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### Record of Revision

Version and Date	Page	Old description	New Description
0.0 2016/9/14	All	First Edition	
0.1 2016/11/10	13	PWM Dimming Frequency : 20k Hz Max.	PWM Dimming Frequency : 10k Hz Max.
	21		7.1.1 Connector Illustration update
	23		9.1 LCM Outline Dimension update
	24		9.2 LCM Outline Dimension update
	25		10.1 Shipping Label update

## 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) Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.
- 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 Reflector edge. Instead, press at the far ends of the LED Reflector 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 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 (IEC60950-1 or UL60950-1), 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.

## 2. General Description

G150XTN03.4 is a Color Active Matrix Liquid Crystal Display composed of a TFT-LCD display, a driver circuit, and LED backlight system. The screen format is intended to support 4:3 XGA, 1024(H) x 768(V) screen and 262k/16.7M colors (RGB 8-bits data driver) with LED backlight driving circuit. All input signals are eDP (Embedded DisplayPort) interface compatible. All design rules of this module can correspond to PSWG standard.

G150XTN03.4 is designed for industrial display applications.

### 2.1 Display Characteristics

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

Items	Unit	Specifications
Screen Diagonal	[inch]	15
Active Area	[mm]	304.128(H) x 228.096(V)
Pixels H x V		1024x3(RGB) x 768
Pixel Pitch	[mm]	0.297 x 0.297
Pixel Arrangement		R.G.B. Vertical Stripe
Display Mode		TN, Normally White
Nominal Input Voltage VDD	[Volt]	3.3 typ.
Typical Power Consumption	[Watt]	7.9
Weight	[Grams]	1022g Max.
Physical Size	[mm]	326.5(H) x 253.5(V) x 10.0 (D)
Electrical Interface		1 Lane eDP1.2
Surface Treatment		Anti-glare, Hardness 3H
Support Color		16.7M / 262K colors
Temperature Range Operating Storage (Non-Operating)	[°C] [°C]	0 to +65 (+65 °C as panel surface temperature) -20 to +65
RoHS Compliance		RoHS Compliance
Light Bar Unit		LED, Non-Replaceable

## 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 <sup>2</sup> ]		280	350	-	1
Uniformity	%	9 Points	75	80	-	1, 2, 3
Contrast Ratio			400	800	-	4
Cross talk	%		-	--	1.5	5
Response Time	[msec]	Rising	-	5.7		6
	[msec]	Falling	-	2.3		
	[msec]	Raising + Falling	-	8		
Viewing Angle	[degree]	Horizontal (Right) CR = 10 (Left)	70	80	-	7
	[degree]		70	80	-	
	[degree]	Vertical (Upper) CR = 10 (Lower)	60	70	-	
	[degree]		70	80	-	
Color / Chromaticity Coordinates (CIE 1931)		Red x	0.547	0.597	0.647	
		Red y	0.289	0.339	0.389	
		Green x	0.279	0.329	0.379	
		Green y	0.546	0.596	0.646	
		Blue x	0.104	0.154	0.204	
		Blue y	0.003	0.053	0.103	
		White x	0.263	0.313	0.363	
		White y	0.279	0.329	0.379	
Color Gamut	%			60	-	

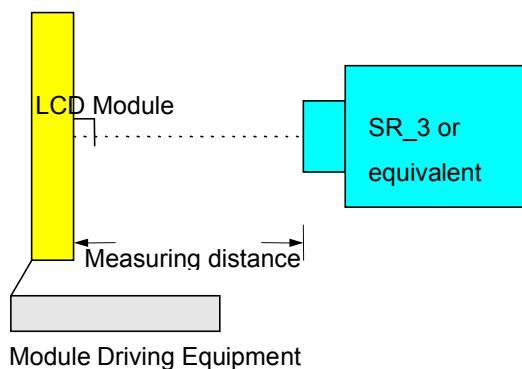
Note 1: Measurement method

Equipment Pattern Generator, Power Supply, Digital Voltmeter, Luminance meter (SR\_3 or equivalent)

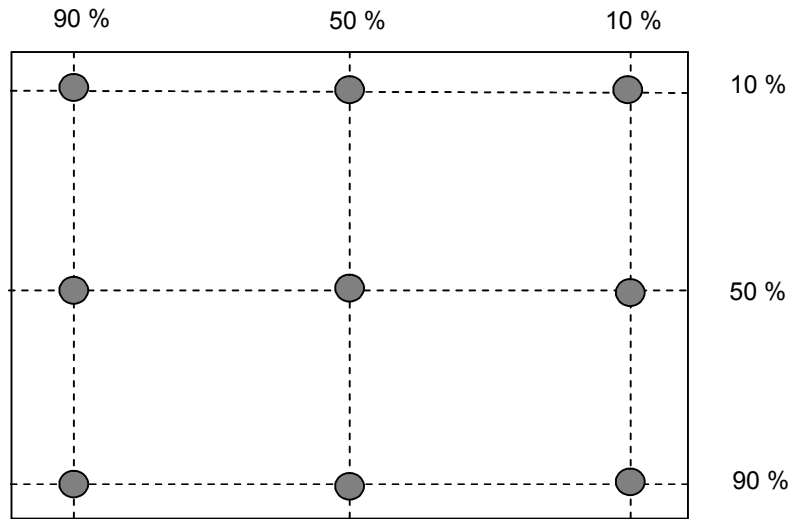
Aperture 1° with 50cm viewing distance

Test Point Center

Environment < 1 lux



Note 2: Definition of 9 points position (Display active area: 304.128(H) x 228.096(V))



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

$$\delta_{w9} = \frac{\text{Minimum Brightness of nine points}}{\text{Maximum Brightness of nine points}}$$

Note 4 : Definition of contrast ratio (CR):

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

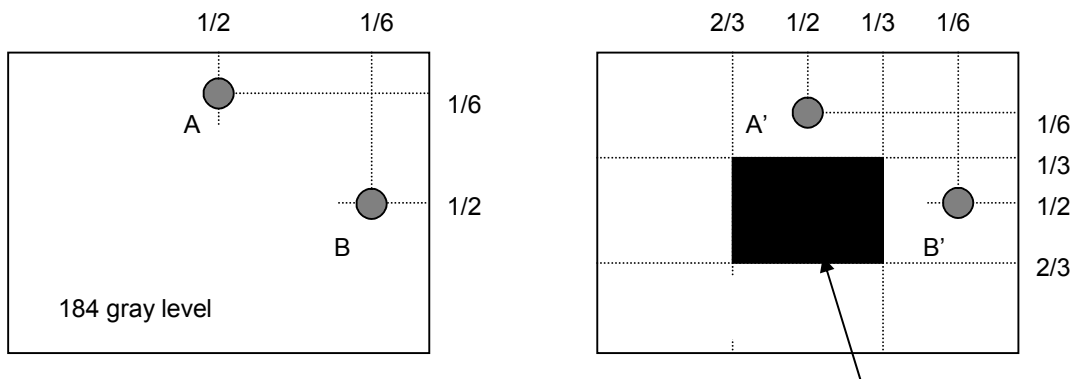
Note 5 : Definition of cross talk (CT)

$$CT = |YB - YA| / YA \times 100 (\%)$$

Where

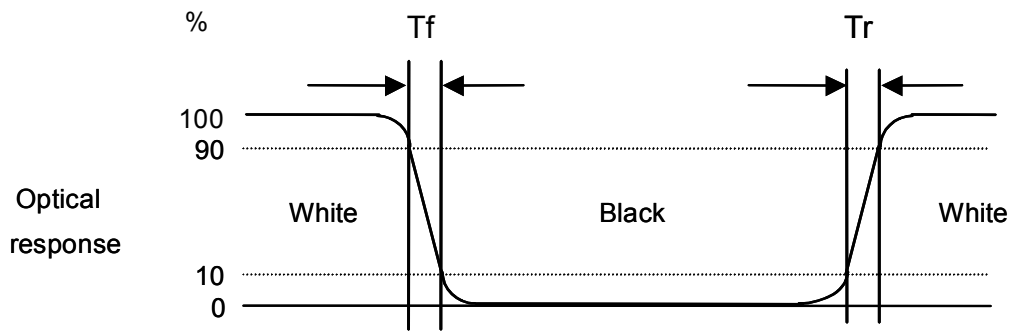
YA = Luminance of measured location without gray level 0 pattern (cd/m<sup>2</sup>)

YB = Luminance of measured location with gray level 0 pattern (cd/m<sup>2</sup>)



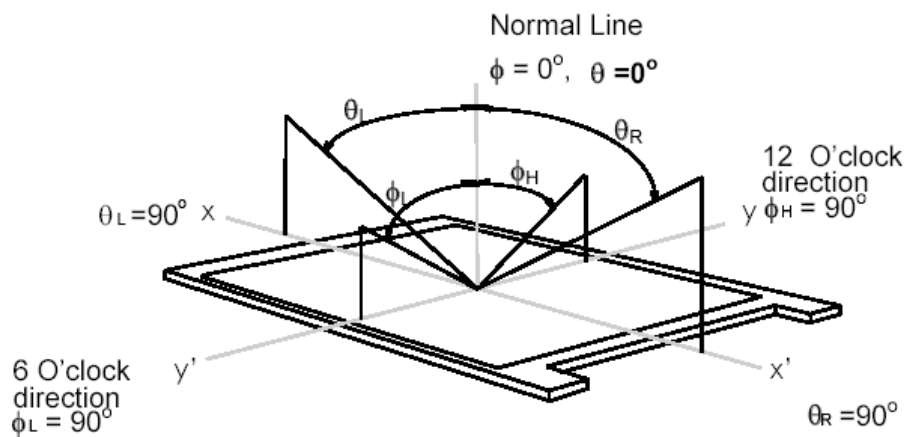
Note 6: Definition of response time:

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 7: Definition of viewing angle

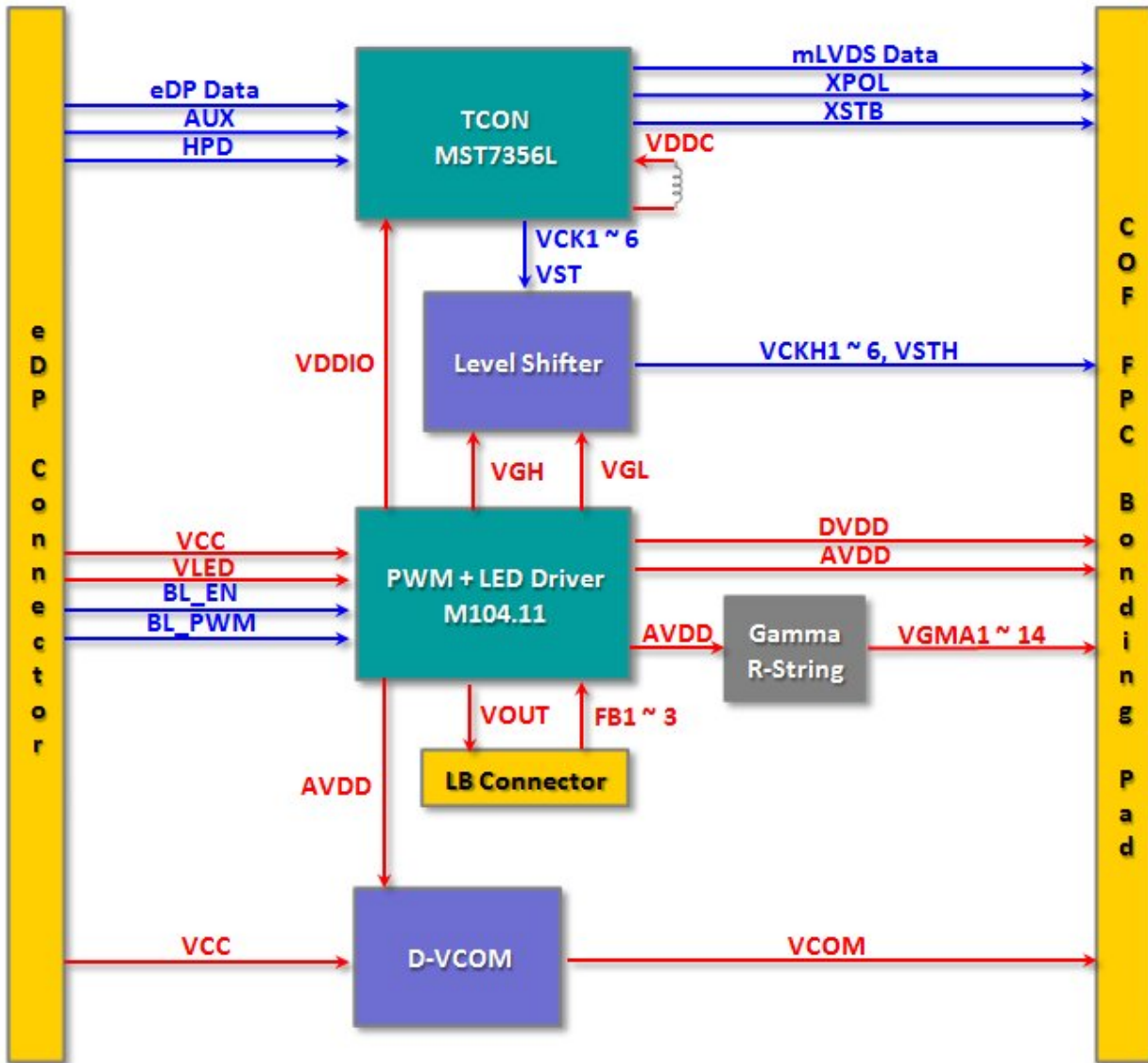
Viewing angle is the measurement of contrast ratio  $\geq 10$ , at the screen center, over a  $180^\circ$  horizontal and  $180^\circ$  vertical range (off-normal viewing angles). The  $180^\circ$  viewing angle range is broken down as below:  $90^\circ$  ( $\theta$ ) horizontal left and right, and  $90^\circ$  ( $\Phi$ ) 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 inch color TFT/LCD module:



## 4. Absolute Maximum Ratings

### 4.1 Absolute Ratings of TFT LCD Module

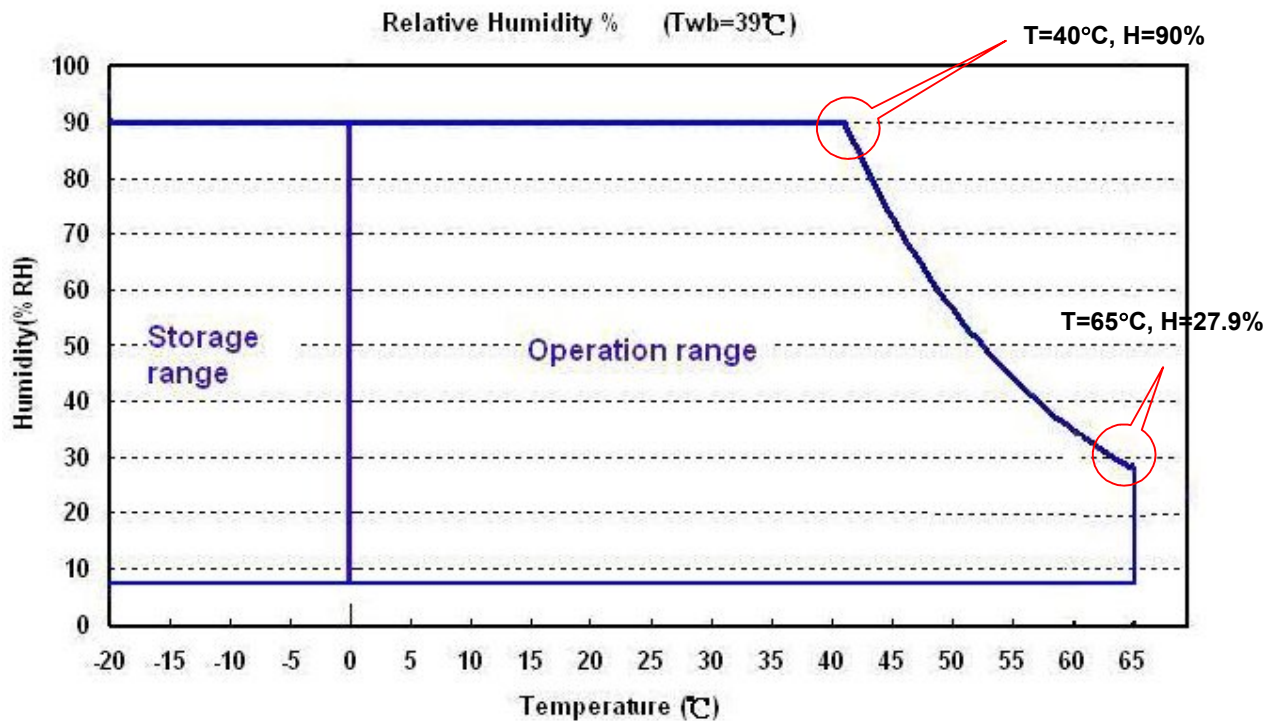
Item	Symbol	Min	Max	Unit
Logic/LCD Drive Voltage	Vin	-0.3	+3.6	[Volt]

### 4.2 Absolute Ratings of Environment

Item	Symbol	Min	Max	Unit
Operating Temperature	TOP	0	+65*	[°C]
Operation Humidity	HOP	8	90	[%RH]
Storage Temperature	TST	-20	+65	[°C]
Storage Humidity	HST	8	90	[%RH]

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

\* 65 °C is panel surface temperature

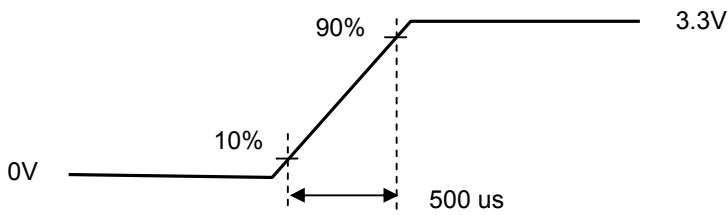
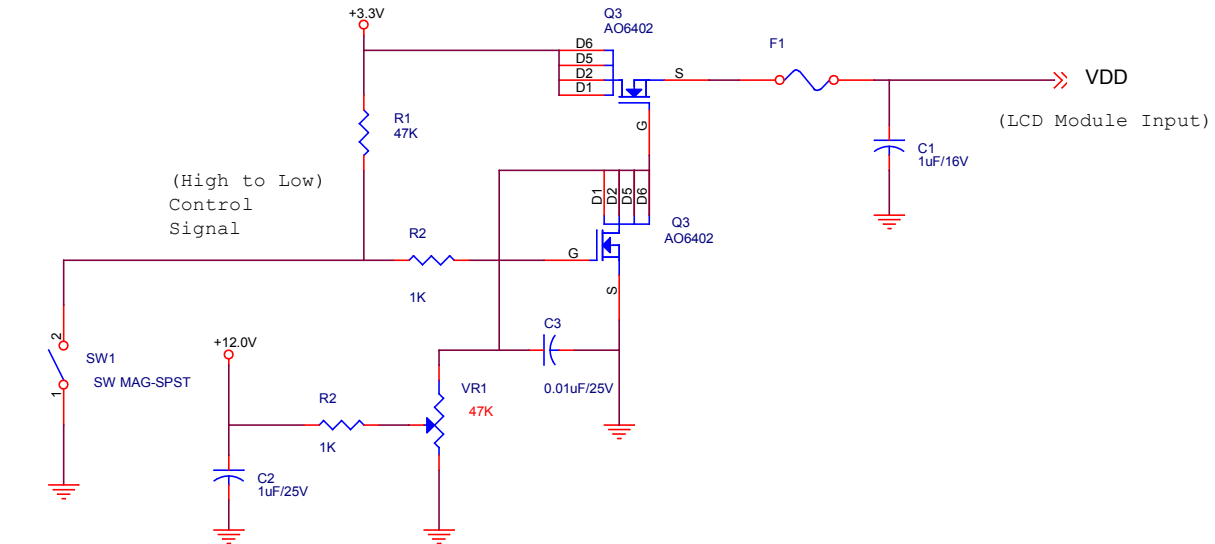


## 5.1 TFT LCD Module

### 5.1.1 Power Specification

Symbol	Parameter	Min	Typ	Max	Units	Remark
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	± 10%
IDD	VDD Current	-	1	1.5	[A]	
Irush	LCD Inrush Current			2	[A]	Note 1
PDD	VDD Power	-	3.3	5	[Watt]	

Note 1: Measurement condition:



VDD rising time



64 Gray pattern

### 5.1.2 Signal Electrical Characteristics

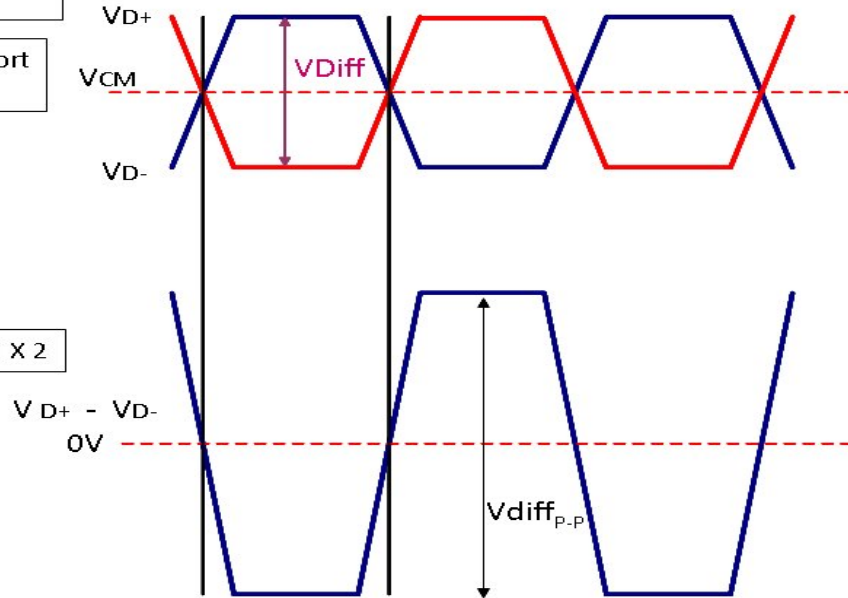
Signal electrical characteristics are as follows:

#### Display Port main link signal:

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

VCM of Display port  
Main link

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

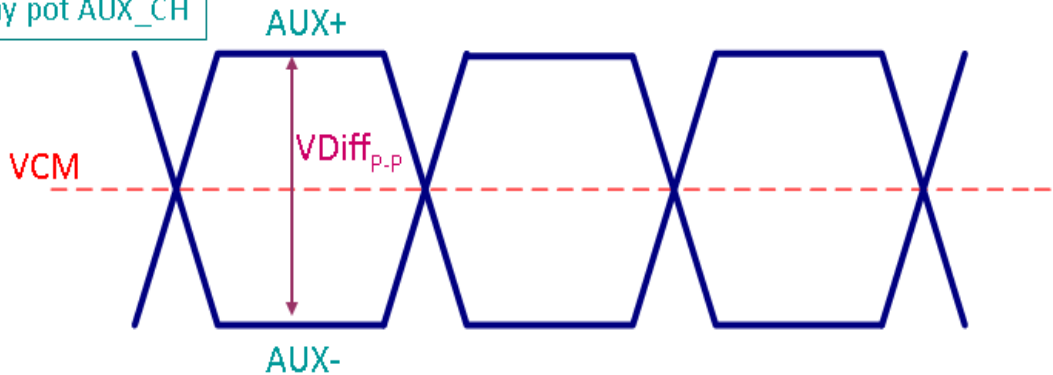


Display port main link					
		Min	Typ	Max	unit
VCM	RX input DC Common Mode Voltage		0		V
VDiff <sub>P-P</sub>	Peak-to-peak Voltage at a receiving Device	150		1320	mV

Follow as VESA display port standard V1.1a

#### Display Port AUX\_CH signal:

Differential AUX+ , AUX-  
Which is Display pot AUX\_CH



Display port AUX_CH					
		Min	Typ	Max	unit
VCM	AUX DC Common Mode Voltage		0		V
VDiff <sub>P-P</sub>	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.

**5.2 Backlight Unit**

**5.2.1 Parameter guideline for LED**

Following characteristics are measured under stable condition using a LED driving board at 25°C (Room Temperature).

Symbol	Parameter	Min.	Typ.	Max.	Unit	Remark
V <sub>cc</sub>	Input Voltage	10.8	12	13.2	Volt	
I <sub>vcc</sub>	Input Current	-	0.375		A	100% Dimming
P <sub>LED</sub>	Power Consumption	-	4.5	5	Watt	100% Dimming
I <sub>rush</sub>	Inrush Current			1	A	
V <sub>LED on/off</sub>	On Control Voltage	2.5	3.3	5.5	Volt	
	Off Control Voltage			0.8	Volt	
FPWM	PWM Dimming Frequency	200		10k	Hz	
	High Voltage	2.5	3.3	5.5	Volt	
	Low Voltage			0.8	Volt	
	Dimming Duty Cycle	5	-	100	%	
I <sub>F</sub>	LED Forward Current		60		mA	Ta = 25°C
Operating Life		50,000			Hrs	Ta = 25°C

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

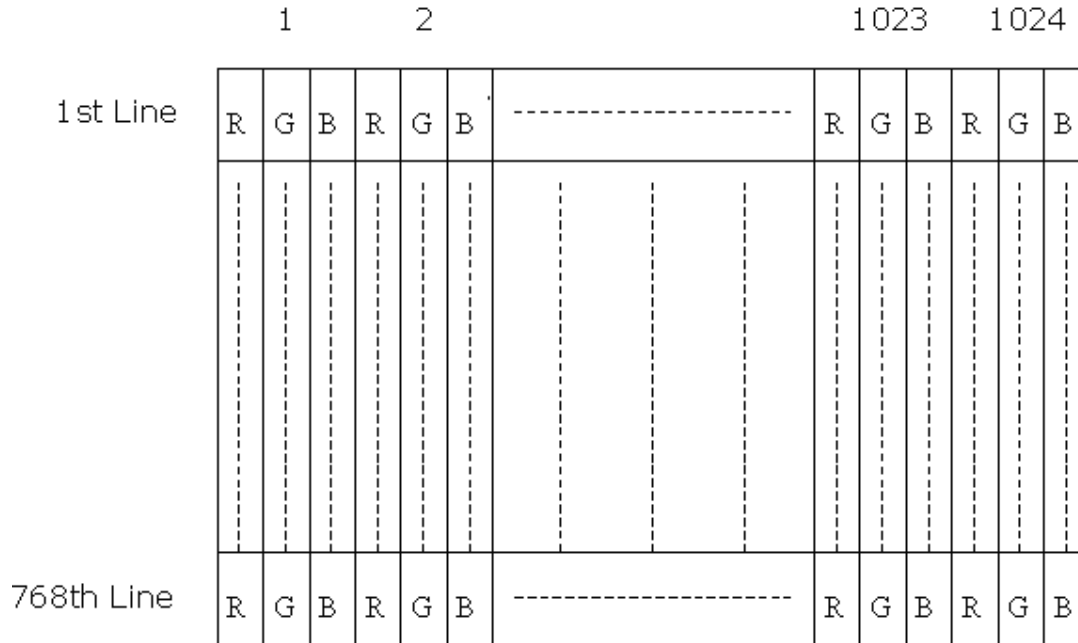
Note 2: If G150XTN03.4 module is driven at high ambient temperature & humidity condition. The operating life will be reduced.

Note 3: Definition of life time: LED brightness becomes 50% of its original value. The minimum life time of LED unit is defined at the condition of I<sub>RLED</sub> = 60 mA and 25±2°C (Room temperature).

## 6. Signal Characteristic

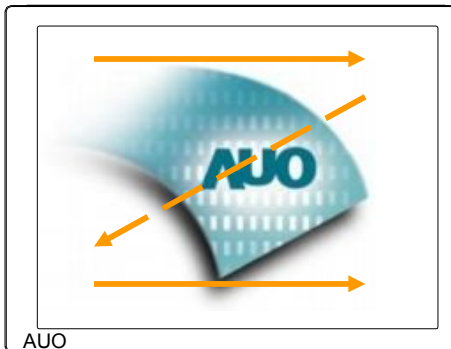
### 6.1 Pixel Format Image

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



### 6.2 Scanning Direction

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



## 6.3 Signal Description

### 6.3.1 Timing Characteristics

Basically, interface timings should match the 1024x768 /60Hz manufacturing guide line timing.

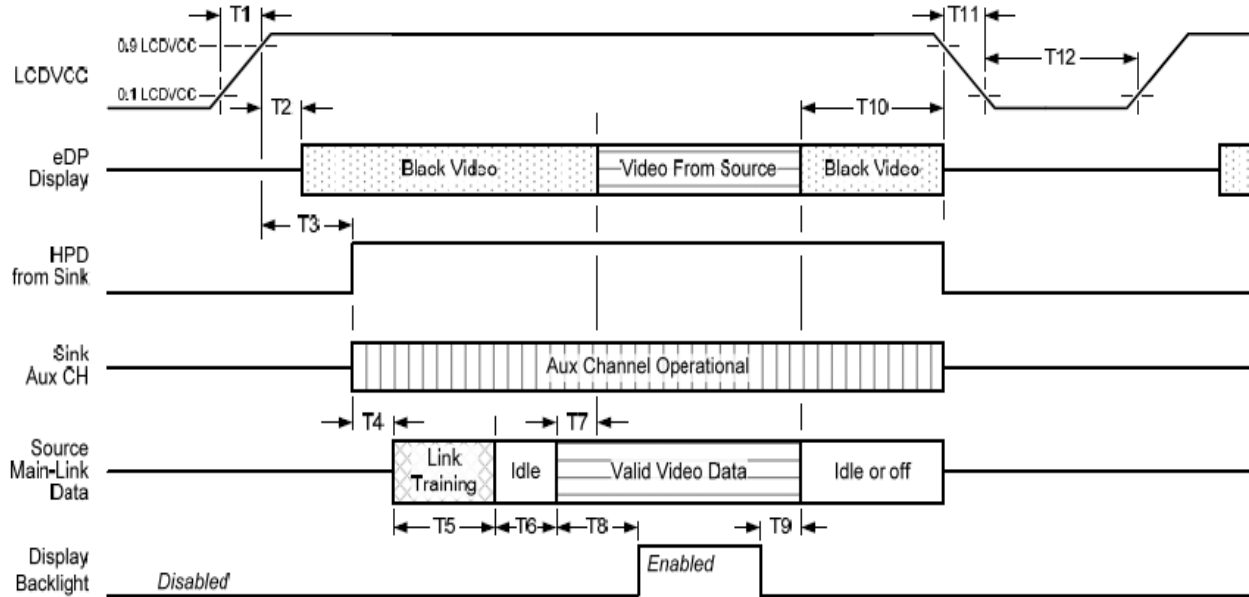
Parameter	Symbol	Min.	Typ.	Max.	Unit	
Frame Rate	-		60	-	Hz	
Clock frequency	$1/ T_{\text{Clock}}$	50	65	81	MHz	
Vertical Section	Period	$T_V$	783	806	968	$T_{\text{Line}}$
	Active	$T_{VD}$	768			
	Blanking	$T_{VB}$	15	38	200	
Horizontal Section	Period	$T_H$	1224	1344	2024	$T_{\text{Clock}}$
	Active	$T_{HD}$	1024			
	Blanking	$T_{HB}$	200	320	1000	

Note 1 : DE mode only

Note 2 : The maximum clock frequency =  $T_V * T_H * 60 < 81\text{MHz}$

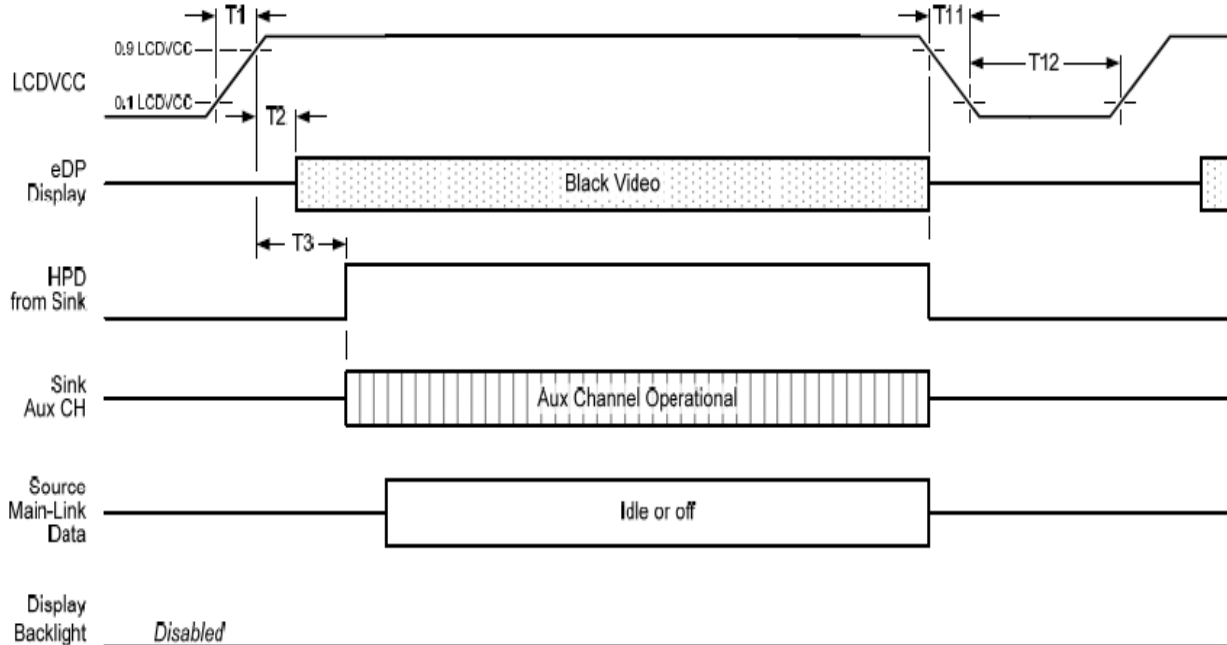
## 6.4 Power ON/OFF Sequence

### 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	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, 90% to 10%	source			10ms	
T12	power off time	source	500ms			

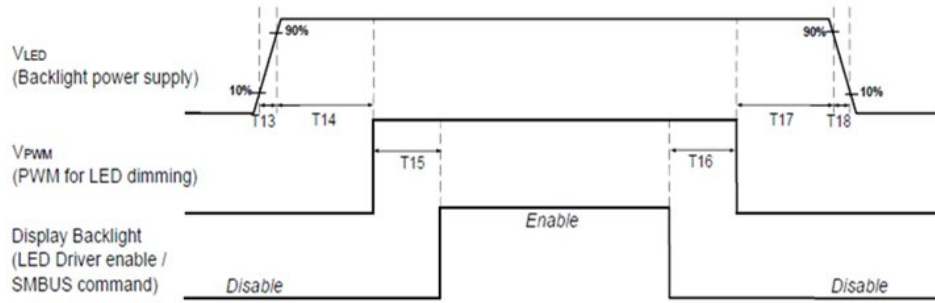
**Note 1:** The sink must include the ability to generate black video autonomously. The sink must automatically enable black video under the following conditions:

- 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.

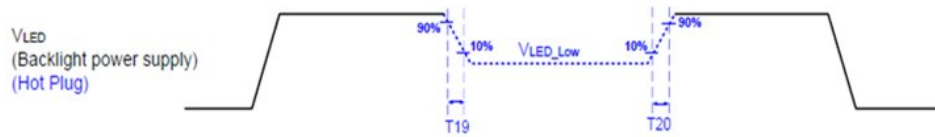
**Note 2:** The sink may implement the ability to disable the black video function, as described in Note 1, above, for system development and debugging purpose.

**Note 3:** The sink must support AUX\_CH polling by the source immediately following LCDVDD 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.

**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:  $T19/T20 = 5 \times T_{PWM}^*$

\* $T_{PWM} = 1/PWM \text{ Frequency}$

## 7. Integration Interface Requirement

Physical interface is described as for the connector on module.

These connectors are capable of accommodating the following signals and will be following components.

### 7.1 Connector Description

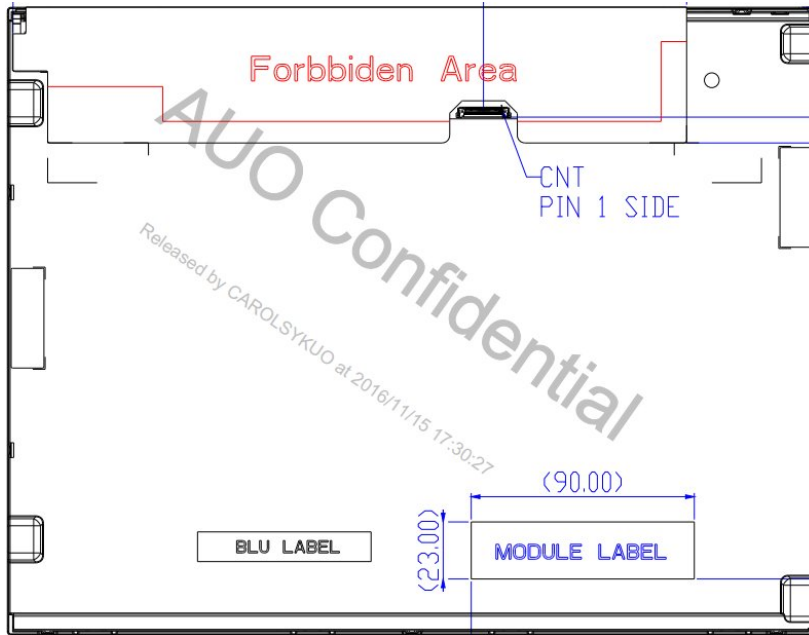
Connector Name / Designation	For Signal Connector
Manufacturer	IPEX or Compatible
Type / Part Number	IPEX 20455-030E-12 or Compatible
Mating Housing/Part Number	IPEX 20453-030T-11 or Compatible

## 7.2 Pin Assignment (1 Lane)

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

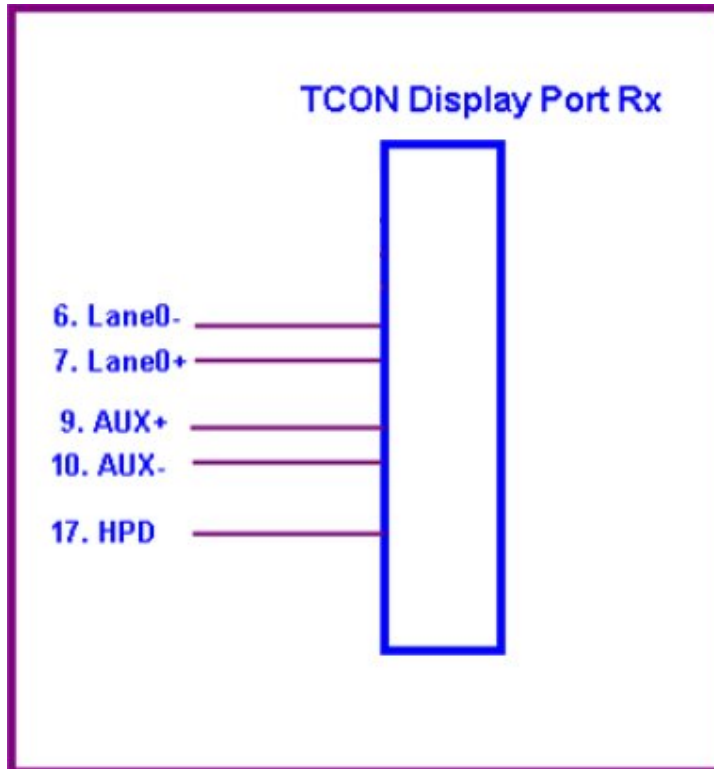
PIN NO	Symbol	Function
1	NC	No Connect
2	H_GND	High Speed Ground
3	Lane 1_N	NC
4	Lane 1_P	NC
5	H_GND	High Speed Ground
6	Lane0_N	Comp Signal Link Lane 0
7	Lane0_P	True Signal Link Lane 0
8	H_GND	High Speed Ground
9	AUX_CH_P	True Signal Auxiliary Ch.
10	AUX_CH_N	Comp Signal Auxiliary Ch.
11	H_GND	High Speed Ground
12	LCD_VCC	LCD logic and driver power
13	LCD_VCC	LCD logic and driver power
14	NC	No connect
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	No connect
25	NC	No connect
26	BL_PWR	Backlight power (10.8V~13.2V)
27	BL_PWR	Backlight power (10.8V~13.2V)
28	BL_PWR	Backlight power (10.8V~13.2V)
29	BL_PWR	Backlight power (10.8V~13.2V)
30	NC	No Connect

## 7.1.1 Connector Illustration



**Note1:** Start from Right side.

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



## 8. Reliability Test Criteria

Items	Required Condition	Note
Temperature Humidity Bias	50°C/80%,300 hours	
High Temperature Operation	65°C,300 hours	
Low Temperature Operation	0°C,300 hours	
Hot Storage	65°C,300 hours	
Cold Storage	-20°C,300 hours	
Thermal Shock Test	-20°C/30 min ,60°C/30 min ,100cycles	
Shock Test (Non-Operating)	50G,20ms,Half-sine wave,( ±X, ±Y, ±Z)	
Vibration Test (Non-Operating)	1.5G, (10~200~10Hz, P-P) 30 mins/axis (X, Y, Z)	
On/off test	On/10 sec, Off/10 sec, 30,000 cycles	
ESD	Contact Discharge: ± 8KV, 150pF(330Ω ) 1sec, 8 points, 25 times/ point Air Discharge: ± 15KV, 150pF(330Ω ) 1sec, 8 points, 25 times/ point	Note 1

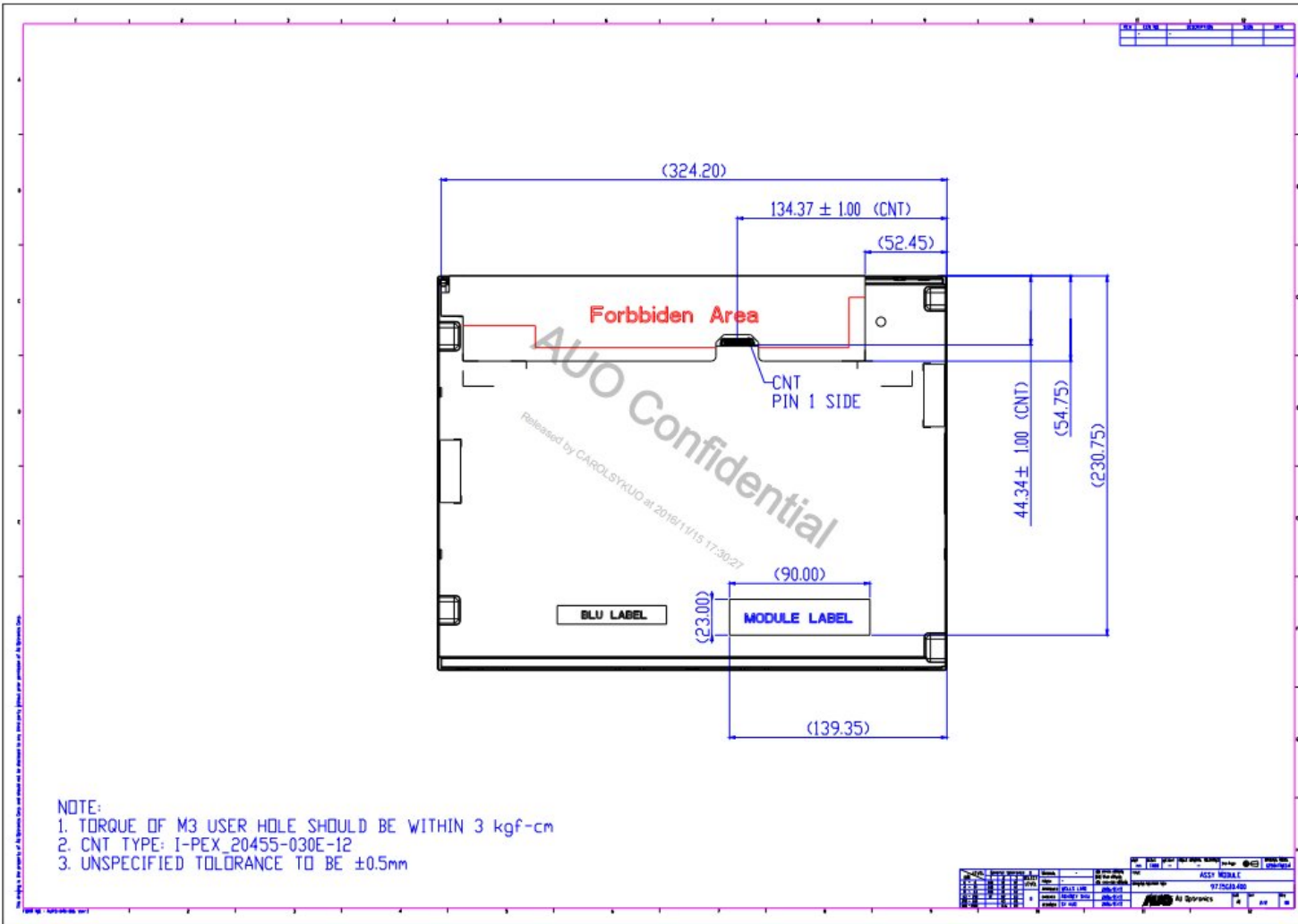
Note1: According to EN61000-4-2, ESD class B: Some performance degradation allowed. No data lost  
Self-recoverable. No hardware failures.

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.



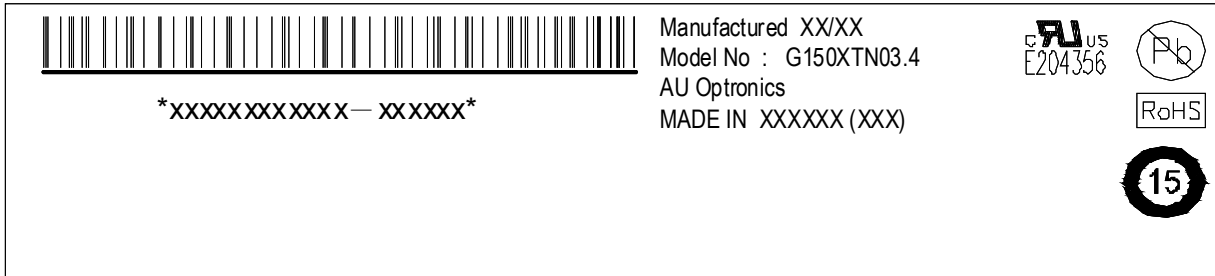
## 9.2 LCM Outline Dimension (Rear View)





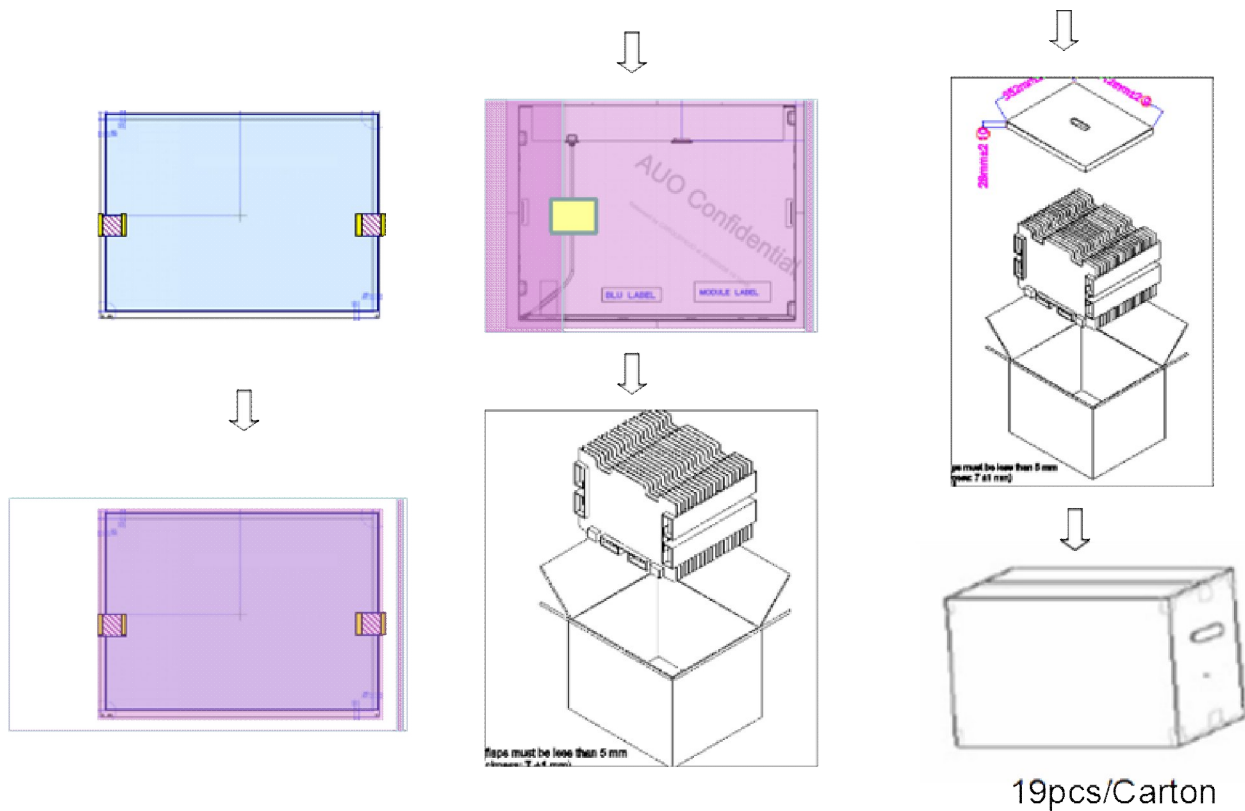
## 10. Label and Packaging

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



### 10.2 Carton Package

Max capacity : 19 TFT-LCD module per carton  
 Max weight: 20 kg per carton  
 Outside dimension of carton: 430mm(L)\* 370mm(W)\*350mm(H)  
 Pallet size : 1140 mm \* 890 mm \* 135mm



### 10.3 Palletizing

Module by air\_Max: (2 \*3) \*4 layers , one pallet put 24 boxes , total 456pcs module  
 Module by sea\_Max: (2 \*3) \*4 layers + (2 \*3) \*1 layers , two pallet put 30 boxes , total 570pcs module  
 Module by sea\_HQ\_Max: (2 \*3) \*4 layers+(2 \*3) \*2 layers, two pallet put 36 boxes, total 684pcs module

	MAX SHIPPING BY AIR	MAX SHIPPING BY SEA	MAX SHIPPING BY SEA_HQ
MODULE/CARTON	19	19	19
CARTON/LAYER	6	6	6
LAYER/PALLET	4	4+	4+2
MODULE/PALLET	36	45	54
CARTON SIZE(MM)	430(L)*370(w)*350(h)	430(L)*370(w)*350(h)	430(L)*370(w)*350(h)
PALLET SIZE(MM)	1140(L)*890(W)*125(H)	1140(L)*890(W)*125(H)	1140(L)*890(W)*125(H)
TOTAL PALLET HEIGHT(MM)	1532	2014	2364
TOTAL PALLET WEIGHT(KG)	492	626	746

ONE PALLET SHIPMENT EXAMPLE SHIPPING BY AIR USED

TWO PALLET SHIPMENT EXAMPLE SHIPPING BY SEA USED

TWO PALLET SHIPMENT EXAMPLE SHIPPING BY SEA\_HQ USED

## 11 Safety

### 11.1 Sharp Edge Requirements

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

### 11.2 Materials

#### 11.2.1 Toxicity

There will be no carcinogenic materials used anywhere in the display module. If toxic materials are used, they will be reviewed and approved by the responsible AUO toxicologist.

### **11.2.2 Flammability**

All components including electrical components that do not meet the flammability grade UL94-V1 in the module will complete the flammability rating exception approval process.

The printed circuit board will be made from material rated 94-V1 or better. The actual UL flammability rating will be printed on the printed circuit board.

### **11.3 Capacitors**

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

### **11.4 National Test Lab Requirement**

The display module will satisfy all requirements for compliance to:

**UL 60950-1, Second Edition**

U.S.A. Information Technology Equipment