



深圳市一众显示科技有限公司

SHEN ZHEN TEAM SOURCE DISPLAYTECH. CO, TD.

# TFT-LCD Module Specification

**Module NO.:** TST156FHBH-D174

**Version:** V1.0

APPROVAL FOR SPECIFICATION

APPROVAL FOR SAMPLE

For Customer' s Acceptance:	
Approved by	Comment

Team Source Display:		
Presented by	Reviewed by	Organized by

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## 1.0 GENERAL DESCRIPTION

### 1.1 Introduction

TST156FHBH-D174 is a color active matrix TFT LCD module using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This module has a 15.6 inch diagonally measured active area with Full-HD resolutions (1920 horizontal by 1080 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 16.7M(6bit+2FRC) colors and color gamut 45%. The TFT-LCD panel used for this module is a low reflection and higher color type. Therefore, this module is suitable for Notebook PC. The LED driver for back-light driving is built in this model.

All input signals are eDP1.2 interface compatible.

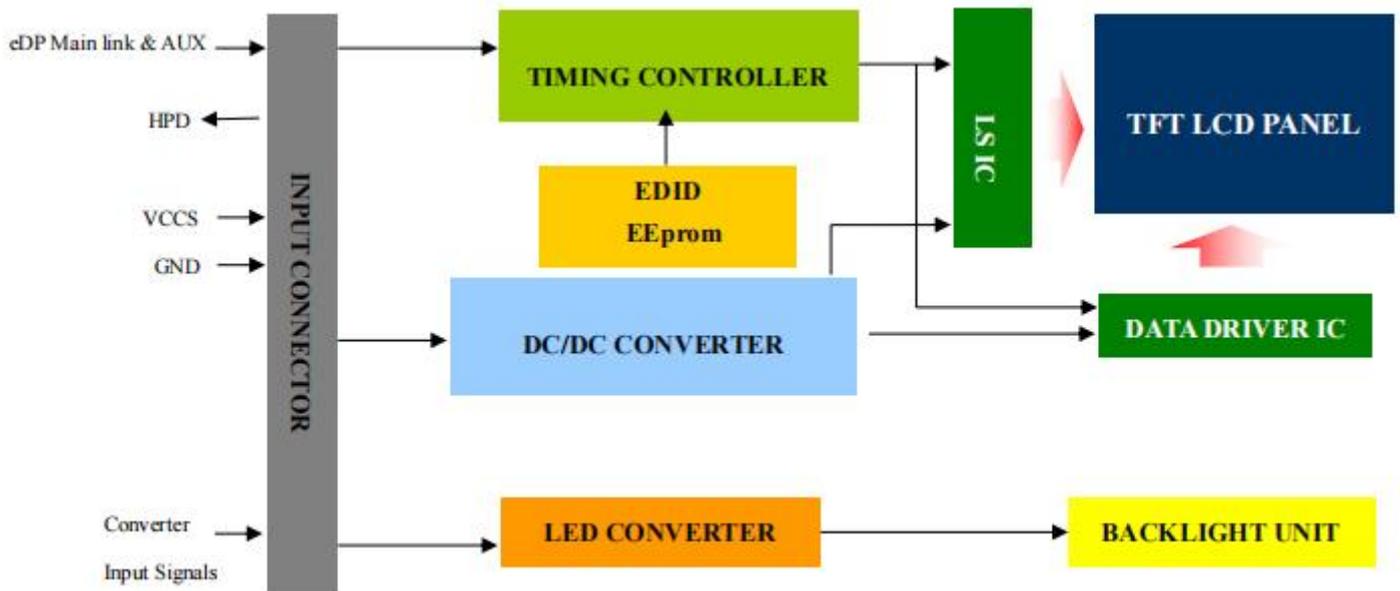


Figure 1. Drive Architecture

### 1.2 Features

- 2 lane eDP interface with 2.7Gbps link rates
- Thin and light weight
- 16.7M(6bit+2FRC)color depth, color gamut 45%
- Single LED lighting bar (Bottom side/Horizontal Direction)
- Data enable signal mode
- Side mounting frame
- Green product (RoHS & Halogen free product)
- On board LED driving circuit
- Low driving voltage and low power consumption
- On board EDID chip

## 1.3 Application

- Notebook PC (Wide type)

## 1.4 General Specification

<Table 1. General Specifications>

Parameter	Specification	Unit	Remarks
Active area	344.16(H) *193.59(V)	mm	
Number of pixels	1920 (H) *1080 (V)	pixels	
Pixel pitch	179.25(H) *179.25(V)	um	
Pixel arrangement	RGB		
Display colors	16.7M(6bit+2FRC)		
Color gamut	45%		
Display mode	HFS, Normally Black		
Dimensional outline	350.66 ± 0.3(H)*205.25 ± 0.3(V)(W/O PCB)*3.0(MAX) 350.66 ± 0.3(H)*213.24 ± 0.5(V)(W/PCB)*3.0(MAX)	mm	
Weight	342(TYP.)	g	
Surface treatment	Anti-Glare		
Back-light	Bottom edge side, 1-LED lighting bar type		Note 1
Power consumption	P <sub>D</sub> : 0.52(TYP.)	W	@Mosaic
	P <sub>BL</sub> :3.30(TYP.)	W	
	P <sub>Total</sub> :3.82(TYP.)	W	@Mosaic

Notes : 1. LED Lighting Bar (50\*LED Array)

## 2.0 ABSOLUTE MAXIMUM RATINGS

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum voltage and current values are listed in Table 2

< Table 2. Absolute Maximum Ratings >

Ta=25±2°C

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	V <sub>CCS</sub>	-0.3	+4.0	V	Note 1
Logic Supply Voltage	V <sub>IN</sub>	V <sub>SS</sub> -0.3	V <sub>CCS</sub> +0.3	V	
Operating Temperature	T <sub>OP</sub>	0	+50	°C	Note 2
Storage Temperature	T <sub>ST</sub>	-20	+60	°C	

Notes :

1. Permanent damage to the device may occur if maximum values are exceeded functional operation should be restricted to the condition described under normal operating conditions.
2. Temperature and relative humidity range are shown in the figure below.

90 % RH Max. ( 40°C ≥ Ta) Maximum wet - bulb temperature at 39°C or less. (Ta > 40°C ) No condensation.

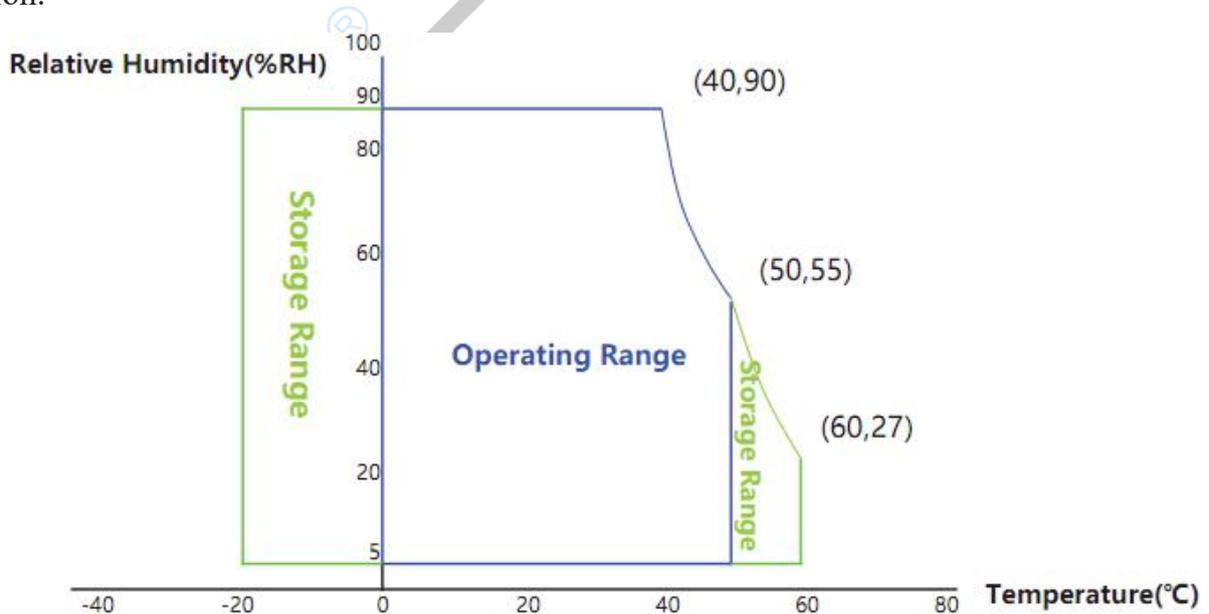


Figure 2. Temperature and Relative Humidity Range

## 3.0 ELECTRICAL SPECIFICATIONS

### 3.1 Electrical Specifications

< Table 3. Electrical Specifications >

Ta=25±2°C

Parameter		Min.	Typ.	Max.	Unit	Remarks	
Power Supply Voltage		V <sub>CCS</sub>	3.0	3.3	3.6	V	Note 1
Permissible Input Ripple Voltage		V <sub>RF</sub>	-10% V <sub>CCS</sub>	-	+10% V <sub>CCS</sub>	V	Note 4
Power Supply Inrush Current		I <sub>rush</sub>	-	-	1.5	A	Note3
Power Supply Current	Mosaic	I <sub>DD</sub>	-	157	-	mA	Note1
	RGB		-	-	336	mA	
Power Consumption	Mosaic	P <sub>M</sub>	-	0.52	-	W	
	RGB	P <sub>RGB</sub>	-	-	1.12	W	
	BLU	P <sub>BL</sub>	-	3.30	-	W	Note2
	Total	P <sub>Total</sub>	-	3.82	-	W	@Mosaic

## 3.0 ELECTRICAL SPECIFICATIONS

### 3.1 Electrical Specifications

Notes :

1. The supply voltage is measured and specified at the interface connector of LCM.

The current draw and power consumption specified is for 3.3V at 25 °C.

a) Mosaic pattern 8\*6

b) R/G/B patterns



Figure 3. Power Measure Patterns

2. Calculated value for reference ( $V_{LED} * I_{LED}$ )

3. Measure condition (Figure 4)

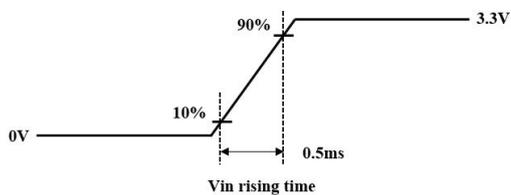


Figure 4. Inrush Measure Condition

4. Input voltage range:3.0~3.6V.Test condition: Oscilloscope bandwidth 20MHz, AC coupling

### 3.2 Backlight Unit

< Table 4. LED Driving Guideline Specifications >

Ta=25±2°C

Parameter		Min.	Typ.	Max.	Unit	Remarks
LED Forward Voltage		V <sub>F</sub>	2.7	2.9	3.1	V
LED Forward Current		I <sub>F</sub>	-	20	-	mA
LED Power Input Voltage		V <sub>LED</sub>	7	12	21	V
LED Power Input Current		I <sub>LED</sub>	-	275	-	mA
LED Power Consumption		P <sub>LED</sub>	-	3.30	-	W
Power Supply Voltage for LED Driver Inrush		I <sub>led inrush</sub>	-	-	1.5	A
LED Life-Time		N/A	15,000	-	-	Hour I <sub>F</sub> = 20mA Note 2
EN Control Level	Backlight On	V <sub>BL_EN</sub>	2.5	-	5.0	V
	Backlight Off		0	-	0.4	V
PWM Control Level	High Level	V <sub>BL_PWM</sub>	2.5	-	5.0	V
	Low Level		0	-	0.4	V
PWM Control Frequency		F <sub>PWM</sub>	200	-	10,000	Hz
Duty Ratio		-	1	-	100	%

Notes :

1. Power supply voltage 12V for LED driver.  
Calculator value for reference  $I_F * V_F * 50 / \text{driver efficiency} = P_{LED}$
2. The LED life-time define as the estimated time to 50% degradation of initial luminous.
3. Measure condition (Figure 5)
4. 1% duty cycle is achievable with a dimming frequency less than 1KHz.

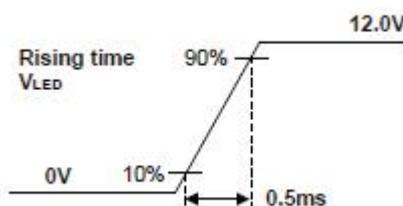
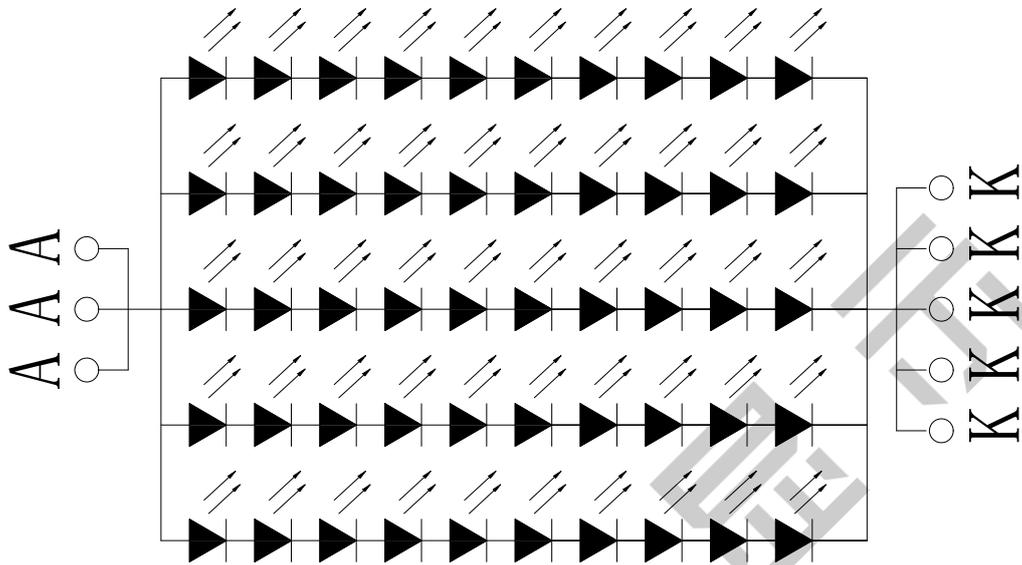


Figure 5. Inrush Measure Condition

### 3.3 LED Structure

Figure 6. LED Structure



Backlight LED Circuit

## 4.0 OPTICAL SPECIFICATION

### 4.1 Overview

The test of optical specifications shall be measured in a dark room (ambient luminance  $\leq 1$  lux and temperature =  $25 \pm 2^\circ\text{C}$ ) with the equipment of luminance meter system (PR730&PR810) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of  $\theta$  and  $\Phi$  equal to  $0^\circ$ . We refer to  $\theta=0$  ( $=\theta_3$ ) as the 3 o'clock direction (the "right"),  $\theta=90$  ( $=\theta_{12}$ ) as the 12 o'clock direction ("upward"),  $\theta=180$  ( $=\theta_9$ ) as the 9 o'clock direction ("left") and  $\theta=270$  ( $=\theta_6$ ) as the 6 o'clock direction ("bottom"). While scanning  $\theta$  and/or  $\Phi$ , the center of the measuring spot on the display surface shall stay fixed. The backlight should be operating for 30 minutes prior to measurement. VCCS shall be  $3.3 \pm 0.3\text{V}$  at  $25^\circ\text{C}$ .

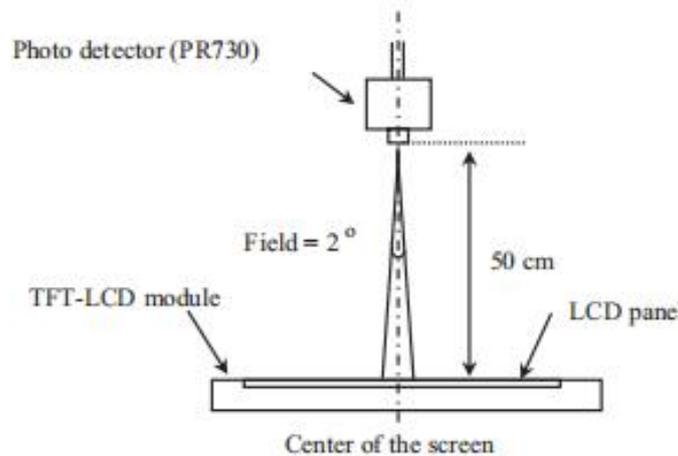
### 4.2 Optical Specifications

<Table 5. Optical Specifications>

Parameter.		Symbol.	Condition.	Min.	Typ.	Max.	Unit.	Remark
Viewing Angle Range	Horizontal	$\theta_3$	CR > 10	85	89	-	Deg.	Note 1
		$\theta_9$		85	89	-	Deg.	
	Vertical	$\theta_{12}$		85	89	-	Deg.	
		$\theta_6$		85	89	-	Deg.	
Luminance Contrast Ratio		CR	$\theta = 0^\circ$	800	1000	-		Note 2
Luminance of White	9 Points	$Y_w$	$\theta = 0^\circ$ $I_{LED} = 20\text{mA}$	320	350	-	$\text{cd/m}^2$	Note 3
White Luminance Uniformity	9 Points	$\Delta Y_9$		75	80	-	%	Note 4
White Chromaticity		$W_x$	$\theta = 0^\circ$	0.283	0.313	0.343		Note 5
		$W_y$		0.339	0.369	0.399		
Reproduction of Color	Red	$R_x$	$\theta = 0^\circ$	Typ. -0.03	0.580	Typ. +0.03		
		$R_y$			0.366			
	Green	$G_x$			0.347			
		$G_y$			0.571			
	Blue	$B_x$			0.160			
		$B_y$			0.135			
Color Gamut(NTSC)		-	-	-	45	-	%	@CIE1931
Response Time (Rising + Falling)		$T_{RT}$	$T_a = 25^\circ\text{C}$ $\theta = 0^\circ$	-	20	25	Ms	Note 6
Cross Talk		CT	$\theta = 0^\circ$	-	-	2.0	%	Note 7

Notes :

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface (see Figure 7).



Optical characteristics measurement setup

Figure 7. Measurement Set Up

2. Contrast measurements shall be made at viewing angle of  $\Theta = 0$  and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state . (see Figure 7) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Center Luminance of white is defined as luminance values of the center position "9" across the LCD surface (see Figure 8 ). Luminance shall be measured with all pixels in the view field set first to white.

4. The White luminance uniformity on LCD surface is then expressed as :  $\Delta Y = \text{Minimum Luminance of 9 points} / \text{Maximum Luminance of 9 points}$ .(see Figure 8 ).

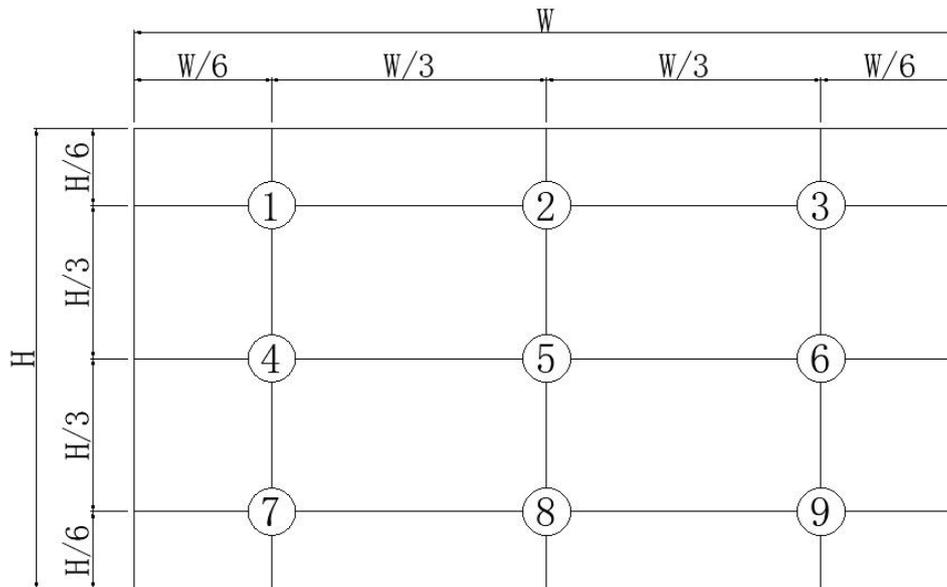


Figure 8. White Luminance and Uniformity Measurement Locations (9 points)

5. The color chromaticity coordinates specified in Table 5 shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

6. The electro-optical response time measurements shall be made as shown in Figure 9 by switching the “data” input signal ON and OFF.  $T_r$ : The luminance to change from 10% to 90% ,  $T_f$ : The luminance to change from 90% to 10% .

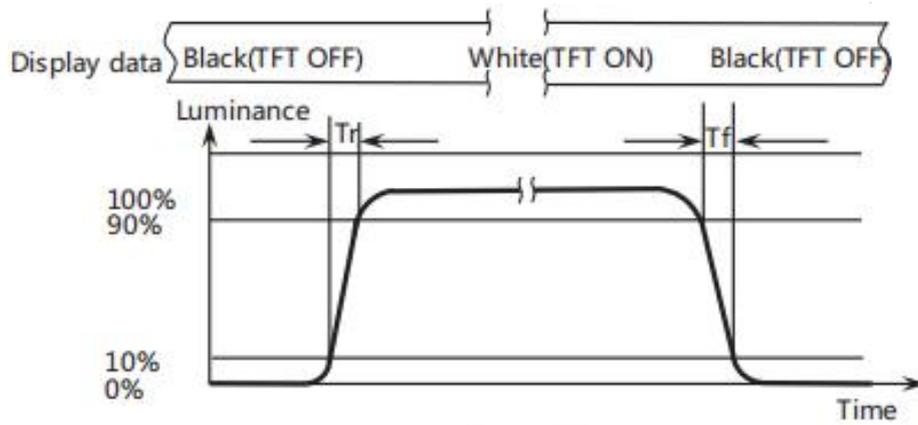
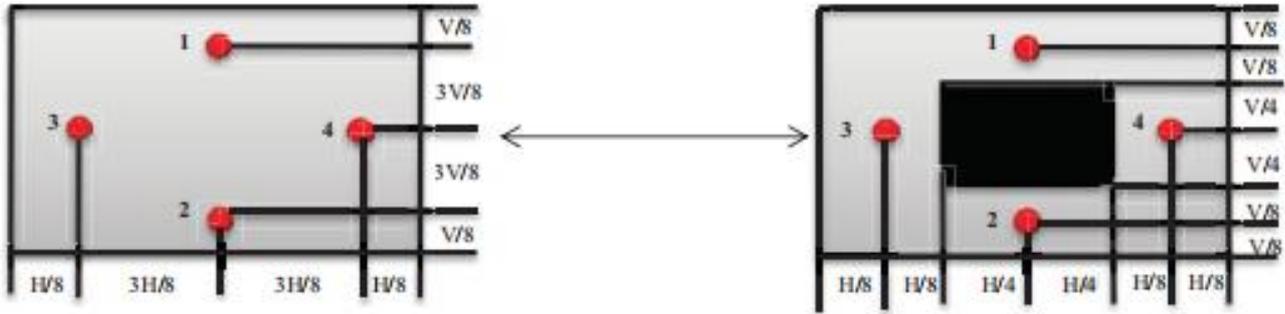


Figure 9. Response Time Testing

7. Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance ( $Y_A$ ) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance ( $Y_B$ ) of that same area when any adjacent area is driven dark. (See Figure 10).



$$\text{Cross Talk (\%)} = \left| \frac{Y_B - Y_A}{Y_A} \right| \times 100$$

Figure 10. Cross Talk Modulation Test Description

Where:

$Y_A$  = Initial luminance of measured area ( $\text{cd/m}^2$ )

$Y_B$  = Subsequent luminance of measured area ( $\text{cd/m}^2$ )

The location 1/2/3/4 measured will be exactly the same in both patterns. The test background gray is from L64 to L192. Take the largest data as the result.

Cross Talk of one area of the LCD surface by another shall be measured by comparing the luminance ( $Y_A$ ) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance ( $Y_B$ ) of that same area when any adjacent area is driven dark. (Refer to Figure 10)

## 5.0 INTERFACE CONNECTION

### 5.1 Electrical Interface Connection

The electronics interface connector is LV03030-13100 .

The connector interface pin assignments are listed in Table 6.

<Table 6. Pin Assignments for the Interface Connector>

Terminal Pin No.	Symbol	Functions Description
1	NC	No Connection
2	H_GND	Ground
3	LANE1_N	eDP RX Channel 1 Negative
4	LANE1_P	eDP RX Channel 1 Positive
5	H_GND	Ground
6	LANE0_N	eDP RX channel 0 negative
7	LANE0_P	eDP RX channel 0 positive
8	H_GND	Ground
9	AUX_CH_P	eDP AUX CH positive
10	AUX_CH_N	eDP AUX CH negative
11	H_GND	Ground
12	LCD_VCC	Power Supply, 3.3V (typ.)
13	LCD_VCC	Power Supply, 3.3V (typ.)
14	NC	No Connection
15	H_GND	Ground
16	H_GND	Ground
17	HPD	Hot plug detect output
18	BL_GND	LED Ground
19	BL_GND	LED Ground
20	BL_GND	LED Ground
21	BL_GND	LED Ground
22	BL_ENABLE	LED enable pin(+3.3V Input)
23	BL_PWM	System PWM Signal Input
24	NC	No Connection
25	NC	No Connection
26	BL_POWER	LED Power Supply 7V-21V
27	BL_POWER	LED Power Supply 7V-21V
28	BL_POWER	LED Power Supply 7V-21V
29	BL_POWER	LED Power Supply 7V-21V
30	NC	No Connection

## 5.2 eDP Interface

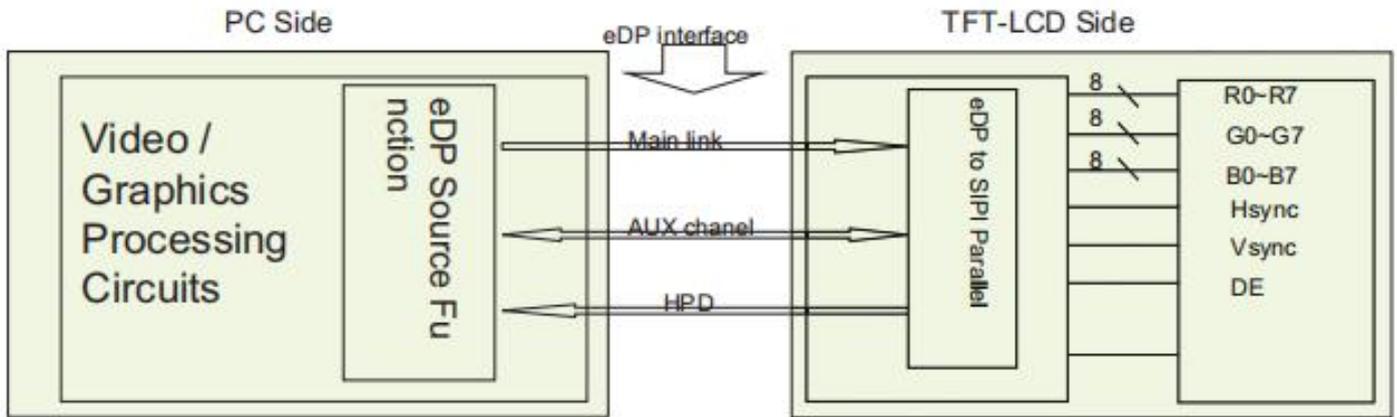


Figure 11. eDP Interface Architecture

## 5.3.eDP Input signal

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



## 6.0 SIGNAL TIMING SPECIFICATION

### 6.1 The LCM Is Operated By The DE Only

< Table 7. Signal Timing Specification >

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	-	152.53	-	MHz
Frame Period		Tv	-	1140	-	lines
			-	60	-	Hz
			-	16.7	-	ms
Vertical Display Period		Tvd	-	1080	-	lines
One line Scanning Period		Th	-	2230	-	clocks
Horizontal Display Period		Thd	-	1920	-	clocks

Note : The above is as optimized setting.

## 6.2 eDP AUX Channel Characteristics

<Table 8. eDP AUX Channel Characteristics>

Item	Symbol	Min	Typ	Max	Unit	Note
Unit Interval for AUX channel	UIAUX	0.4	-	0.6	μS	
Peak-to-peak voltage at TP1	VAUX-DIFFp-	0.39	-	1.38	V	
AUX DC Common mode Voltage	VAUX_DC_C M	0	-	2	V	
AUX Short current limit	IAUX_SHORT	-	-	90	mA	
AUX CH termination DC resistor	RAUX_TERM	80	100	120	Ω	Differential input
AUX AC coupling capacitor	CAUX	75	-	200	nF	
Number of pre-charge pulses	Pre-charge pulses	10	-	16		

## 6.3 eDP Main Link Receiver Characteristics

<Table 9. eDP Main Link Receiver Characteristics>

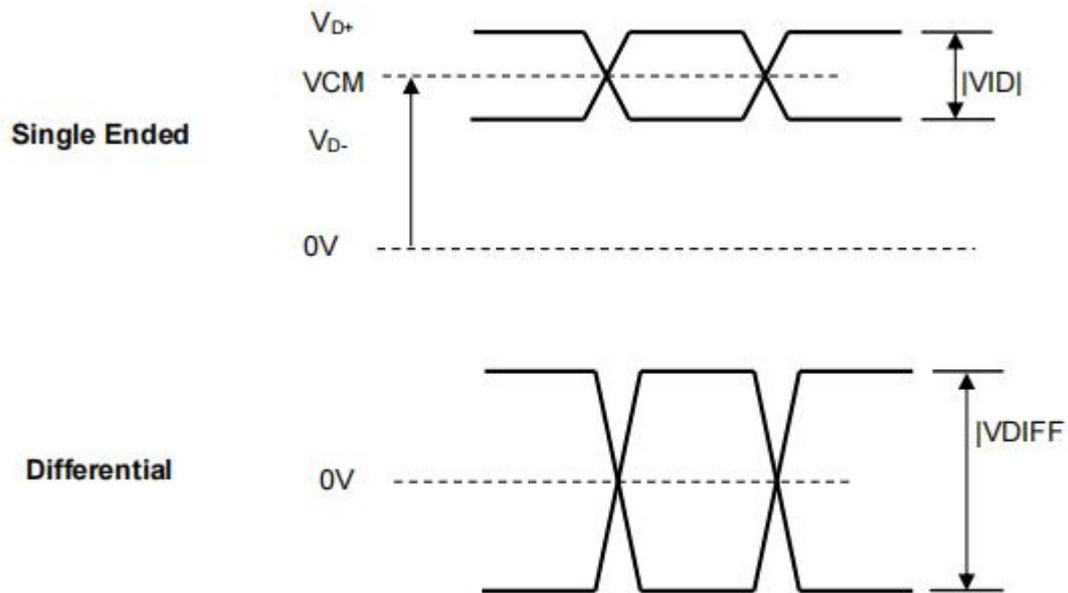
Item	Symbol	Min	Typ	Max	Unit	Note
Link clock down spreading	Down_Spread_Amplitude	0.4	-	0.5	%	
Differential Peak-to-peak Input Voltage at Rx package pins	VRX-DIFFp-p	120	-	1200	mV	
Differential termination resistance	RRX-TERM	90	100	110	Ω	
RX short circuit Current Limit	IRX_SHORT	-	-	50	mA	
Lane Intra-pair Skew at RX package pins	TRX-SKEW-INTRA-PA IR-High-Bit-Rate	-	-	50	ps	

## 6.4 eDP AUX Channel Characteristics

<Table 10. eDP AUX Channel Characteristics>

Parameter	Symbol	Min	Typ	Max	Unit	Note
Hot plug Detect	VHPD	2.25	-	3.6	V	

Note (1) Display port interface related AC coupled signals are following VESA Display Port Standard V1.4.



## 7.0 INPUT SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

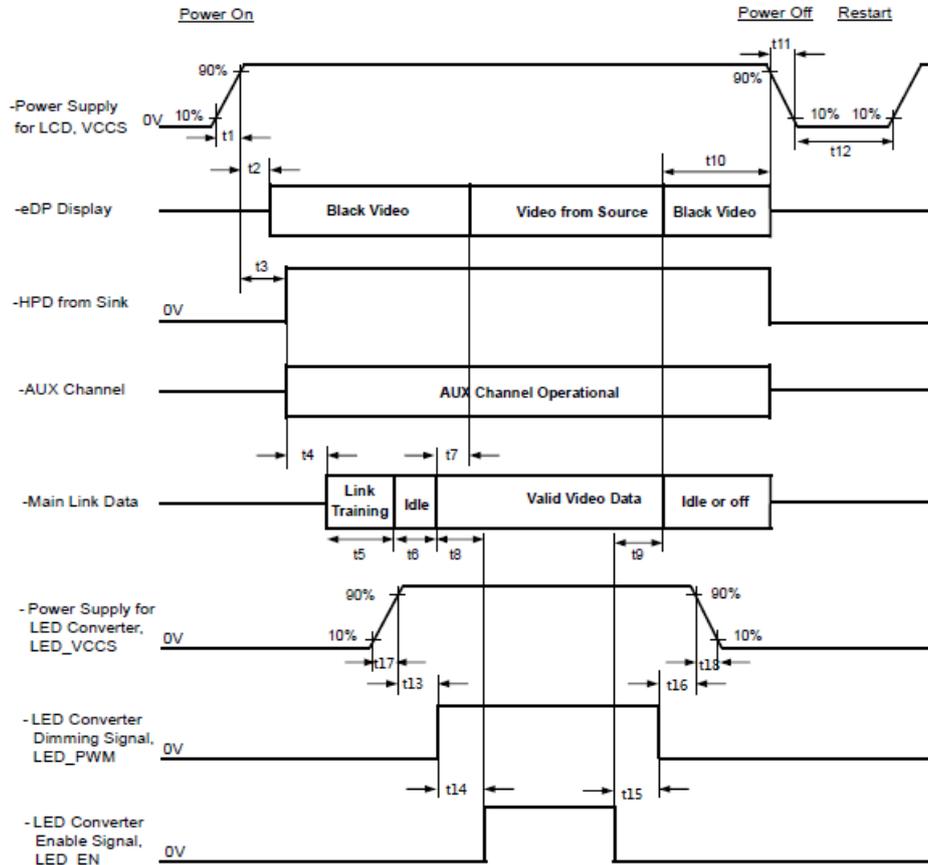
<Table 11. Input Signal & Basic Display Colors & Gray Scale of Colors >

	Colors & Gray scale	Data signal															
		R0 R1 R2 R3 R4 R5 R6 R7	G0 G1 G2 G3 G4 G5 G6 G7	B0 B1 B2 B3 B4 B5 B6 B7													
Basic colors	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													
	Blue	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1													
	Green	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0													
	Light Blue	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1													
	Red	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0													
	Purple	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1													
	Yellow	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	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 scale of Red	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													
	Δ	1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0													
	Darker	0 1 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0													
	Δ		↑	↑													
	▽		↓	↓													
	Brighter	1 0 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0													
	▽	0 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0													
	Red	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0													
Gray scale of Green	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													
	Δ	0 0 0 0 0 0 0 0	1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0													
	Darker	0 0 0 0 0 0 0 0	0 1 0 0 0 0 0 0	0 0 0 0 0 0 0 0													
	Δ		↑	↑													
	▽		↓	↓													
	Brighter	0 0 0 0 0 0 0 0	1 0 1 1 1 1 1 1	0 0 0 0 0 0 0 0													
	▽	0 0 0 0 0 0 0 0	0 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0													
	Green	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0													
Gray scale of Blue	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													
	Δ	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 0 0 0 0 0 0 0													
	Darker	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 1 0 0 0 0 0 0													
	Δ		↑	↑													
	▽		↓	↓													
	Brighter	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 0 1 1 1 1 1 1													
	▽	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 1 1 1 1 1 1 1													
	Blue	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1													
Gray scale of White & Black	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													
	Δ	1 0 0 0 0 0 0 0	1 0 0 0 0 0 0 0	1 0 0 0 0 0 0 0													
	Darker	0 1 0 0 0 0 0 0	0 1 0 0 0 0 0 0	0 1 0 0 0 0 0 0													
	Δ		↑	↑													
	▽		↓	↓													
	Brighter	1 0 1 1 1 1 1 1	1 0 1 1 1 1 1 1	1 0 1 1 1 1 1 1													
	▽	0 1 1 1 1 1 1 1	0 1 1 1 1 1 1 1	0 1 1 1 1 1 1 1													
	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													

## 8.0 POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown in below.

Figure 13. Power Sequence



Symbol	Description	Min	Typ.	Max	Unit	Note
t1	Power rail rise time, 10% to 90%	0.5		10	ms	
t2	Delay from LCD,VCCS to eDP Display	0		200	ms	
t3	Delay from LCD,VCCS to HPD high	0		200	ms	
t4	Delay from Sink AUX to link training initialization	-		-	ms	(5)
t5	Link training duration	-		-	ms	(5)
t6	Link idle	-		-	ms	(5)
t7	Delay from valid video data from Source to video on display	0		50	ms	
t8	Delay from valid video data from Source to backlight on	50		-	ms	(5)
t9	Delay from backlight off to end of valid video data	0		-	ms	
t10	Delay from end of valid video data from Source to power off	0		500	ms	

t11	VCCS power rail fall time, 90% to 10%	0.5		10	ms	(1)
t12	VCCS Power off time	500		-	ms	
t13	Delay from VCC to PWM	0		-	ms	
t14	Delay from PWM to LED ENABLE	0		-	ms	
t15	Delay from LED ENABLE to PWM Disable	0		-	ms	
t16	Delay from PWM Disable to VBL 90%	0		-	ms	
t17	Delay from VBL 10% to VBL 90%	0.5		-	ms	
t18	VBL power rail fall time, 90% to 10%	0.5		-	ms	

Note (1) Please follow the power on/off sequence described above. Otherwise, the LCD module might abnormal display or be damaged.

Note (2) Please avoid floating state of interface signal at invalid period. When the interface signal is invalid, be sure to pull down the power supply of LCD VCCS to 0 V.

Note (3) The backlight must be turned on after the power supply for the logic and the interface signal is valid. The backlight must be turned off before the power supply for the logic and the interface signal is invalid.

Note (4) Please follow the LED backlight power sequence as above. If the customer could not follow, it might cause backlight flash issue during display ON/OFF or damage the LED backlight controller

## 9.0 RELIABILITY TEST

The reliability test items and its conditions are shown in below

<Table 12. Reliability Test>

No	Test Items	Conditions	Remark
1	High temperature storage test	Ta = 60°C , 240 hrs	
2	Low temperature storage test	Ta = -20°C , 240 hrs	
3	High temperature & high humidity	Ta = 50°C , 80%RH, 240 hrs	
4	High temperature operation test	Ta = 50°C , 240 hrs	
5	Low temperature operation test	Ta = 0°C , 240 hrs	
6	Thermal shock	Ta = -20°C (0.5 hr) ↔ 60°C (0.5 hr), 100cycle	
7	Vibration test (non-operating)	1.5G, 10~500Hz, Sine X,Y,Z / Sweep rate : 1 hour	Note 1
8	Shock test (non-operating)	220G, Half Sine Wave 2msec ± X, ± Y, ± Z Once for each direction	Note 1
9	Electro-static discharge test (operating)	Air : 150 pF, 330Ω, ±8 KV Contact : 150 pF, 330Ω, ±4 KV	Note 2
10	Image Sticking	25°C ; 1hrs	Note 3

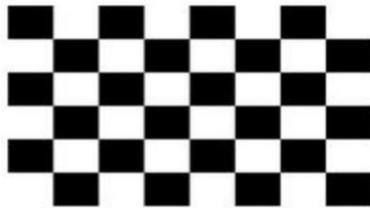
Notes :

1. The fixture must be hard enough , so that the module would not be twisted or bent.

2. Self- recovery and restart recovery is allowed. No hardware failures.

3. Condition of image sticking test : 25°C ± 2°C

Operation with test pattern sustained for 1hrs, then change to 50% gray pattern immediately after 5 mins, the mura must be disappeared completely.



(a) Test Pattern (chess board Pattern)



(b) Gray Pattern

## 10.0 HANDLING & CAUTIONS

### (1) Cautions when taking out the module

Pick the pouch only, when taking out module from a shipping package.

### (2) Cautions for handling the module

As the electrostatic discharges may break the LCD module, handle the LCD module with care. Peel a protection sheet off from the LCD panel surface as slowly as possible.

As the LCD panel and back - light element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.

As the surface of the polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.

Do not pull the interface connector in or out while the LCD module is operating.

Put the module display side down on a flat horizontal plane.

Handle connectors and cables with care.

### (3) Cautions for the operation

When the module is operating, do not lose CLK, ENAB signals. If any one of these signals is lost, the LCD panel would be damaged.

Obeys the supply voltage sequence. If wrong sequence is applied, the module would be damaged.

### (4) Cautions for the atmosphere

Dew drop atmosphere should be avoided.

Do not store and/or operate the LCD module in a high temperature and/or humidity atmosphere.

Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.

### (5) Cautions for the module characteristics

Do not apply fixed pattern data signal to the LCD module at product aging.

Applying fixed pattern for a long time may cause image sticking

### (6) Other cautions

Do not disassemble and/or re-assemble LCD module.

Do not re-adjust variable resistor or switch etc.

When returning the module for repair or etc. Please pack the module not to be broken.

We recommend to use the original shipping packages.

## 11.0 LABEL

(1) Product Label

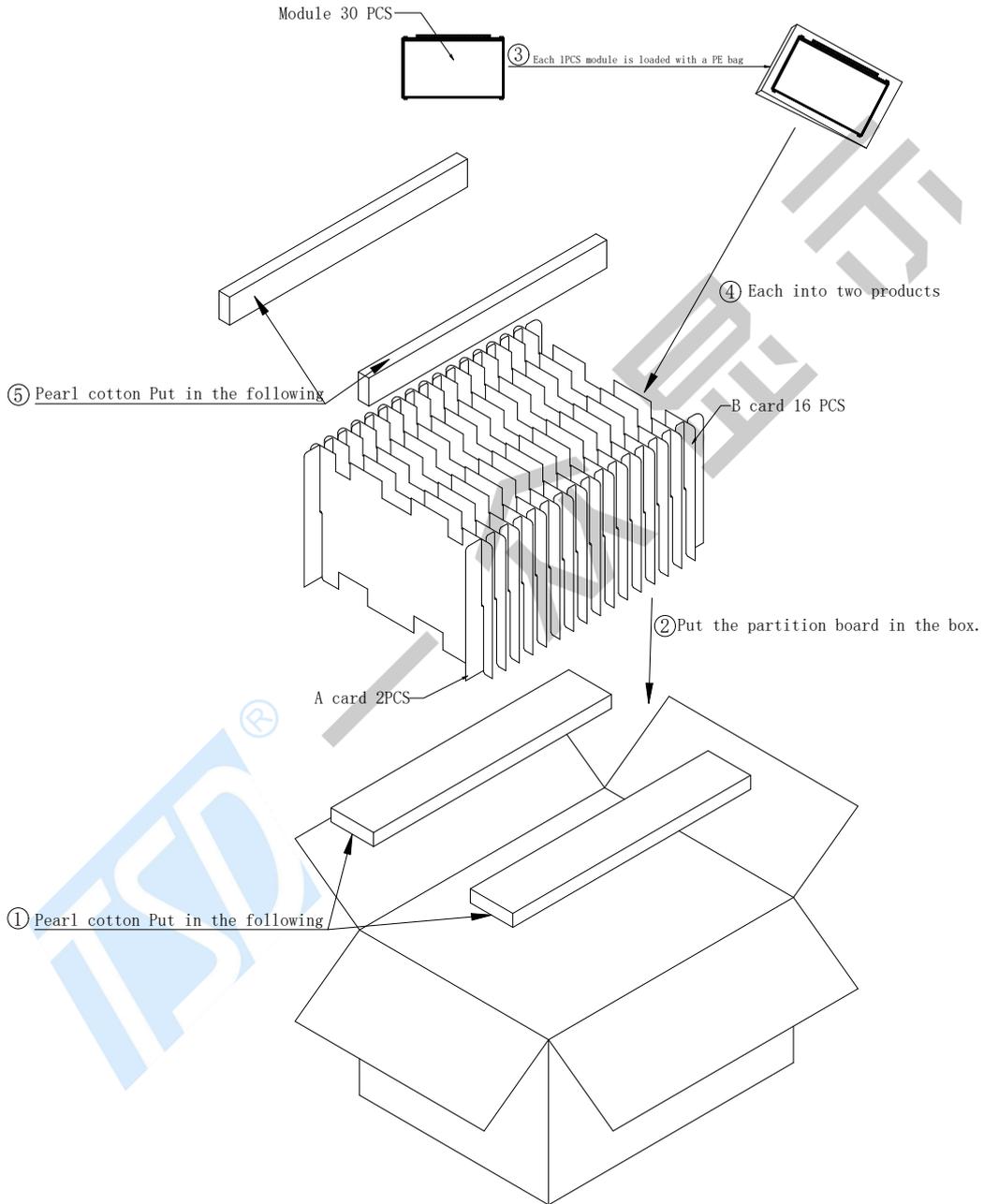
TBD



## 12.0 PACKING INFORMATION

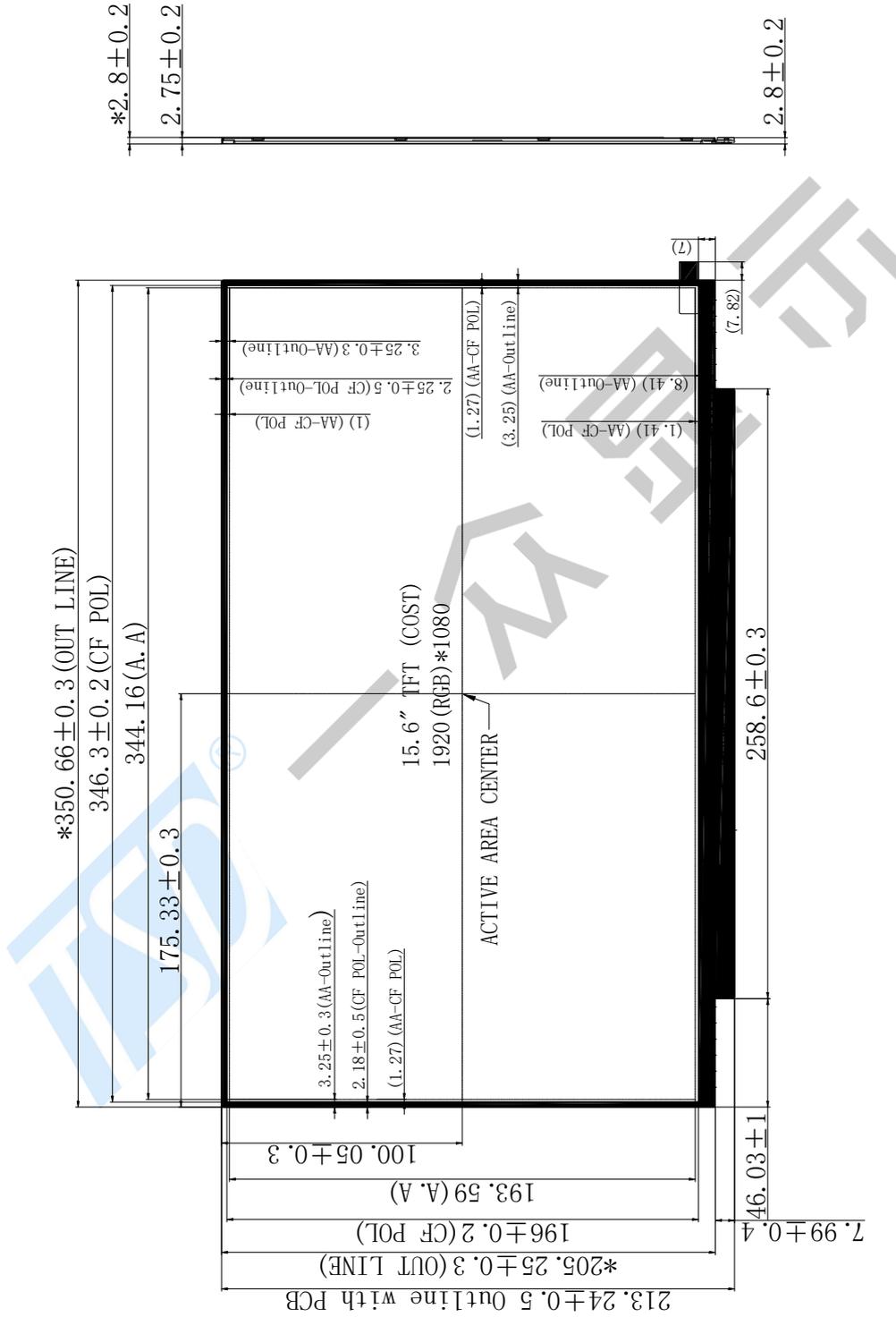
### 12.1 Packing Order

Figure 16. Packing Order



### 13.0 MECHANICAL OUTLINE DIMENSION

Figure 17. TFT-LCD Module Outline Dimension (Front View)





## 14.0 EDID Table

Address (HEX)	Function	Hex	Dec	crc	Input values.	Notes
00	Header	00	0		0	EDID Header
01		FF	255		255	
02		FF	255		255	
03		FF	255		255	
04		FF	255		255	
05		FF	255		255	
06		FF	255		255	
07		00	0		0	
08	ID Manufacturer Name	28	40		JDZ	ID = JDZ
09		9A	154			
0A	ID Product Code	ED	237		771	ID = 771
0B		60	96			
0C	32-bit serial No.	00	0		0	
0D		00	0		0	
0E		00	0		0	
0F		00	0		0	
10	Week of manufacture	08	8		42	
11	Year of Manufacture	21	33		2024	Manufactured in 2024
12	EDID Structure Ver.	01	1		1	EDID Ver 1.0
13	EDID revision #	04	4		4	EDID Rev. 0.4
14	Video input definition	A5	165		-	Refer to right table
15	Max H image size	23	35		35	35 cm (Approx)
16	Max V image size	14	20		20	20 cm (Approx)
17	Display Gamma	78	120		2.2	Gamma curve = 2.2
18	Feature support	02	2		-	Refer to right table
19	Red/Green low bits	90	144		-	Red / Green Low Bits
1A	Blue/White low bits	15	21		-	Blue / White Low Bits
1B	Red x high bits	96	150	594	0.580	Red (x) = 10010110 (0.58)
1C	Red y high bits	5E	94	375	0.366	Red (y) = 01011110 (0.3662)
1D	Green x high bits	59	89	355	0.347	Green (x) = 01011001 (0.3468)
1E	Green y high bits	92	146	585	0.571	Green (y) = 10010010 (0.5712)
1F	Blue x high bits	29	41	163	0.160	Blue (x) = 00101001 (0.1595)
20	BLue y high bits	21	33	138	0.135	Blue (y) = 00100001 (0.1349)
21	White x high bits	50	80	321	0.313	White (x) = 01010000 (0.313)
22	White y high bits	54	84	378	0.369	White (y) = 01010100 (0.369)
23	Established timing 1	00	0		-	Refer to right table
24	Established timing 2	00	0		-	
25	Established timing 3	00	0		-	

26	Standard timing #1	01	1			Not Used	
27		01	1				
28	Standard timing #2	01	1			Not Used	
29		01	1				
2A	Standard timing #3	01	1			Not Used	
2B		01	1				
2C	Standard timing #4	01	1			Not Used	
2D		01	1				
2E	Standard timing #5	01	1			Not Used	
2F		01	1				
30	Standard timing #6	01	1			Not Used	
31		01	1				
32	Standard timing #7	01	1			Not Used	
33		01	1				
34	Standard timing #8	01	1			Not Used	
35		01	1				
36	Detailed timing/monitor descriptor #1	96	150		152.5	152.532MHz Main clock	
37		3B	59				
38		80	128		1920	Hor Active = 1920	
39		36	54		310	Hor Blanking = 310	
3A		71	113		-	4 bits of Hor. Active + 4 bits of Hor. Blanking	
3B		38	56		1080	Ver Active = 1080	
3C		3C	60		60	Ver Blanking = 60	
3D		40	64		-	4 bits of Ver. Active + 4 bits of Ver. Blanking	
3E		30	48		48	Hor Sync Offset = 48	
3F		20	32		32	H Sync Pulse Width = 32	
40		36	54		3	V sync Offset = 3 line	
41		00	0		6	V Sync Pulse width : 6 line	
42		59	89		345	Horizontal Image Size = 345 mm (Low 8 bits)	
43		C3	195		195	Vertical Image Size = 195 mm (Low 8 bits)	
44		10	16		-	4 bits of Hor Image Size + 4 bits of Ver Image Size	
45		00	0		0	Hor Border (pixels)	
46		00	0		0	Vertical Border (Lines)	
47		1A	26		-	Refer to right table	
48		Detailed timing/monitor descriptor #2	00	0			MHz Main clock
49			00	0			Hor Active =
4A	00		0			Hor Blanking =	
4B	00		0			Ver Active =	
4C	00		0			Ver Blanking =	
4D	00		0			4 bits of Ver. Active + 4 bits of Ver. Blanking	
4E	00		0			Hor Sync Offset =	
4F	00		0			H Sync Pulse Width =	
50	00		0			V sync Offset = line	
51	00		0			V Sync Pulse width : line	
52	58		88			Horizontal Image Size = mm (Low 8 bits)	
53	C2		194			Vertical Image Size = mm (Low 8 bits)	
54	10		16			4 bits of Hor Image Size + 4 bits of Ver Image Size	
55	00		0			Hor Border (pixels)	
56	00		0			Vertical Border (Lines)	
57	1A		26				
58							
59							

5A	Detailed timing/monitor descriptor #3	00	0			Indicates descriptor #3 is a display Descriptor
5B		00	0			
5C		00	0			Reserved
5D		FE	254			Tag: ASCII String
5E		00	0			Reserved
5F		47	71		G	Manufacture name : G156ED11
60		31	49		1	
61		35	53		5	
62		36	54		6	
63		45	69		E	
64		44	68		D	
65		31	49		1	
66		31	49		1	
67		0A	10			
68		20	32			
69		20	32			
6A		20	32			
6B		20	32			
6C	Detailed timing/monitor descriptor #4	00	0			Indicates descriptor #4 is a display Descriptor
6D		00	0			
6E		00	0			Reserved
6F		FE	254			Tag: ASCII String
70		00	0			Reserved
71		47	71		G	Model name : G156ED11
72		31	49		1	
73		35	53		5	
74		36	54		6	
75		45	69		E	
76		44	68		D	
77		31	49		1	
78		31	49		1	
79		0A	10			
7A		20	32			
7B		20	32			
7C		20	32			
7D		20	32			
7E	Extension flag	00	0		1	0 : 1個EDID; N-1: N個EDID
7F	Checksum	89	137	137	-	

## 15.0 GENERAL PRECAUTIONS

### 15.1 HANDLING

- (1) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist or bend the modules.
- (2) Refrain from strong mechanical shock or any force to the module. Otherwise, it may cause improper operation or damage to the module.
- (3) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than 1 HB pencil lead.
- (4) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.
- (5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage to the polarizer due to chemical reaction.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth .In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static , it may cause damage to the module.
- (9) Use fingerstalls with soft gloves to keep display clean during the incoming inspection and assembly process.
- (10) Do not disassemble the module.
- (11) Do not pull or fold the LED FPC.
- (12)Do not touch any component which is located on the back side.
- (13) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (14) Pins of connector shall not be touched directly with bare hands.

### 15.2 STORAGE

- (1) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35℃ and relative humidity of less than 70%.
- (2) Do not store the TFT-LCD module in direct sunlight.
- (3) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

## 15.3 OPERATION

- (1) Do not connect, disconnect the module in the “ Power On” condition.
- (2) Power supply should always be turned on/off by following item 8.0 “ Power on/off sequence “.
- (3) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (4) The standard limited warranty is only applicable when the module is used for general notebook applications. If used for purposes other than as specified, is not to be held reliable for the defective operations. It is strongly recommended to contact to find out fitness for a particular purpose.

## 15.4 OTHERS

- (1) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (2) Do not exceed the absolute maximum rating value. ( the supply voltage variation, input voltage variation, Variation in part contents and environmental temperature, so on) Otherwise the module may be damaged.
- (3) If the module displays the same pattern continuously for a long period of time, it can be the situation when The “ image sticks” to the screen.
- (4) This module has its circuitry PCB’s on the rear or bottom side and should be handled carefully to avoid being stressed.