SPECIFICATION

FOR

TFT LCD MODULE

CUSTOMER : _____

CUSTOMER MODULE : _____

HL MODEL : HG160WQ004

■ **Preliminary Specification**

■ **Final Specification**

Customer Confirmation column:

Approved by :_____ Dept. :_____ Data :_____

Please return one of the copies of the specification with your signature to us within two weeks after you receive this document. If it is not returned, we will assume that you agree to the entire contents of this specification document.

Designed by	Checked by	Approved by

Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

HG160WQ004 is a color active matrix TFT LCD module using Oxide TFT's (Thin Film Transistors) as an active switching devices. This module has a 16.0 inch diagonally measured active area with WQHD 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 sRGB100%. 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 eDP1.4 interface compatible.

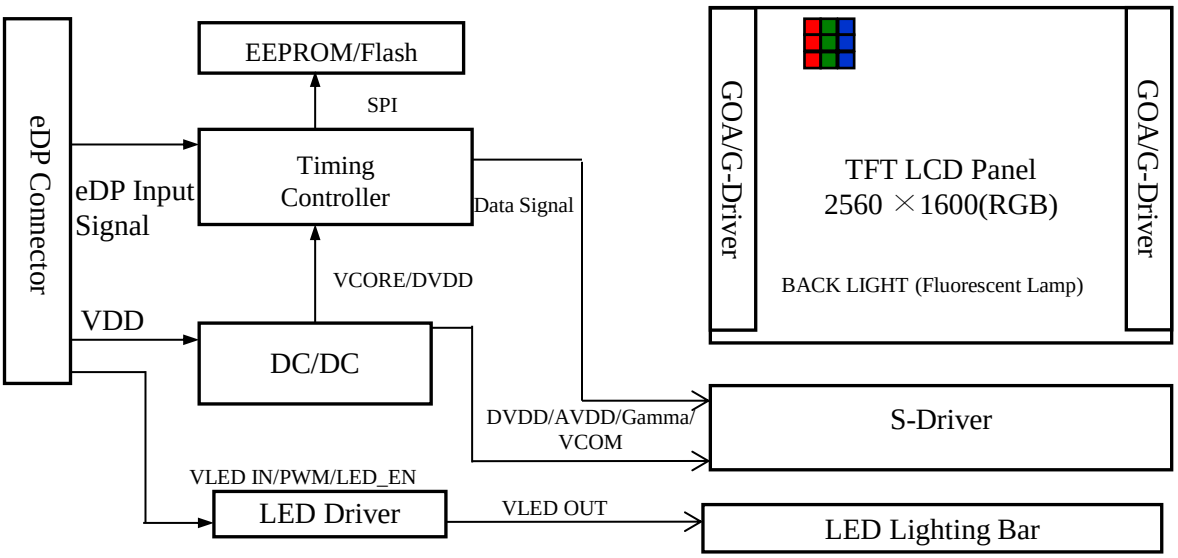


Figure 1. Drive Architecture

1.2 Features

- 4 lane eDP interface with 8.1Gbps link rates
- Thin and light weight
- 1064.3M(8bit+2FRC) color depth, color gamut sRGB100%
- 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
- DPCD Version 1.3
- Adjust backlight brightness with DC mode
- Function：HDR/BIST/FRC/OD/Free Sync; (DDS fuction reverse)

1.3 Application

- Notebook PC (Wide type)

1.4 General Specification

The followings are general specifications at the model HG160WQ004. (listed in Table 1)

<Table 1. General Specifications>

Parameter	Specification	Unit	Remarks
Active area	344.6784(H) ×215.424(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	100% typ		sRGB
Display mode	Normally Black		
Dimensional outline	349.68±0.3 (H)*224.42±0.5(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		
Surface hardness	3H		
Back-light	Bottom edge side, 1-LED lighting bar type		Note 1
Power consumption	P_D : 2.0(Max.) (OD on)/1.85(Max.) (OD off)	W	@Mosaic
	P_{BL} : 4.78(Max.)	W	
	P_{Total} :6.78 (Max.)	W	@Mosaic

Notes : 1. LED Lighting Bar (88*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_{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	°C	Note 2
Storage Temperature	T_{ST}	-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.

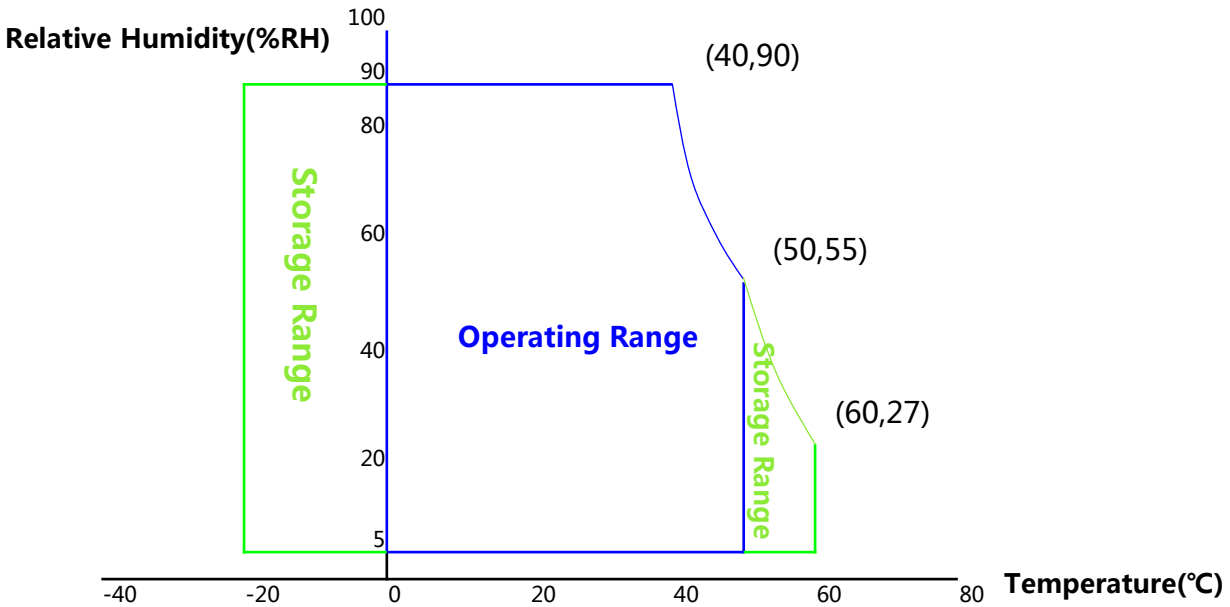


Figure 2. Temperature and Relative Humidity Range

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_{DD}	3.0	3.3	3.6	V	Note 1
Permissible Input Ripple Voltage		V_{RF}	-10% VDD	-	+10% VDD	V	Note 4
BIST Control Level		High Level	0.8 VDDIO	-	3.3	V	@V_{DDIO}=1.8 V
		Low Level	0	-	0.15 VDDIO	V	
Power Supply Inrush Current		I_{nrush}	-	-	2	A	Note3
Power Supply Current	Mosaic	I_{DD}	-	-	560.6	mA	Note 1
	RGB		-	-	560.6	mA	
Power Consumption	Mosaic(OD on)	P_M	-	-	2.0	W	
	Mosaic(OD off)	P_M	-	-	1.85	W	
	RGB	P_{RGB}	-	-	1.85	W	
	BLU	P_{BL}	-	-	4.78	W	Note 2
	Total	P_{Total}	-	-	6.78	W	@Mosaic

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

(a) (b)

Figure 3. Power Measure Patterns

2. Calculated value for reference ($V_{LED} \times I_{LED}$)
3. Measure condition (Figure 4)

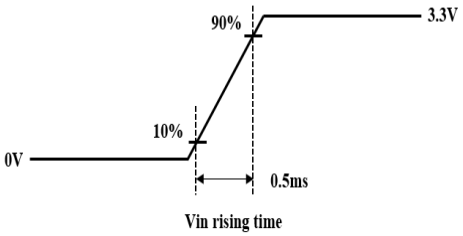


Figure 4. Inrush Measure Condition

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_F	-	-	2.9	V	
LED Forward Current		I_F	-	16.5	-	mA	
LED Power Input Voltage		VLED	5	12	21	V	
LED Power Input Current		I_{LED}	-	-	398.3	mA	Note 1
LED Power Consumption		P_{LED}	-	-	4.78	W	
Power Supply Voltage for LED Driver Inrush		Iled inrush	-	-	1.5	A	Note 3
LED Life-Time		N/A	15,000	-	-	Hour	I_F = 16.5mA Note 2
EN Control Level	Backlight On	V_{BL_EN}	2.5	-	5.0	V	
	Backlight Off		0	-	0.5	V	
PWM Control Level	High Level	V_{BL_PWM}	2.5	-	5.0	V	
	Low Level		0	-	0.5	V	
PWM Control Frequency		F_{PWM}	200	-	2,000	Hz	
Duty Ratio			1	-	100	%	

Notes :

1. Power supply voltage12V for LED driver.
   Calculator value for reference IF × VF ×88 /driver efficiency = PLED
2. The LED life-time define as the estimated time to 50% degradation of initial luminous.
3. Measure condition (Figure 5)

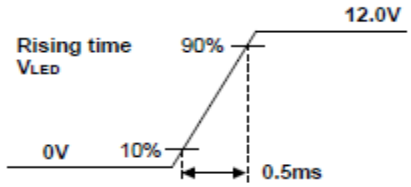


Figure 5. Inrush Measure Condition

3.3 LED Structure

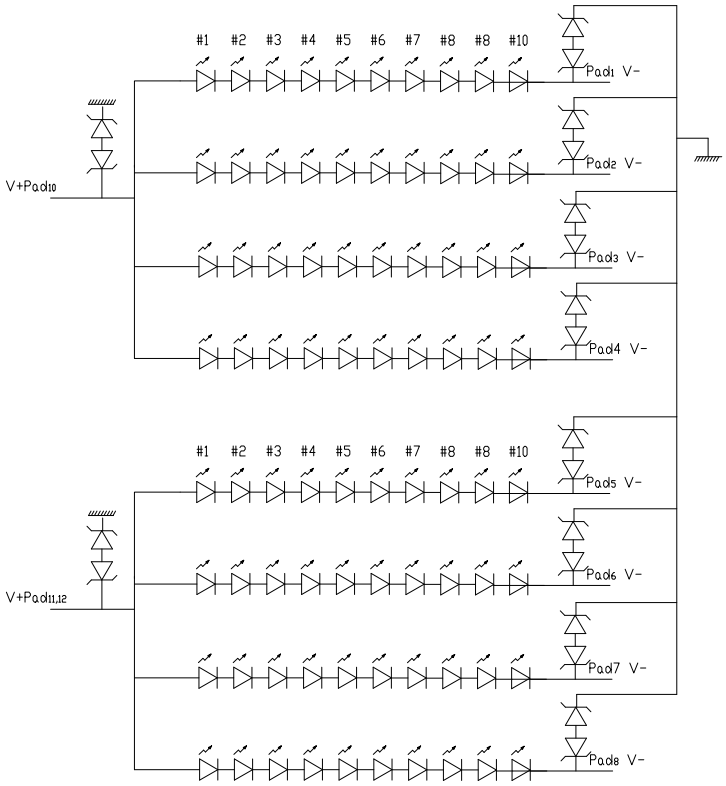


Figure 6. LED Structure

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±2℃) 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 θ and Φ equal to 0°. We refer to θØ=0 (=θ3) as the 3 o'clock direction (the "right"), θØ=90 (= θ12) as the 12 o'clock direction ("upward"), θØ=180 (= θ9) as the 9 o'clock direction ("left") and θØ=270(= θ6) as the 6 o'clock direction ("bottom"). While scanning θand/or Ø, 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+/- 0.3V at 25°C. Optimum viewing angle direction is 6 'clock.

4.2 Optical Specifications

<Table 5. Optical Specifications>

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle Range	Horizontal	Θ_3	CR > 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	Θ = 0°	1000	1200	-		Note 2
Luminance of White	5 Points	Y_w	Θ = 0° I_{LED} = 16.5mA	425	500	625	cd/m^2	Note 3
White Luminance Uniformity	5 Points	ΔY5					%	Note 4
	13 Points	ΔY13					%	
White Chromaticity		W_x	Θ = 0°	0.283	0.313	0.343		Note 5
		W_y		0.299	0.329	0.359		
Reproduction of Color	Red	R_x	Θ = 0°	Typ. -0.03	0.646	Typ. +0.03		
		R_y			0.324			
	Green	G_x			0.289			
		G_y			0.619			
	Blue	B_x			0.148			
		B_y			0.062			
Color Gamut				95	100	-	%	@1976
Response Time (Rising + Falling)		T_{RT}	Ta= 25℃ Θ = 0°	-	9	12	ms	Note 6
GTG ave.		T_{RT}	Ta= 25℃ Θ = 0°	-	3	5	ms	OD on
Cross Talk		CT	Θ = 0°	-	-	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).

2. Contrast measurements shall be made at viewing angle of Θ= 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 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.

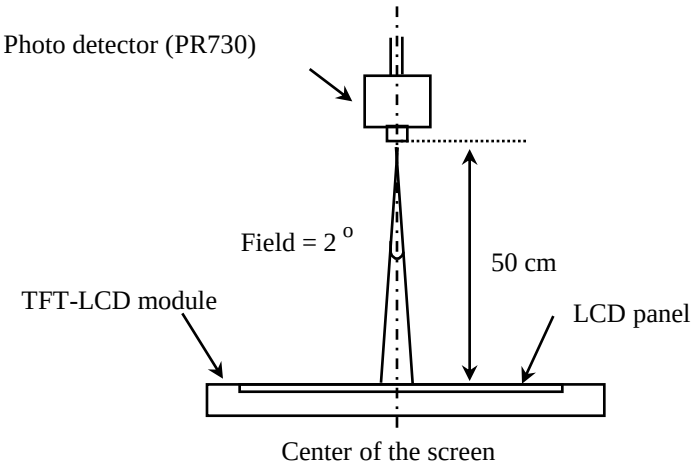
4. The White luminance uniformity on LCD surface is then expressed as : ΔY =Minimum Luminance of 5(or 13) points / Maximum Luminance of 5(or 13) points.(see Figure 8 and Figure 9).

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 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_f, and 90% to 10% is T_r.

7. 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).

4.3 Optical Measurements



Optical characteristics measurement setup

Figure 7. Measurement Set Up

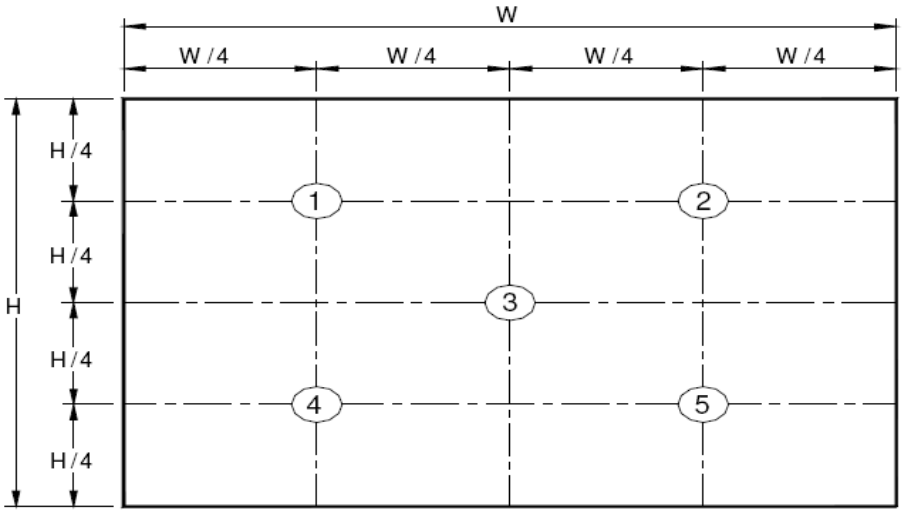


Figure 8. White Luminance and Uniformity Measurement Locations (5 points)

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.

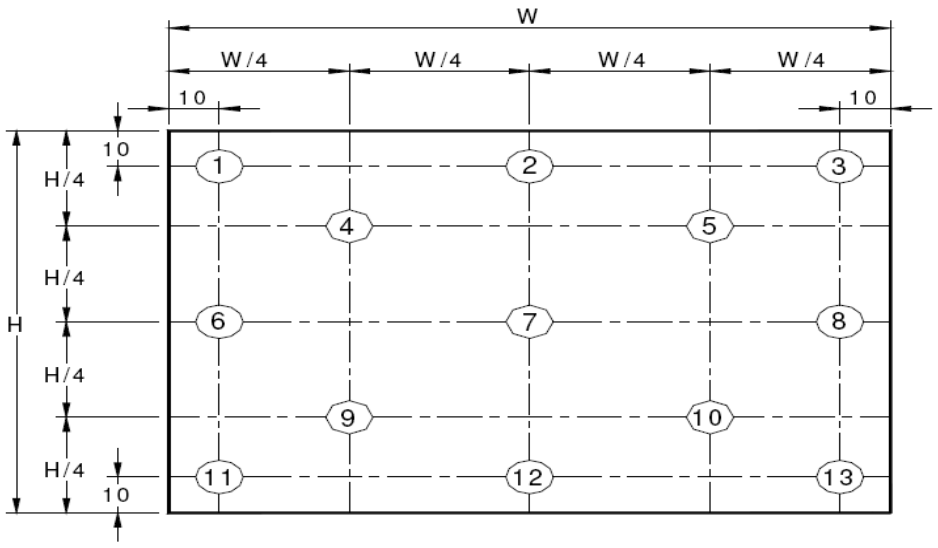


Figure 9. Uniformity Measurement Locations (13 points)

The White luminance uniformity on LCD surface is then expressed as : ΔY5 = Minimum Luminance of five points / Maximum Luminance of five points (see Figure 8) , ΔY13 = Minimum Luminance of 13 points /Maximum Luminance of 13 points (see Figure 9).

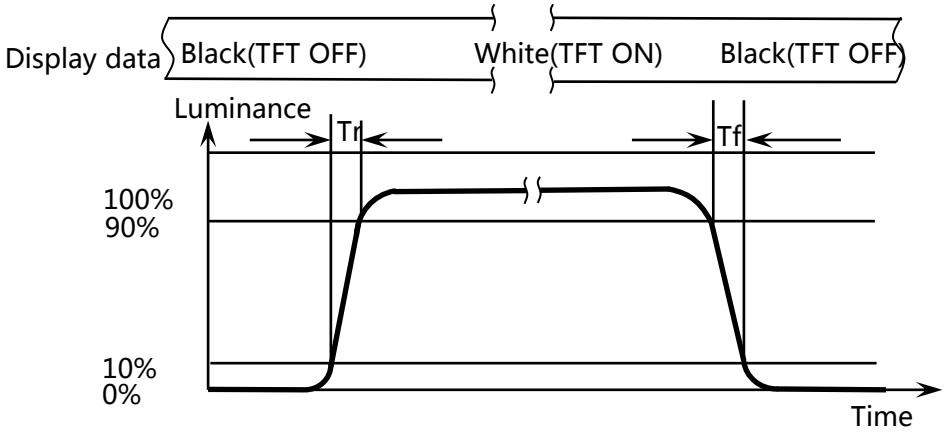
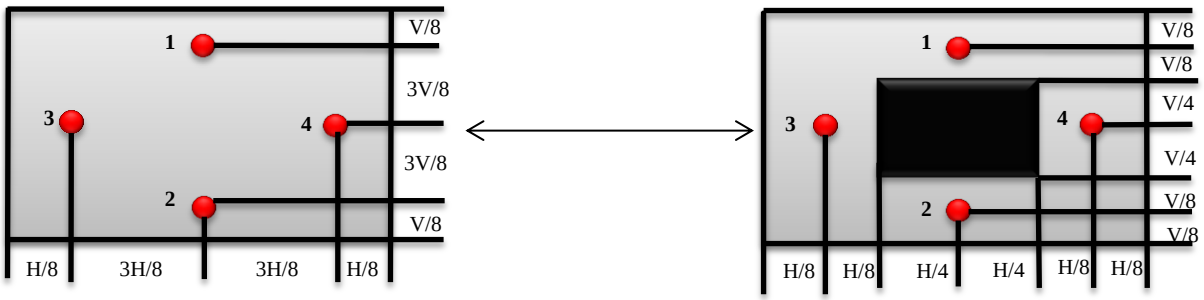


Figure 10. Response Time Testing

The electro-optical response time measurements shall be made as shown in Figure 10 by switching the "data" input signal ON and OFF. Tr: The luminance to change from 10% to 90% ,Tf: The luminance to change from 90% to 10% .

The test system : LMS PR810



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

Figure 11. Cross Talk Modulation Test Description

Where:

Y_A = Initial luminance of measured area (cd/m^2)

Y_B = Subsequent luminance of measured area (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 (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.(Refer to Figure 11)

The test system: PR730

5.0 INTERFACE CONNECTION

5.1 Electrical Interface Connection

The electronics interface connector is STM MSAK24025P40.
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	Reverse for supplier only (DDS function)	21	LCD_VCC	LCD logic and driver power
2	H_GND	High Speed Ground	22	LCD Self Test	LCD 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_DIM	System PWM signal Input
14	H_GND	High Speed Ground	34	I2C_SDA	Reverse for supplier only (DDS function)
15	AUX_CH_P	True Signal Auxiliary Ch.	35	NC	Reverse for supplier only
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	OD_Eable	Pull high Enable , Pull low Disable

5.2 eDP Interface

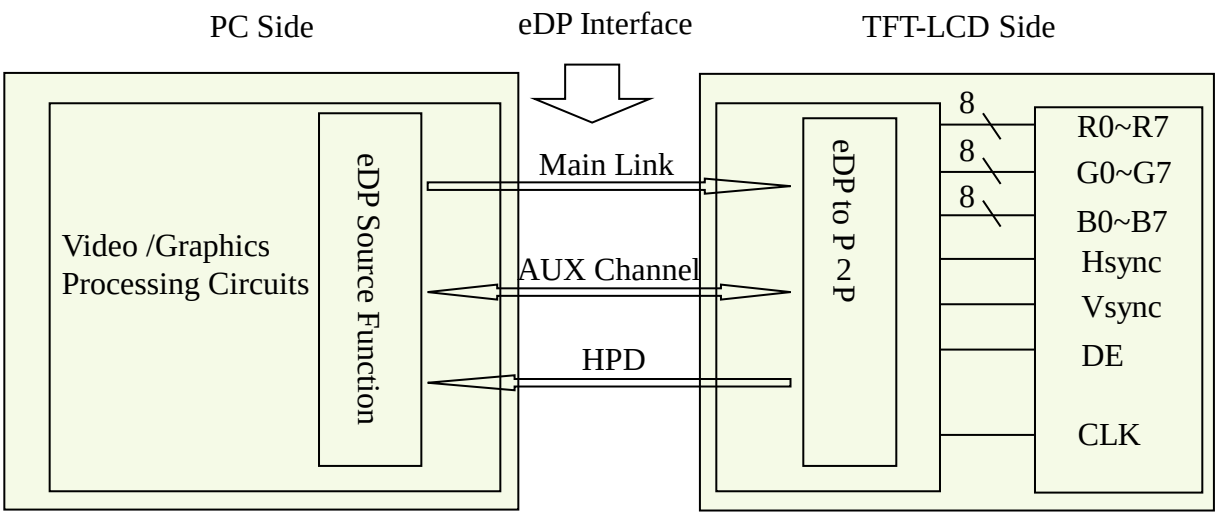


Figure 12. eDP Interface Architecture

Note:
Transmitter : Parade DP501 or equivalent.
Transmitter is not contained in module.

5.3 Data Input Format

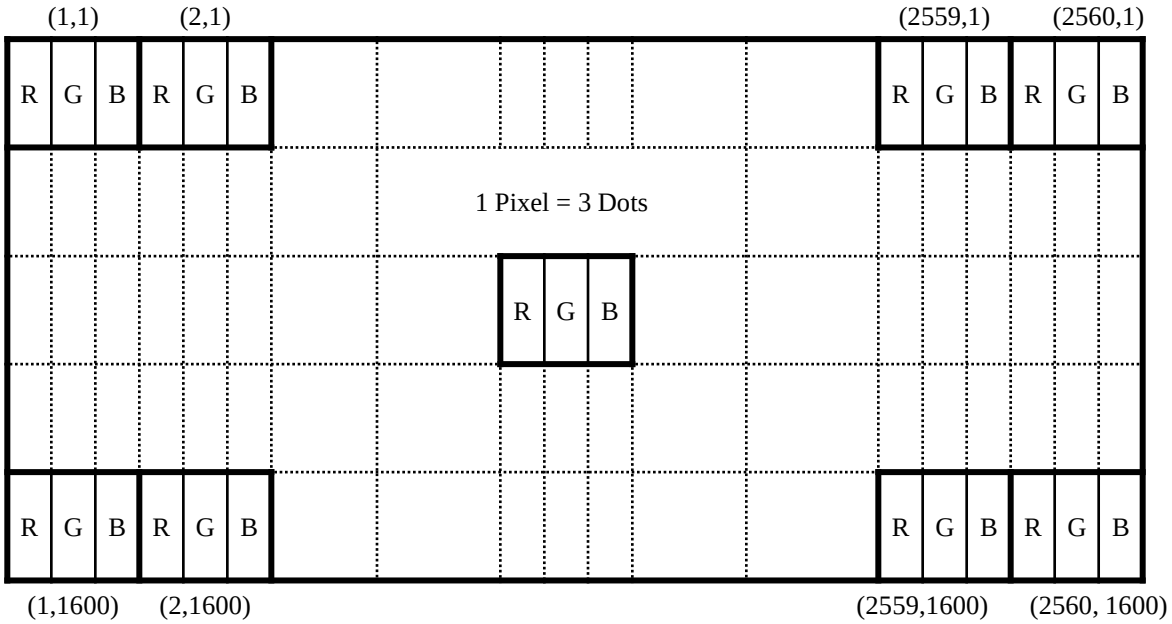


Figure 13. Display Position of Input Data (V-H)

5.4 Back-light & LCM Interface Connection

BLU Interface Connector: STM MSAK24037P12D.

<Table 7. Pin Assignments for the BLU Connector>

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

6.0 SIGNAL TIMING SPECIFICATION

6.1 The HG160WQ004Is Operated By The DE Only

< Table 8. Signal Timing Specification >

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	-	756	-	MHz
Frame Period		Tv	-	1660	-	lines
			-	165	-	Hz
			-	6.06	-	ms
Vertical Display Period		Tvd	-	1600	-	lines
One line Scanning Period		Th	-	2760	-	clocks
Horizontal Display Period		Thd	-	2560	-	clocks

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	-	275	-	MHz
Frame Period		Tv	-	1660	-	lines
			-	60	-	Hz
			-	16.67	-	ms
Vertical Display Period		Tvd	-	1600	-	lines
One line Scanning Period		Th	-	2760	-	clocks
Horizontal Display Period		Thd	-	2560	-	clocks

Note : The above is as optimized setting.

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	$V_{RX-DIFFp-p}$	120	-	1200	mV	
Rx input DC common mode voltage	$V_{RX\_DC\_CM}$	0	-	2	V	
Differential termination resistance	$R_{RX-DIFF}$	80	-	120	Ω	
Single-ended termination resistance	R_{RX-SE}	40	-	60	Ω	
Rx short circuit current limit	I_{RX_SHORT}	-	-	50	mA	
Intra-pair skew at Rx package pins (HBR) RX intra-pair skew tolerance at HBR	$L_{RX\_SKEW\_INTRA\_PAIR}$	-	-	60	ps	
AC Coupling Capacitor	C_{SOURCE_ML}	75		200	nF	Source side

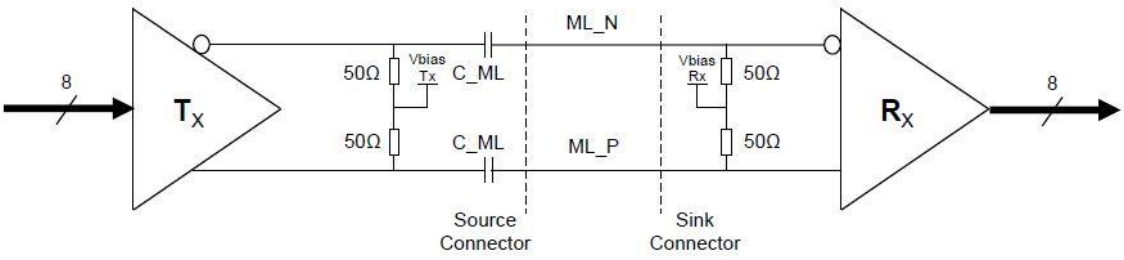


Figure 14. Main link differential pair

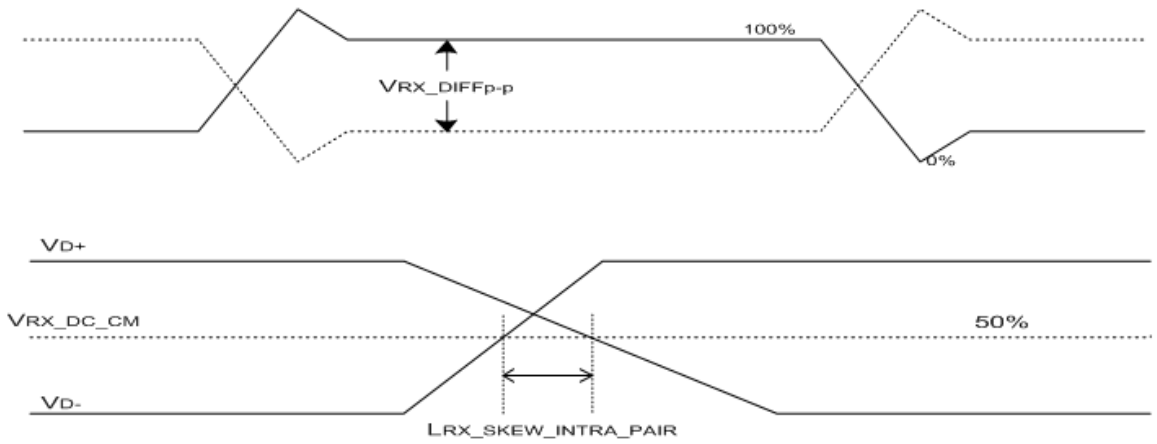


Figure 15. VRX-DIFFp-p & LRX_SKEW_INTRA_PAIR

<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	

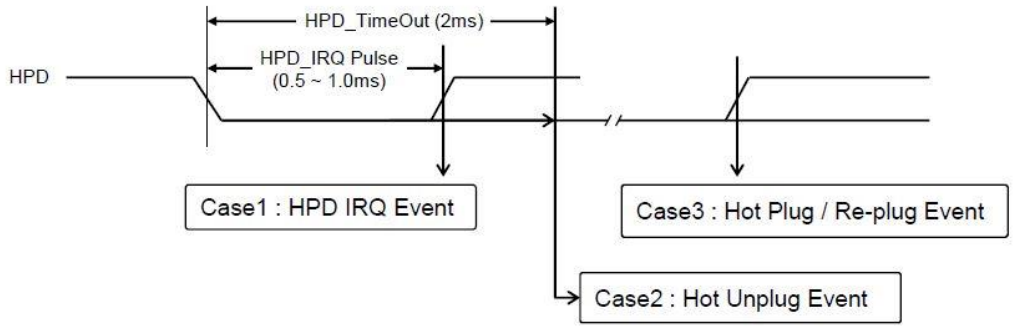


Figure 16. HPD Events

<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-DIFFp-p	0.29	-	1.38	V	
AUX CH termination DC resistance	RAUX-TERM	80	100	120	Ohm	
AUX DC common mode voltage	VAUX-DC-CM	0	-	2	V	
AUX turn around common mode voltage	VAUX-TURN-CM	-	-	0.3	V	
AUX short circuit current limit	IAUX-SHORT	-	-	90	mA	
AUX AC Coupling Capacitor	CSOURCE-AUX	75	-	200	nf	Source side

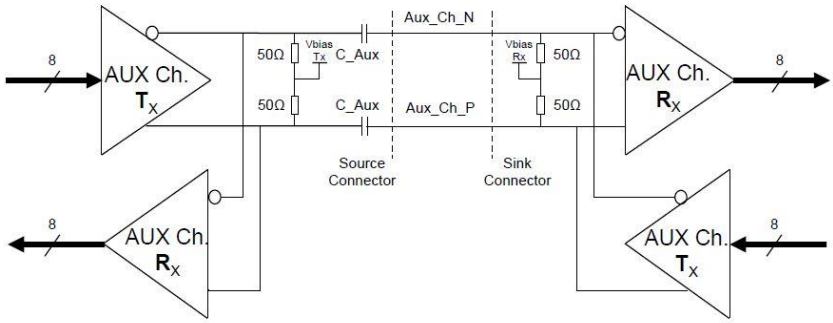


Figure 17. AUX differential pair

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

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.

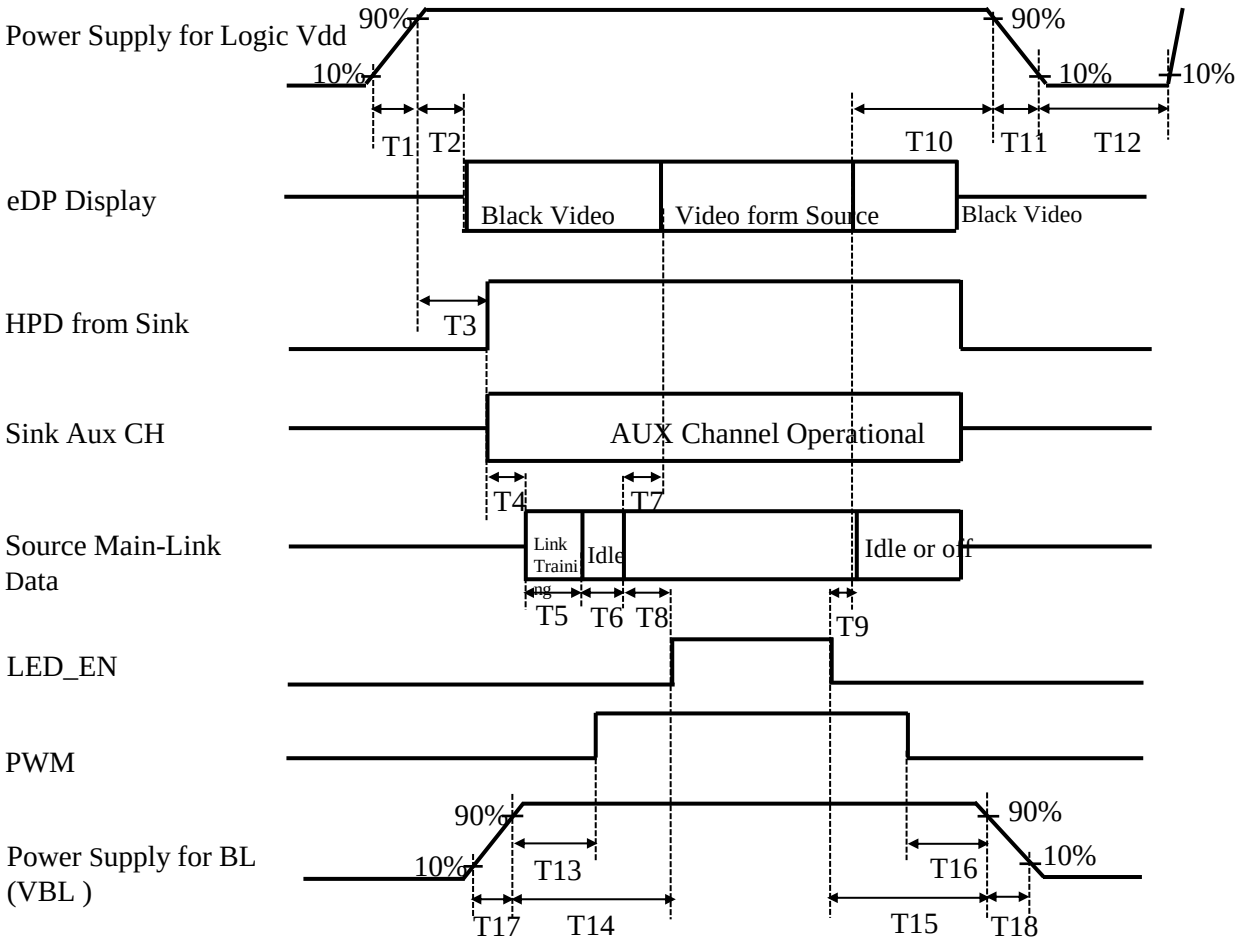


Figure 18. Power Sequence

- 0.5ms ≤ T1 ≤ 10 ms
- 0ms < T2 ≤ 200 ms
- 0ms < T3 ≤ 200 ms
- T4+T5+T6+T8>80ms
- 0ms < T7 ≤ 50ms
- 50ms < T8
- 0ms < T9
- 100ms < T10 < 500 ms
- 0.5ms ≤ T11 ≤ 10 ms
- 500ms ≤ T12
- 0ms < T13
- 0ms < T14
- 0ms < T15
- 0ms < T16
- 0.5ms ≤ T17
- 0.5ms ≤ T18

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.

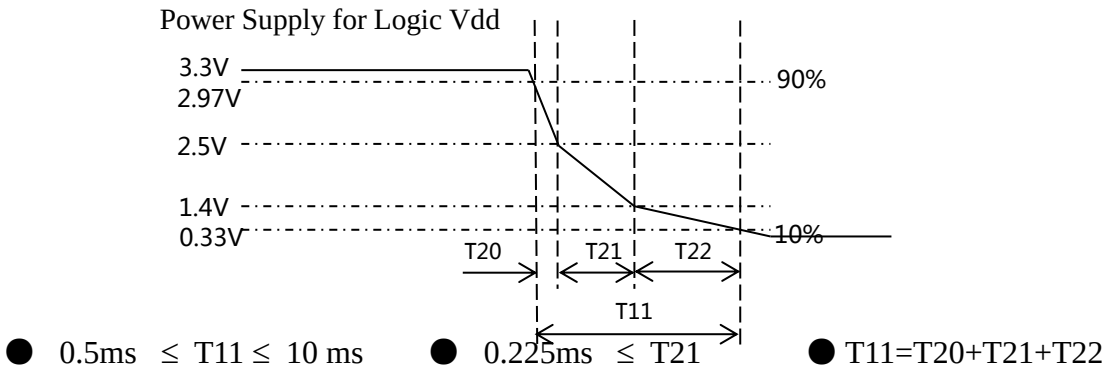


Figure 19. T11 timing requirements

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	STM
Type/ Part Number	MSAK24025P40
Mating Housing/ Part Number	I-PEX 20454-040T

10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

Figure 23 shows mechanical outlines for the model HG160WQ004.
Other parameters are shown in Table 14.

<Table 14. Dimensional Parameters>

Parameter	Specification	Unit
Active Area	344.6784 (H) ×215.424 (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+RFC)	
Display mode	Normally Black	
Dimensional outline	349.68±0.3 (H)*224.42±0.5(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 LCD has an Anti-Glare coating to minimize reflection and a 3H hardness coating 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.

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 , 60%RH, 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 = 50˚C , 60%RH, 240 hrs	
5	Low temperature operation test	Ta = 0˚C , 240 hrs	
6	Thermal shock	Ta = -20 ˚C ↔ 60 ˚C (0.5 hr), 60%±3%RH, 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.

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.

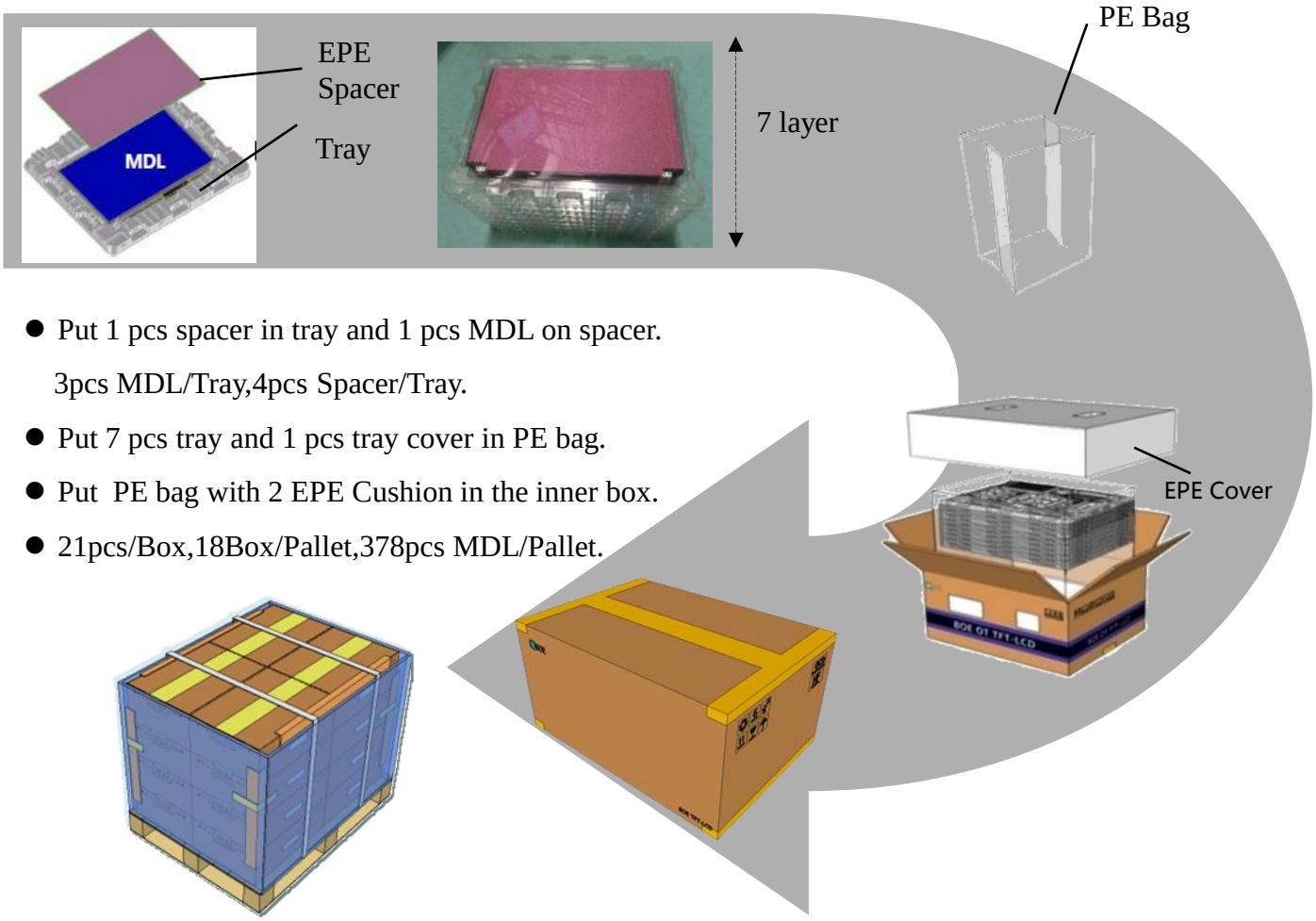
(4) Cautions for the atmosphere
- Dew drop atmosphere should be avoided.
- Do not store and/or operate the LCD module in a high temperature and/or humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.

(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.

13.0 PACKING INFORMATION

13.1 Packing Order



- Put 1 pcs spacer in tray and 1 pcs MDL on spacer.
  3pcs MDL/Tray,4pcs Spacer/Tray.
- Put 7 pcs tray and 1 pcs tray cover in PE bag.
- Put PE bag with 2 EPE Cushion in the inner box.
- 21pcs/Box,18Box/Pallet,378pcs MDL/Pallet.

Figure 23. Packing Order

13.2 Note

- Box dimension: 480mm*350mm*285mm
- Package quantity in one box: 21pcs
- Total weight: 13.4kg/Box（Typ）

14.0 MECHANICAL OUTLINE DIMENSION

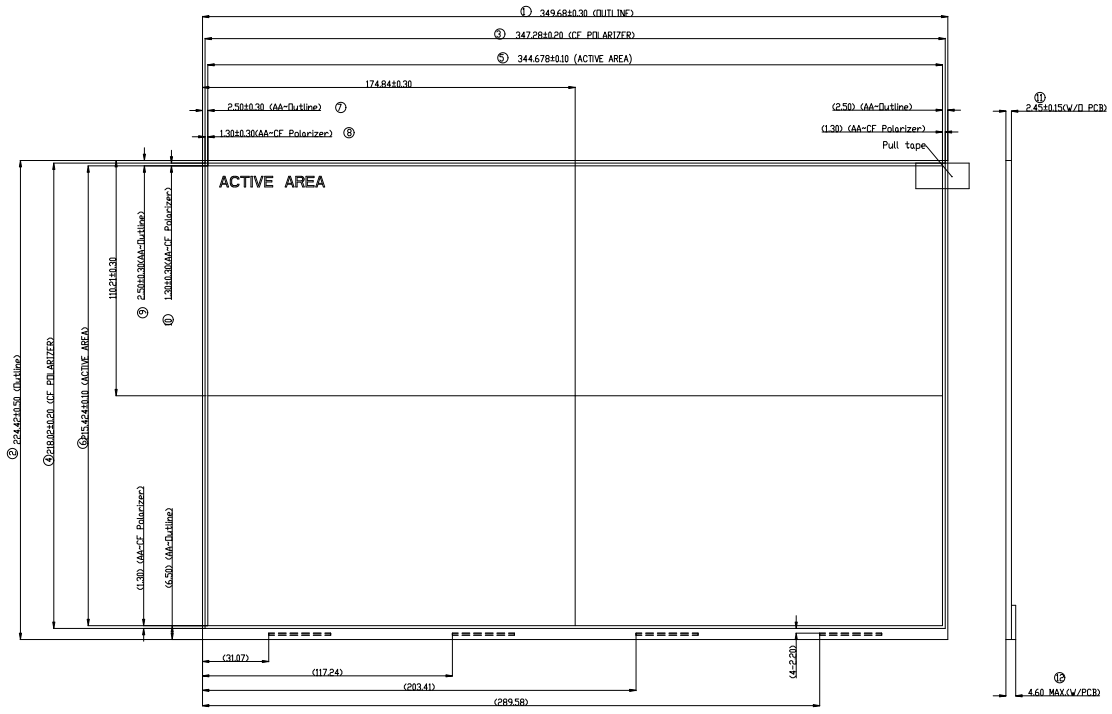


Figure 24. TFT-LCD Module Outline Dimension (Front View)

NOTES:

1.WARPAGE AND DEFORMATION SPEC.: 0.5mm MAX.

2.EDP CONNECTOR IS MEASURED AT PIN 1 AND MATING LINE

3.UNSPECIFIED TOLERANCE IS ±0.5MM..

4.THE MODULE BORDER TOLERANCE TEST TOOL IS A VERNIER CALIPER.

5.TOP POLARIZER MUST BE THE HIGHEST PORTION.

6.PRITICAL DIMENSION: ① ~ ⑮

CPK: ① ② ⑪

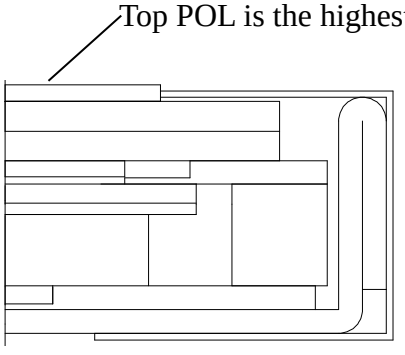


Figure 25. Highest Point Position

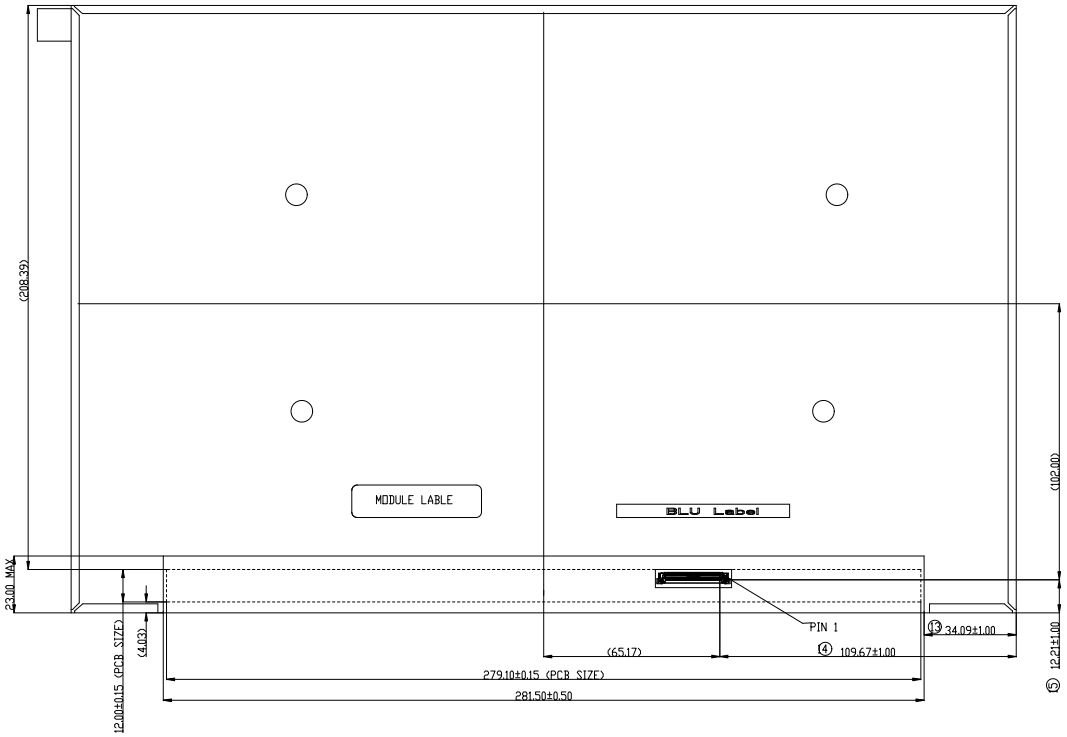


Figure 26. TFT-LCD Module Outline Dimensions (Rear view)

NOTES:
1.WARPAGE AND DEFORMATION SPEC.: 0.5mm MAX.
2.EDP CONNECTOR IS MEASURED AT PIN 1 AND MATING LINE
3.UNSPECIFIED TOLERANCE IS ±0.5MM..
4.THE MODULE BORDER TOLERANCE TEST TOOL IS A VERNIER CALIPER.
5.TOP POLARIZER MUST BE THE HIGHEST PORTION.
6.PRITICAL DIMENSION: ① ~ ⑮
CPK: ① ② ⑪

15 .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	09	9		BOE	ID = BOE
09		E5	229			
0A	ID Product Code	90	144		2448	ID = 2448
0B		09	9			
0C	32-bit serial No.	00	0		0	
0D		00	0		0	
0E		00	0		0	
0F		00	0		0	
10	Week of manufacture	1C	28		28	
11	Year of Manufacture	1E	30		2020	Manufactured in 2020
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	22	34		34	34.468 cm (Approx)
16	Max V image size	15	21		22	21.542 cm (Approx)
17	Display Gamma	78	120		2.2	Gamma curve = 2.2
18	Feature support	03	3		-	Refer to right table
19	Red/Green low bits	82	130		-	Red / Green Low Bits
1A	Blue/White low bits	35	53		-	Blue / White Low Bits
1B	Red x high bits	A5	165	662	0.646	Red (x) = 10100101 (0.646)
1C	Red y high bits	53	83	332	0.324	Red (y) = 01010011 (0.324)
1D	Green x high bits	4A	74	296	0.289	Green (x) = 01001010 (0.289)
1E	Green y high bits	9E	158	634	0.619	Green (y) = 10011110 (0.619)
1F	Blue x high bits	26	38	152	0.148	Blue (x) = 00100110 (0.148)
20	BLue y high bits	0F	15	63	0.062	Blue (y) = 00001111 (0.062)
21	White x high bits	50	80	321	0.313	White (x) = 01010000 (0.313)
22	White y high bits	54	84	337	0.329	White (y) = 01010100 (0.329)
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	3C	60		287.3160	287.316MHz Main clock
37		70	112			
38		00	0		2560	Hor Active = 2560
39		C8	200		200	Hor Blanking = 200
3A		A0	160		-	4 bits of Hor. Active + 4 bits of Hor. Blanking
3B		40	64		1600	Ver Active = 1600
3C		87	135		135	Ver Blanking = 135
3D		60	96		-	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		58	88		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		18	24		-	Refer to right table

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		30	48		48	Minimum Vertical Rate:48 Hz
4E		A5	165		165	Maximum Vertical Rate:165 Hz
4F		1F	31		286.275	Minimum Horizontal Rate:286.275 kHz
50		1F	31		286.275	Maximum Horizontal Rate:286.275 kHz
51		4F	79		790.1190	Maximum Pixel Clock:790.119 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			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		42	66		B	Manufacture name : BOECQ
60		4F	79		O	
61		45	69		E	
62		20	32			
63		43	67		C	
64		51	81		Q	
65		0A	10			
66		20	32			
67		20	32			
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		4E	78		N	Model name：HG160WQ004
72		45	69		E	
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		59	89		Y	
7C		31	49		1	
7D		0A	10			
7E	Extension flag	01	1			0 ：1個EDID；N-1：N个EDID
7F	Checksum	**AF**	**175**	**175**	-	
80	EDID Extension Block Tag	70	112		112	DisplayID EDID Extension Block Tag (Tag 70h would be reserved)
81	Display ID version	13	19		19	
82	section size	79	121		121	
83	product Type identifier	00	0		0	
84	extension count	00	0		0	
85	block tag	03	3		3	
86	block rev	01	1		1	
87	Payload	14	20		20	
88	pixel clock	A4	164		790.119	790.119MHz Main clock
89		34	52			
8A		01	1			
8B	timing options	85	133		133	
8C	H-Active	FF	255		2560	Hor Active =2560
8D		09	9			
8E	H-Blanking	C7	199		200	Hor Blanking = 200
8F		00	0			
90	H-offset	2F	47		48	Hor Sync Offset = 48
91		00	0			
92	H-sync pulse width	1F	31		32	H Sync Pulse Width = 32
93		00	0			
94	V-Active	3F	63		1600	Ver Active =1600
95		06	6			
96	V-Blanking	86	134		135	Ver Blanking = 135
97		00	0			
98	V-offset	02	2		3	V sync Offset =3 line
99		00	0			
9A	V-sync pulse width	05	5		6	V Sync Pulse width：6 line
9B		00	0			

9C		00	0			
9D		00	0		-	Unused
9E		00	0		-	Unused
9F		00	0		-	Unused
A0		00	0		-	Unused
A1		00	0		-	Unused
A2		00	0		-	Unused
A3		00	0		-	Unused
A4		00	0		-	Unused
A5		00	0		-	Unused
A6		00	0		-	Unused
A7		00	0		-	Unused
A8		00	0		-	Unused
A9		00	0		-	Unused
AA		00	0		-	Unused
AB		00	0		-	Unused
AC		00	0		-	Unused
AD		00	0		-	Unused
AE		00	0		-	Unused
AF		00	0		-	Unused
B0		00	0		-	Unused
B1		00	0		-	Unused
B2		00	0		-	Unused
B3		00	0		-	Unused
B4		00	0		-	Unused
B5		00	0		-	Unused
B6		00	0		-	Unused
B7		00	0		-	Unused
B8		00	0		-	Unused
B9		00	0		-	Unused
BA		00	0		-	Unused
BB		00	0		-	Unused
BC		00	0		-	Unused
BD		00	0		-	Unused
BE		00	0		-	Unused
BF		00	0		-	Unused
C0		00	0		-	Unused
C1		00	0		-	Unused
C2		00	0		-	Unused
C3		00	0		-	Unused
C4		00	0		-	Unused
C5		00	0		-	Unused
C6		00	0		-	Unused
C7		00	0		-	Unused
C8		00	0		-	Unused
C9		00	0		-	Unused
CA		00	0		-	Unused
CB		00	0		-	Unused
CC		00	0		-	Unused
CD		00	0		-	Unused
CE		00	0		-	Unused

CF		00	0		-	Unused
D0		00	0		-	Unused
D1		00	0		-	Unused
D2		00	0		-	Unused
D3		00	0		-	Unused
D4		00	0		-	Unused
D5		00	0		-	Unused
D6		00	0		-	Unused
D7		00	0		-	Unused
D8		00	0		-	Unused
D9		00	0		-	Unused
DA		00	0		-	Unused
DB		00	0		-	Unused
DC		00	0		-	Unused
DD		00	0		-	Unused
DE		00	0		-	Unused
DF		00	0		-	Unused
E0		00	0		-	Unused
E1		00	0		-	Unused
E2		00	0		-	Unused
E3		00	0		-	Unused
E4		00	0		-	Unused
E5		00	0		-	Unused
E6		00	0		-	Unused
E7		00	0		-	Unused
E8		00	0		-	Unused
E9		00	0		-	Unused
EA		00	0		-	Unused
EB		00	0		-	Unused
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(81~FD)	0F	15		-	
FF	Checksum(80~FE)	90	144			

16.0 GENERAL PRECAUTIONS

16.1 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.

(l2) 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.

16.2 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.

16.3 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.

16.4 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.

17.0 Appendix

Appendix A

The Measurement Methods for the Dimensions of Module

Caliper:
a. Length of Outline
b. Width of Outline (Without/With PCB)
c. Thickness of Outline (Without/ With PCB)

Coordinate Measuring Machine:
CF Polarizer Size
Active Area Size
Active Area to Outline (Without Tape Wrinkle or Bulged)
Active Area to CF Polarizer
The Distance of Bracket Holes
P-Cover to Outline (Without Tape Wrinkle or Bulged)
Length of P-Cover
Connector Pin 1 to Outline (Without Tape Wrinkle or Bulged)

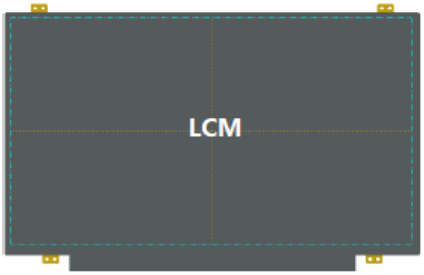
Height Gauge: The Different Height of Root and Top on the Bracket
(Need to Calculate From Bracket Angle Spec.)

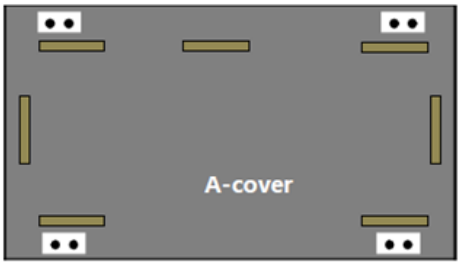
Feeler Gauge: The Warpage Spec. of Module

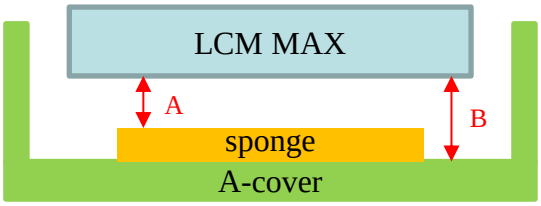
Notes:
Except the Critical Dimensions as Above, Other Dimensions are Measured by Coordinate Measuring Machine If Necessary.

Appendix B

LCM to A-Cover / sponges z-gap



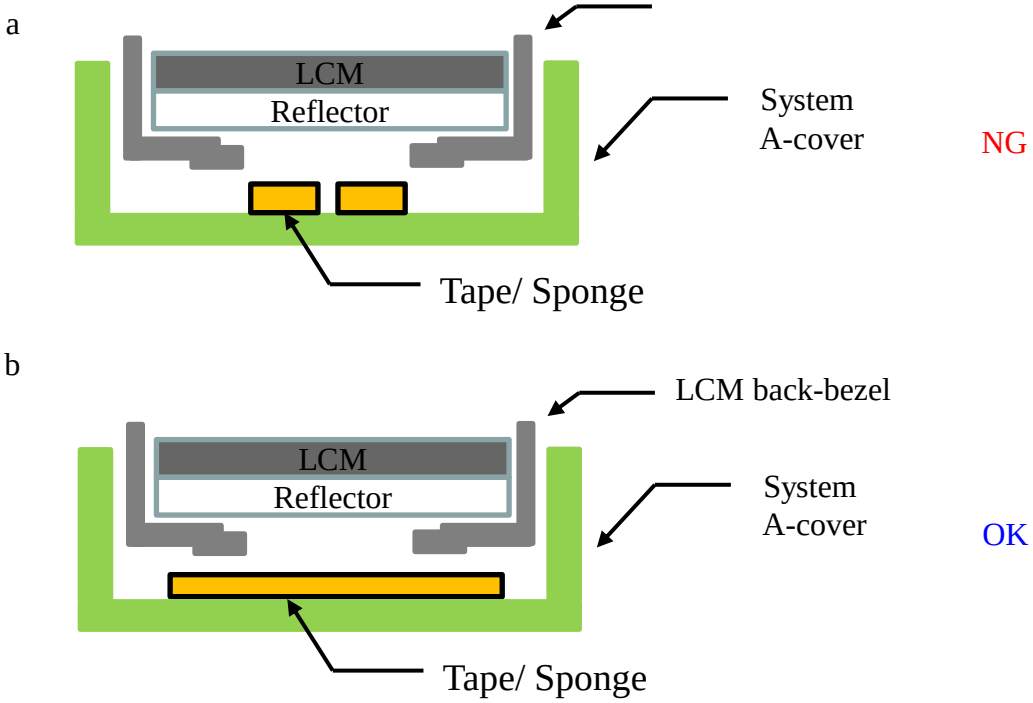




	Plastic Cover (LCM Thickness: Max)	Metal Cover (LCM Thickness: Max)
A	>0mm	>0mm
B	Min: 1.0mm	Min: 0.8mm
Without the open area of back cover		

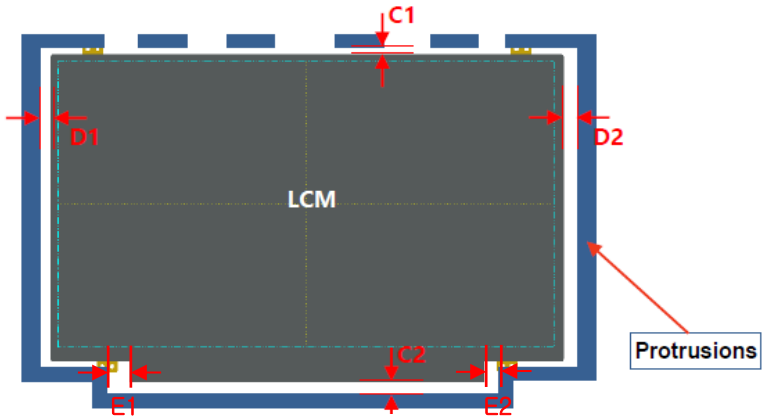
Purpose	The reflector area is very sensitive, we suggest that design enough z-gap to decrease the risk of water ripple, white spot and other abnormal display

Appendix B

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 relate issues. We suggest that attach wide range sponges / rubbers which can cover the LCM back-bezel opening

Appendix B

LCM to side wall / protrusions

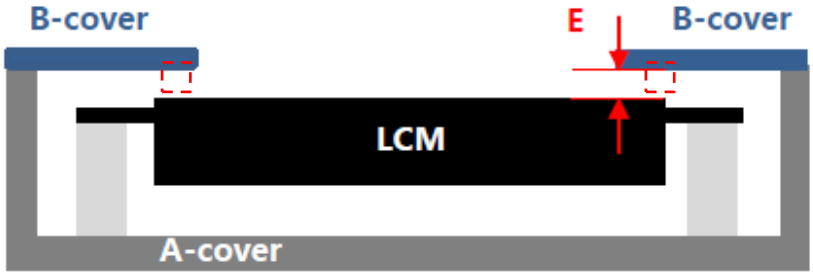


	Normal border	Narrow border
D1/D2	Min: 0.45mm	Min: 0.35mm
C1	Min: 0.50mm	
C2	Min: 0.50mm	
E1/E2	Min: 0.55mm	

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

Appendix B

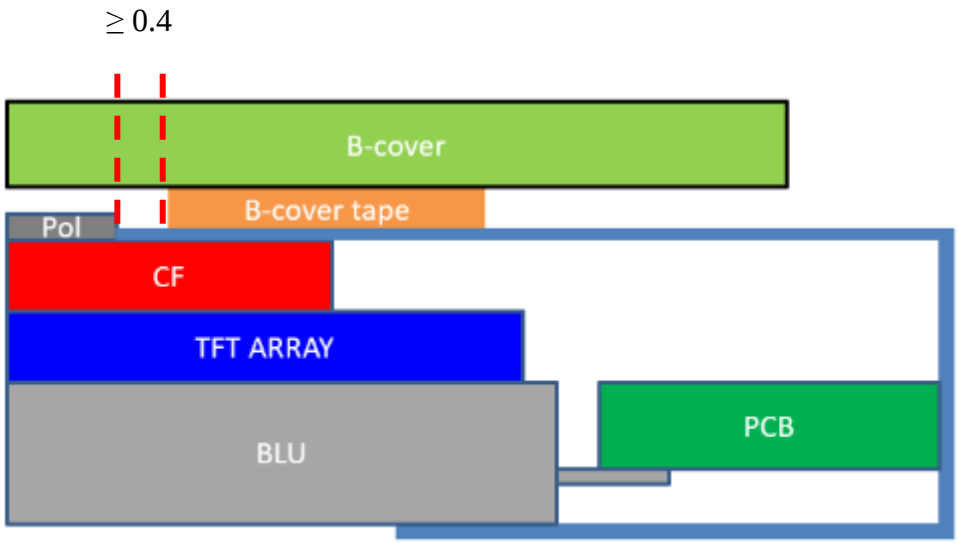
LCM to B-cover z-gap



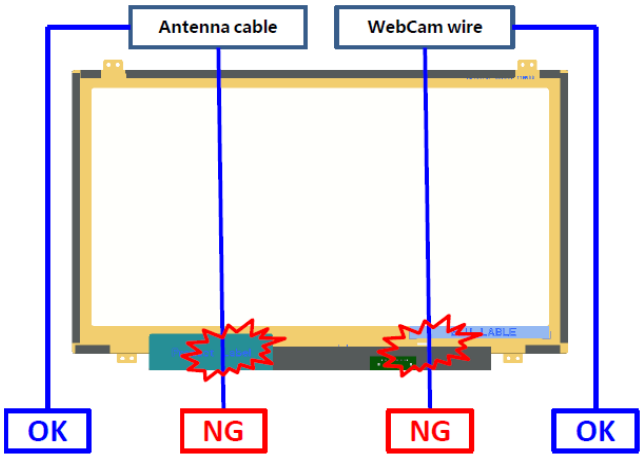
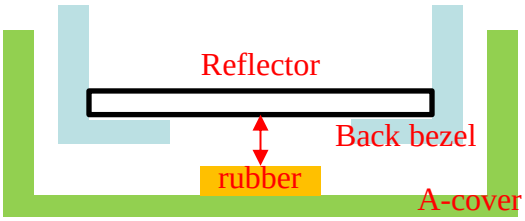
B-cover Tape	Gap
Without	0.15 ~ 0.25mm
With	0.15 ~ 0.20mm

Purpose	Too less z-gap between system B-cover and LCM top pol has high risk to cause cell crack, pooling, light leakage and other issues

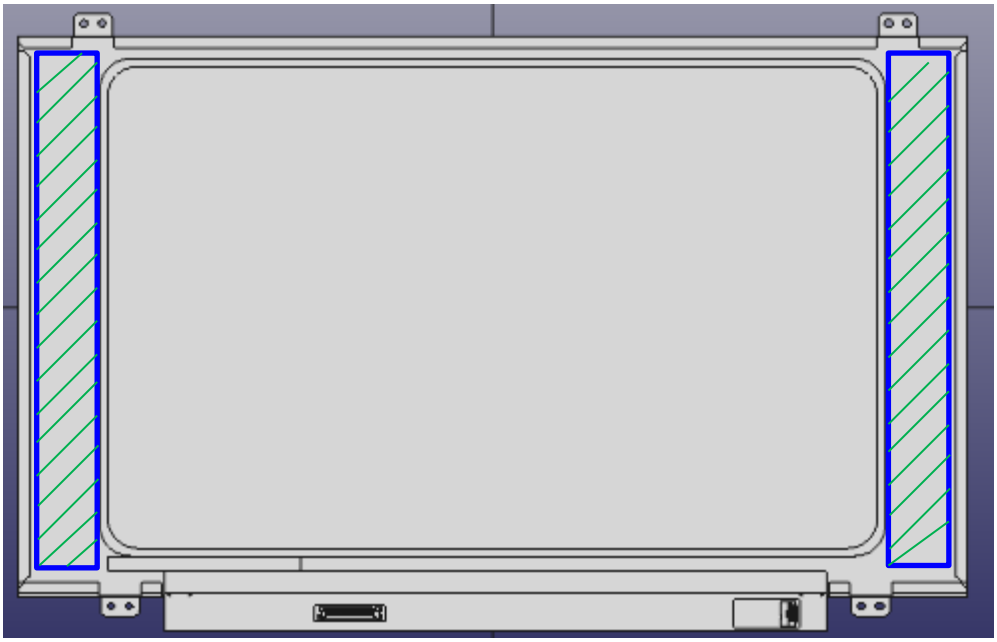
Appendix B

B-cover tape to top pol edge	
 If attach b-cover and LCM with tapes, Please let tapes to be located out of top pol edges 0.4mm away on 4 sides	
Purpose	To avoid the B-cover tape override top pol and cause pooling or light leakage issue

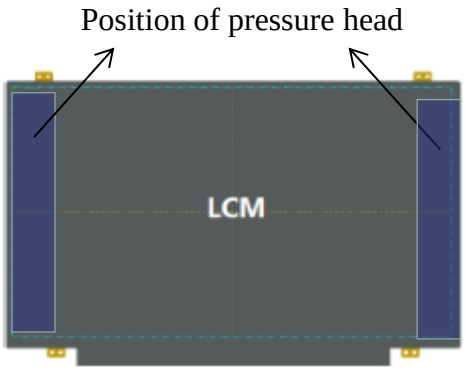
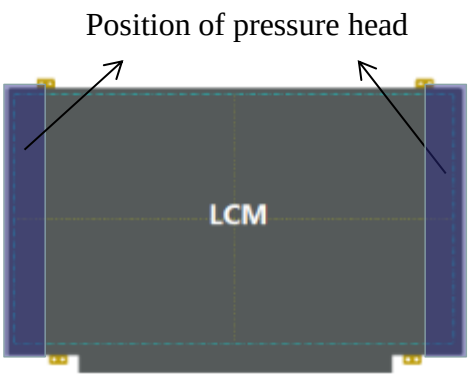
Appendix B

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. We 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 sponge / 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

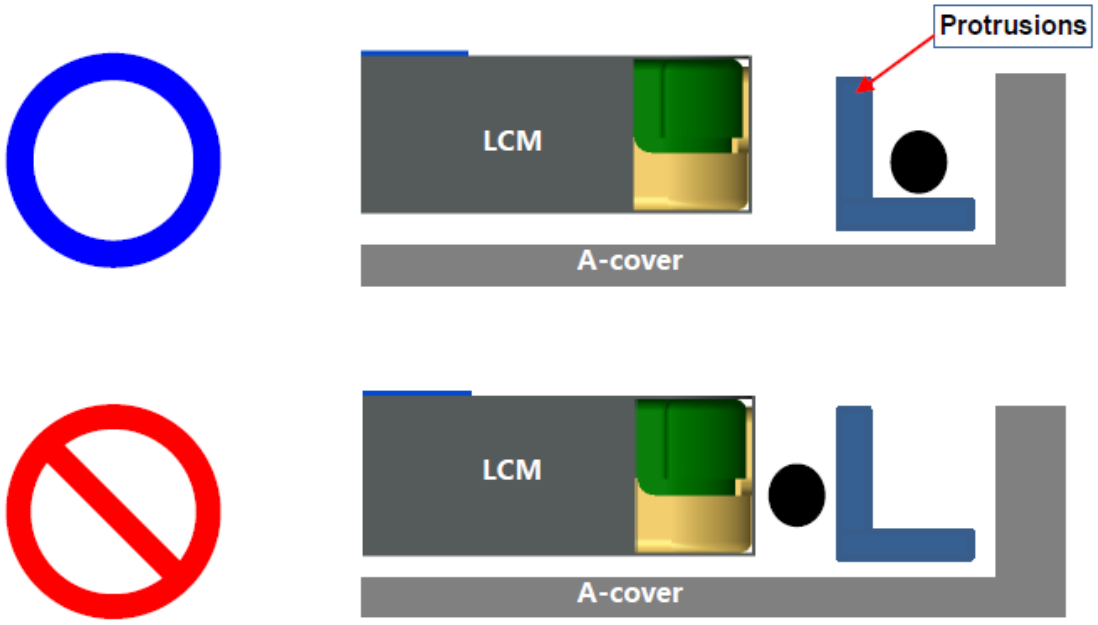
Appendix B

LCM paste 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

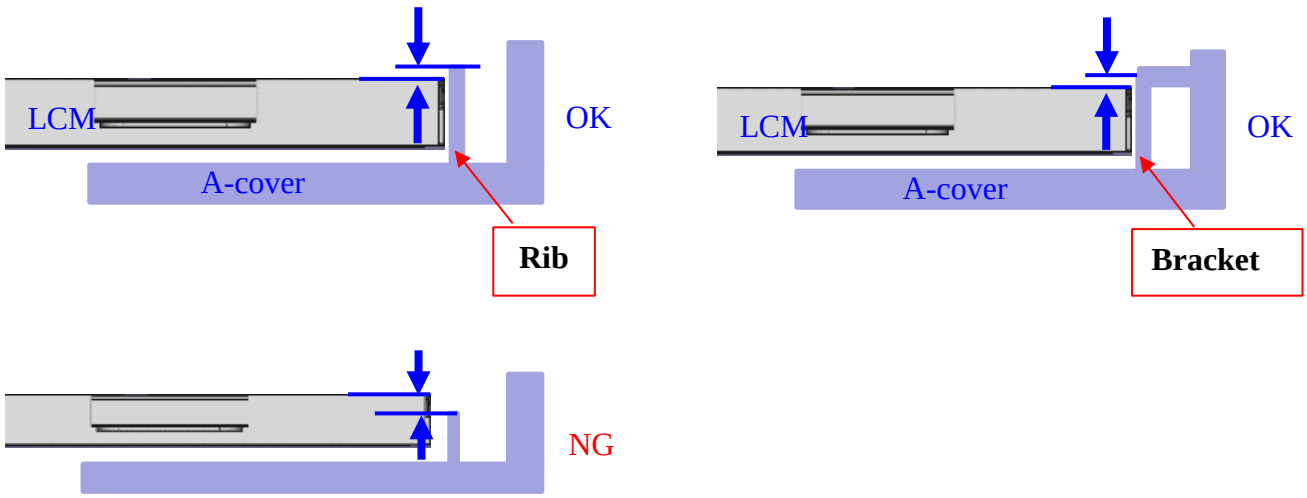
Appendix B

LCM pressable area	
 NG  OK	
Purpose	1. LCM is fixed on A-cover by double-sided tap which can stick LCM after using the press jig stress LCM 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.

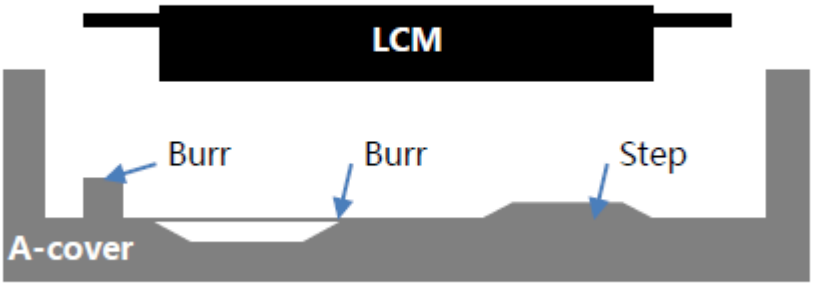
Appendix B

Wire setting	
	
Purpose	Wire should be placed between Protrusions and A-cover. If place the wire between LCM and Protrusions, it may interfere with LCM when assembling B-covers, or even cause LCM breakage in reliability test.

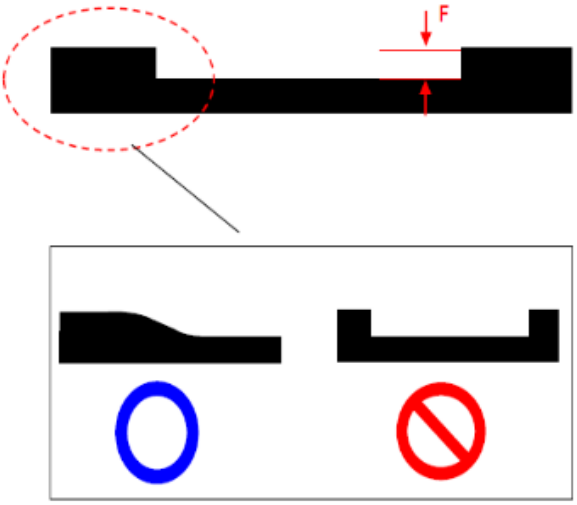
Appendix B

A-cover strength	
	
Purpose	1. It is recommended that Rib height is higher than LCM, in order to avoiding press on LCM edge panels. 2. As for LCM is more stronger than Rib, the L Bracket is be recommended.

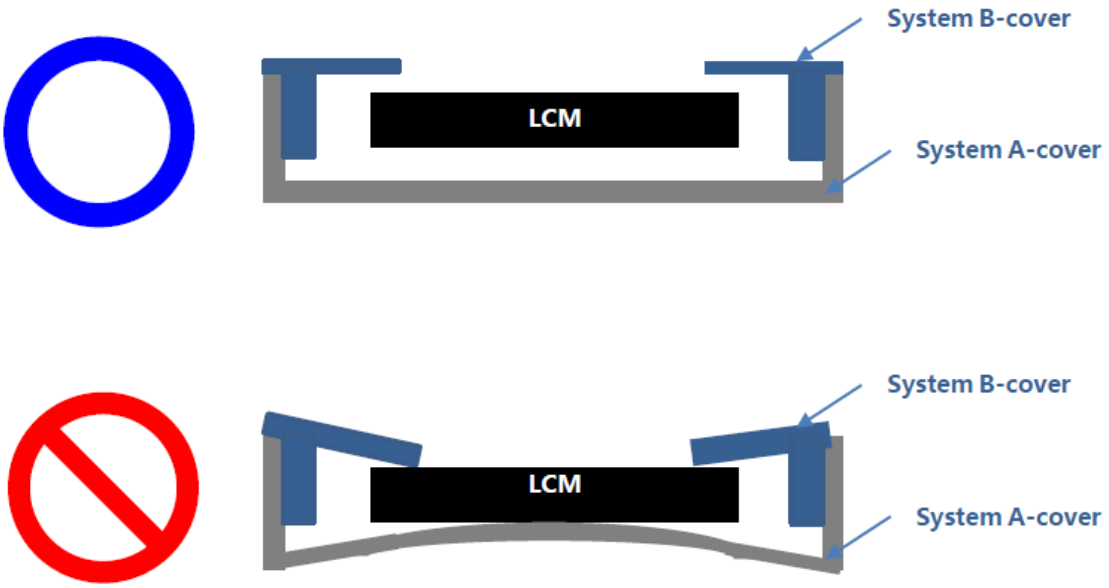
Appendix B

System A-cover Inner Surface	
	
Purpose	There should not exist any burr, segment gap or protrusions beside Logo, which would cause White Spot or Glass Broken by stress concentration.

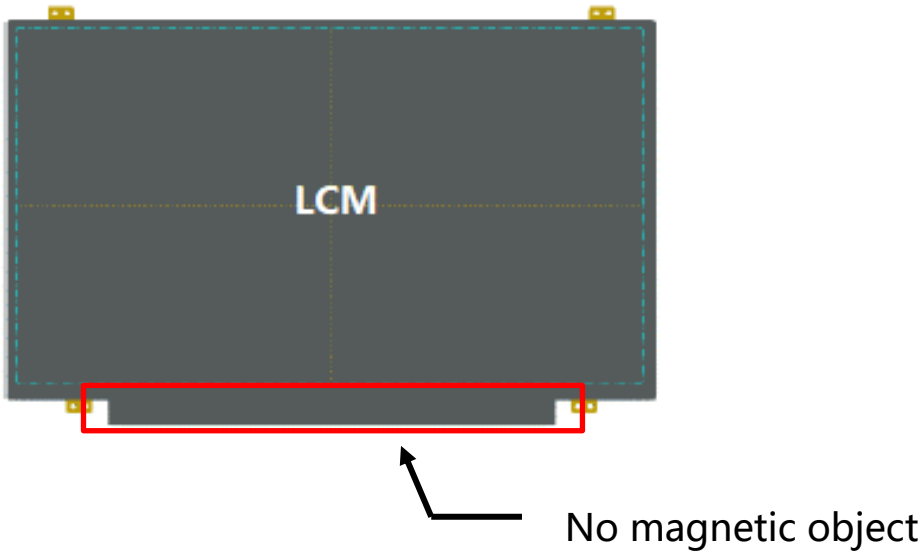
Appendix B

Keyboard area & Mouse pad	
  ➢ F: max 0.3mm	
Purpose	In order to avoiding LCM fragments in reliability test, the step surface of Keyboard and Mouse pad transmits smoothly, and should not be right-angle. For example, when Pogo testing, if the broken hole is done in this location, it is easy to produce fragments.

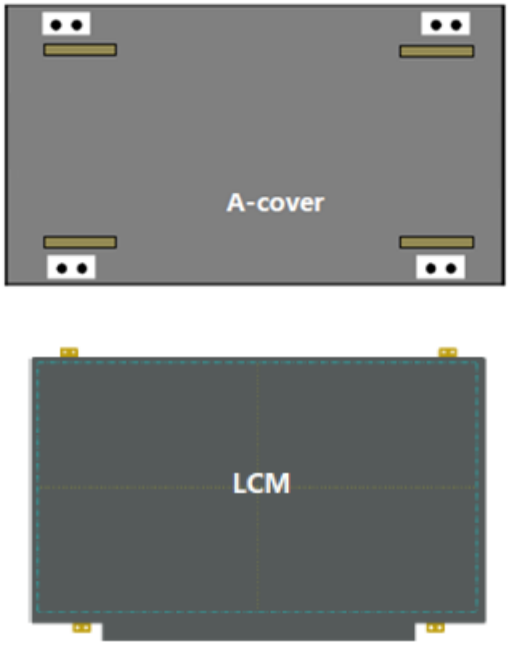
Appendix B

System cover reliability	
	
Purpose	The permanent deformation part of System cover after the reliability test, including sponge and other structures or components, can not touch LCM.

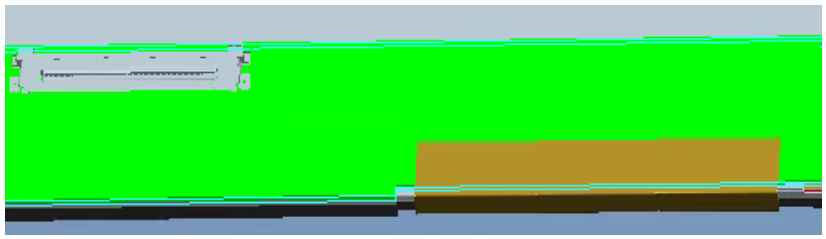
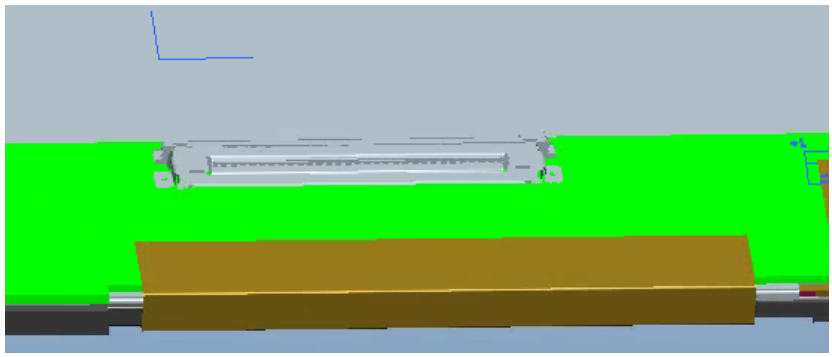
Appendix B

A/B-cover near LCD PCBA	
	
Purpose	There should not have magnet object near LCM PCBA, which is prone to cause physical or electricity noise issue

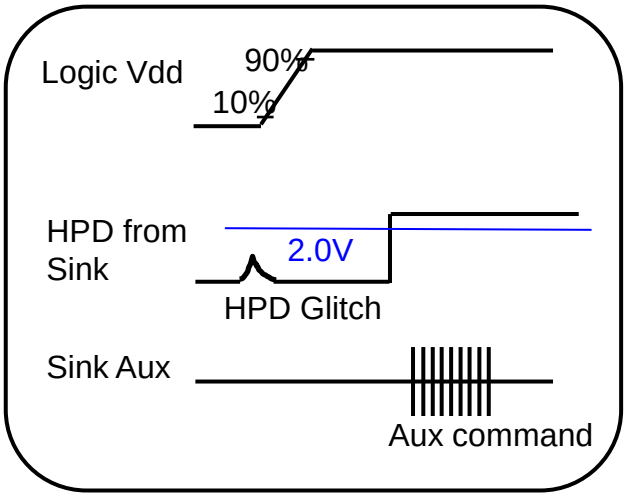
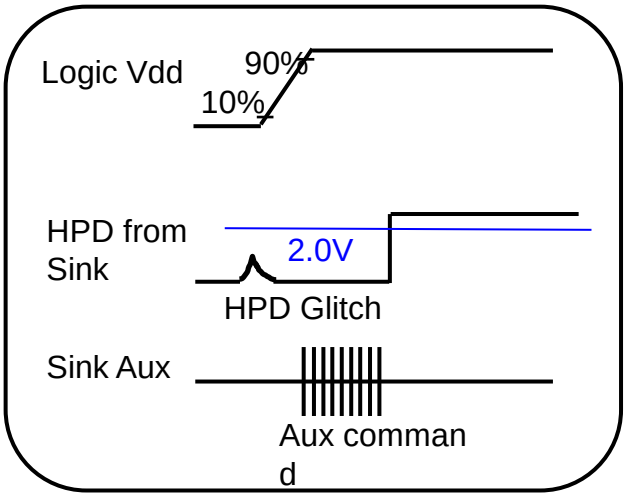
Appendix B

A-cover add sponges on Boss side wall	
 	
Purpose	We suggest to attach Sponges to the side of the Boss column of A-cover to reduce the panel broken possibility in assembly. It is recommended to this design synchronously.

Appendix B

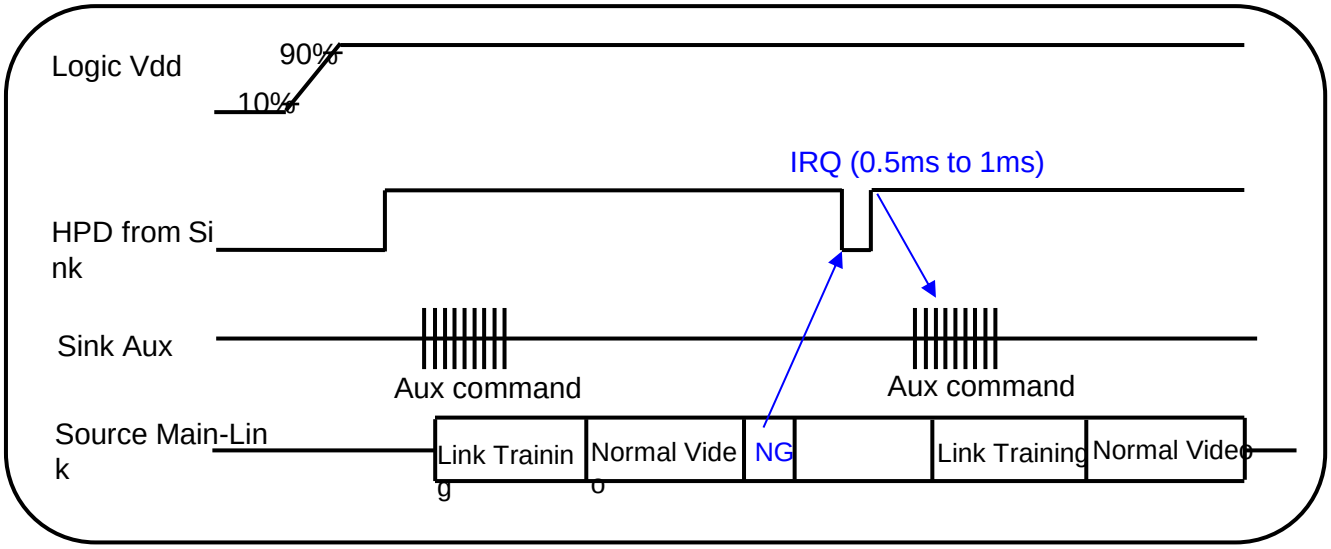
LCM to A-Cover / sponges z-gap	
   	
Purpose	Bent product: The position of system connector and FPC should be staggered in X direction. Otherwise, when testing, the system Cable line extrudes FPC, leading to FPC Crack; (Panel FPC Bonding location is related to Mask and can not be changed easily)

Appendix C

HPD Signal recognition	
 Normal Signal (Ignore HPD Glitch)	 Abnormal Signal
Purpose	When HPD glitch of source device minimum is 2.0(V).

Appendix C

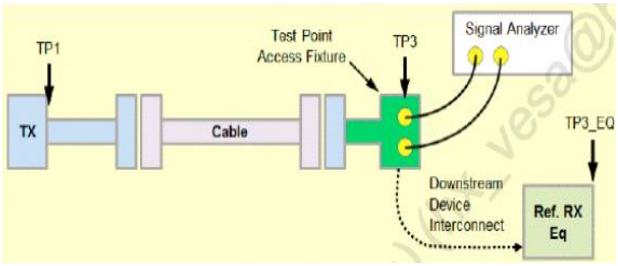
HPD Signal Definition IRQ (Interrupt Request)



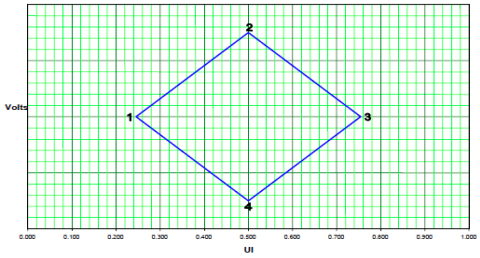
Purpose	When HPD signal low than 0.5ms to 1ms, the source device should check sink status field from the DPCD and take link training again.

Appendix C

Main link eye diagram of TP3



Measured TP3 on LCM connector.



Downstream Device Mask at TP3

	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

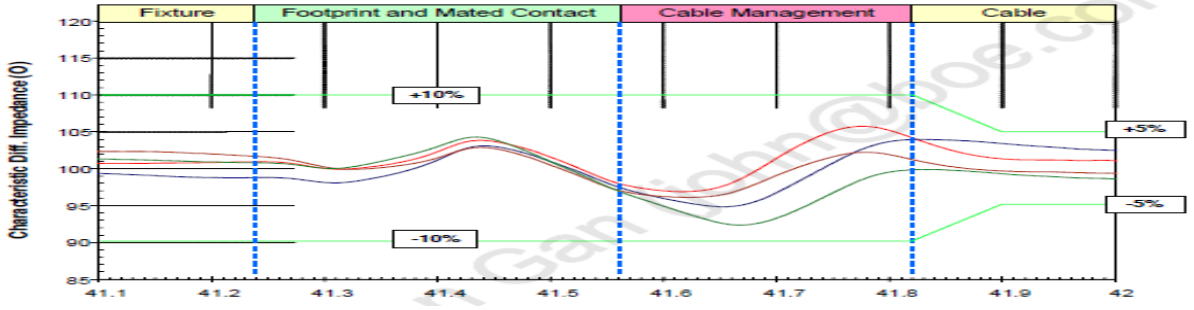
	UI	Voltage
1	0.375	0
2	0.5	0.023
3	0.625	0
4	0.5	-0.023

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.

Appendix C

Impedance Profile through a DP Connector



Differential Impedance Profile Measurement Data Example

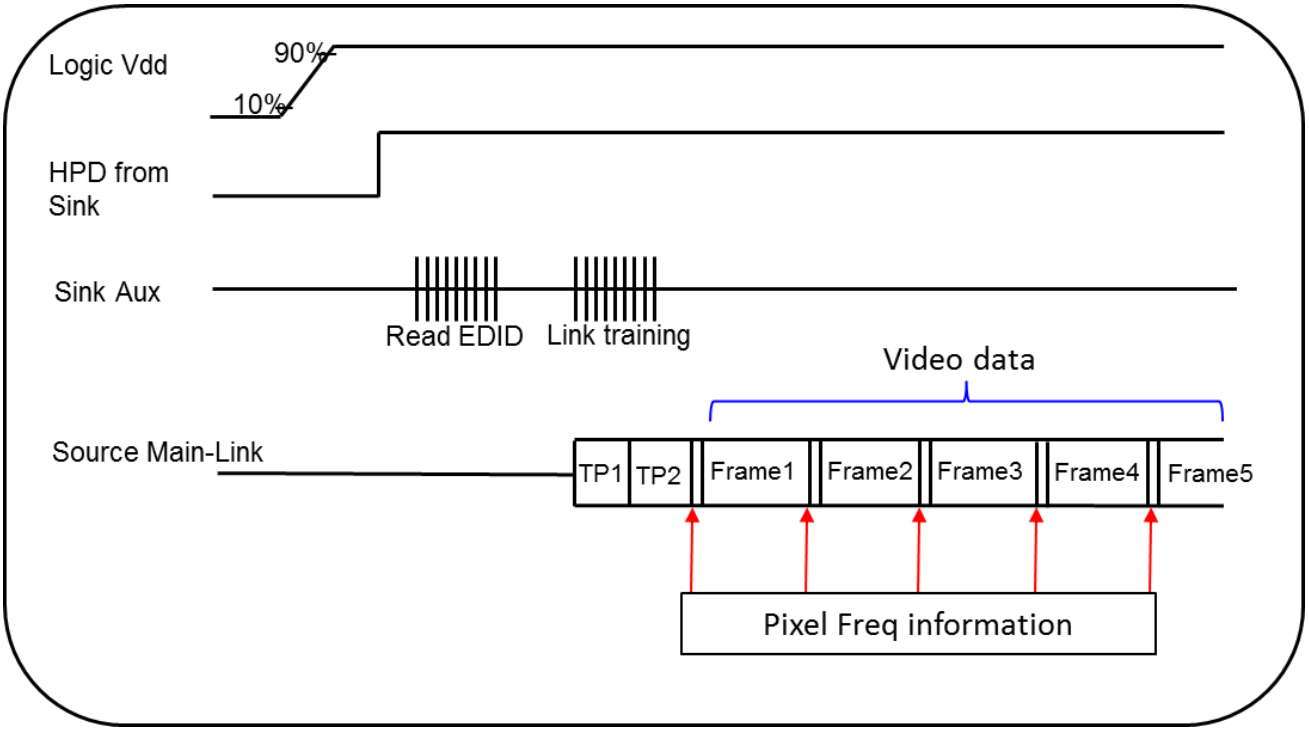
Segment	Differential Impedance Value	Maximum Tolerance
Fixture	100Ω/85Ω VESA	±10%
Connector	100Ω/85Ω VESA	±10%
Wire management	100Ω/85Ω VESA	±10%
Cable	100Ω/85Ω VESA	±5%

Impedance Profile Values for Cable Assembly

Purpose	Cable Impedance Profile 100ohm for Cable Assembly

Appendix C

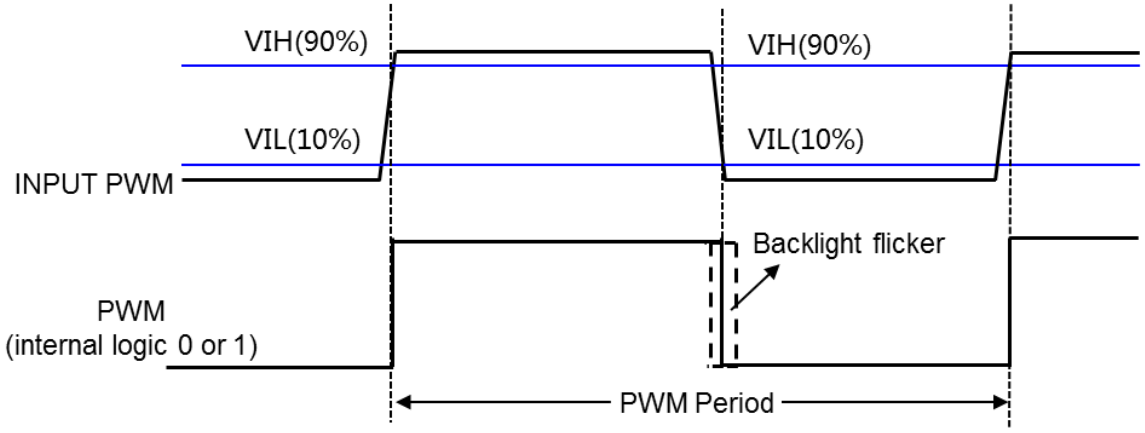
Main Link Pixel Freq information value of MSA data



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.

Appendix C

Main Link Pixel Freq information value of MSA data



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 ≤ 200ppm*cycle time ; PWM falling ≤ 200ppm*cycle time.