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NS160QDM-NZ1**Thunderobot****Product Specification****Rev. P0****Beijing BOE CHUANGYUAN Technology Co., Ltd**

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TFT-LCD

P0

2024.11.25

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REVISION HISTORY

☒ Preliminary Specification

☐ Final Specification

Revision No.	Page	Description of Changes	Date	Prepared
P0	65	Initial Release	2024.11.25	He Xiaofei

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1.0 GENERAL DESCRIPTION

1.1 Introduction

NS160QDM-NZ1 is a color active matrix TFT LCD module using LTPS TFT's (Thin Film Transistors) as an active switching devices. This module has a 16.0 inch diagonally measured active area with WQXGA resolutions (2560 horizontal by 1600 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 1064.3M(8bit+FRC) colors and color gamut DCI-P3 Coverage ratio Typ .100% min 95% . 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 eDP1.4b interface compatible.

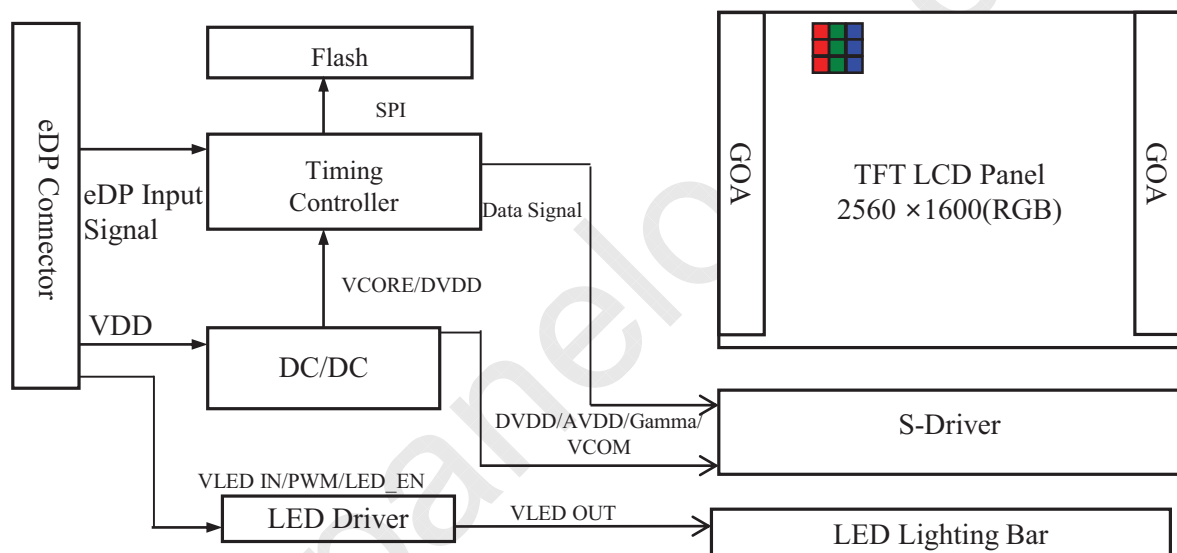


Figure 1. Drive Architecture

1.2 Features

- 4 lane eDP interface with 5.4Gbps link rates
- Thin and light weight, Low Blue Light
- 1064.3M(8bit+FRC) color depth, color gamut 100%
- Single LED lighting bar (Bottom side/Horizontal Direction)
- Data enable signal mode
- Green product (RoHS & Halogen free product)
- On board LED driving circuit
- On board EDID chip
- Function : DSC/FRC/**PSR1**
- Adjust backlight brightness with PWM mode

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1.0 GENERAL DESCRIPTION

1.2 Features

DPCD Ver.	sDRRS	DCR	DMRRS	PSR	LRR	MBO
1.4	on	off	off	on PSR1	off	off
VESA DSC	MSO	AMD Free-sync	HDR	Dimming	OD	BIST
on	on	off	off	PWM in DC out	off	yes
FRC	DDS	G-sync				
on	off	no				

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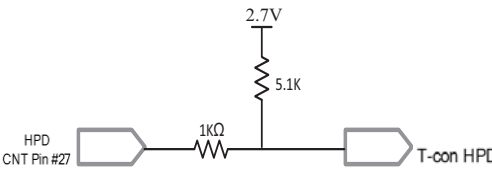
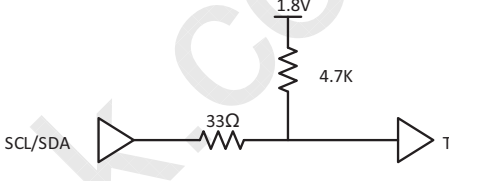
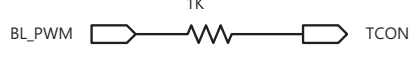
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1.2.1 Features Circuit

Feature		HPD feature	I2C
		(pin 27)	(pin 1/pin 34)
I/O		Input	Input/Output
Input Status	High	/	/
	Floating	/	/
	Low	/	/
Circuit			
Symbol		BL_EN	BL_PWM
		(pin 32)	(pin 33)
I/O		Input	Input
Input Status	High	/	/
	Floating	/	/
	Low	/	/
Circuit			

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1.2.2 eDP link rate and Link training config

<Table 1. eDP link rate TCON link rate capability >

eDP link rate NT71877 TCON link rate capability			
I/O	DSC	Without DSC	Unit
10bpc (HDR/SDR)	5.4G	8.1G	Gbps/Lane
8bpc (SDR)	5.4G	8.1G	Gbps/Lane

<Table 2. eDP link rate Actual link rate >

eDP link rate Actual link rate			
I/O	DSC	Without DSC	Unit
10bpc (HDR/SDR)	5.4G	N/A	Gbps/Lane
8bpc (SDR)	5.4G	N/A	Gbps/Lane

<Table 3. Link training condition >

Link training condition		
eDP link training Default link training form	Swing 0 Pre-emphasis 0	Gbps/Lane
TCON → SOURCE SSC percentage	0.5%	Gbps/Lane

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1.3 Application

- Notebook PC (Wide type)

1.4 General Specification

The followings are general specifications at the model NS160QDM-NZ1. (listed in Table 1)

<Table 1. General Specifications>

Parameter	Specification	Unit	Remarks
Active area	344.67(H) × 215.42(V)	mm	
Number of pixels	2560 (H) × 1600 (V)	pixels	
Pixel pitch	134.64(H) × 134.64(V)	um	
Pixel arrangement	RGB Vertical stripe		
Display colors	1064.3M(8bit+FRC)		
Color gamut	DCI-P3 Typ 100% min 95%		
Display mode	Normally black		
Dimensional outline	349.68±0.3 (H)*224.42±0.3(V)(W/O PCB)*2.6 (Max) 349.68±0.3(H)*224.42±0.5(V) (W/PCB)*4.6(Max)	mm	
Weight	312(max)	g	
Surface treatment	Anti-Glare & low reflection		
Surface hardness	3H		
Back-light	Bottom edge side, 1-LED lighting bar type		Note 1
Power consumption	P _D : 1.7(Max.)	W	@Mosaic
	P _{BL} : 5.17(Max.)	W	@VLED=12V
	P _{Total} : 6.87(Max.)	W	@Mosaic

Notes : 1. LED Lighting Bar (88*LED Array)

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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>

 $T_a=25\pm 2^{\circ}\text{C}$

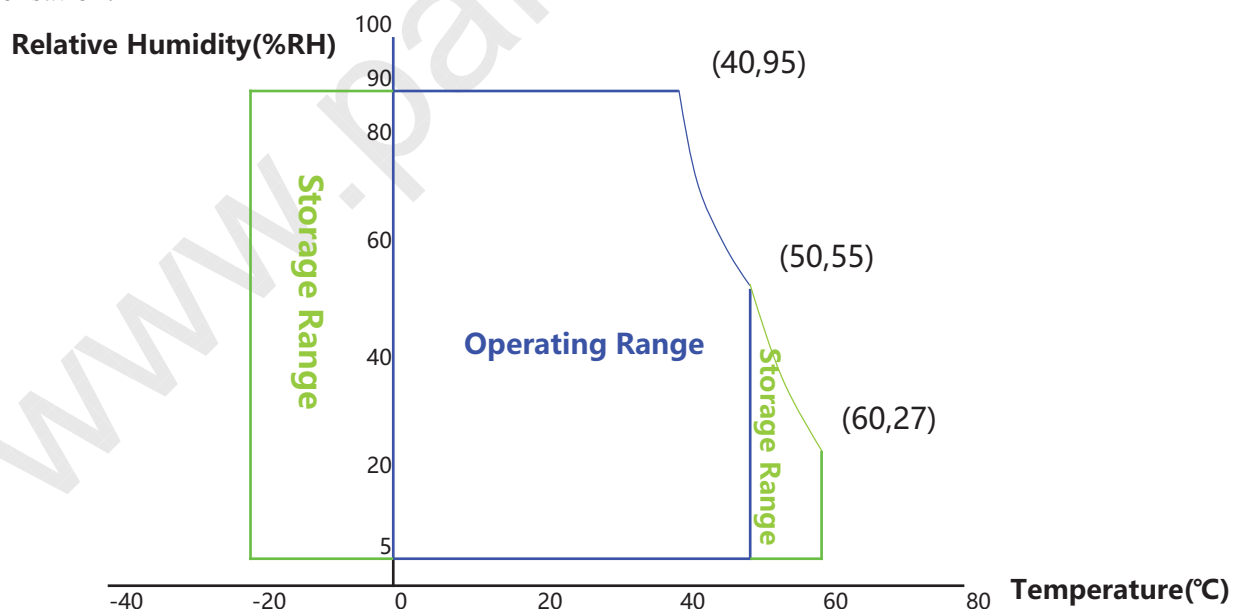
Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	-0.3	4.0	V	Note 1
eDP input Voltage	V_{eDP}	0	2.0	V	
Logic Supply Voltage	V_{IN}	$V_{SS}-0.3$	$V_{DD}+0.3$	V	
Operating Temperature	T_{OP}	0	+50	$^{\circ}\text{C}$	Note 2
Storage Temperature	T_{ST}	-20	+60	$^{\circ}\text{C}$	

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.

95 % RH Max. ($40^{\circ}\text{C} \geq T_a$) Maximum wet - bulb temperature at 39°C or less. ($T_a > 40^{\circ}\text{C}$) No condensation.



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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 _{DD}	3.0	3.3	3.6	V	Note 1
Permissible Input Ripple Voltage	V _{RF}	-10% VDD	-	+10% VDD	V	@ V _{DD} = 3.3V , note4
Power Supply Inrush Current	I _{rush}	-	-	2	A	Note3
Power Supply I _{peak} Current	I _{Peak}	-	-	2.5	A	VDD 3.0@ Heavy Loding Note3
Power Supply Current	Mosaic	I _{DD}	-	566.67	mA	Note 1
	RGB		-	700.00	mA	
	Heavy Pattern			1633.33	mA	
Power Consumption	Mosaic	P _M	-	1.7	W	Note 1 Only for reference
	RGB	P _{RGB}	-	2.1	W	
	Heavy Pattern	P _{cc}	-	4.9	W	
	BLU	P _{BL}	-	5.17	W	Note 2
	Total	P _{Total}	-	6.87	W	@Mosaic

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Parameter		Min.	Typ.	Max.	Unit	Remarks
BIST Control Level	High Level	1.62	-	1.98	V	@V _{DDIO} =1.8V
	Low Level	0	-	0.36	V	
I2C SDA/SCL Level	High Level	1.62	-	1.98	V	@V _{DDIO} =1.8
	Low Level	0	-	0.36	V	

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3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Specifications

Notes :

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

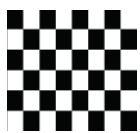
The current draw and power consumption specified is for 3.3V at 25 °C.

a) Mosaic pattern 8*8

b) R/G/B patterns

c) Heavy pattern(maximum logic power consumption) : H 1line

The pattern and Power Consumption is shown for reference only



(a)



(b)



(c)

Figure 3. Power Measure Patterns

2. Calculated value for reference ($V_{LED} \times I_{LED}$) , The power consumption with LED Driver are under the $V_{LED} = 12.0V$, 25°C, PWM Duty 100% .

3. Measure condition (Figure 4) ,Need $V_{in} - V_{ripple} > 2.75V$

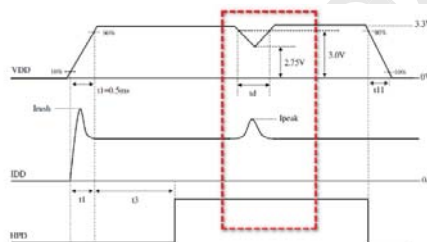
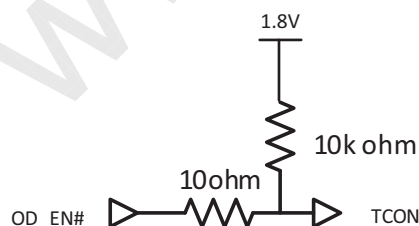


Figure 4. Inrush Measure Condition

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

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3.2 Backlight Unit

< Table 4. LED Driving Guideline Specifications >

Ta=25+/-2°C

Parameter		Min.	Typ.	Max.	Unit	Remarks	
LED Forward Voltage		V _F	-	-	2.9	V	
LED Forward Current		I _F	-	17.9	-	mA	
LED Power Input Voltage		V _{LED}	5	12	21	V	
LED Power Input Current		I _{LED}	-	-	430	mA	Note 1
LED Power Consumption		P _{LED}	-	-	5.17	W	
Power Supply Voltage for LED Driver Inrush		I _{led} inrush	-	-	1.5	A	Note 3
LED Life-Time		N/A	15,000	-	-	Hour	I _F = 17.9mA Note 2
EN Control Level	Backlight On	V _{BL_EN}	1.62	-	3.6	V	
	Backlight Off		0	-	0.36	V	
PWM Control Level	High Level	V _{BL_PWM}	1.62	-	1.98	V	
	Low Level		0	-	0.36	V	
PWM Control Frequency		F _{PWM}	200	-	2,000	Hz	
Duty Ratio			1	-	100	%	

Notes :

1. Power supply voltage 12V for LED driver.

Calculator value for reference $I_F \times V_F \times 36 / \text{driver efficiency} = P_{LED}$

2. The LED life-time define as the estimated time to 50% degradation of initial luminous.

3. Measure condition (Figure 5)

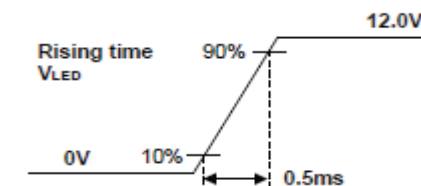


Figure 5. Inrush Measure Condition

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3.3 LED Structure

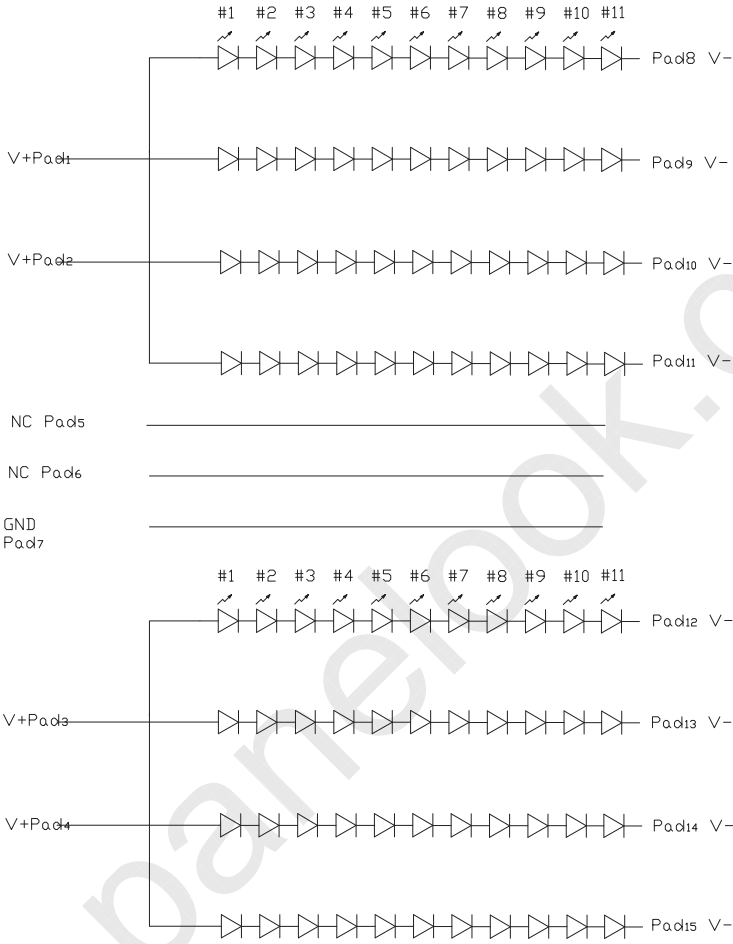


Figure 6. LED Structure

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4.0 OPTICAL SPECIFICATION

4.1 Overview

The test of optical specifications shall be measured in a dark room (ambient luminance ≤ 1 lux and temperature = $25\pm 2^{\circ}\text{C}$) with the equipment of luminance meter system (CS2000) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0° . We refer to $\theta\Phi=0$ ($=\theta_3$) as the 3 o'clock direction (the "right"), $\theta\Phi=90$ ($=\theta_{12}$) as the 12 o'clock direction ("upward"), $\theta\Phi=180$ ($=\theta_9$) as the 9 o'clock direction ("left") and $\theta\Phi=270$ ($=\theta_6$) as the 6 o'clock direction ("bottom"). While scanning θ and/or Φ , the center of the measuring spot on the display surface shall stay fixed. The backlight should be operating for 30 minutes prior to measurement. VDD shall be $3.3\pm 0.3\text{V}$ at 25°C .

4.2 Optical Specifications

<Table 5. Optical Specifications>

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle Range	Horizontal	Θ_3	$CR \geq 10$	85	89	-	Deg.	Note 1
		Θ_9		85	89	-	Deg.	
	Vertical	Θ_{12}		85	89	-	Deg.	
		Θ_6		85	89	-	Deg.	
Luminance Contrast Ratio		CR	$\Theta = 0^{\circ}$	1000	1200	-		Note 2
Ambient Contrast Ratio		ACR	$\Theta = 0^{\circ}$	120	150	-		Note 9
Luminance of White	5 Points	Y_w	$\Theta = 0^{\circ}$ ILED = 17.9mA	425	500	-	cd/m ²	Note 3
White Luminance Uniformity	5 Points	ΔY_5		80	-	-	%	Note 4
	13 Points	ΔY_{13}		67	-	-	%	
White Chromaticity		W_x	$\Theta = 0^{\circ}$	0.283	0.313	0.343		Note 5
		W_y		0.299	0.329	0.359		
Reproduction of Color	Red	R_x	$\Theta = 0^{\circ}$	Typ.-0.03	0.681	Typ.+0.03		
		R_y			0.312			
	Green	G_x			0.263			
		G_y			0.697			
	Blue	B_x			0.142			持续更新
		B_y			0.053			持续更新
Color Gamut			DCI-P3	95	100	-	%	1931
White Temperature		-	-	5500	6500	7000	K	
Blue light ratio		-	$\Theta = 0^{\circ}$	-	-	50	%	TUV
Response Time (Rising + Falling)		T_{RT}	Ta= 25°C $\Theta = 0^{\circ}$	-	9	12	ms	Note 6
Cross Talk		CT	$\Theta = 0^{\circ}$	-	-	2.0	%	Note 7
Gamma		-	-	2.0	2.2	2.4	-	

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Notes : - 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). - Contrast measurements shall be made at viewing angle of $\Theta = 0^\circ$ 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.$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$ - Center Luminance of white is defined as luminance values of 5 point average across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in Figure 8 for a total of the measurements per display. - The White luminance uniformity on LCD surface is then expressed as : $\Delta Y = \text{Minimum Luminance of 5(or 9 or 13) points} / \text{Maximum Luminance of 5(or 9 or 13) points.}$(see Figure 8 and Figure 9). - 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. - The electro-optical response time measurements shall be made as Figure 10 by switching the “data” input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is T_r, and 90% to 10% is T_r. - Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (YA) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (YB) of that same area when any adjacent area is driven dark. (See Figure 11).			
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8. Response time 9*9 matrix

Response time 9*9 matrix										
Response Time	To									
From	L0	L32	L64	L96	L128	L159	L191	L223	L255	
	L32									
	L64									
	L96									
	L128									
	L159									
	L191									
	L223									
	L255									
Response time (Tr+Tf)=L0 to L255 + L255 to L0										
Response time(gray to gray) average =average time in 9*9 matrix										

9. Ambient Cotrast Ratio

Ambient Cotrast Ratio (ACR) is defined as below:

Lw: white image luminance in darkroom

Lk: black image luminance in darkroom

Lh: white image luminance in sphere

Ld: black image luminance in sphere

Eh: illuminance for white

Ed: illuminance for black

E0: set illuminance in sphere

$$ACR = \frac{\frac{E_0(L_h - L_w)}{E_h} + L_w}{\frac{E_0(L_d - L_k)}{E_d} + L_k}$$

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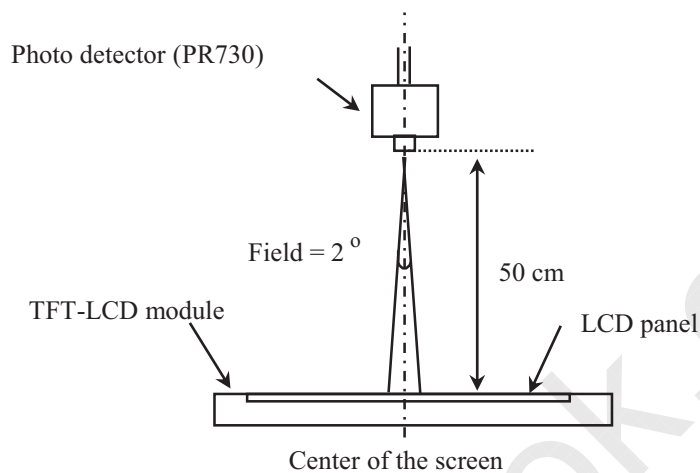
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4.3 Optical Measurements



Optical characteristics measurement setup

Figure 7. Measurement Set Up

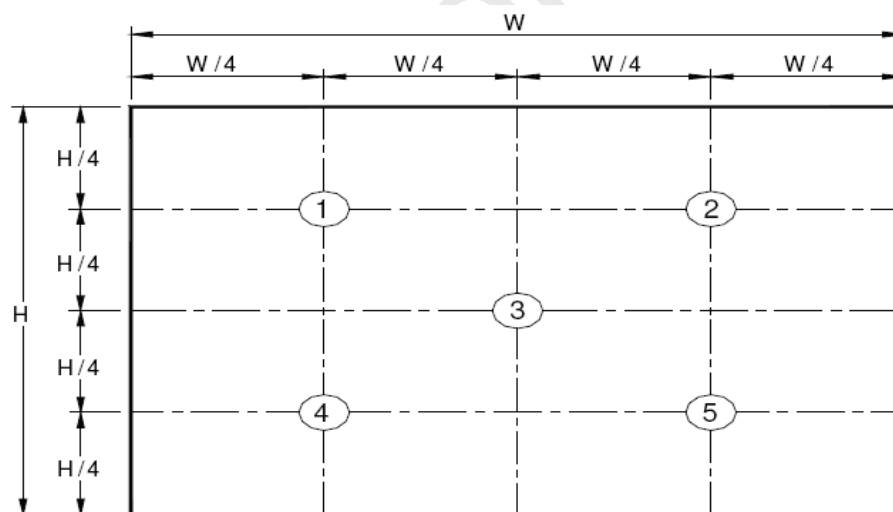


Figure 8. White Luminance and Uniformity Measurement Locations (5 points)

Center Luminance of white is defined as luminance values of center 5 points across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in Figure 7 for a total of the measurements per display.

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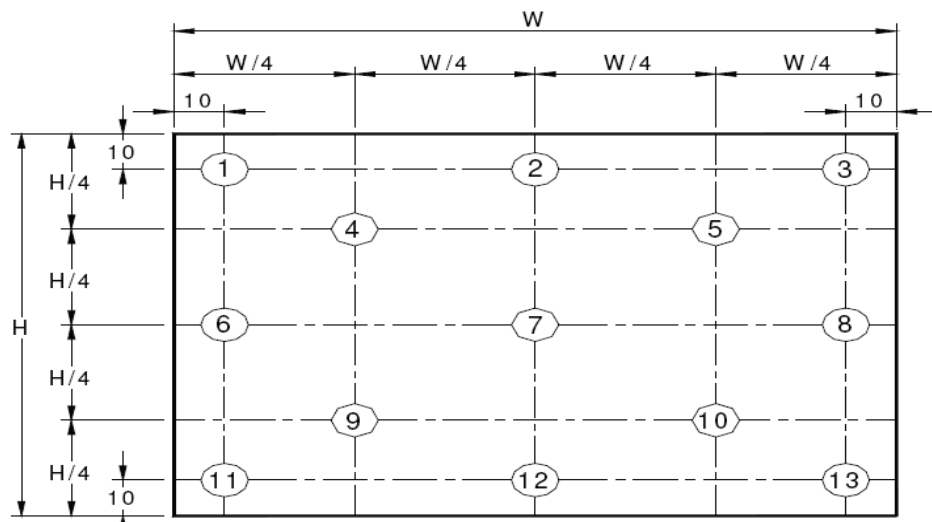


Figure 9. Uniformity Measurement Locations (13 points)

The White luminance uniformity on LCD surface is then expressed as : $\Delta Y5$ = Minimum Luminance of five points / Maximum Luminance of five points (see Figure 8) , $\Delta Y13$ = Minimum Luminance of 13 points /Maximum Luminance of 13 points (see Figure 9).

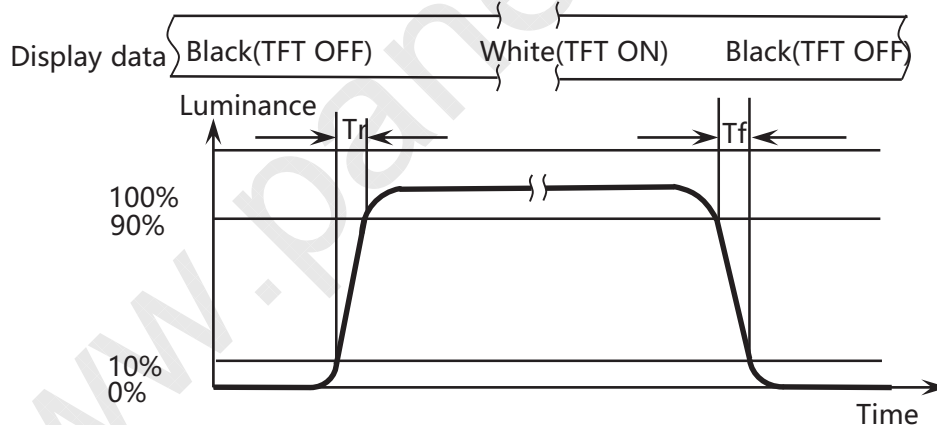


Figure 10. Response Time Testing

The electro-optical response time measurements shall be made as shown in Figure 10 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% .

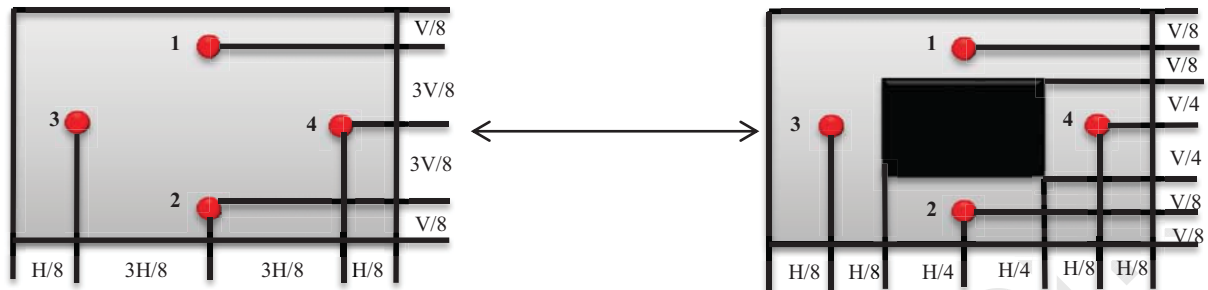
The test system : LMS PR810

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

Figure 11. Cross Talk Modulation Test Description

Where:

Y_A = Initial luminance of measured area (cd/m²)

Y_B = Subsequent luminance of measured area (cd/m²)

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 11)

The test system: PR730

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5.0 INTERFACE CONNECTION

5.1 Electrical Interface Connection

The electronics interface connector is Changtong W05025-40P-H.

The connector interface pin assignments are listed in Table 6.

<Table 6. Pin Assignments for the Interface Connector>

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	I2C_SCL	I2C_SCL for APOL	21	LCD_VCC	LCD logic and driver power
2	H_GND	High Speed Ground	22	BIST	Panel Self Test Enable
3	Lane3_N	Comp Signal Link Lane 3	23	LCD_GND	LCD logic and driver ground
4	Lane3_P	True Signal Link Lane 3	24	LCD_GND	LCD logic and driver ground
5	H_GND	High Speed Ground	25	LCD_GND	LCD logic and driver ground
6	Lane2_N	Comp Signal Link Lane 2	26	LCD_GND	LCD logic and driver ground
7	Lane2_P	True Signal Link Lane 2	27	HPD	HPD signal pin
8	H_GND	High Speed Ground	28	BL_GND	Backlight_ground
9	Lane1_N	Comp Signal Link Lane 1	29	BL_GND	Backlight_ground
10	Lane1_P	True Signal Link Lane 1	30	BL_GND	Backlight_ground
11	H_GND	High Speed Ground	31	BL_GND	Backlight_ground
12	Lane0_N	Comp Signal Link Lane 0	32	BL_Enable	Backlight On / Off
13	Lane0_P	True Signal Link Lane 0	33	BL_PWM_DI M	System PWM signal Input
14	H_GND	High Speed Ground	34	I2C_SDA	I2C SDA for APOL
15	AUX_CH_P	True Signal Auxiliary Ch.	35	HW	MOS preventing I2C overwrite*
16	AUX_CH_N	Comp Signal Auxiliary Ch.	36	BL_PWR	Backlight power
17	H_GND	High Speed Ground	37	BL_PWR	Backlight power
18	LCD_VCC	LCD logic and driver power	38	BL_PWR	Backlight power
19	LCD_VCC	LCD logic and driver power	39	BL_PWR	Backlight power
20	LCD_VCC	LCD logic and driver power	40	NC	No Connection

Note: I2C using information 1.Tcon I2C(DDS) address: 1100001x 2.Digital Vcom Address: 1001111x
3.LED driver: 0110110x

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5.2 eDP Interface

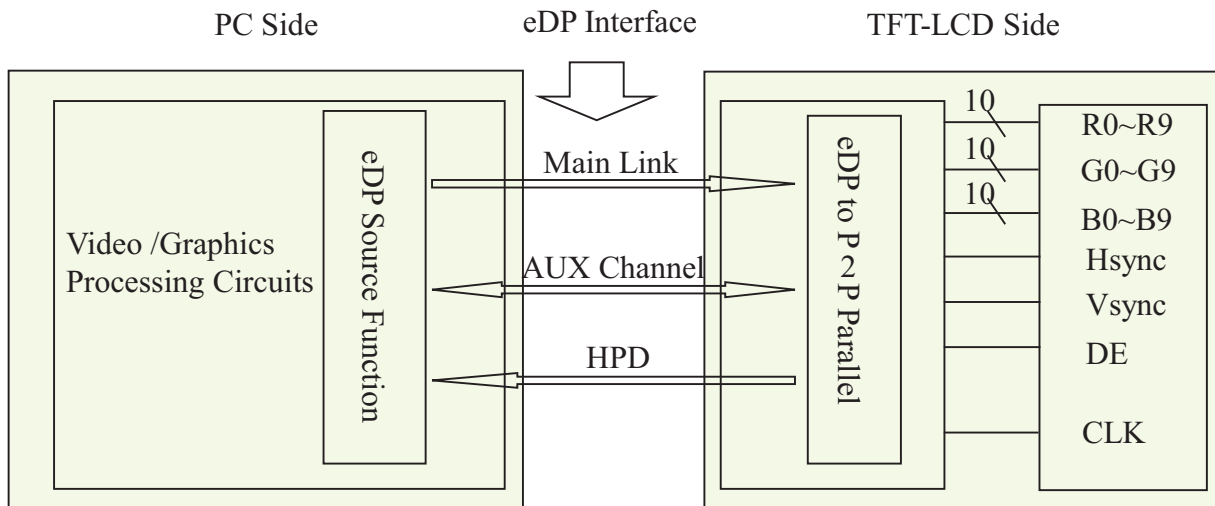


Figure 12. eDP Interface Architecture

Note:

Transmitter : Parade DP501 or equivalent.

Transmitter is not contained in module.

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5.3 Data Input Format

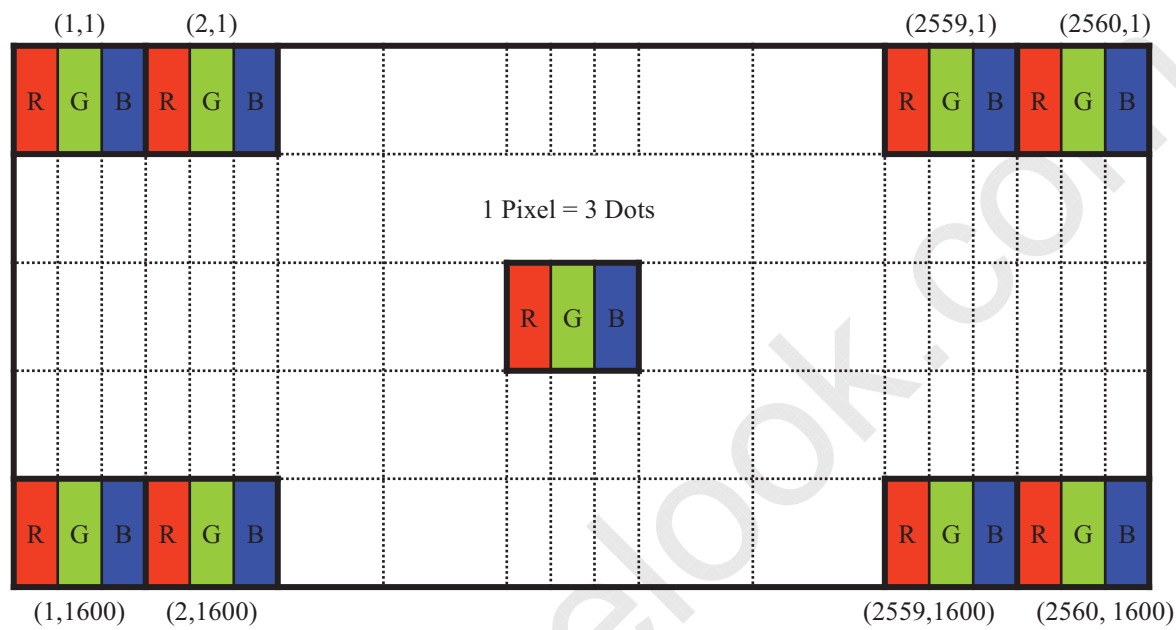


Figure 13. Display Position of Input Data (V-H)

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5.4 Back-light & LCM Interface Connection

BLU Interface Connector: Changtong F03005FA015D8WL.

<Table 7. Pin Assignments for the BLU Connector>

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	LED	LED cathode connection	9	GND	Ground
2	LED	LED cathode connection	10	NC	No Connection
3	LED	LED cathode connection	11	NC	No Connection
4	LED	LED cathode connection	12	Vout	LED anode connection
5	LED	LED cathode connection	13	Vout	LED anode connection
6	LED	LED cathode connection	14	Vout	LED anode connection
7	LED	LED cathode connection	15	Vout	LED anode connection
8	LED	LED cathode connection			

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6.0 SIGNAL TIMING SPECIFICATION

6.1 The NT156FHM-N41 Is Operated By The DE Only

< Table 8. Signal Timing Specification >

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	-	1175.04	-	MHz
Frame Period		Tv	-	1680	-	lines
			-	240	-	Hz
			-	4.17	-	ms
Vertical Display Period		Tvd	-	1600	-	lines
One line Scanning Period		Th	-	2720	-	clocks
Horizontal Display Period		Thd	-	2560	-	clocks

Note : The above is as optimized setting.

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6.2 eDP Rx Interface Timing Parameter

The specification of the eDP Rx interface timing parameter is shown in Table 9.

<Table 9. eDP Main-Link RX TP4 Package Pin Parameters>

Item	Symbol	Min	Typ	Max	Unit	Remark
Spread spectrum clock (Link clock down-spreading)	SSC	-	-	0.5	%	
Differential peak-to-peak input voltage at package pins	VRX-DIFFp-p	120	-	1200	mV	
Rx input DC common mode voltage	VRX_DC_CM	0	-	2	V	
Differential termination resistance	RRX-DIFF	80	-	100	Ω	
Single-ended termination resistance	RRX-SE	40	-	60	Ω	
Rx short circuit current limit	IRX_SHORT	-	-	20	mA	
Intra-pair skew at Rx package pins (HBR) RX intra-pair skew tolerance at HBR	LRX_SKEW_ INTRA_PAIR	-	-	60	ps	
AC Coupling Capacitor	CSOURCE_ML	75		200	nF	Source side

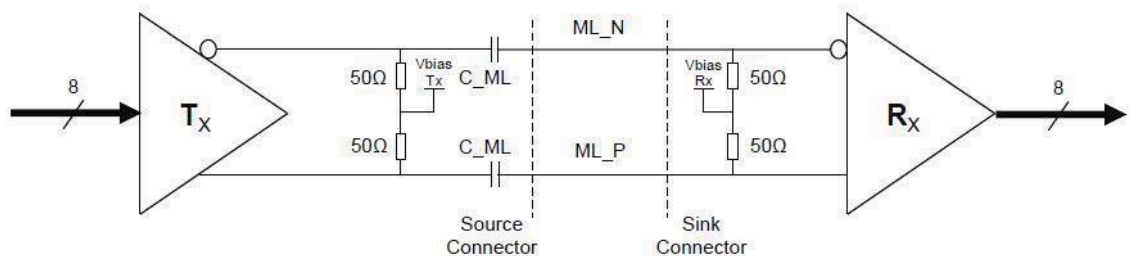


Figure 14. Main link differential pair

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The diagram illustrates the timing relationship between VRX-DIFFp-p and LRX_SKEW_INTRA_PAIR. The top section shows a differential signal VRX-DIFFp-p with a peak-to-peak voltage swing. The bottom section shows the common-mode signal VRX_DC_CM and the differential signals VD+ and VD-. The time skew LRX_SKEW_INTRA_PAIR is indicated between the signals.

Figure 15. VRX-DIFFp-p & LRX_SKEW_INTRA_PAIR

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<Table 10. HPD Characteristics>

Item	Symbol	Min	Typ	Max	Unit	Remark
HPD voltage	V _{HPD}	2.25	-	3.6	V	
Hot Plug Detection Threshold	-	2.0	-	-	V	Source side Detecting
Hot Unplug Detection Threshold	-	-	-	0.8	V	
HPD_IRQ Pulse Width	HPD_IRQ	0.5	-	1	ms	
HPD_TimeOut	-	2.0	-	-	ms	

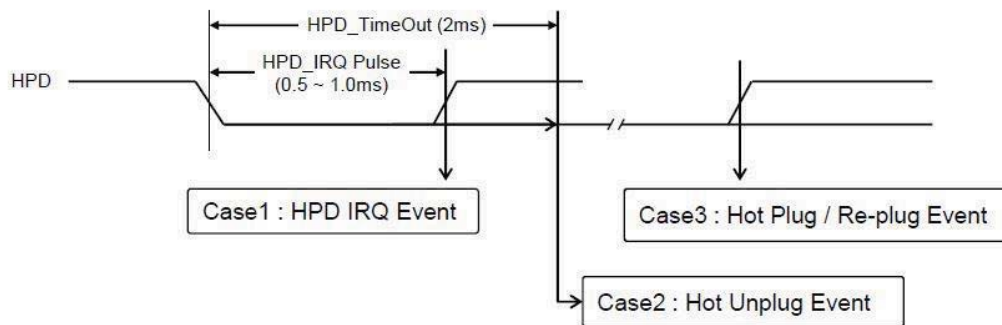


Figure 16. HPD Events

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<Table 11. AUX Characteristics>

Item	Symbol	Min	Typ	Max	Unit	Remark
AUX unit interval	UIAUX	0.4	0.5	0.6	Us	
AUX peak-to-peak input differential voltage	VAUX-RX-D IFFp-p	0.29	-	1.38	V	
AUX CH termination DC resistance	RAUX-TER M	80	100	120	Ohm	
AUX DC common mode voltage	VAUX-DC-C M	0	-	2	V	
AUX turn around common mode voltage	VAUX-TUR N-CM	-	-	0.3	V	
AUX short circuit current limit	IAUX-SHOR T	-	-	90	mA	
AUX AC Coupling Capacitor	CSOURCE-A UX	75	-	200	nf	Source side

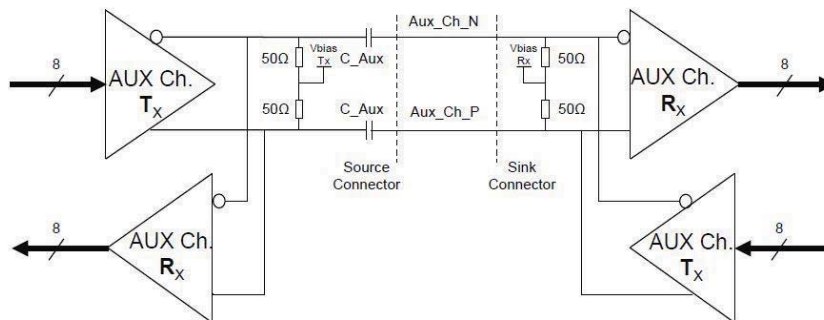


Figure 17. AUX differential pair

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

<Table 12. Input Signal & Basic Display Colors & Gray Scale of Colors >

	Colors & Gray scale	Data signal																											
		R0 R1 R2 R3 R4 R5 R6 R7 R8 R9	G0 G1 G2 G3 G4 G5 G6 G7 G8 G9	B0 B1 B2 B3 B4 B5 B6 B7 B8 B9																									
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 0 0 0 0 0 0																									
	Blue	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1																									
	Green	0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0																									
	Light Blue	0 0 0 0 0 0 0 0 0 0	1 1 1 1 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 1 1	0 0 0 0 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 1 1	0 0 0 0 0 0 0 0 0 0	1 1 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 1 1 1 1	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 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 0 0 0 0 0 0																									
	△	1 0 0 0 0 0 0 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 0 0 0 0 0 0																									
	△	↑									↑									↑									
	▽	↓									↓									↓									
	Brighter	1 0 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0																									
	▽	0 1 1 1 1 1 1 1 1 1	0 0 0 0 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 1 1	0 0 0 0 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 0 0 0 0 0 0																									
	△	0 0 0 0 0 0 0 0 0 0	1 0 0 0 0 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 0	0 1 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0																									
	△	↑									↑									↑									
	▽	↓									↓									↓									
	Brighter	0 0 0 0 0 0 0 0 0 0	1 0 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0																									
	▽	0 0 0 0 0 0 0 0 0 0	0 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0																									
	Green	0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1	0 0 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 0 0 0 0 0 0																									
	△	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	1 0 0 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 0 0 0	0 1 0 0 0 0 0 0 0 0																									
	△	↑									↑									↑									
	▽	↓									↓									↓									
	Brighter	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	1 0 1 1 1 1 1 1 1 1																									
	▽	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	0 1 1 1 1 1 1 1 1 1																									
	Blue	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	1 1 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 0 0 0 0 0 0																									
	△	1 0 0 0 0 0 0 0 0 0	1 0 0 0 0 0 0 0 0 0	1 0 0 0 0 0 0 0 0 0																									
	Darker	0 1 0 0 0 0 0 0 0 0	0 1 0 0 0 0 0 0 0 0	0 1 0 0 0 0 0 0 0 0																									
	△	↑									↑									↑									
	▽	↓									↓									↓									
	Brighter	1 0 1 1 1 1 1 1 1 1	1 0 1 1 1 1 1 1 1 1	1 0 1 1 1 1 1 1 1 1																									
	▽	0 1 1 1 1 1 1 1 1 1	0 1 1 1 1 1 1 1 1 1	0 1 1 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 1 1 1 1 1 1																								

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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.

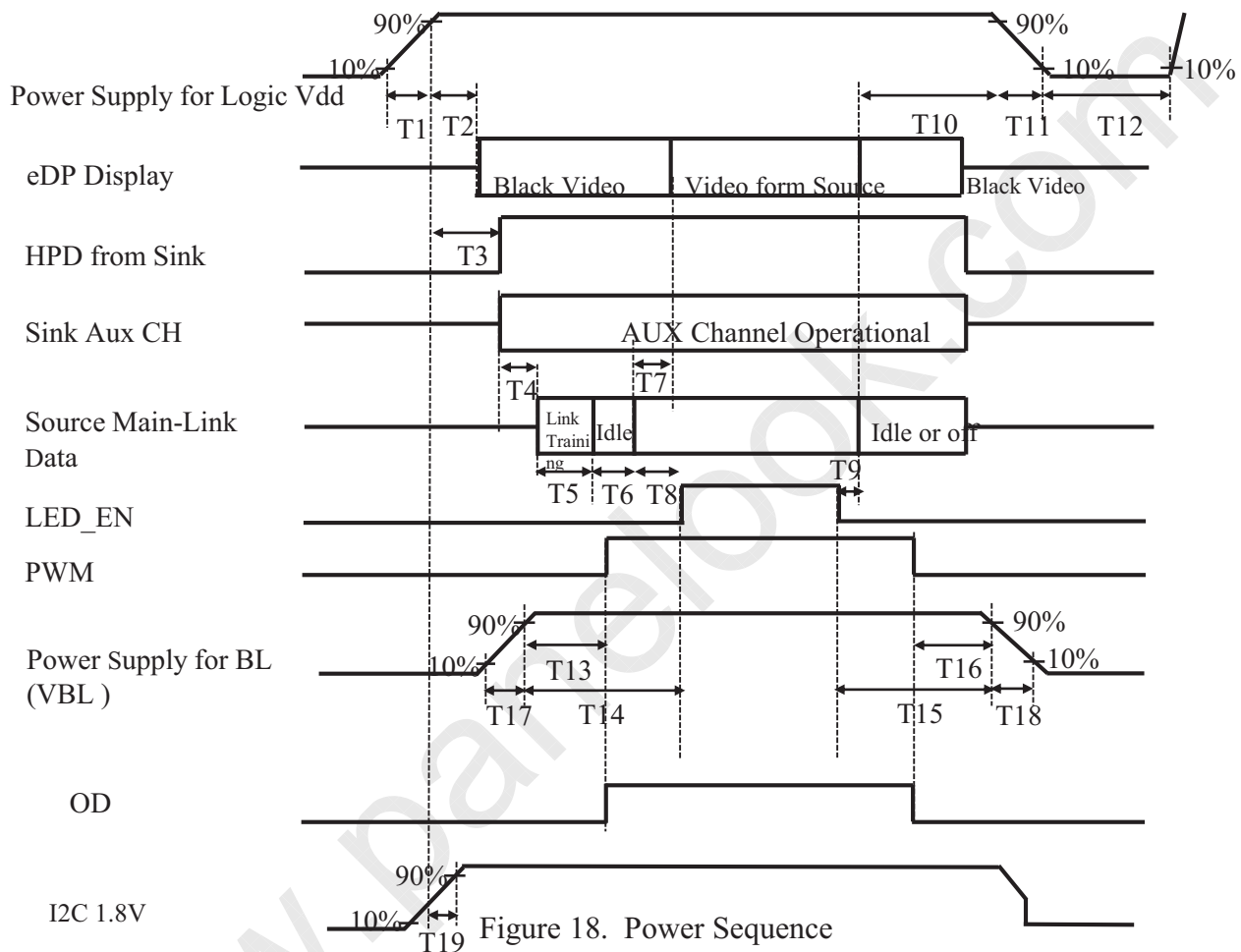


Figure 18. Power Sequence

- $0.5\text{ms} \leq T1 \leq 10\text{ ms}$
- $0\text{ms} < T2 \leq 80\text{ ms}$
- $0\text{ms} < T3 \leq 200\text{ ms}$
- $T4+T5+T6+T8 > 80\text{ms}$
- $0\text{ms} < T7 \leq 50\text{ms}$
- $50\text{ms} < T8$
- $0\text{ms} < T9$
- $100\text{ms} < T10 < 500\text{ ms}$
- $0.5\text{ms} \leq T11 \leq 10\text{ ms}$
- $500\text{ms} \leq T12$
- $0\text{ms} < T13$
- $0\text{ms} < T14$
- $0\text{ms} < T15$
- $0\text{ms} < T16$
- $0.5\text{ms} \leq T17$
- $0.5\text{ms} \leq T18$
- $20\text{ms} \leq T19$

Notes:

1. When the power supply VDD is 0V, keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on. Back Light must be turn on after power for logic and interface signal are valid.

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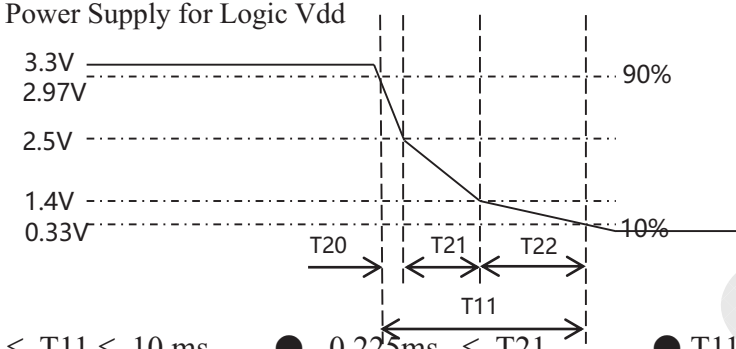
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Power Supply for Logic Vdd  ● $0.5\text{ms} \leq T11 \leq 10\text{ ms}$ ● $0.225\text{ms} \leq T21$ ● $T11=T20+T21+T22$ Figure 19. T11 timing requirements			
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9.0 Connector Description

Physical interface is described as for the connector on LCM.

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

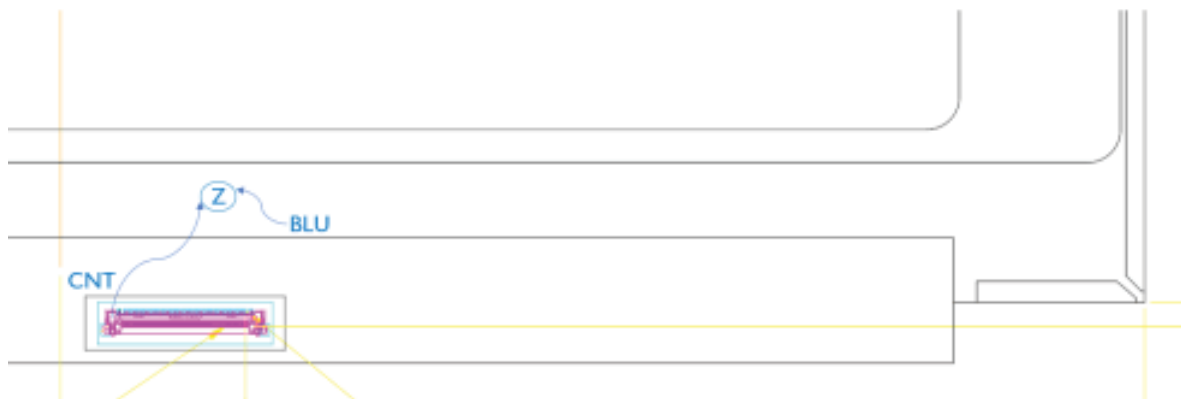
9.1 TFT LCD Module

< Table 13. Signal Connector >

Connector Name /Description	For Signal Connector
Manufacturer	Changtong
Type/ Part Number	W05025-40P-H.
Mating Housing/ Part Number	I-PEX 20454-040T

9.2 Impedence between Connector to BLU (Panel non-operation grounding)

The impedance of any two metal points must be less than 5 ohms (The distance between two points less than 3cm). Refer to the following picture.



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10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

Figure 23 shows mechanical outlines for the model NT156FHM-N41.
Other parameters are shown in Table 14.

<Table 14. Dimensional Parameters>

Parameter	Specification	Unit
Active Area	344.67 (H) × 215.42 (V)	mm
Number of pixels	2560 (H) X 1600 (V) (1 pixel = R + G + B dots)	pixels
Pixel pitch	134.64(H) X 134.64 (V)	um
Pixel arrangement	RGB Vertical stripe	
Display colors	1064.3M(8bit+FRC)	
Display mode	Normally black	
Dimensional outline	349.68±0.3 (H)*224.42±0.3(V)(W/O PCB)*2.6 (Max) 349.68±0.3(H)*224.42±0.5(V) (W/PCB)*4.6(Max)	mm
Weight	312 (max)	g

10.2 Mounting

See Figure 24.

10.3 Anti-Glare and Polarizer Hardness.

The surface of the polarizer has an Anti-Glare and low reflection coating to minimize reflection , the polarizer hardness is 3H to reduce scratching.

10.4 Light Leakage

There shall not be visible light from the back-lighting system around the edges of the screen as seen from a distance 50cm from the screen with an overhead light level of 350lux.

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11.0 RELIABILITY TEST

The reliability test items and its conditions are shown in below.

<Table 15. 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 operation test	Ta = 50°C , 80%RH, 240 hrs	
4	High temperature operation test	Ta = 60°C ,240 hrs	
5	Low temperature operation test	Ta = -5°C , 240 hrs	
6	Thermal shock	Ta = -20 °C ↔ 60 °C (0.5 hr), 100 cycle	
7	Vibration test (non-operating)	Ta = 25°C , 60%RH, 1.5G, 10~500Hz, Sine X,Y,Z / Sweep rate : 1 hour	Note 1
8	Shock test (non-operating)	Ta = 25°C , 60%RH, 220G, Half Sine Wave 2msec±X,±Y,±Z Once for each direction	Note 1
9	Electro-static discharge test (operating)	Air : 150 pF, 330Ω, ±15 KV Contact : 150 pF, 330Ω, ±8 KV Ta = 25°C , 60%RH,	Note 2

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.

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12.0 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.

• Obey 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.

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13.0 LABEL

(1) Product Label

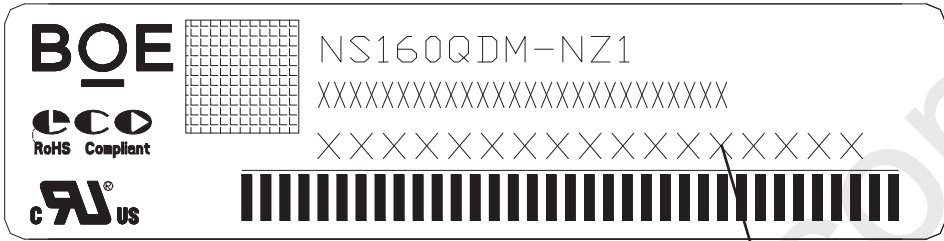


Figure 22. Product Label

<Table 17. Module ID Naming Rule for example>

Digit Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Code	B	9	A	F	1	7	8	8	D	3	1	0	0	0	0	6	8
Description	Product Name		Product Grade	B8	Year		Month	Model Extension Code (Last 4 Digits of FG CODE)				Serial No. 00001-ZZZZZZ					

(2) High voltage caution label

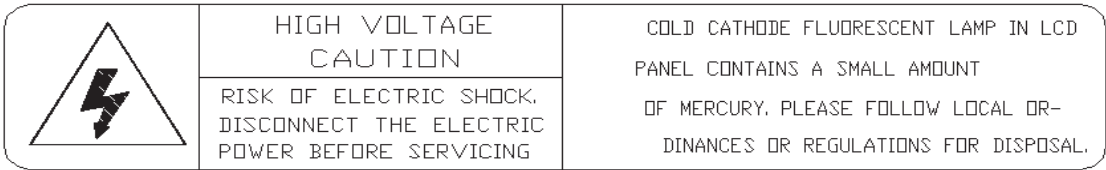


Figure 21. High Voltage Caution Label

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(3) Box label

 CHONGQING BOE OPTOELECTRONICS
TECHNOLOGY Co., LTD

MODEL: XXXXXXXXXXXXXXXX (1)

Q'TY: XX (2)

SERIAL NO: XXXXXXXXXXXXXXXX (3)

DATE: XXXXXXXX (4)

BOX ID

XXXXXXXXXX (5) XXXX (6) XXXX (7)


RoHS Compliant

液晶显示板
重庆京东方光电科技有限公司
重庆市北碚区水土高新技术产业园云汉大道7号

Figure 21. Box Label

Serial number marked part needs to print, show as follows:

1. FG-CODE(Before 12 bit)
2. Product quantity
3. Box ID
4. Date
5. The client section material number(The client)
6. FG-Code After four
7. The supplier code

Total Size:100×60mm

<Table 17. Box Label Naming Rule >

Digit Code	1	2	3	4	5	6	7	8	9	10	11	12	13
Code	X	X	X	X	X	X	X	X	X	X	X	X	X
Description	Product Name		Product Grade	Facility Code	Year		Month	Revision	Box Serial NO.				

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14.0 PACKING INFORMATION

14.1 Packing Order

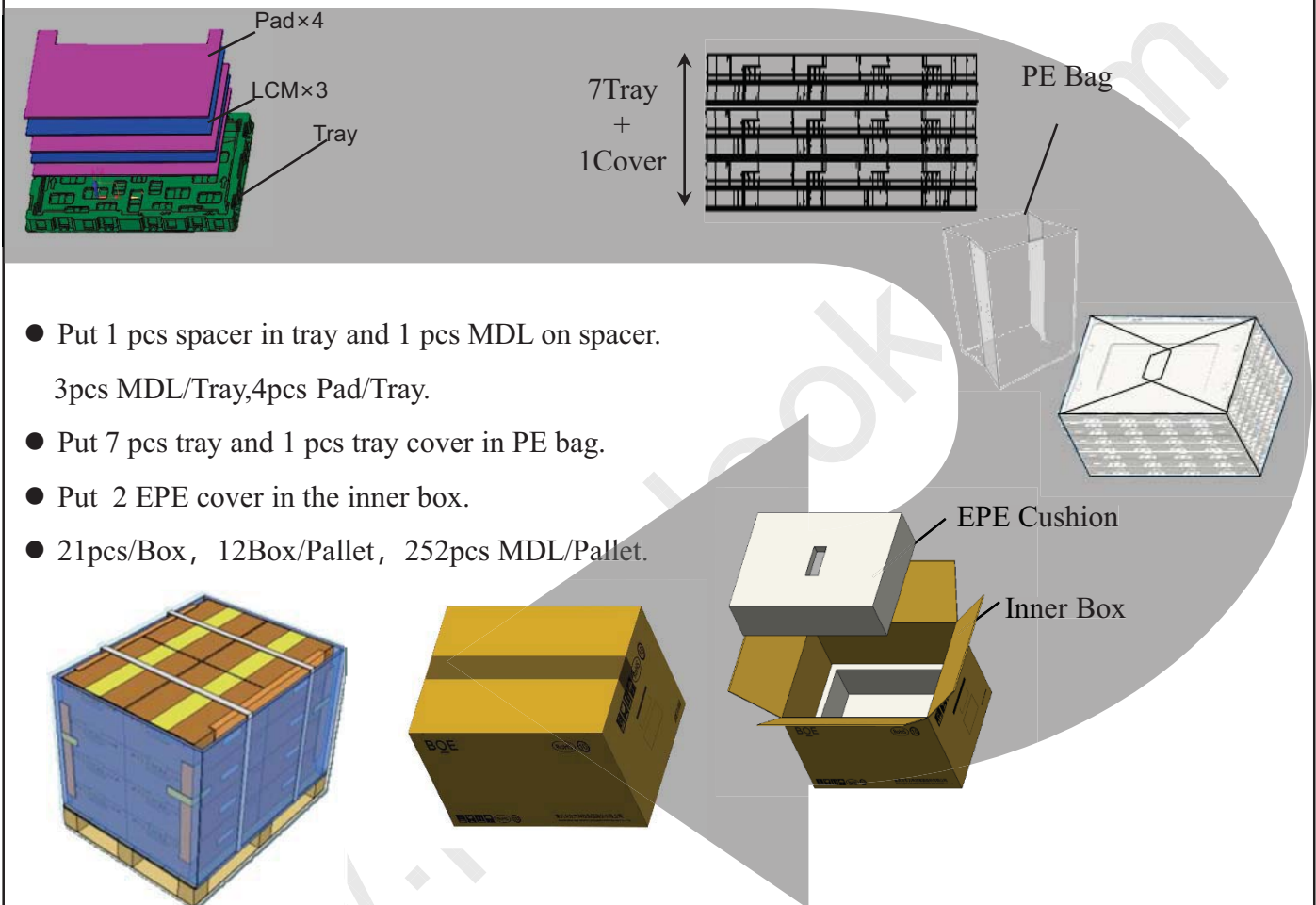


Figure 25. Packing Order

14.2 Note

- Box dimension: 522mm*392mm*294mm
- Package quantity in one box: 21pcs
- Total weight: 10.1kg/Box

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15.0 MECHANICAL OUTLINE DIMENSION

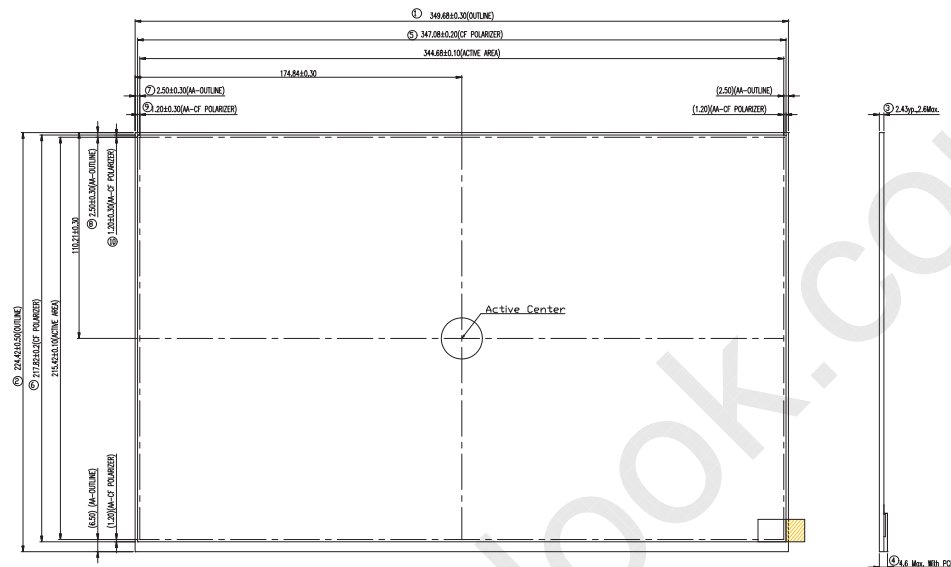


Figure 24. TFT-LCD Module Outline Dimension (Front View)

Notes:

1. Warpage and deformation Spec.: 0.6mm Max..
2. The eDP connector is measured at PIN 1 and mating line.
3. Unspecified tolerance refer to ± 0.3 mm.
4. Top polarizer is the highest portion.
5. Critical dimension: ① ~ ⑫
6. Do not have light leakage on four corners of module.
7. Measurement method refer to Appendix A
8. System matching refer to Appendix B
9. “()”marks the reference dimensions.

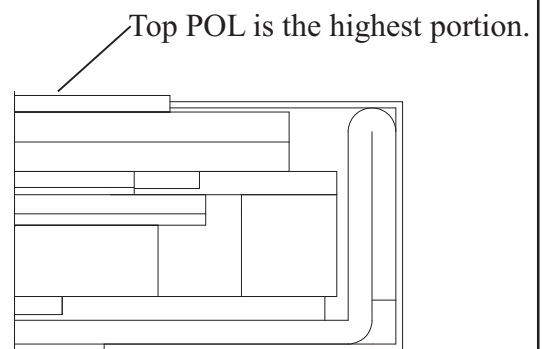


Figure 25. Highest Point Position

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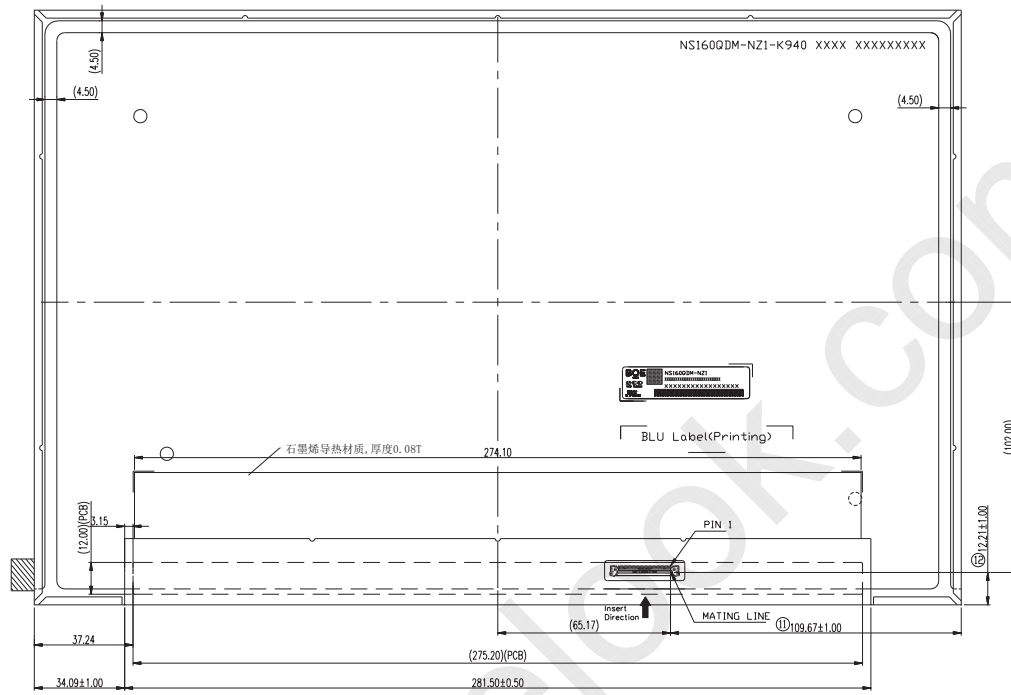


Figure 26. TFT-LCD Module Outline Dimensions (Rear view)

Notes:

1. Warpage and deformation Spec.: 0.6mm Max..
2. The eDP connector is measured at PIN 1 and mating line.
3. Unspecified tolerance refer to ± 0.3 mm.
4. Top polarizer is the highest portion.
5. Critical dimension: ① ~ ⑫
6. Do not have light leakage on four corners of module.
7. Measurement method refer to Appendix A
8. System matching refer to Appendix B
9. “()”marks the reference dimensions.

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16.0 EDID Table

Address (HEX)	Function	Hex	Dec	crc	Input values.	Notes
00	Header			-		
01	Header	00	0	-	0	EDID Header
02		FF	255	-	255	
03		FF	255	-	255	
04		FF	255	-	255	
05		FF	255	-	255	
06		FF	255	-	255	
07		FF	255	-	255	
08		00	0	-	0	
09	ID Manufacturer Name	09	9	-	BOE	ID = BOE
0A		E5	229	-		
0B	ID Product Code	81	129	-	3457	ID = 3457
0C		0D	13	-		
0D	32-bit serial No.	00	0	-	0	-
0E		00	0	-	0	
0F		00	0	-	0	
10		00	0	-	0	
11	Week of manufacture	05	5	-	5	
12	Year of Manufacture	23	35	-	2025	Manufactured in 2025
13	EDID Structure Ver.	01	1	-	1	EDID Ver 1.0
14	EDID revision #	04	4	-	4	EDID Rev. 0.4
15	Video input definition	B5	181	-	-	Refer to right table
16	Max H image size	22	34	-	34.47	34.468 cm (Approx)
17	Max V image size	16	22	-	21.54	21.542 cm (Approx)
18	Display Gamma	78	120	-	2.2	Gamma curve = 2.2
19	Feature support	03	3	-	-	Refer to right table
1A	Red/Green low bits	76	118	-	-	Red / Green Low Bits
1B	Blue/White low bits	65	101	-	-	Blue / White Low Bits
1C	Red x high bits	AE	174	697	0.681	Red (x) = 10101110 (0.681)
1D	Red y high bits	4F	79	319	0.312	Red (y) = 01001111 (0.312)
1E	Green x high bits	43	67	269	0.263	Green (x) = 01000011 (0.263)
1F	Green y high bits	B2	178	714	0.697	Green (y) = 10110010 (0.697)
20	Blue x high bits	24	36	145	0.142	Blue (x) = 00100100 (0.142)
21	Blue y high bits	0D	13	54	0.053	Blue (y) = 00001101 (0.053)
22	White x high bits	50	80	321	0.313	White (x) = 01010000 (0.313)
23	White y high bits	54	84	337	0.329	White (y) = 01010100 (0.329)
24	Established timing 1	00	0	-	-	Refer to right table
25	Established timing 2	00	0	-	-	

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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	34	52	-	548.35	548.352MHz Main clock		
37		D6	214	-				
38		00	0	-	2560	Hor Active = 2560		
39		A0	160	-	160	Hor Blanking = 160		
3A		A0	160	-	-	4 bits of Hor. Active + 4 bits of Hor. Blanking		
3B		40	64	-	1600	Ver Active = 1600		
3C		E0	224	-	1760	Ver Blanking = 1760		
3D		66	102	-	-	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		66	102	-	6	V sync Offset = 6 line		
41		00	0	-	6	V Sync Pulse width : 6 line		
42		59	89	-	345	Horizontal Image Size = 344.68 mm (Low 8 bits)		
43		D7	215	-	215	Vertical Image Size = 215.42 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		
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48	Detailed timing/monitor descriptor #2	00	0	-	-	Indicates descriptor is a display Descriptor	
49		00	0	-	-		
4A		00	0	-	-	Reserved	
4B		FD	253	-	-	Tag Number for Display Range Limits Descriptor	
4C		0C	12	-	12	Vertical/Horizontal Rate Offset are zero	
4D		3C	60	-	60	Minimum Vertical Rate:60 Hz	
4E		F0	240	-	240	Maximum Vertical Rate:240 Hz	
4F		94	148	-	403.2	Minimum Horizontal Rate:403.2 kHz	
50		94	148	-	403.2	Maximum Horizontal Rate:403.2 kHz	
51		6E	110	-	1096.7040	Maximum Pixel Clock:1096.704 MHz	
52		01	1	-	-	Range Limits Only	
53		0A	10	-	-	Display Range Limits & CVT Support Definition	
54		20	32	-	-		
55		20	32	-	-		
56		20	32	-	-		
57		20	32	-	-		
58		20	32	-	-		
59		20	32	-	-		
5A	Detailed timing/monitor descriptor #3	00	0	-	-	-	
5B		00	0	-	-	-	
5C		00	0	-	-	-	
5D		00	0	-	-	-	
5E		00	0	-	-	-	
5F		00	0	-	-	-	
60		00	0	-	-	-	
61		00	0	-	-	-	
62		00	0	-	-	-	
63		00	0	-	-	-	
64		00	0	-	-	-	
65		00	0	-	-	-	
66		00	0	-	-	-	
67		00	0	-	-	-	
68	00	0	-	-	-		
69	00	0	-	-	-		
6A	00	0	-	-	-		
6B	00	0	-	-	-		
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6C	Detailed timing/monitor descriptor #4	00	0	-	-	Indicates descriptor #4 is a display Descriptor	
6D		00	0	-	-	Reserved	
6E		00	0	-	-	Tag: ASCII String	
6F		FC	252	-	-	Reserved	
70		00	0	-	-	Model name : NS160QDM-NZ1	
71		4E	78	-	N		
72		53	83	-	S		
73		31	49	-	1		
74		36	54	-	6		
75		30	48	-	0		
76		51	81	-	Q		
77		44	68	-	D		
78		4D	77	-	M		
79		2D	45	-	-		
7A		4E	78	-	N		
7B		5A	90	-	Z		
7C		31	49	-	1		
7D		0A	10	-	-		
7E	Extension flag	01	1	-	2	0 : 1個EDID; N-1: N个EDID	
7F	Checksum	A6	166	166	-		
80	DID Extension Header	70	112	-	112	DisplayID EDID Extension Block tag	
81		20	32	-	32	DisplayID Version/Revision = 2.0	
82		79	121	-	121	Section Size (byte) = 121 bytes	
83		02	2	-	2	Display Product Primary Use Case	
84	DID Block #1 Header	00	0	-	0	Extension count	
85		21	33	-	33	DID2.0 Data block tag[21h] =Display Parameters Data Block	
86		00	0	-	0	Block Revision and Other Data Block revision = Revision 0 Multiplier = 0 (0.1-mm precision).	
87		1D	29	-	29	Number of Payload Bytes in block= 29 Bytes	
88	DID Display Parameters Data Block #1	7A	122	-	345.0	Horizontal Image Size=345	
89		0D	13	-			
8A		66	102	-	215.0	Vertical Image Size=215	
8B		08	8	-			
8C		00	0	-	2560	Horizontal Pixel Count=2560	
8D		0A	10	-			
8E		40	64	-	1600	Vertical Pixel Count=1600	
8F		06	6	-			
90		80	128	-	128	Bit 7 = Audio Speaker Information = 1 (Audio speakers are not integrated into the display). Bit 6 = Color Information = 0 (specified in terms of CIE 1931 (x, y) coordinates). Bit 5 = RESERVED = 0. Bits 4:3 = Luminance Information = 00b (minimum guaranteed value). Bits 2:0 = Scan Orientation = 000b (left to right, top to bottom)	
91		E5	229	2789	0.681	Rx=0.681	
92		DA	218				
93		4F	79	1277	0.312	Ry=0.312	
94		35	53	1077	0.263	Gx=0.263	
95		64	100				
96		B2	178	2854	0.697	Gy=0.697	
97		45	69	581	0.142	Bx=0.142	
98		92	146				
99		0D	13	217	0.053	By=0.053	
9A		02	2	1282	0.313	Wx=0.313	
9B		35	53				
9C		54	84	1347	0.329	Wy=0.329	
9D		D0	208	-	500	Native Maximum Luminance(Full Coverage)=500nit	
9E		5F	95	-	500	Native Maximum Luminance(10%)=500nit	
9F		D0	208	-			
A0		5F	95	-			
A1		00	0	-	5.00	Native Minimum Luminance=5nit	
A2		45	69	-			
A3		13	19	-	19	10bit,LCD	
A4		78	120	-	2.2	Gamma =2.2	
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A5	DID Block #1 Header	22	34	-	34	DID2.0 Data block tag[22h] =Detailed Timing Data Block	
A6		00	0	-	0	Block revision = Revision 1	
A7		14	20	-	20	Number of Payload Bytes in block= 40 Bytes	
A8	DID DATA Detailed Timing Data Block #1	FF	255	-	1096.7	Pixel Clock (Low bit, Range = 0.001Mhz (000000h) ~ 16,777.216Mhz (FFFFFFh))	
A9		BB	187	-		Minium Pixel Clock (Middle bit)	
AA		10	16	-		Minium Pixel Clock (High bit)	
AB		85	133	-	133	timing options	
AC		FF	255	-	2560	H-Active	
AD		09	9	-			
AE		9F	159	-	160	H-Blanking	
AF		00	0	-			
B0		2F	47	-	48	H-offset	
B1		00	0	-			
B2		1F	31	-	32	H-sync pulse width	
B3		00	0	-			
B4		3F	63	-	1600	V-Active	
B5		06	6	-			
B6		4F	79	-	80	V-Blanking	
B7		00	0	-			
B8		05	5	-	6	V-offset	
B9		00	0	-			
BA		05	5	-	6	V-sync pulse width	
BB		00	0	-			
BC	DID Block #2 Header	2B	43	-	43	DID2.1 Data block tag[2Bh] = Adaptive-Sync Data Block	
BD		00	0	-	0	Block revision = Revision 0	
BE		0C	12	-	12	Number of Payload Bytes in block= 67Bytes	
BF	DID DATA Block #2 Adaptive-Sync	27	39	-	39	Adaptive-Sync Operation and Range Information	
C0		00	0	-	0	Flicker performance is met in any duration decrease within the refresh rate range without jitter impact.	
C1		3C	60	-	60	Min. Vertical Rate : 60 Hz	
C2		EF	239	-	239	Maximum Refresh Rate7:0	
C3		00	0	-	0	bit1:0 =01: Maximum Refresh Rate9:8	
C4	DID DATA Block #3 Adaptive-Sync	00	0	-	0	Flicker performance is met in any duration decrease within the refresh rate range without jitter impact.	
C5		27	39	-	39	Adaptive-Sync Operation and Range Information	
C6		00	0	-	0	Flicker performance is met in any duration decrease within the refresh rate range without jitter impact.	
C7		3C	60	-	60	Min. Vertical Rate : 48 Hz	
C8		3B	59	-	60	Maximum Refresh Rate7:0	
C9	DID DATA Block #6 Brightness Luminance Range Data Block	00	0	-	0	bit1:0 =01: Maximum Refresh Rate9:8	
CA		00	0	-	0	Flicker performance is met in any duration decrease within the refresh rate range without jitter impact.	
CB		2E	46	-	46	DID2.0 Data block tag[2Eh] = Brightness Luminance Range Data Block	
CC		00	0	-	0	Block revision = Revision 0	
CD		06	6	-	6	Number of Payload Bytes in block= 6 Bytes	
CE		00	0	-	5.00	Minimum SDR Luminance (Full Coverage)	
CF		45	69	-		Minimum SDR Luminance (Full Coverage)	
D0		D0	208	-	500	Maximum Suggested SDR Luminance (Full Coverage)	
D1		5F	95	-		Maximum Suggested SDR Luminance (Full Coverage)	
D2		D0	208	-	500	Maximum Boost SDR Luminance	
D3		5F	95	-		Maximum Boost SDR Luminance	
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D4	DID Block #3 Header(VSDB)	81	129	-	129	DID2.0 Data block tag[81h] = CTA DisplayID	
D5		00	0	-	0	Block revision = Revision 0	
D6		13	19	-	19	Number of Payload Bytes in block= 21 Bytes	
D7	DID DATA Block #4(VSDB3)	74	116	-	116	CTA Block1 Tag Code and Block1 Length = Vendor Specific Data Block(03h), Size(byte) = 18 bytes	
D8		1A	26	-	26	AMD IEEE OUI value (0x00001A)	
D9		00	0	-		(Hex. LSB first)	
DA		00	0	-		(Hex. LSB first)	
DB		03	3	-	3	AMD VSDB Version 3	
DC		01	1	-	1	Bit 7 = Fast Transport Supported Bit 6 = Replay Mode Supported Bit 5 =SPRS Supported Bit 4 = Replay/PSR Switch supported Bit 3 = Local Dimming Control Supported Bit 2 = RESERVED = 0 Bit 1 = Native Color Space Set Supported Bit 0 = FreeSync supported by panel	
DD		3C	60	-	60	Min Refresh Rate	
DE		F0	240	-	240	Max Refresh Rate	
DF		00	0	-	0	Freesync MCCC VCP Code	
E0		00	0	-	0	Bit 7:6 =Panel Type (00 = Not Specified 01 = miniLED 10 = OLED 11 = Reserved) Bit 5 = PQ EOTF Supported Bit 4 = RESERVED = 0 Bit 3 = RESERVED = 0 Bit 2 = Gamma 2.2 EOTF Supported Bit 1 = RESERVED = 0 Bit 0 = RESERVED = 0	
E1		6B	107	-	500	Max Luminance 1 (for HDR) = 500 Cd/m2	
E2		FF	255	-	5	Min Luminance 1 (for HDR) = 5 Cd/m2	
E3		6B	107	-	500	Max Luminance 2 (for HDR) = 500 Cd/m2	
E4		FF	255	-	5	Min Luminance 2 (for HDR) = 5 Cd/m2	
E5		F0	240	-	240	Bits 7:0 -Freesync Maximum Refresh Rate (MSB)	
E6		00	0	-	0	Bits 9:8 - MSB FreeSync Maximum refresh rate [Hz]	
E7		00	0	-	0.0	Maximum Fast Transport Input Pixel Rate [kHz] - bits 7:0	
E8		00	0	-	0.0	Maximum Fast Transport Input Pixel Rate [kHz] - bits 15:8	
E9		00	0	-	0.0	Maximum Fast Transport Input Pixel Rate [kHz] - bits 23:16	
EA		00	0	-	0	Additional Sink information offset DP/eDP Port: offset from DPCD 0x403	
EB		00	0	-	-	Embedded display features handshaking	
EC	-	00	0	-	-	Unused	
ED	-	00	0	-	-	Unused	
EE	-	00	0	-	-	Unused	
EF	-	00	0	-	-	Unused	
F0	-	00	0	-	-	Unused	
F1	-	00	0	-	-	Unused	
F2	-	00	0	-	-	Unused	
F3	-	00	0	-	-	Unused	
F4	-	00	0	-	-	Unused	
F5	-	00	0	-	-	Unused	
F6	-	00	0	-	-	Unused	
F7	-	00	0	-	-	Unused	
F8	-	00	0	-	-	Unused	
F9	-	00	0	-	-	Unused	
FA	-	00	0	-	-	Unused	
FB	-	00	0	-	-	Unused	
FC	-	00	0	-	-	Unused	
FD	-	00	0	-	-	Unused	
FE	Checksum(00~7E)	40	64	-	-		
FF	Checksum(00~7F)	90	144	-	-		
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16.1 Tcon code & DDS checksum							
<table><tr><th>Item</th><th>Checksum</th></tr><tr><td>Tcon code</td><td>C5BD</td></tr></table>				Item	Checksum	Tcon code	C5BD
Item	Checksum						
Tcon code	C5BD						
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17.0 GENERAL PRECAUTIONS

17.1 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.

17.2 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°C 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.

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17.3 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, BOE is not to be held reliable for the defective operations. It is strongly recommended to contact BOE to find out fitness for a particular purpose. 17.4 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.			
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Appendix A The Measurement Methods for the Dimensions of Module 1. Caliper: a. Thickness of Outline (Without/With PCB For Flat Project) (Without/With PCB For Bend Project) b. Length of Outline (Without Tape Wrinkle or Bulged) c. Width of Outline (Without PCB) (Without Tape Wrinkle or Bulged) d. Width of Outline (With PCB) (Without Tape Wrinkle or Bulged) 2. Coordinate Measuring Machine: a. CF Polarizer Size b. Active Area (Or AA_BM) Size c. Active Area to Outline (Without Tape Wrinkle or Bulged) d. Active Area to CF Polarizer e. The Distance of Bracket Holes f. P-Cover to Outline (Without Tape Wrinkle or Bulged) g. Length of P-Cover h. Connector Pin 1 to Outline (Without Tape Wrinkle or Bulged) 3. Height Gauge: The Different Height of Root and Top on the Bracket (Need to Calculate From Bracket Angle Spec.) 4. Feeler Gauge: The Warpage Spec. of Module Notes: Except the Critical Dimensions as Above, Other Dimensions are Measured by Coordinate Measuring Machine If Necessary.			
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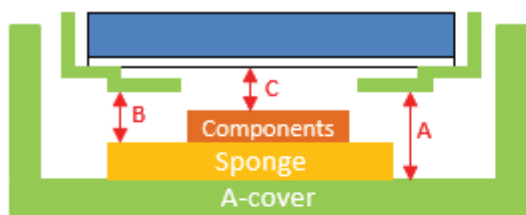
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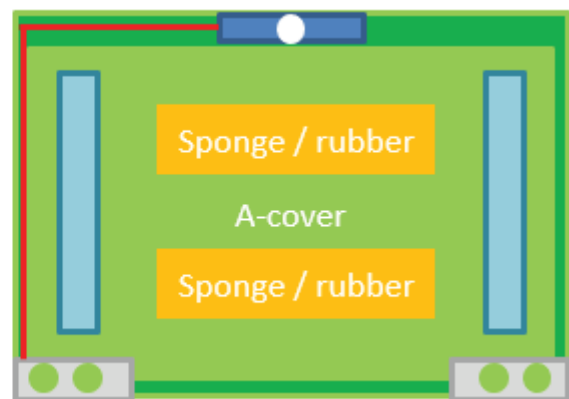
2024.11.25

Appendix B: System design Recommendation

LCM to A-Cover / sponges Z-gap



	Plastic Cover	Metal Cover
A	≥ 1.0mm	≥ 0.8mm
B	≥ 0mm	
C	> 0.5mm	



Purpose

The reflector area is very sensitive, BOE would suggest that design enough z-gap to decrease the risk of water ripple, white spots and other abnormal display

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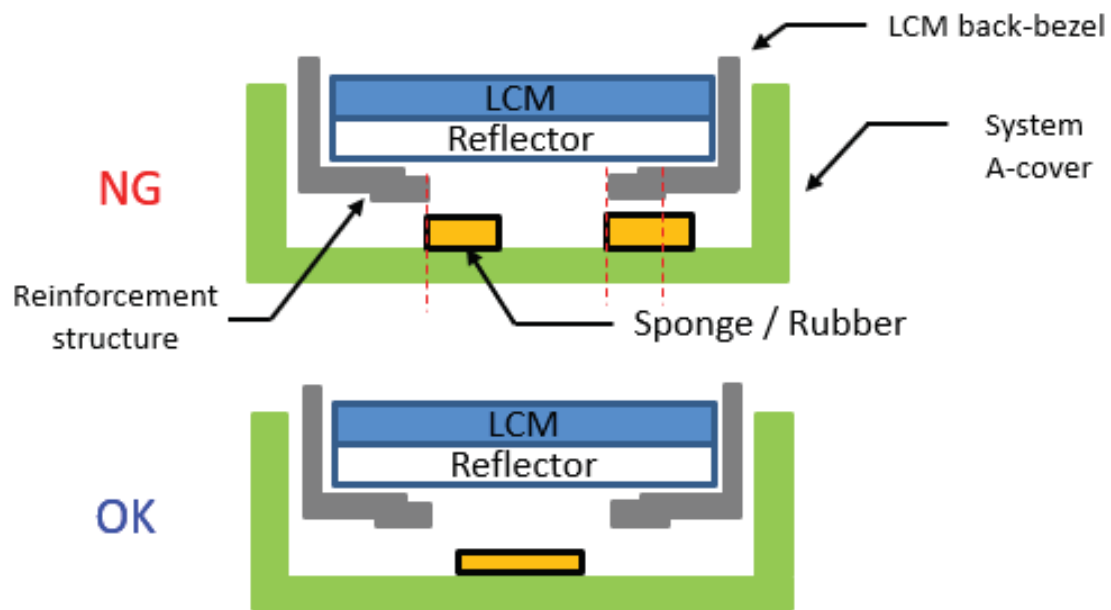
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Appendix B: System design Recommendation

LCM to A-Cover / sponges z-gap



Purpose

If attach sponges or rubbers which correspond to white reflector area, it may cause white spot, pooling or other relative issues. BOE would suggest that attach wide range sponges / rubbers which can cover the LCM back-bezel opening

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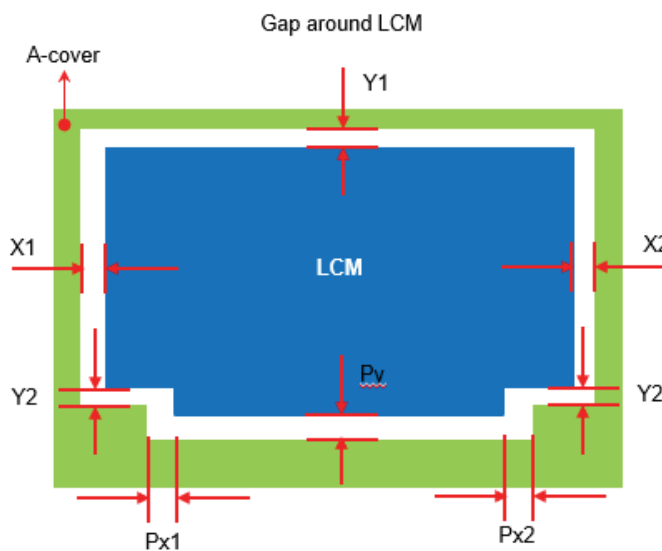
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Appendix B: System design Recommendation

LCM to side wall / protrusions

	Normal border (screws)	Narrow border (fix by tapes)
X1 / X2	Min: 0.45mm	Min: 0.35mm
Y1 / Y2	Min: 0.45mm	Min: 0.35mm
Px1 / Px2	Min: 0.55mm	
<u>Py</u>		

Purpose

BOE would suggest that design enough gap around LCM to prevent shock test failure, or interference, cell crack, abnormal display...etc. in the reliability test

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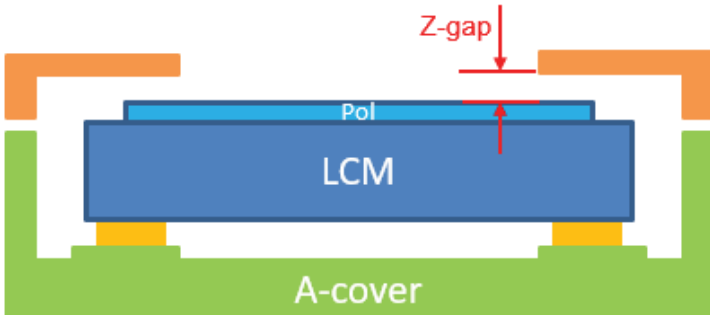
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Appendix B: System design Recommendation									
LCM to B-cover z-gap  <table><tr><th>Bezel Tape</th><th>Z-Gap</th></tr><tr><td>Without</td><td>0.15 ~ 0.25mm</td></tr><tr><td>With</td><td>0.15 ~ 0.20mm</td></tr></table>				Bezel Tape	Z-Gap	Without	0.15 ~ 0.25mm	With	0.15 ~ 0.20mm
Bezel Tape	Z-Gap								
Without	0.15 ~ 0.25mm								
With	0.15 ~ 0.20mm								
Purpose	Too less z-gap between system B-cover and LCM top pol has high risk that may cause cell crack, pooling, light leakage and other issues								
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B-cover tape to top pol edge



Please let tapes to be located out of top pol edges 0.4mm away on 4 sides

To avoid the B-cover tape override top pol then cause pooling or light leakage issue

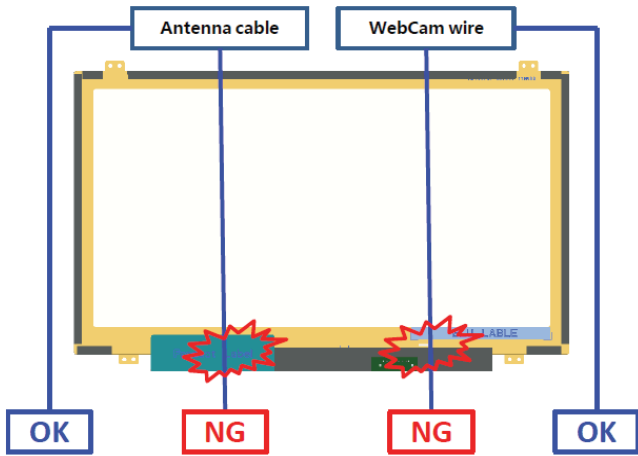
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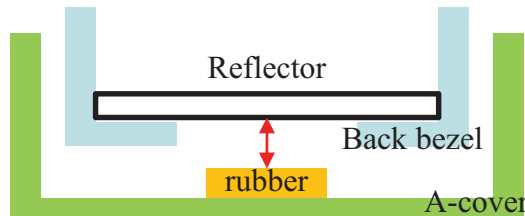
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Appendix B: System design Recommendation

Antenna Cable & Webcam wire





If sponge within the reflector area is necessary, we suggest that the gap between reflector and sponge is more than 0.5mm

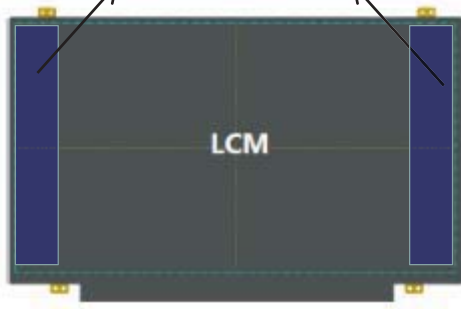
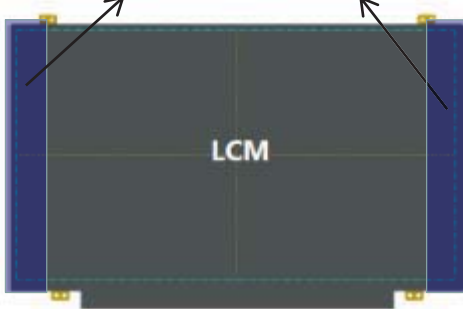
Purpose	1. BOE would suggest that do not set Antenna or WebCam cable / wire go behind LCM to avoid backpack test, hinge test ,twist test or pogo test with abnormal display 2. If the cable / wire is necessary to go behind LCM, please make a groove with rounds or chamfers to protect the cable / wire, or attach with higher sponges / rubbers adjacent to the cable / wire route 3. Suggest that attach the cable / wire with tapes to A-cover 4. Do not attach anything with LCM reflector area. If attach cable / wire with LCM reflector area, it may cause pooling, white spot, light leakage and other related issues

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Appendix B: System design Recommendation			
LCM paste area			
LCM rear view White Reflector Attachable area			
Purpose	If use the stretch remove tapes to fix LCM with A-cover, please set the stretch remove tapes correspond to the LCM back-bezel and do not let the tapes override the back-bezel’s level step of opening		
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Appendix B: System design Recommendation			
LCM pressable area			
Position of pressure head (Inside AA W/O border)  NG Position of pressure head (With Border)  OK			
Purpose	1. If LCM is fixed on A-cover by using the press jig during assembling. 2. To avoid panel broken the design of pressure head of press jig can not only pin on cell panel. The pressure head needs to pin on the LCM frame, which the LCM frame can share the pressure of the pressing head.		
www.panelook.com			
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Appendix B: System design Recommendation			
Wire setting			
LCM A-cover OK cable LCM A-cover Not Recommend cable			
Purpose	Wires should be placed between protrusions/side wall and A-cover. If place the wires between LCM and Protrusions/side wall, it may interfere with LCM when assembling, or even cause LCM broken in reliability test.		
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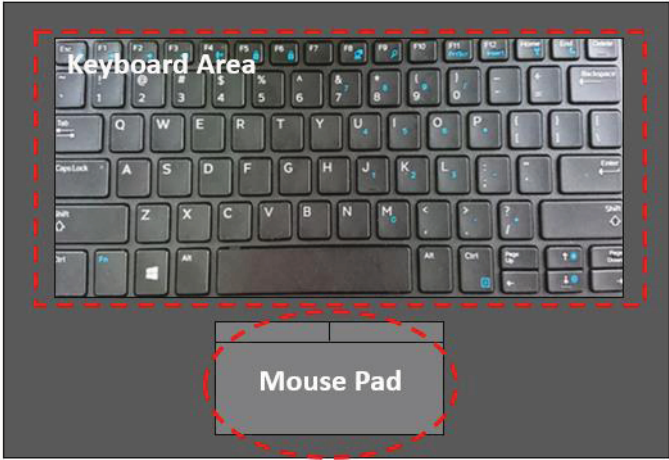
BOE	PRODUCT GROUP	REV	ISSUE DATE
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Appendix B: System design Recommendation			
A-cover strength			
LCM A-cover Rib/ Bracket OK LCM A-cover Not Recommend			
Purpose	1. BOE would recommend that structural Rib/Bracket height is higher than LCM, in order to avoiding pressures to LCM. 2. The L-shape Bracket is recommended.		
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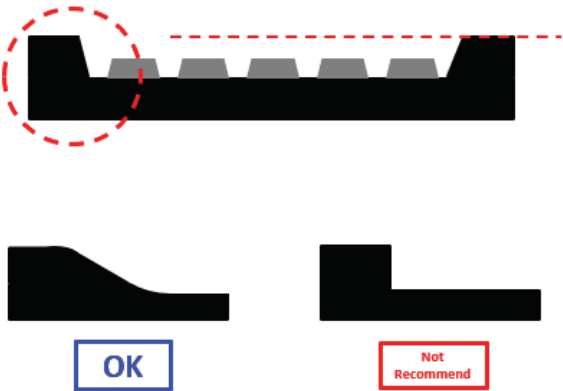
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Appendix B: System design Recommendation			
System A-cover Inner Surface			
LCM Step Burr sponge A-cover Brand logo			
Purpose	There should not exist any burr, segment gap or protrusions beside Logo, which may cause White Spot or Glass Broken by stress concentration.		
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Appendix B: System design Recommendation

Keyboard area & Mouse pad



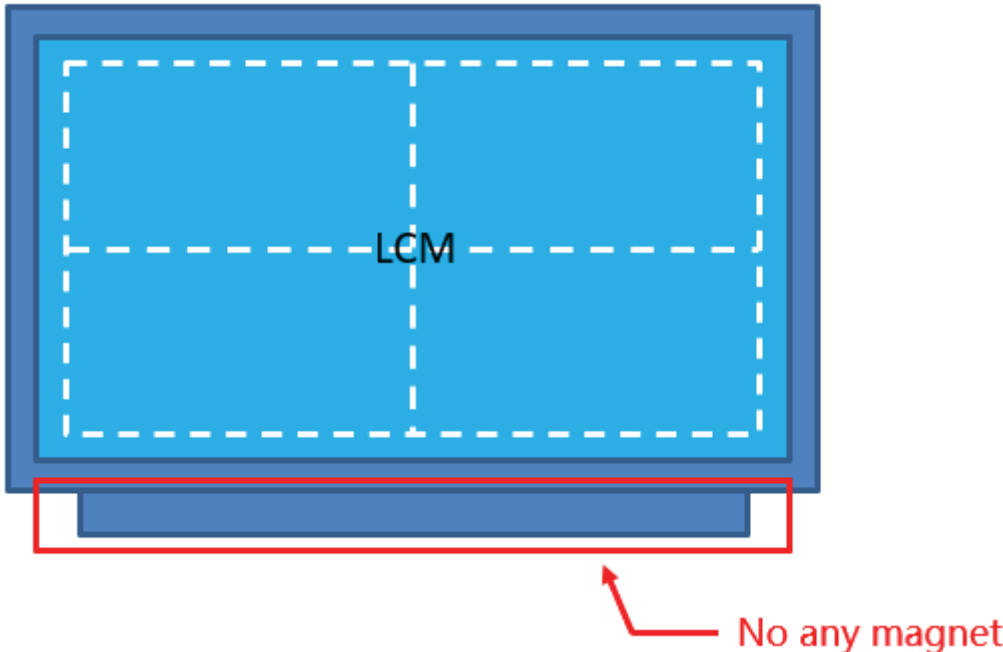


Purpose	The transition surface between keyboard and mouse pad should be smooth and without vertical steps\ too large level steps
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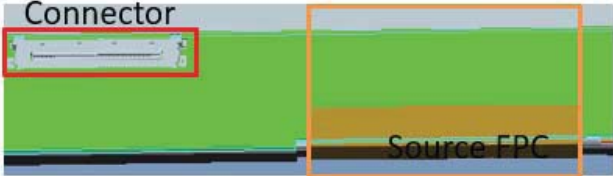
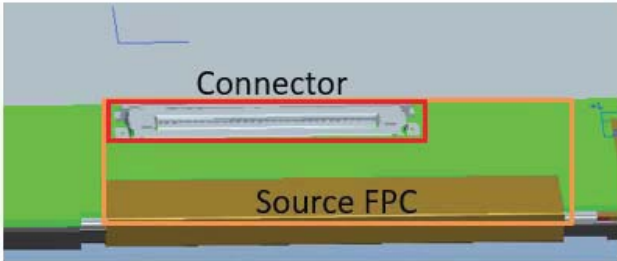
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Appendix B: System design Recommendation			
System cover reliability			
 			
Purpose	1. No interference between system and LCM in assembly process except compressible grounding gaskets 2. The permanent deformation which caused by Reliability test is not allowed to contact LCM		
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Appendix B: System design Recommendation			
A/B-cover near LCD PCBA			
			
Purpose	There should not been any magnet object close to LCM PCBA, it may cause physical or electricity noise issue		
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Appendix B: System design Recommendation			
A-cover add sponges on Boss side wall			
A-cover A-cover 			
Purpose	BOE would suggest to attach Sponges to the side-wall of the Boss column of A-cover to reduce the risk of panel broken in assembling process.		
www			
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Appendix B: System design Recommendation			
LCM to A-Cover / sponges z-gap			
Connector  Source FPC Y ↑ • → X OK Connector  Source FPC Not Recommend			
Purpose	Bent type product: The System Connector should not overlap with LCM FPC in X-direction, it may cause FPC lead broken during system connector plug and un-plug process (Panel FPC Bonding location is related to Mask and can not be changed easily)		
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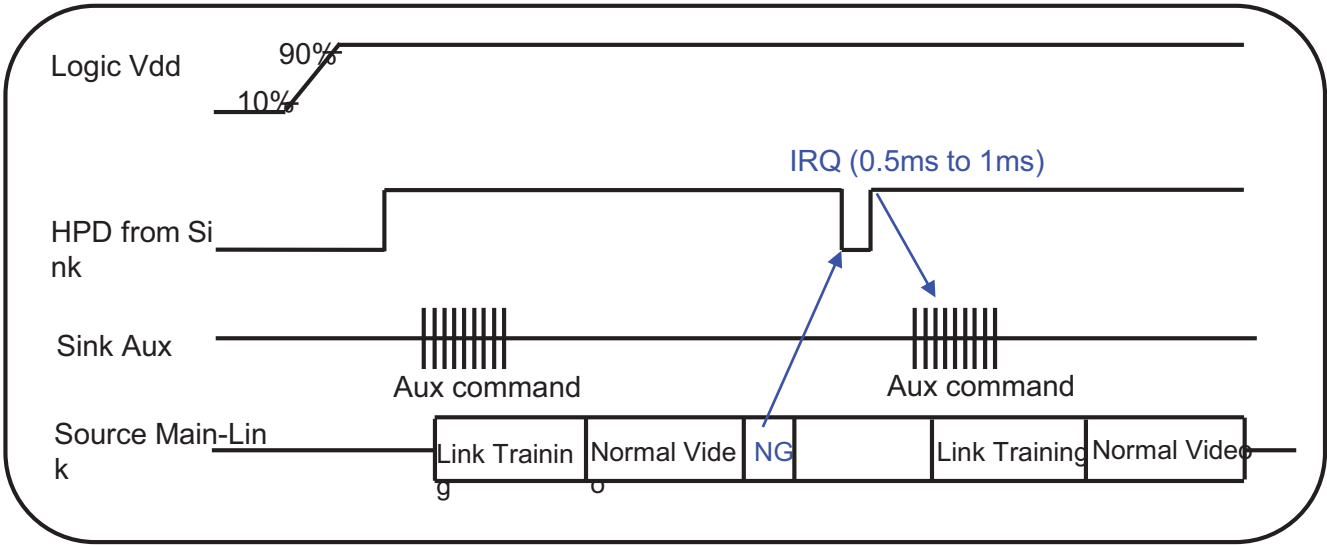
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Appendix C : System design Recommendation			
HPD Signal recognition			
Logic Vdd 90% 10% HPD from Sink 2.0V HPD Glitch Sink Aux Aux command Normal Signal (Ignore HPD Glitch) Logic Vdd 90% 10% HPD from Sink 2.0V HPD Glitch Sink Aux Aux command Abnormal Signal			
Purpose	When HPD glitch voltage less than 2.0(V), system signal can't output AUX command data.		
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Appendix C : System design Recommendation

HPD Signal Definition IRQ (Interrupt Request)



Purpose	When HPD signal low than 0.5ms to 1ms, the source device should check sink status field from the DPCD and take link training again.
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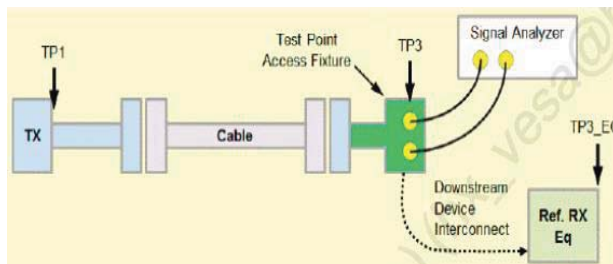
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Appendix C : System design Recommendation

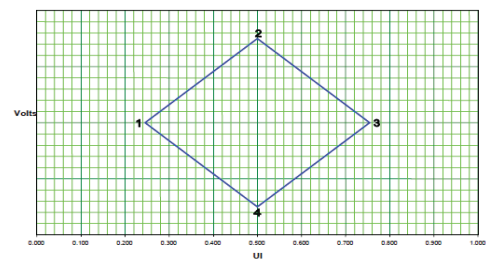
Main link eye diagram of TP3



Measured TP3 on LCM connector.

	UI	Voltage
1	0.246	0
2	0.5	0.075
3	0.755	0
4	0.5	-0.075

Eye for TP3 at HBR



Downstream Device Mask at TP3

	UI	Voltage
1	0.375	0
2	0.5	0.023
3	0.625	0
4	0.5	-0.023

Eye for TP3 at RBR

Purpose

1. Main Link EYE Diagram should meet TP3 point of VESA.
2. The measure method is through access fixture.

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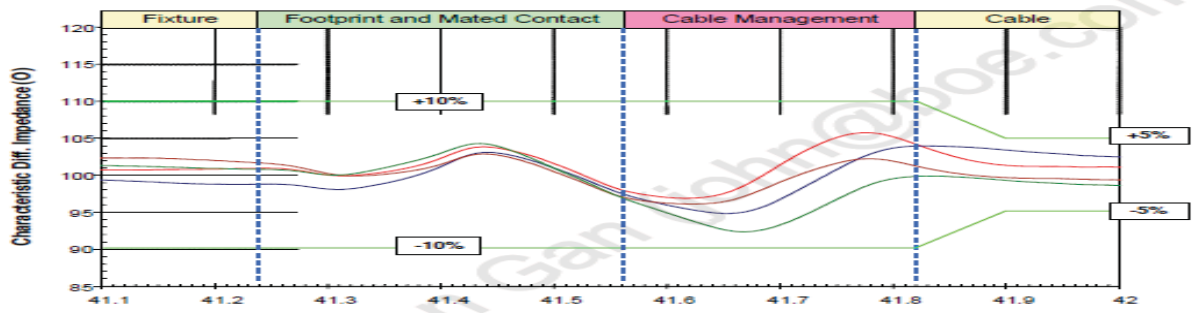
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Appendix C : System design Recommendation

Impedance Profile through a DP Connector



Differential Impedance Profile Measurement Data Example

Segment	Differential Impedance Value	Maximum Tolerance
Fixture	100Ω/VESA	±10%
Connector	100Ω/VESA	±10%
Wire management	100Ω/VESA	±10%
Cable	100Ω/VESA	±5%

Impedance Profile Values for Cable Assembly

Purpose	Cable Impedance Profile 100ohm for Cable Assembly
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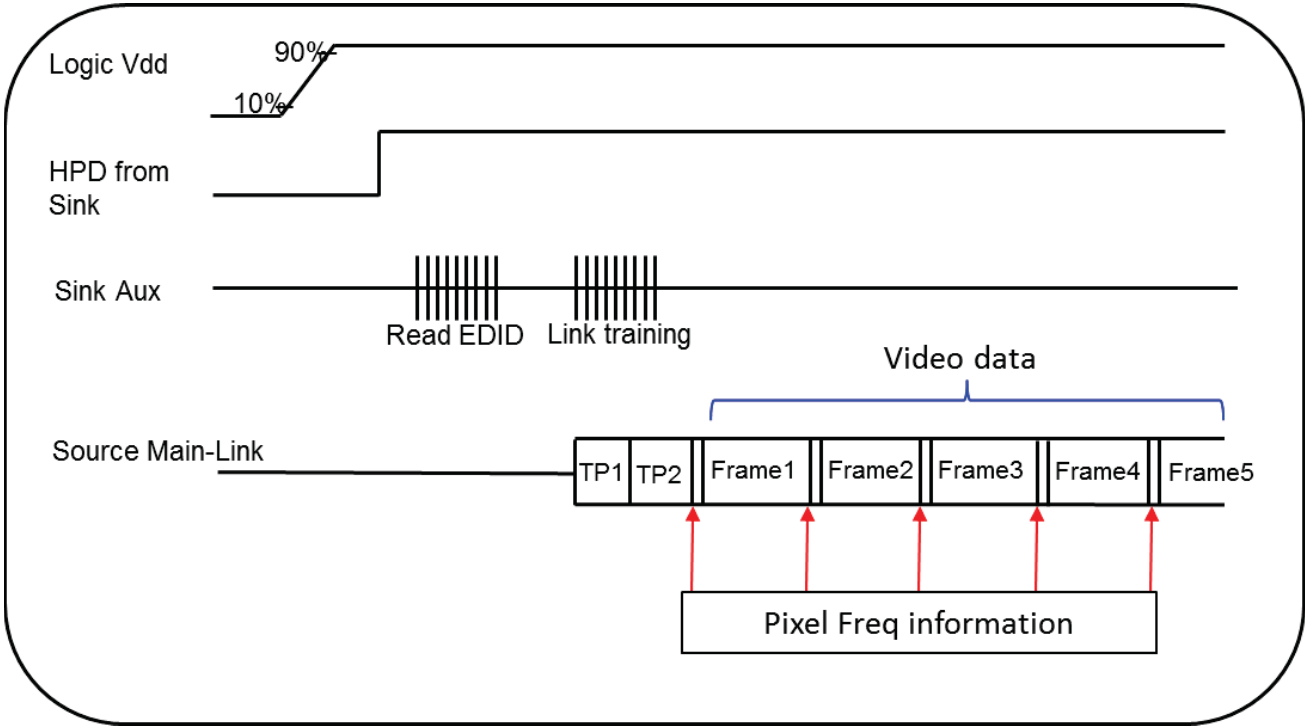
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Appendix C : System design Recommendation

Main Link Pixel Freq information value of MSA data		
		
Purpose	1. It need to fix pixel freq information value of MSA data output to prevent the initial abnormal pixel freq information value from incoming after power on. 2. BOE can read DPCD to check this value. Ex: BIOS is 1.62G , but into windows is 2.7G.	
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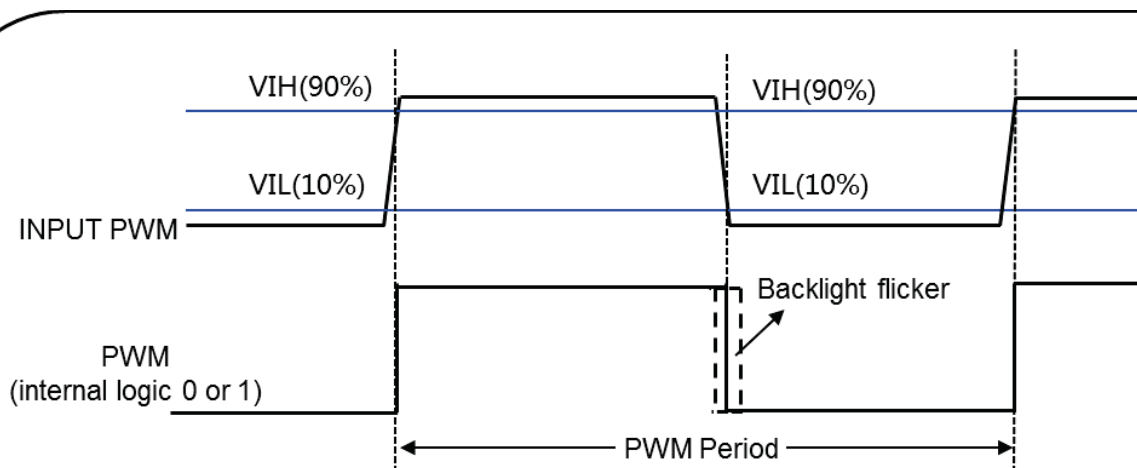
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Appendix C : System design Recommendation

System Input PWM Rising/Falling time

Example:

Freq	Cycle Time	PWM Rising Time	PWM Falling Time
200Hz	5ms	≤1us	≤1us
1KHz	1ms	≤200ns	≤200ns

Purpose

1. LED driver need to calculate the duty cycle of input PWM signal.
2. To avoid backlight flicker visible on LCD, system input PWM suggest :
PWM rising $\leq 200\text{ppm} \times \text{cycle time}$; PWM falling $\leq 200\text{ppm} \times \text{cycle time}$.

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