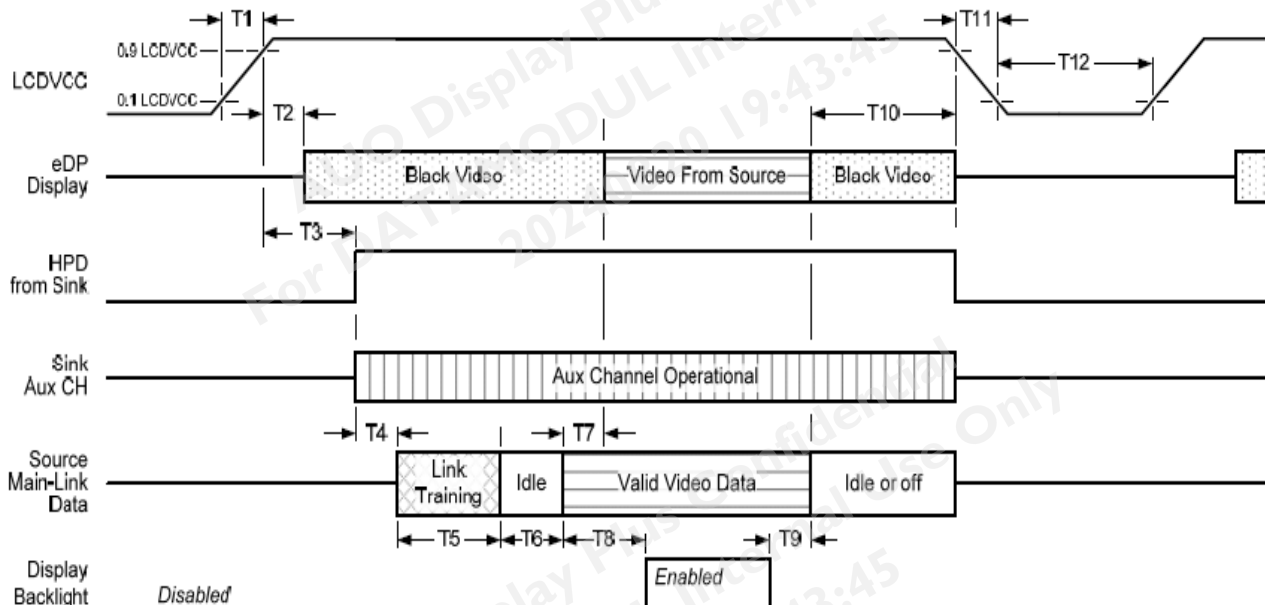
Display port interface power up/down sequence, normal system operation

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Display Port AUX_CH transaction only:

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

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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	delay from LCDVDD to black video generation	sink	0ms		200ms	prevents display noise until valid video data is received from the source
T3	delay from LCDVDD to HPD high	sink	0ms		200ms	sink AUX_CH must be operational upon HPD high.
T4	delay 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, 905 to 10%	source			10ms	
T12	power off time	source	500ms			

Note1: The sink must include the ability to generate black video autonomously. The sink must automatically enable black video under the following conditions:
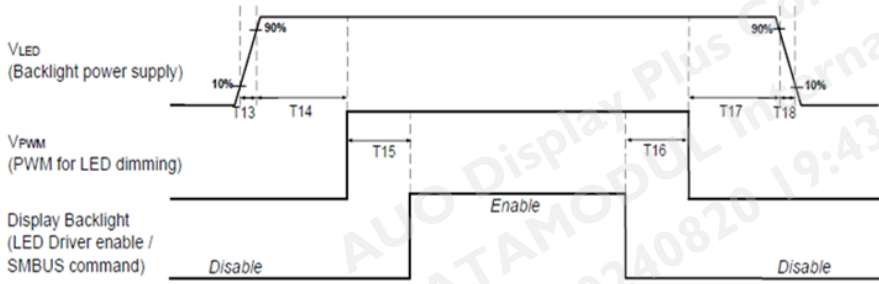 -upon LCDVDD power on (with in T2 max)-when the "Novideostream_Flag" (VB-ID Bit 3) is received from the source (at the end of T9).
 -when no main link data, or invalid video data, is received from the source. Black video must be displayed within 64ms (typ) from the start of either condition. Video data 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 VDD 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.
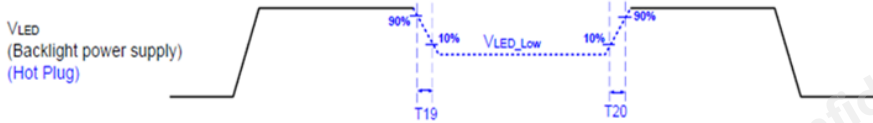
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Display Port panel B/L power sequence timing parameter:

Note : When the adapter is hot plugged, the backlight power supply sequence is shown as below.

	Min (ms)	Max (ms)
T13	0.5	10
T14	10	-
T15	10	-
T16	10	-
T17	10	-
T18	0.5	10
T19	1*	-
T20	1*	-

Seamless change: T19/T20 = 5xT_{PWM}*

*T_{PWM}= 1/PWM Frequency

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7. Reliability Test

Items	Required Condition	Note
Temperature Humidity Bias	Ta= 50℃, 80%RH, 300h	Note 1,2
High Temperature Operation	Ta= 70℃, Dry, 300h (For panel surface temp.)	
Low Temperature Operation	Ta= -20℃, 300h	
High Temperature Storage	Ta= 70℃, 300h	
Low Temperature Storage	Ta= -20℃, 300h	
Thermal Shock Test	Ta= -20℃ to 60℃, Duration at 30 min, 100 cycles	
Vibration	Test method: Non-Operation Acceleration: 1.5 G Frequency: 10 - 200 -10Hz Sweep: Sine wave vibration; 30 minutes each axis (X, Y, Z)	
Mechanical Shock	Test method: Non-Operation Acceleration: 50 G; Wave: Half-sine Active time: 20 ms Direction: ±X,±Y,±Z (one time for each axis)	
Drop Test	Height: 46 cm, package test	
ESD	Contact : ±8 KV Air : ±15 KV	Note 1

Note 1: According to EN 61000-4-2 , ESD class B: Some performance degradation allowed. Self-recoverable. No
data lost, No hardware failures.

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.
- No function failure occurs. Mura shall be ignored after high temperature reliability test
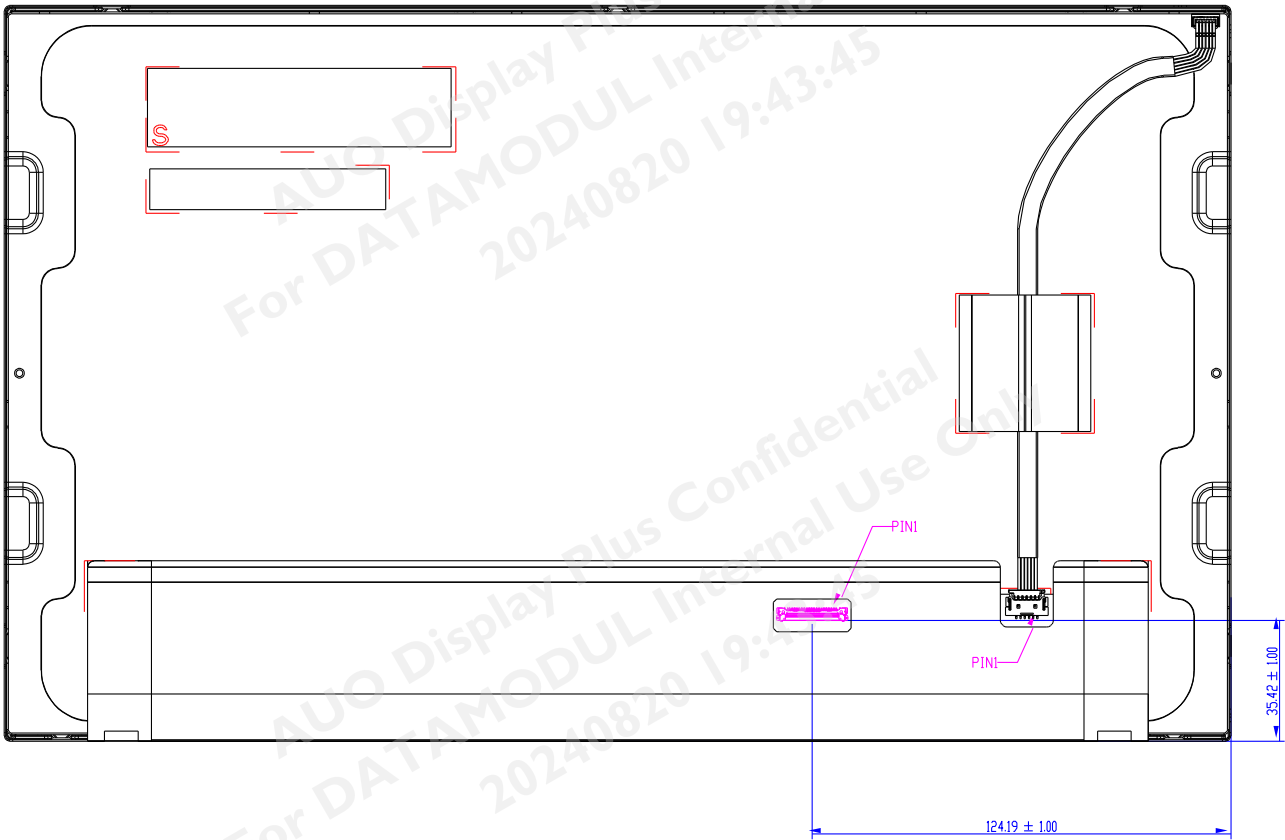
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8. Mechanical Characteristics

8.1 Outline Dimension (Front View)
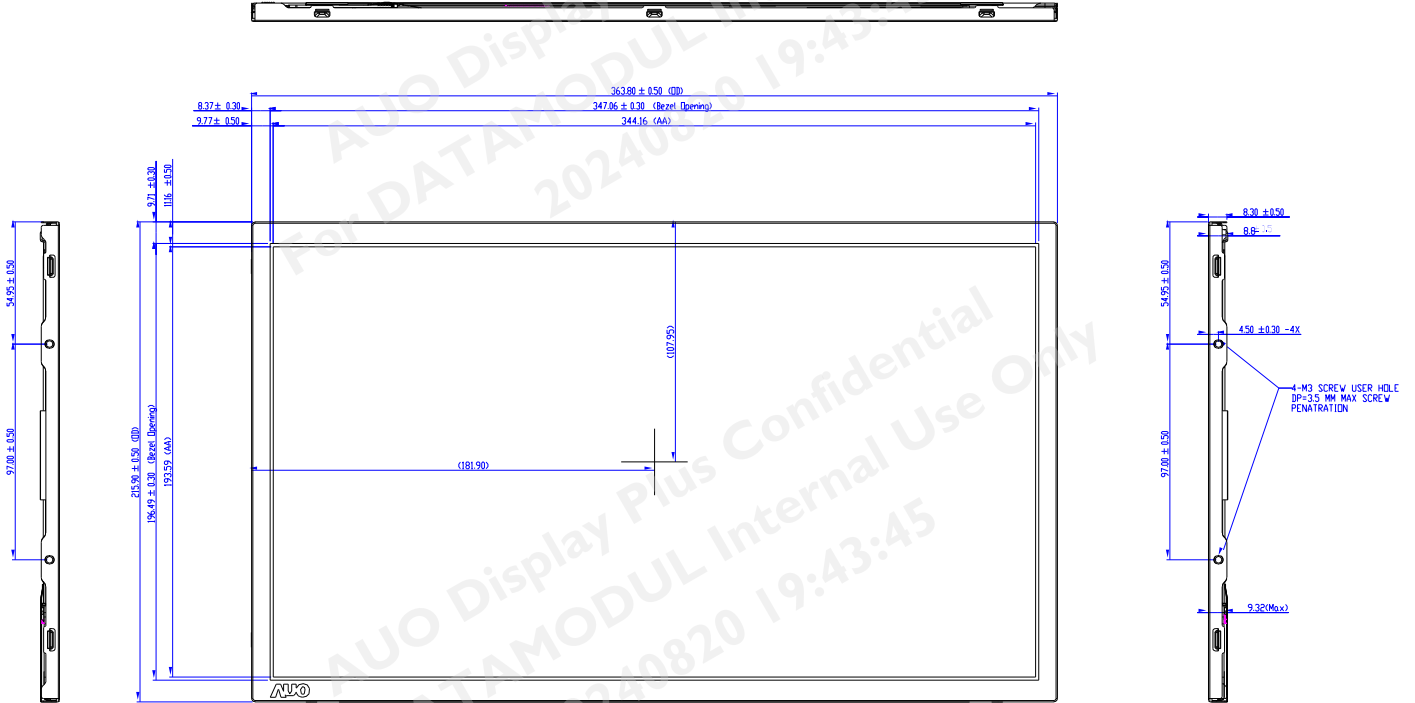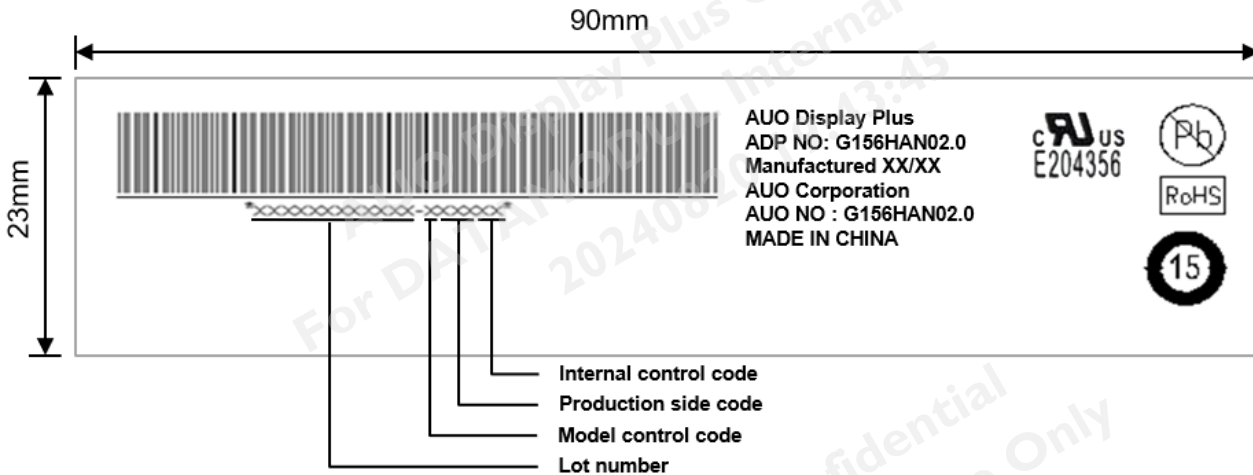

Note : Support portrait used

8.2 Outline Dimension (Rear View)

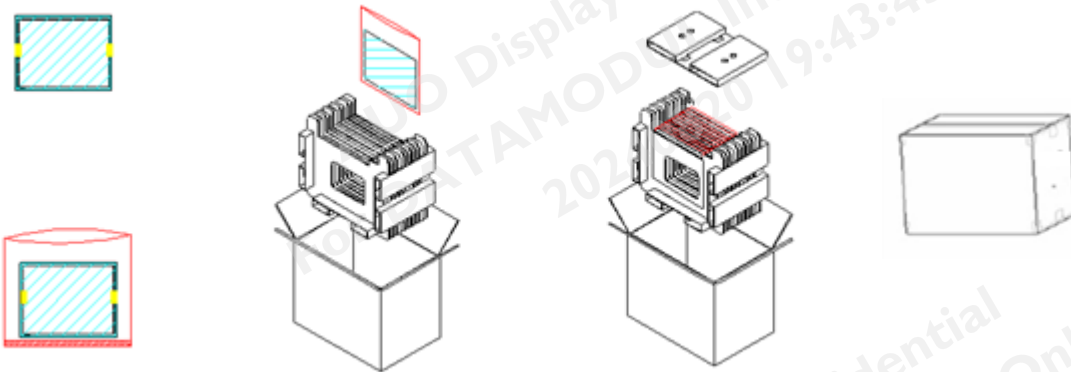**For DATAMODUL internal use only - provided by sisihu on 2024/08/20**

![AUO logo]
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9. Packaging Spec

9.1 Shipping Label

9.2 Carton & Pallet Package

Max capacity：16 TFT-LCD module per carton

Max weight: 13.2 kg per carton

Outside dimension of carton: 450mm(L)*375mm(W)*319mm(H)
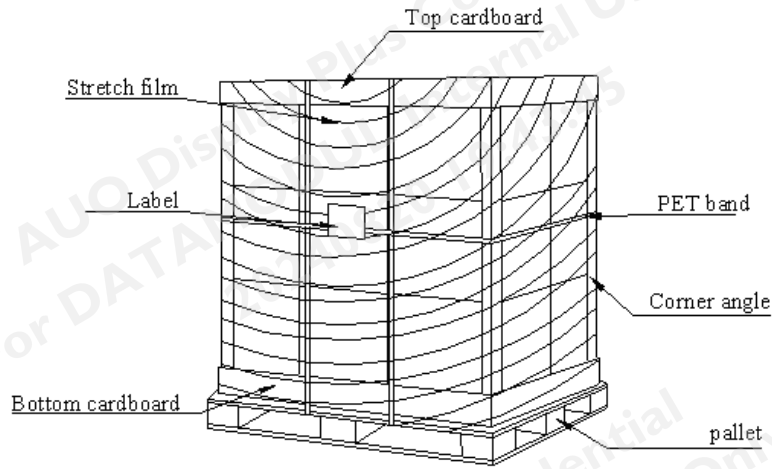
Pallet size： 1150 mm * 910 mm * 132mm

Box stacked

Module by air：(2 *3) *4 layers，one pallet put 24 boxes，total 384pcs module

Module by sea：(2 *3) *4 layers+(2 *3) *1 layers， two pallet put 30 boxes，total 480pcs module

Module by sea_HQ：(2 *3) *4 layers+(2 *3) *2 layers， two pallet put 36 boxes，total 576 pcs module

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9.3 Shipping Package of Palletizing Sequence

10 Safety

10.1 Keen Edge Requirements

There will be no keen 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 TFT-LCD module. If toxic materials are used, they will be reviewed and approved by the responsible AUO toxicologist.

10.2.2 Flammability

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 TFT-LCD module, provisions will be made to keep them from being inserted backwards.

10.4 International Safety Standard Compliance

The TFT-LCD Module will satisfy all requirements for compliance to IEC/UL 62368-1.
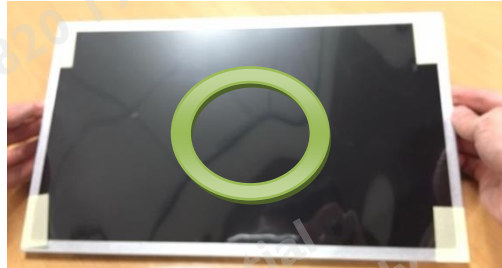
AUO Display+

11. Handling guide

This is a LCD model, and please be cautious when pulling it out of package or assembling it onto platform. Careless handlings, e.g. twist, bending, pressing, or collision, will result malfunction of LCD models.

(1) Handling method notice

Do not lift and hold the panel with Single hand at right or left side from tray.

Lift and hold the panel up with both hands from tray.

(2) On the table notice

Do not press edge of panel to avoid glass broken.

Do not press the surface of the panel to avoid the glass broken or polarizer scratch.

Do not put anything or tool on the panel to avoid the glass broken or polarizer scratch.

(3) Cable assembly notice

Do not insert the connector with single hand and touching the PCBA.

Insert the connector by pushing right and left edge.

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