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SPECIFICATION
FOR
APPROVAL

( ) **Preliminary Specification**
(◆) **Final Specification**

Title	15.6” WUXGA TFT LCD

Customer	
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LP156WU1
Suffix	SPB1

*When you obtain standard approval,
please use the above model name without suffix

APPROVED BY	SIGNATURE
/	
/	
/	

Please return 1 copy for your confirmation with your signature and comments.

APPROVED BY	SIGNATURE
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Products Engineering Dept.
LG Display Co., Ltd

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Record of Revisions

Revision No	Revision Date	Page	Before	After	EDID version
0.1	Sep. 4. 2020	All	First Draft (Preliminary Specification)	-	TBD
0.2	Nov.2. 2020	7,45	Differential Impedance 100Ω ±10%	Update Differential Impedance 85Ω ±15%	0.1
		26~31	-	Update Label ,Packing Information	
		53~55	-	Update EDID(Rev. code: X10)	
0.3	Nov.30. 2020	17	Power Sequence T9(Min/Max) : None T10(Min) : None	Update Power Sequence T9(Min/Max) : 50/100ms T10(Min) : 100ms	0.2
		53~55	-	Update EDID Adding 2nd Timing Table	
0.4	Dec. 29. 2020	53~55	-	Update EDID(Rev. code: X20)	0.3
1.0	Mar.22. 2021	All	-	Final Spec. Release for MP	1.0
		10	R/C Loading Parameter in VCC Loop (TBD/TBD)	Update . R/C Loading Parameter in VCC Loop (36K/ 52uF)	
		21	Hard Coating(3H), Anti Glare treatment of the front polarizer	Anti Glare treatment (3H) of the front Polarizer	
		22,23	-	Update Drawing for Final Spec.	
		53~55	-	Update EDID(Rev. code: A00)	

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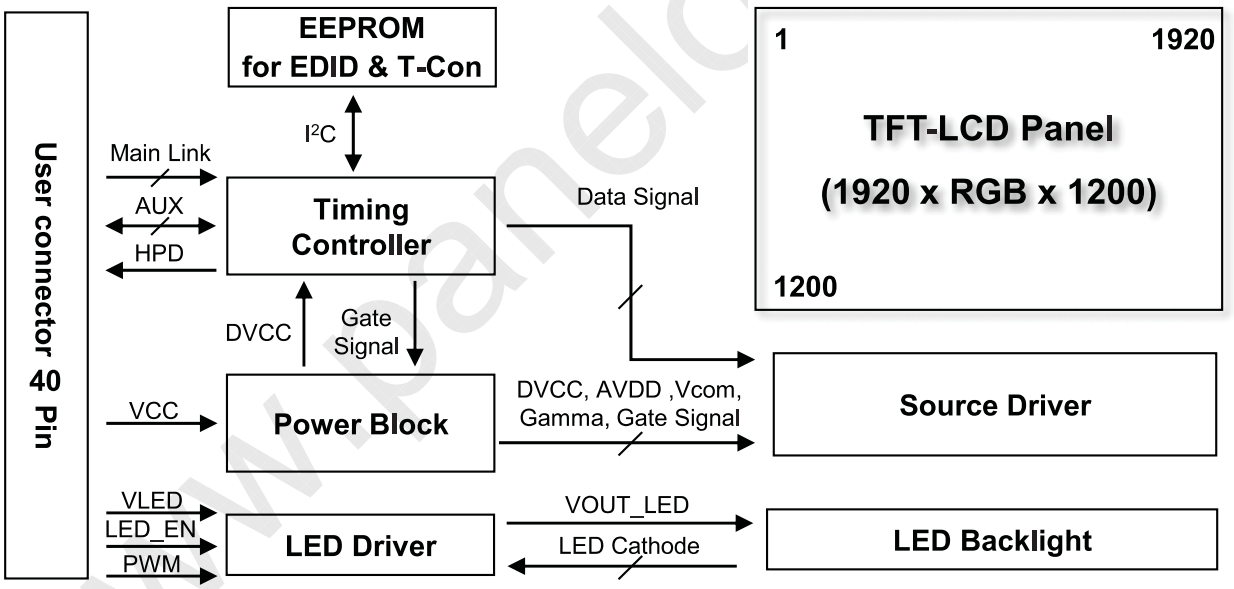
1. General Description

1-1. Introduction

The LP156WU1 is a Color Active Matrix Liquid Crystal Display with an integral LED backlight system. The matrix employs Oxide Thin Film Transistor as the active element. It is a transmissive type display operating in the normally black mode. This TFT-LCD has 15.6 inches diagonally measured active display area with WUXGA resolution (1920 horizontal by 1200 vertical pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16,777,216 colors. The LP156WU1 has been designed to apply the interface method that enables low power, high speed, low EMI. The LP156WU1 is intended to support applications where thin thickness, low power are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LP156WU1 characteristics provide an excellent flat display for office automation products such as Notebook PC.



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1-2. General Feature

Active Screen Size		15.6 inches diagonal
Outline Dimension		340.26(H, Typ.) × 218.02(V, Typ.) × 2.45(D, Max.) [mm] (w/o PCB)
Pixel Pitch		0.1752 mm X 0.1752 mm
Pixel Format		1920 horiz. by 1200 vert. Pixels RGB strip arrangement
Color Depth		8-bit, 16,777,216 colors
Luminance, White		500 cd/m^2(Typ.)
Power Consumption		Total 3.63W (Typ.) Logic : 0.38W (Typ. @ Mosaic), B/L :3.25W (Typ.)
Weight		324g (Max.)
Display Operating Mode		Normally black
Surface Treatment		Anti Glare treatment (3H) of the front Polarizer
Color Gamut		sRGB Min.100%
Low Blue Light Panel		The ratio of light in the range from 415nm - 455nm compared to 400nm - 500nm shall be less than 50%
LED Dimming Control mode		DC Dimming
RoHS Compliance		Yes
BFR / PVC / As Free		Yes for all
eDP version(Tcon)		eDP1.4b
DPCD version		Ver1.4
Function	PSR	PSR2
	sDRRS	Support(48Hz)
	DMRRS	Not support
	Adaptive sync	Not support
	NVSR	Not support
	SSC	Down spread 0.5%

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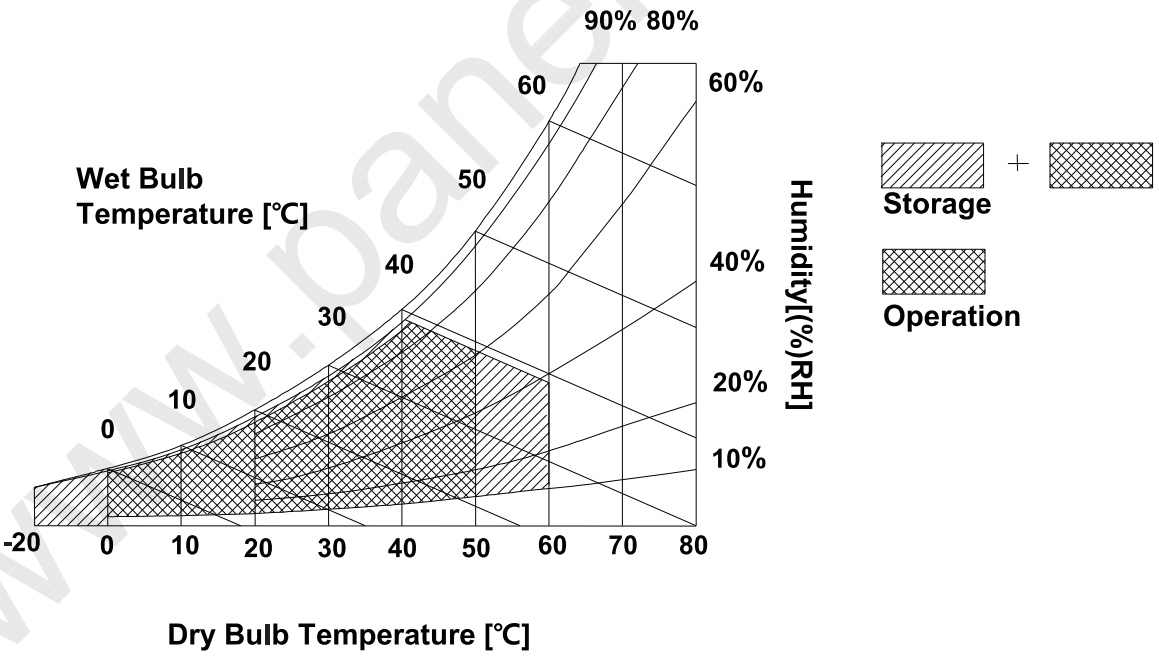
2. Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Input Voltage	VCC	-0.3	4.0	V_{DC}	at 25 ± 2°C
Operating Temperature	TOP	0	50	°C	1
Storage Temperature	TST	-20	60	°C	1,2
Operating Ambient Humidity	HOP	10	90	%RH	1
Storage Humidity	HST	10	90	%RH	1,2

Note : 1. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39°C Max, and no condensation of water.
Note : 2. Storage Condition is guaranteed under packing condition.



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3. Electrical Specifications

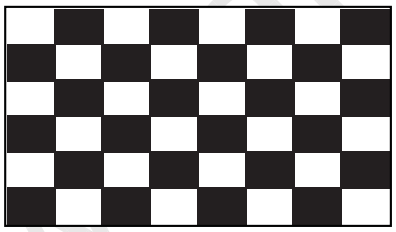
3-1. LCD Electrical Characteristics

Table 2. LCD ELECTRICAL CHARACTERISTICS

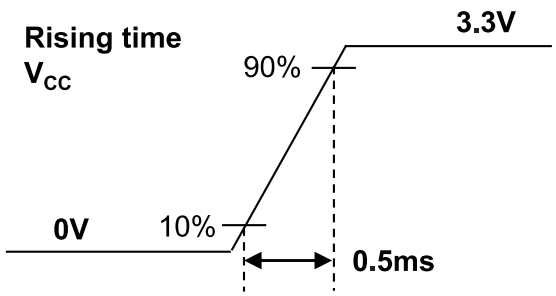
Parameter		Symbol	Values			Unit	Notes
			Min	Typ	Max		
Power Supply Input Voltage		V_{CC}	3.0	3.3	3.6	V	1
Permissive Power Supply Input Ripple		V_{CCrp}	-	-	100	mV_{p-p}	
Power Supply Input Current	Mosaic	I_{CC}	-	115	127	mA	2
Power Consumption		P_{CC}	-	0.38	0.42	W	
Power Supply Input Current	R,G,B	I_{CC}	-	130	142	mA	
Power Consumption		P_{CC}	-	0.43	0.47	W	
Power Supply Inrush Current		I_{CC_P}	-	-	1.5	A	3
Differential Impedance		Z_{eDP}	72.3	85	97.8	Ω	

Note)

1. The measuring position is the connector of LCM and the test conditions are under 25℃, fv = 60Hz
2. The specified I_{CC} current and power consumption are under the V_{CC} = 3.3V , 25℃, fv = 60Hz condition and Mosaic & R,G,B pattern.



3. The V_{CC} rising time is same as the minimum of T1 at Power on sequence.



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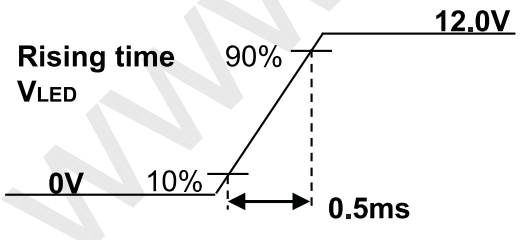
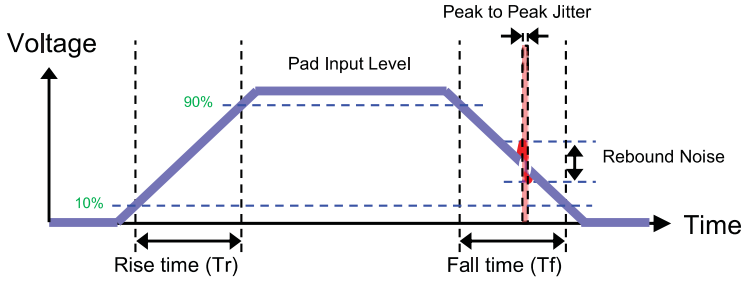
3-2. LED Backlight Electrical Characteristics

Table 3. LED B/L ELECTRICAL CHARACTERISTICS

Parameter		Symbol	Values			Unit	Notes
			Min	Typ	Max		
LED Power Input Voltage		V_{LED}	5.0	12.0	21.0	V	1
LED Power Input Current		I_{LED}	-	271	284	mA	2
LED Power Consumption		P_{LED}	-	3.25	3.41	W	
LED Power Inrush Current		I_{LED_P}	-	-	1.5	A	3
PWM Duty Ratio			5	-	100	%	4
PWM Resolution				10		Bit	5
PWM Jitter			0	-	0.05	%	6
PWM Frequency		F_{PWM}	200	-	2000	Hz	7
PWM	High Level Voltage	V_{PWM_H}	2.5	-	3.6	V	
	Low Level Voltage	V_{PWM_L}	0	-	0.3	V	
	Tr / Tf @ 200Hz		-	-	25/25	us	
	Tr / Tf @ 2Khz		-	-	2.5/2.5	us	
	P to P Jitter @ 200hz		-	-	1	us	8
	P to P Jitter @ 2Khz		-	-	0.1	us	
LED_EN	High Voltage	$V_{LED\_EN\_H}$	2.5	-	3.6	V	
	Low Voltage	$V_{LED\_EN\_L}$	0	-	0.3	V	
Life Time			15,000	-	-	Hrs	9

Note)
1. The measuring position is the connector of LCM and the test conditions are under 25℃.
2. The current and power consumption with LED Driver are under the V_{LED} = 12.0V , 25℃, PWM Duty 100% and White pattern with the normal frame frequency operated(60Hz).
3. The V_{LED} rising time is same as the minimum of T13 at Power on sequence.





4. The operation of LED Driver below minimum dimming ratio may cause flickering or reliability issue.
5. 10bit resolution means it's possible to change PWM duty by 0.1% step. (8bit operated by 0.4% step)
6. If Jitter of PWM is bigger than maximum, it may induce flickering.
7. This Spec. is not effective at 100% dimming ratio as an exception because it has DC level equivalent to 0Hz. In spite of acceptable range as defined, the PWM Frequency should be fixed and stable for more consistent brightness control at any specific level desired.
8. PWM rebound spec ≤ 0.1V
9. The life time is determined as the time at which brightness of LCD is 50% compare to that of minimum value specified in table 7. under general user condition.

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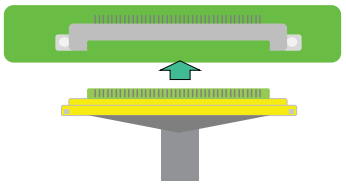
3-3. Interface Connections

Table 4. MODULE CONNECTOR PIN CONFIGURATION (CN1)

Pin	Symbol	Description	Notes
1	DBC_EN	DBC Enable(Active High)	
2	GND	High Speed Ground	
3	NC	NC	
4	NC	NC	
5	GND	High Speed Ground	
6	NC	NC	
7	NC	NC	
8	GND	High Speed Ground	
9	Lane1_N	Complement Signal Link Lane 1	
10	Lane1_P	True Signal Link Lane 1	
11	GND	High Speed Ground	
12	Lane0_N	Complement Signal Link Lane 0	[Connector] I-PEX, 20682-040E-02 (40pin, 0.4pitch) or equivalent
13	Lane0_P	True Signal Link Lane 0	
14	GND	High Speed Ground	
15	AUX_CH_P	True Signal Auxiliary Channel	
16	AUX_CH_N	Complement Signal Auxiliary Channel	
17	GND	High Speed Ground	[Connector pin arrangement] Pin 40 Pin 1 
18	VCC	LCD logic and driver power	
19	VCC	LCD logic and driver power	
20	VCC	LCD logic and driver power	
21	VCC	LCD logic and driver power	
22	BIST_EN	LCD Panel Self Test Enable (Active High)	
23	GND	LCD logic and driver ground	
24	GND	LCD logic and driver ground	
25	GND	LCD logic and driver ground	
26	GND	LCD logic and driver ground	
27	HPD	HPD signal pin	[LGD P-Vcom using information] 1. Pin for P-Vcom : #34, #35 2. P-Vcom Address : 1001111x
28	BL_GND	LED Backlight ground	
29	BL_GND	LED Backlight ground	
30	BL_GND	LED Backlight ground	
31	SOL	SOL function control	
32	BL ENABLE	LED Backlight control on/off control	
33	BL PWM	System PWM signal input for dimming	
34	NC Reserved	Reserved for LCD manufacture's use(SCL)	
35	NC Reserved	Reserved for LCD manufacture's use(SDA)	
36	VLED	LED Backlight power (12V Typical)	
37	VLED	LED Backlight power (12V Typical)	
38	VLED	LED Backlight power (12V Typical)	
39	VLED	LED Backlight power (12V Typical)	
40	NC Reserved	Reserved for LCD manufacture's use	

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3-3-1. Input/output signal circuit

Figure1.HPD Output circuit is as below

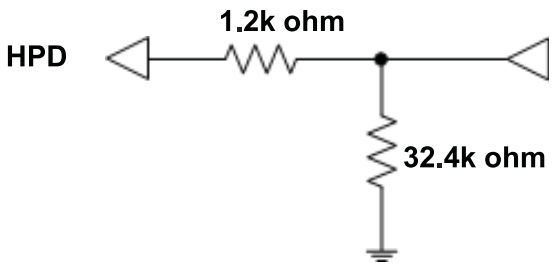


Figure2.BL PWM input circuit is as below

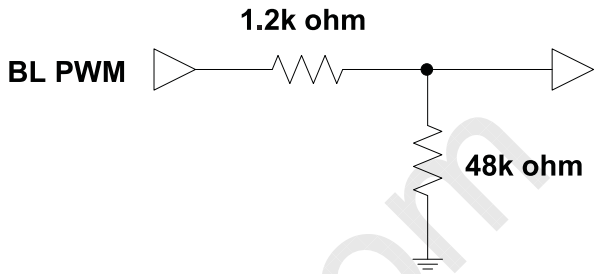


Figure3.BL Enable input circuit is as below

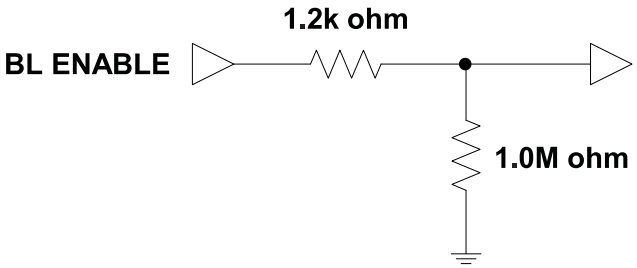


Figure4.BIST input circuit is as below

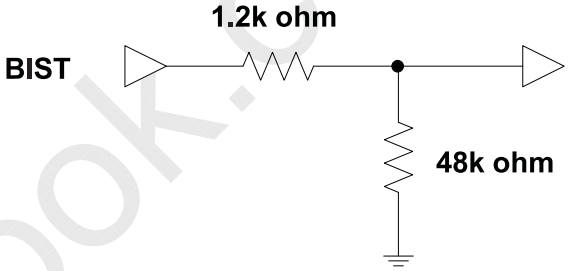


Figure5.DBC input circuit is as below

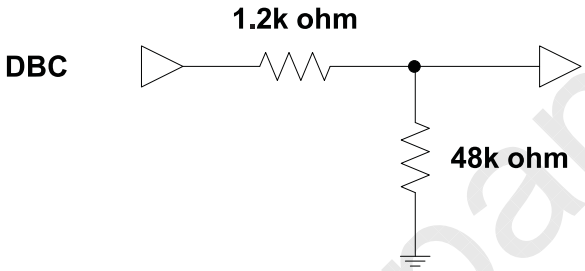


Figure6.SOL input circuit is as below

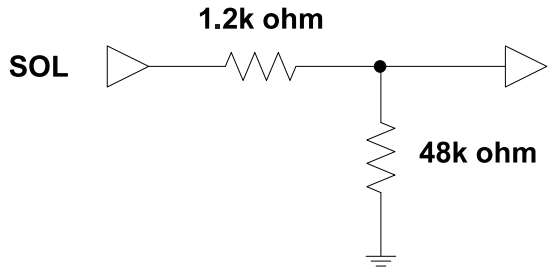
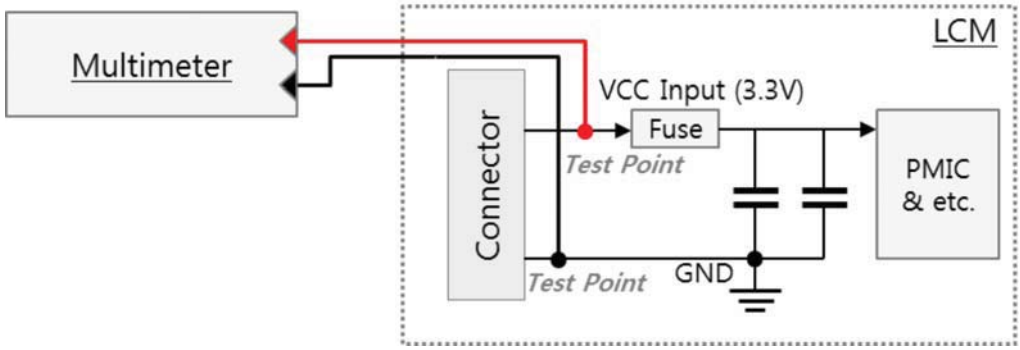


Figure7. R/C Loading Parameter in VCC Loop

Resistance	36 kΩ
Capacitance	52 uF

Figure8.Schematic Diagram for VCC Loop R/C Loading Measurement



Note)
1. Measure the R/C without Cable Connected in Connector
2. Check The R/C Value when the measured value is stabilized after connecting Multimeter

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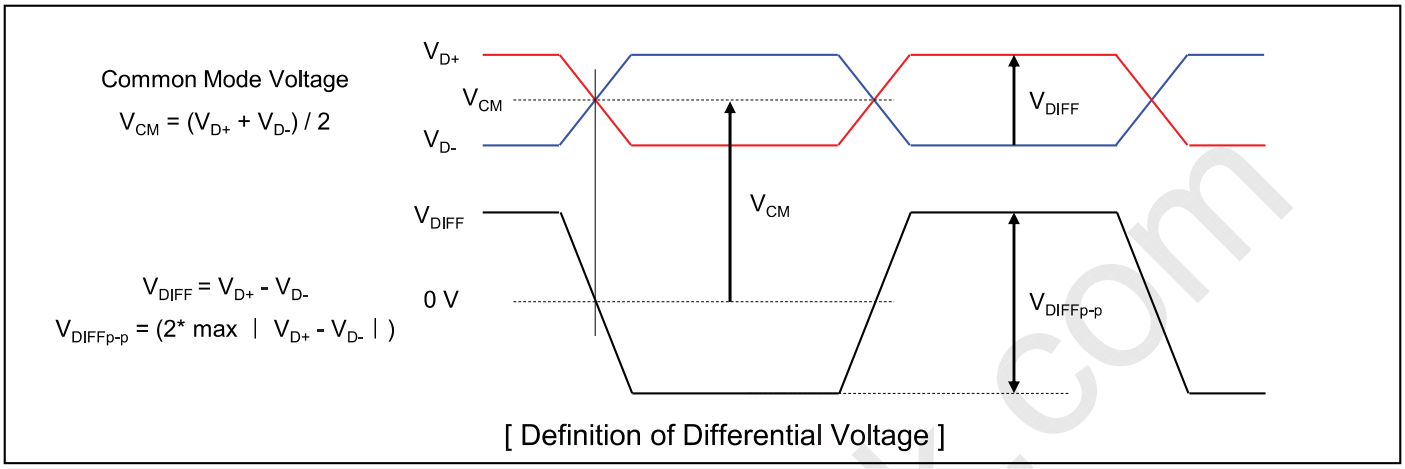
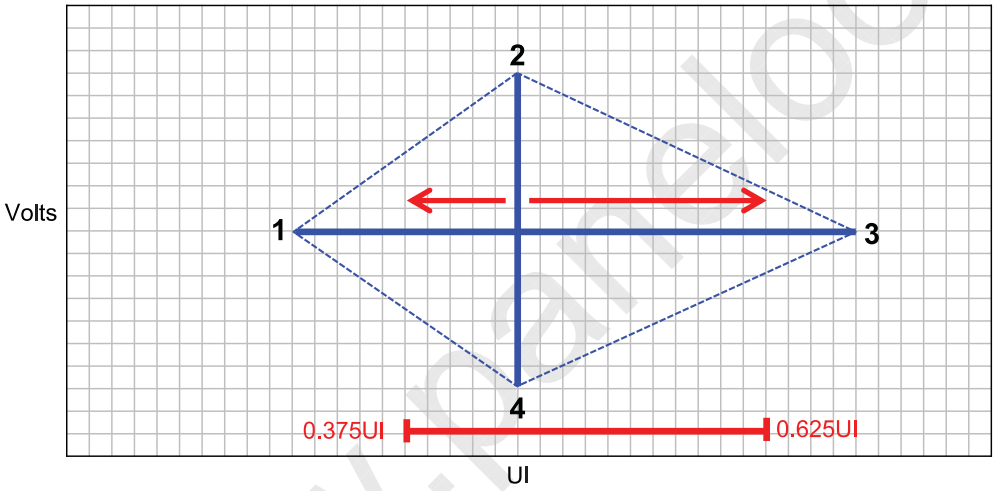
3-4. eDP Signal Timing Specifications

3-4-1. Definition of Differential Voltage



[Definition of Differential Voltage]

3-4-2. Main Link EYE Diagram



[EYE Mask at Source/Sink Connector Pins]

Point	High Bit Rate2	
	Time(UI)	Voltage(V)
1	Any UI location (0mV)	0.000
2	0.375<point2<0.625	0.045
3	Point1 + 0.38	0.000
4	0.375<point4<0.625	-0.045

[EYE Mask Vertices at Source Connector Pins]

Point	High Bit Rate2	
	Time(UI)	Voltage(V)
1	Any UI location (0mV)	0.000
2	0.375<point2<0.625	0.035
3	Point1 + 0.38	0.000
4	0.375<point2<0.625	-0.035

[EYE Mask Vertices at Sink Connector Pins]

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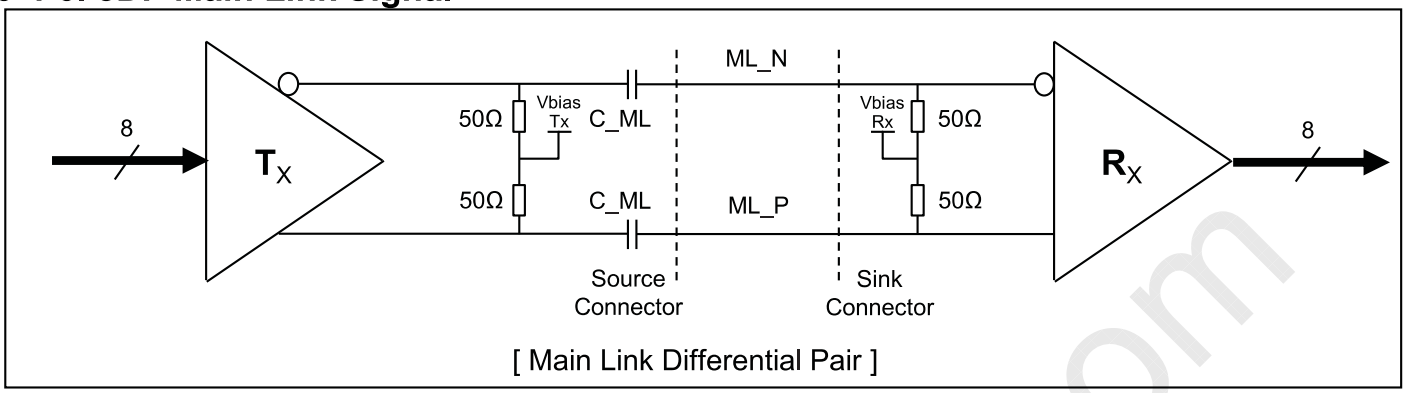
3-4-3. eDP Main Link Signal



[Main Link Differential Pair]

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Unit Interval for high bit rate2 (5.4Gbps / lane)	UI_HBR2	-	185	-	ps	
Unit Interval for high bit rate (2.7Gbps / lane)	UI_HBR	-	370	-	ps	
Unit Interval for reduced bit rate (1.62Gbps / lane)	UI_RBR	-	617	-	ps	
Link Clock Down Spreading	Amplitude	0	-	0.5	%	
	Frequency	30		33	kHz	
Differential peak-to-peak voltage at Source side connector	$V_{TX-DIFFp-p}$	90	-	-	mV	For HBR2(5.4Gbps)
		350	-	-		For HBR(2.7Gbps)
		400	-	-		For RBR(1.62Gbps)
EYE width at Source side connector	$T_{TX-EYE-CONN}$	0.38			UI	For HBR(5.4Gbps)
		0.58	-	-		For HBR(2.7Gbps)
		0.75	-	-		For RBR(1.62Gbps)
Differential peak-to-peak voltage at Sink side connector	$V_{RX-DIFFp-p}$	70			mV	For HBR(5.4Gbps)
		150	-	-		For HBR(2.7Gbps)
		136	-	-		For RBR(1.62Gbps)
EYE width at Sink side connector	$T_{RX-EYE-CONN}$	0.38			UI	For HBR(5.4Gbps)
		0.51	-	-		For HBR(2.7Gbps)
		0.46	-	-		For RBR(1.62Gbps)
Rx DC common mode voltage	$V_{RX\ CM}$	0	-	1.0	V	
AC Coupling Capacitor	C_{SOURCE_ML}	75		200	nF	Source side

Note)
1. Termination resistor is typically integrated into the transmitter and receiver implementations.
2. AC Coupling Capacitor is not placed at the sink side.
3. In cabled embedded system, it is recommended the system designer ensure that EYE width and voltage are met at the sink side connector pins.

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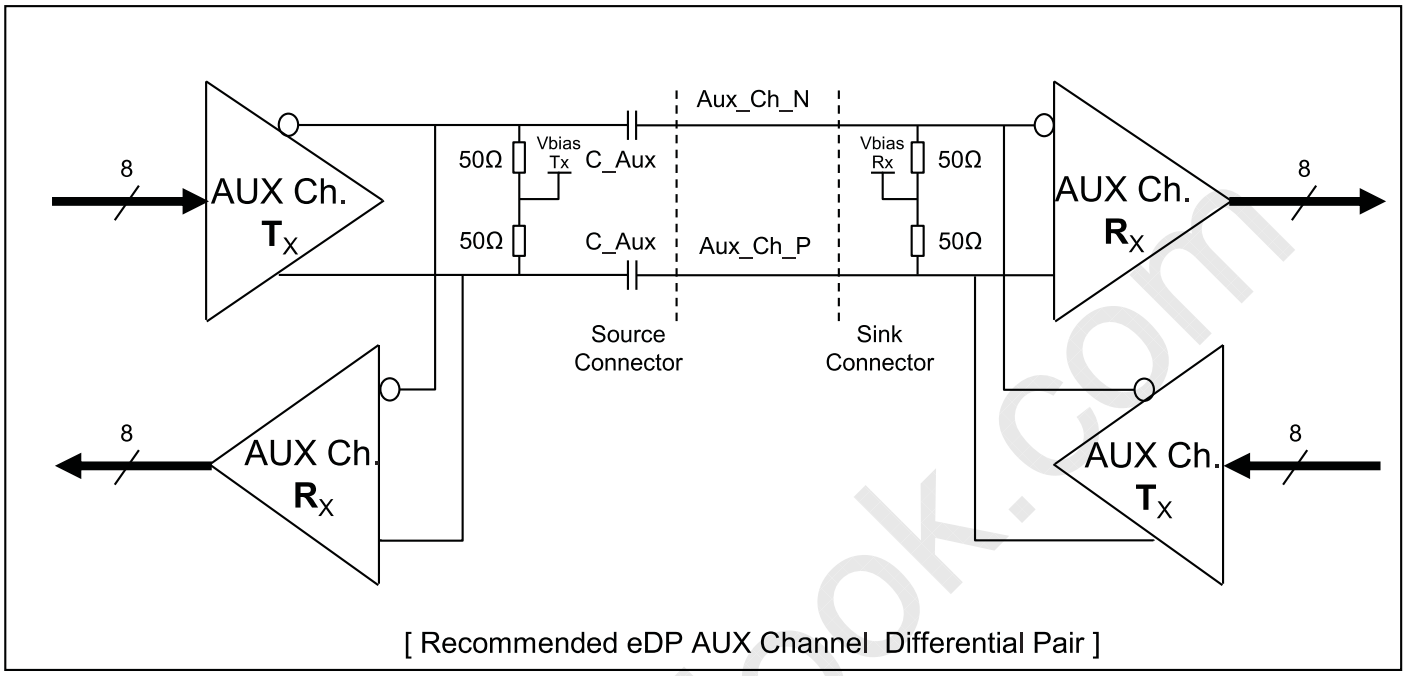
3-4-4. eDP AUX Channel Signal



[Recommended eDP AUX Channel Differential Pair]

Parameter	Symbol	Min	Typ	Max	Unit	Notes
AUX Unit Interval	UI	0.4	-	0.6	us	
AUX Jitter at Tx IC Package Pins	T_{jitter}	-	-	0.04	UI	Equal to 24ns
AUX Jitter at Rx IC Package Pins		-	-	0.05	UI	Equal to 30ns
AUX Peak-to-peak voltage at Connector Pins of Receiving	$V_{AUX-DIFFp-p}$	0.39	-	1.38	V	
AUX Peak-to-peak voltage at Connector Pins of Transmitting		0.36	-	1.36	V	
AUX EYE width at Connector Pins of Tx and Rx		0.98	-	-	UI	
AUX DC common mode voltage	V_{AUX-CM}	0	-	1.0	V	
AUX AC Coupling Capacitor	$C_{SOURCE-AUX}$	75		200	nF	Source side

Note)
1. Termination resistor is typically integrated into the transmitter and receiver implementations.
2. AC Coupling Capacitor is not placed at the sink side.
3. $V_{AUX-DIFFp-p} = 2^* | V_{AUXP}-V_{AUXN} |$

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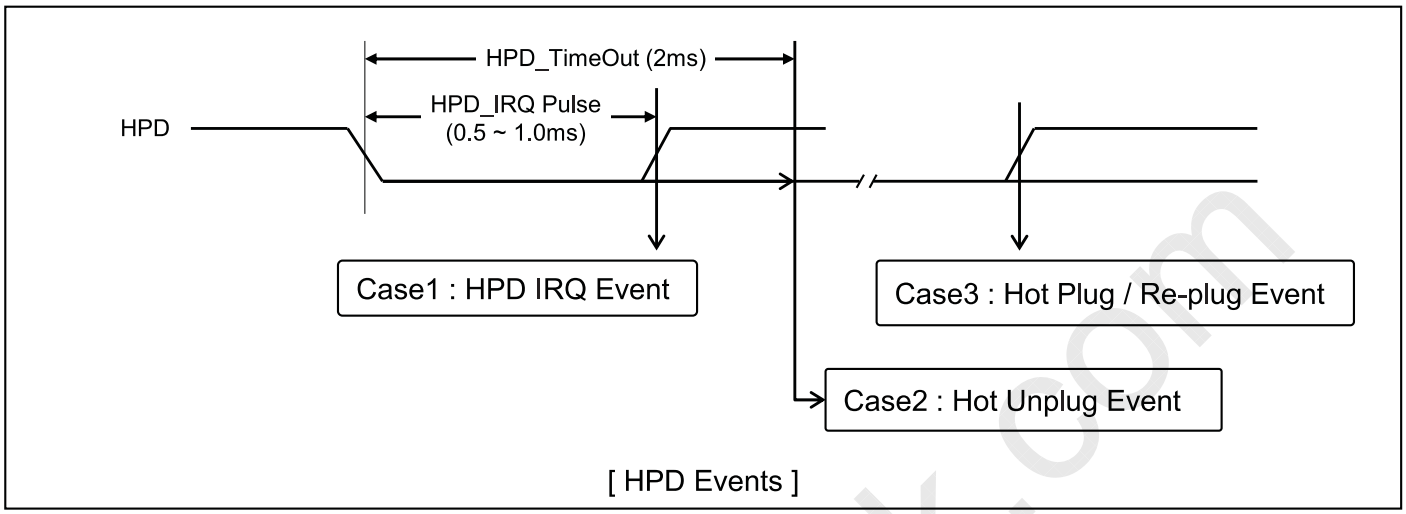
3-4-5. eDP HPD Signal



[HPD Events]

Parameter	Symbol	Min	Typ	Max	Unit	Notes
HPD Voltage	HPD	2.25	-	3.6	V	Sink side Driving
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	-	1.0	ms	
HPD_TimeOut		2.0	-	-	ms	HPD Unplug Event

Note)
1. HPD IRQ : Sink device wants to notify the Source device that Sink's status has changed so it toggles HPD line, forcing the Source device to read its Link / Sink Receiver DPCD field via the AUX-CH
2. HPD Unplug : The Sink device is no longer attached to the Source device and the Source device may then disable its Main Link as a power saving mode
3. Plug / Re-plug : The Sink device is now attached to the Source device, forcing the Source device to read its Receiver capabilities and Link / Sink status Receiver DPCD fields via the AUX-CH

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3-5. Signal Timing Specifications

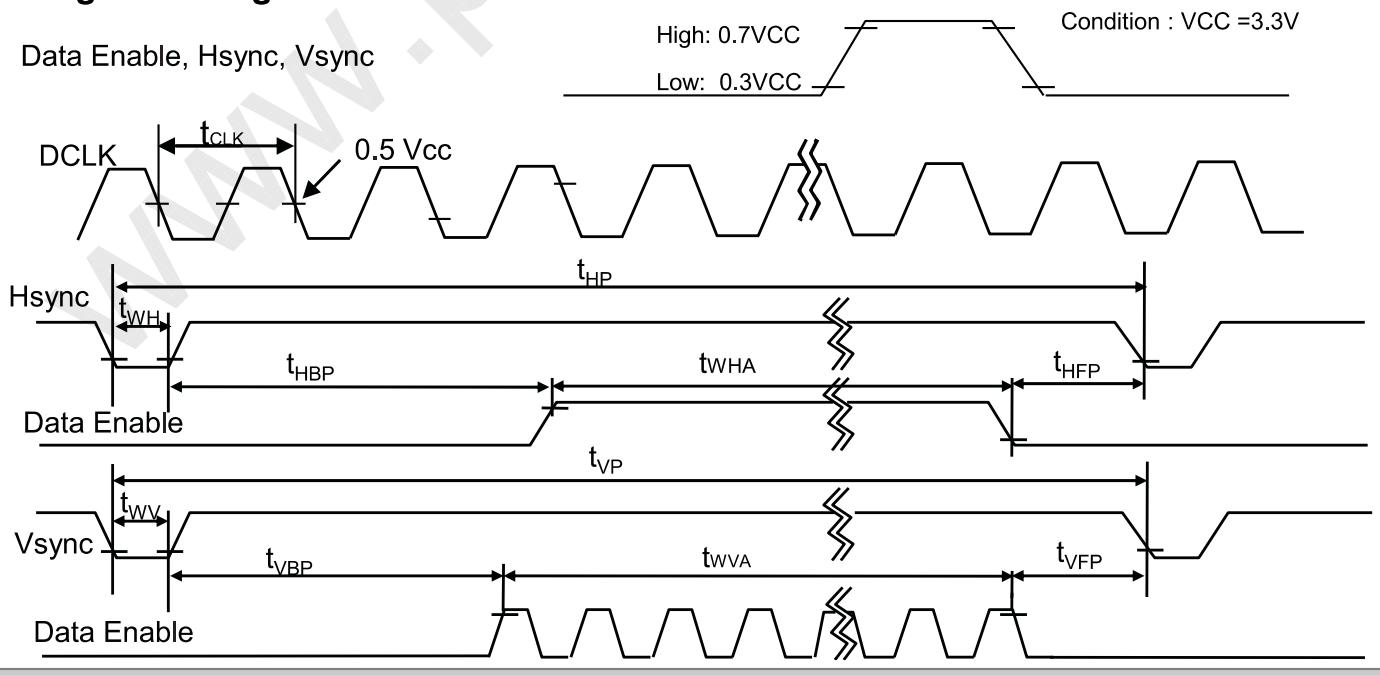
This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications and specifications of eDP Tx/Rx for its proper operation.

Table 4. TIMING TABLE

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Frequency	f_{CLK}	-	154.0	-	MHz	
Hsync	Period	t_{HP}	2076	2080	2084	t_{CLK}	
	Width	t_{WH}	32	32	32		
	Width-Active	t_{WHA}		1920			
Vsync	Period	t_{VP}	1233	1235	1237	t_{HP}	
	Width	t_{WV}	6	6	6		
	Width-Active	t_{WVA}		1200			
Data Enable	Horizontal back porch	t_{HBP}	76	80	84	t_{CLK}	
	Horizontal front porch	t_{HFP}	48	48	48		
	Vertical back porch	t_{VBP}	24	26	28	t_{HP}	
	Vertical front porch	t_{VFP}	3	3	3		
Refresh rate		Hz	-	60	-		

Notice. all reliabilities are specified for timing specification based on refresh rate of 60Hz. However, LP156WU1 has a good actual performance even at lower refresh rate (e.g. 40Hz or 50Hz) for power saving Mode, whereas LP156WU1 is secured only for function under lower refresh rate. 60Hz at Normal mode, 50Hz, 40Hz at Power save mode. Don't care Flicker level (Power save mode).

3-6. Signal Timing Waveforms



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3-7. Color Input Data Reference

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color ; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

Table 5. COLOR DATA REFERENCE

Color		Input Color Data																							
		RED								GREEN								BLUE							
		MSB							LSB	MSB							LSB	MSB							LSB
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Color	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
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED (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
	RED (1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	…					…								…								…			
	RED (254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (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
	GREEN (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	...					...								...								...			
	GREEN (254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	GREEN (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE (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 (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	…					…								…								…			
	BLUE (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	BLUE (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

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3-8. Power Sequence

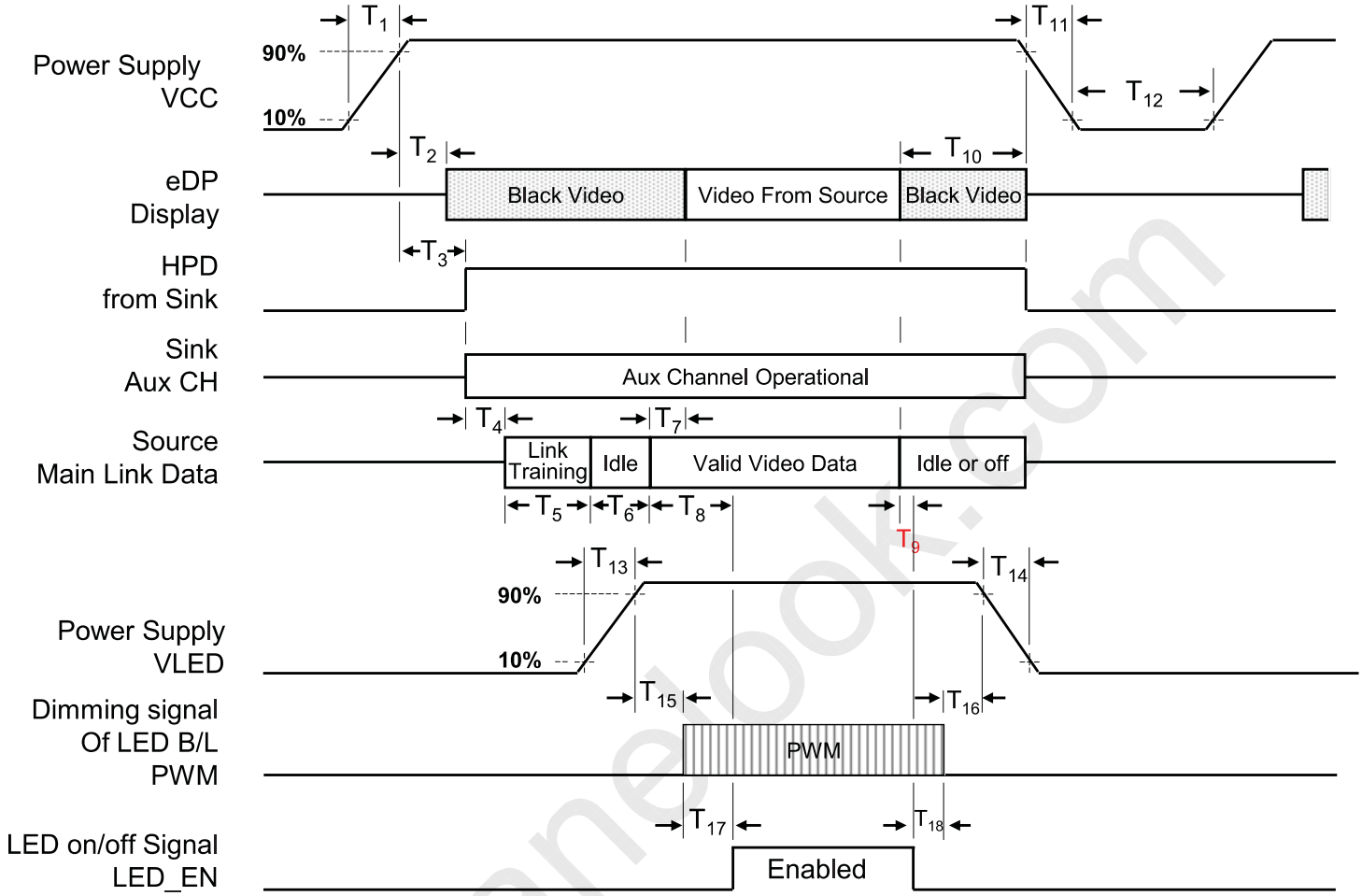

Table 6. POWER SEQUENCE TABLE

Symbol	Required By	Limits		Units	Notes
		Min	Max		
T_1	Source	0.5	10	ms	-
T_2	Sink	0	200	ms	-
T_3	Sink	0	200	ms	-
T_4	Source	-	-	ms	-
T_5	Source	-	-	ms	-
T_6	Source	-	-	ms	-
T_7	Sink	0	50	ms	-
T_8	Source	-	-	ms	5
T_9	Source	50	100	ms	6

Symbol	Required By	Limits		Units	Notes
		Min	Max		
T_{10}	Source	100	500	ms	7
T_{11}	Source	-	10	ms	-
T_{12}	Source	500	-	ms	
T_{13}	Source	0.5	10	ms	-
T_{14}	Source	0.5	10	ms	-
T_{15}	Source	10	-	ms	-
T_{16}	Source	10	-	ms	-
T_{17}	Source	0	-	ms	-
T_{18}	Source	0	-	ms	-

Note) 1. Do not insert the mating cable when system turn on.
2. Valid Data have to meet "3-3. eDP Signal Timing Specifications"
3. Video Signal, LED_EN and PWM need to be on pull-down condition on invalid status.
4. LGD recommend the rising sequence of VLED after the Vcc and valid status of Video Signal turn on.
5. Driving signal of B/L must be "On" after normal video signal (Normal operating data from source) input.
6. When VCC off, LED EN must be dropped to low level within black video data.
7. For stable operation of BL, Black video data have to meet min 100ms.

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4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 20 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and Θ equal to 0°.
FIG. 1 presents additional information concerning the measurement equipment and method.

FIG. 1 Optical Characteristic Measurement Equipment and Method

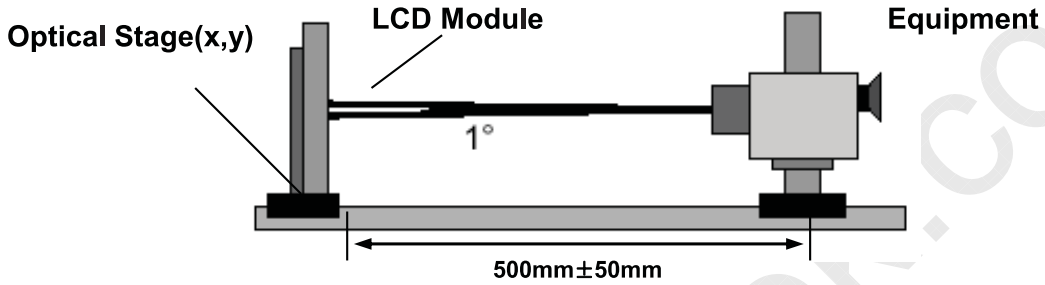

Table 7. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, fv=60Hz

Parameter		Symbol	Values			Units	Notes
			Min	Typ	Max		
Contrast Ratio		CR	1200	1650	-		1
Surface Luminance, white		L_{WH}	425	500	-	cd/m²	2
Luminance Variation		$\delta_{WHITE\ (5P)}$	-	-	20	%	3
		$\delta_{WHITE(13P)}$	-	-	35		
Response Time		Tr + Tf	-	25	35	ms	4
Color Gamut		sRGB	100	-	-	%	CIE 1931
Color Coordinates	RED	Rx	Typical - 0.03	0.650	Typical + 0.03	-	5,6
		Ry		0.330			
	GREEN	Gx		0.285			
		Gy		0.635			
	BLUE	Bx		0.145			
		By		0.055			
	WHITE	Wx		0.313			
		Wy		0.329			
Color Temperature		CCT	6000	6500	7000	K	
Viewing Angle	x axis, right(Φ=0°)	Θr	89	-	-	Degree	7
	x axis, left (Φ=180°)	Θl	89	-	-		
	y axis, up (Φ=90°)	Θu	89	-	-		
	y axis, down (Φ=270°)	Θd	89	-	-		
Gray Scale			1.9	2.2	2.5		8

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Note)

1. It should be measured in the center of screen(1 Point). Contrast Ratio(CR) is defined mathematically as

$$\text{Contrast Ratio(1 Point)} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

2. Surface luminance is the average of 5 point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 2.

$$L_{WH} = \text{Average(33, 37, 55, 73 , 77 Point)}$$

3. The variation in surface luminance , The panel total variation (δ WHITE) is determined by measuring N at each test position 1 through 13 and then defined as following numerical formula. For more information see FIG 2.

$$\delta \text{ WHITE (5P)} = \left(1 - \frac{\text{Min(33,37,55,73,77 Point)}}{\text{Max(33,37,55,73,77 Point)}} \right) \times 100$$

$$\delta \text{ WHITE (13P)} = \left(1 - \frac{\text{Min (All measuring Point)}}{\text{Max (All measuring Point)}} \right) \times 100$$

4. Response time is the time required for the display to transition from black to white (rise time, Tr) and from white to black (falling time, Tf). For additional information see FIG 3.

5. It should be measured in the center of screen (1Point).
Color coordination must be measured with the equipment which has optical wavelength resolution of under 2㎚. (ex. PR670, PR680, CS2000….)

6. Since several instruments are used for color inspection and each instrument contains errors and uncertainties, a Color Coordinate error of about 0.003 in the CIE 1931 plane may occur.

7. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.

8. Gray scale specification

Gray Level	Luminance [%] (Typ)
L0	(0.05)
L32	(1.44)
L64	(5.13)
L96	(11.7)
L128	(21.6)
L160	(35.2)
L192	(52.7)
L224	(74.5)
L255	100

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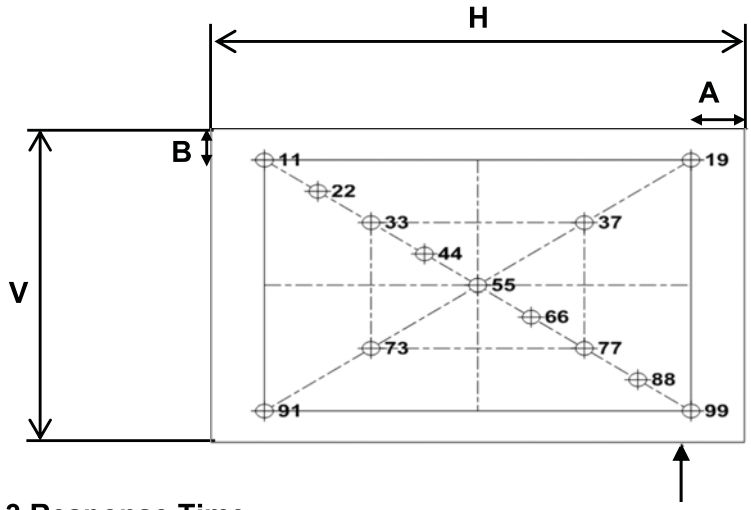
FIG. 2 Luminance

<Measuring point for Average Luminance & measuring point for Luminance variation>



H,V : ACTIVE AREA
A: H/10 mm
B: V/10 mm
POINTS: 13 POINTS

FIG. 3 Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white”.

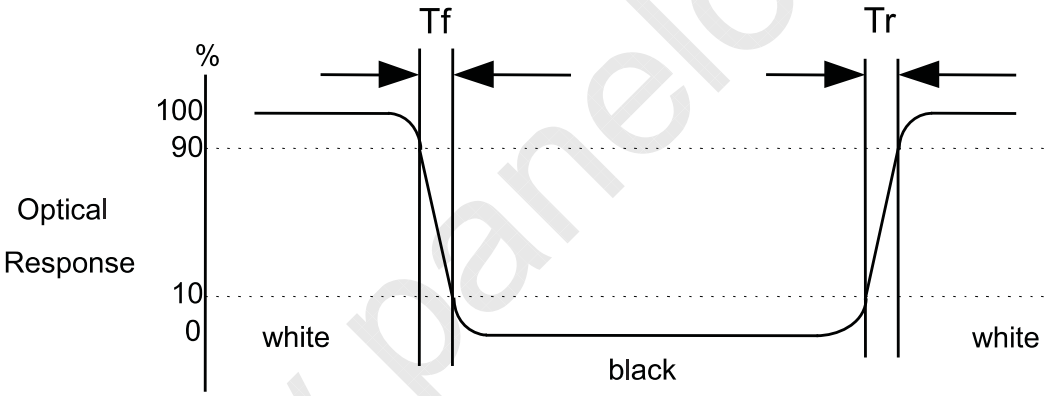
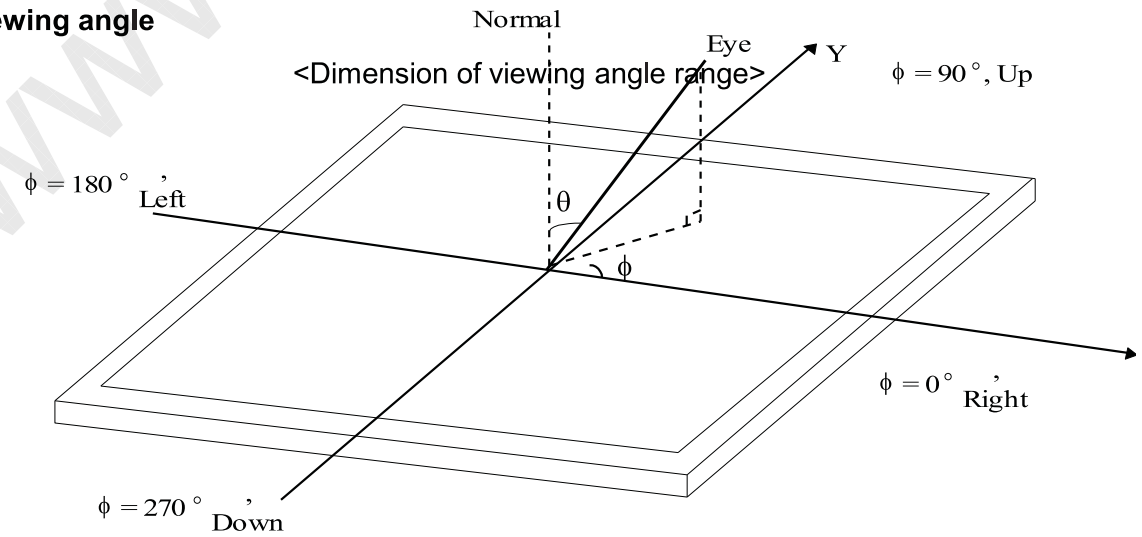


FIG. 4 Viewing angle



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5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LP156WU1. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal	340.26 ± 0.3 mm
	Vertical	218.02 ± 0.3 mm 218.98 ± 0.5 mm
	Thickness(W/O PCB)	2.45 mm (max.) (W/O PCB) 4.26 mm (max.) (W PCB)
Upper Polarizer Dimension	Horizontal	338.78± 0.2 mm
	Vertical	212.34 ± 0.2 mm
Active Display Area	Horizontal	336.38 mm
	Vertical	210.24 mm
Weight	324g (Max.)	
Surface Treatment	Anti Glare treatment (3H) of the front Polarizer	

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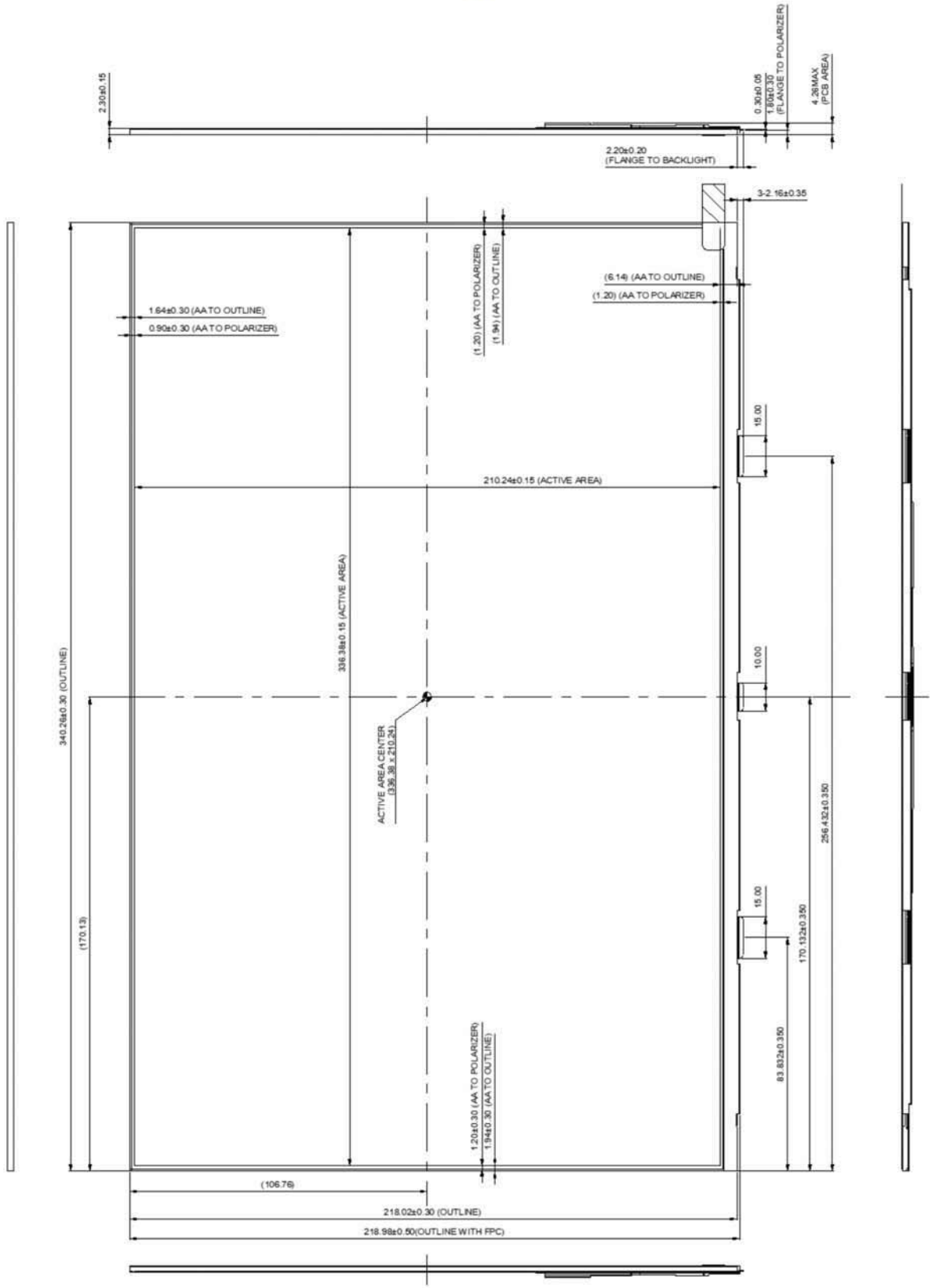
<FRONT VIEW>

Notes (Measurement method refer to the Appendix D)
1) Unit[mm], General tolerance : ± 0.5mm
2) All components except cover shield of LCM is under upper POL.



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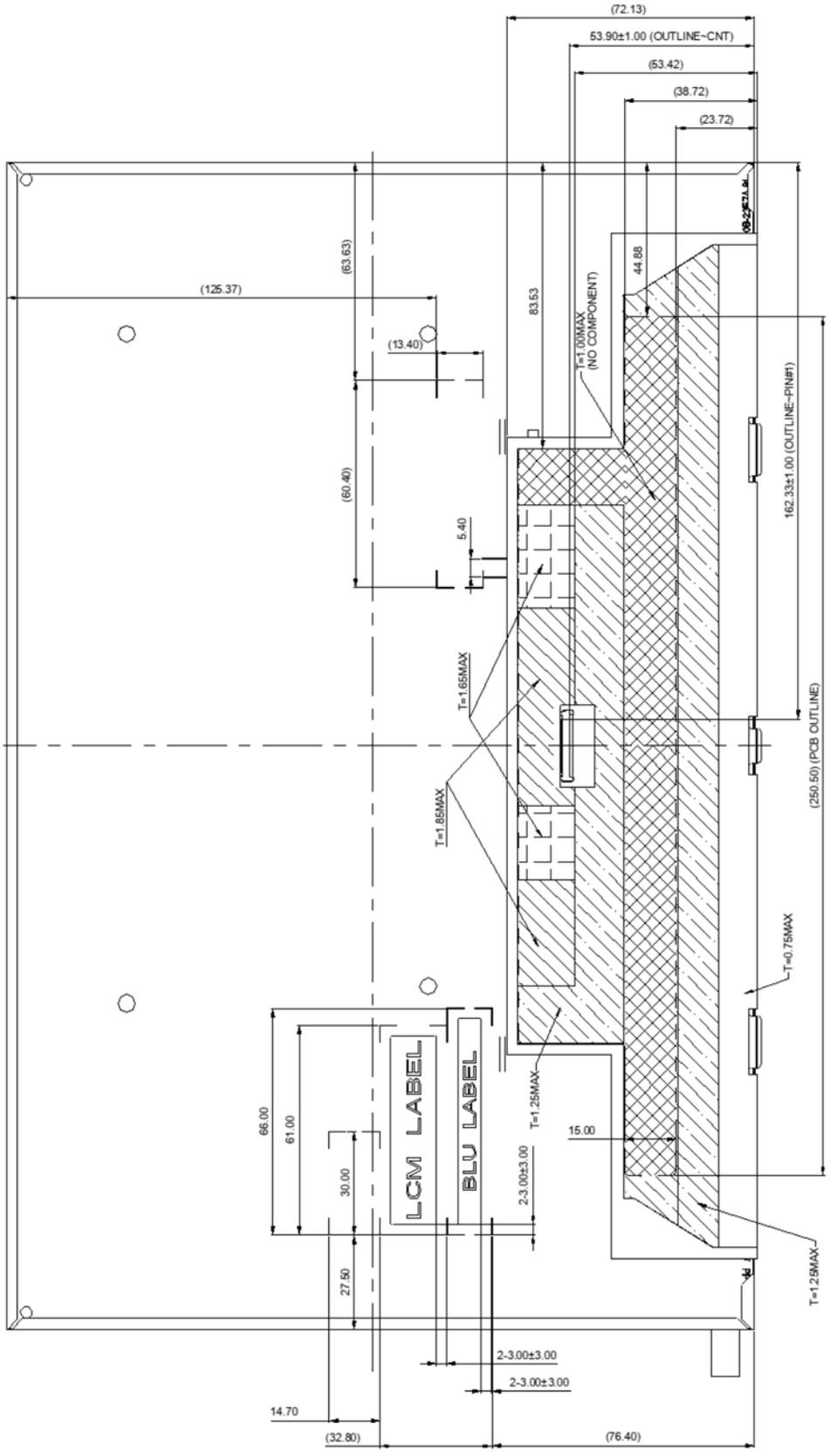
<REAR VIEW>

Notes
1) Unit[mm], General tolerance : ± 0.5mm
2) LCM Label Information refer to the page 26.



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6. Reliability

Environment test condition

No.	Test Item	Conditions
1	High temperature storage test	Ta= 60°C, 240h
2	Low temperature storage test	Ta= -20°C, 240h
3	High temperature operation test	Ta= 50°C, 50%RH, 240h
4	Low temperature operation test	Ta= 0°C, 240h
5	Vibration test (non-operating)	Random, 1.0Grms, 10 ~ 300Hz(PSD 0.0035) 3 axis, 30min/axis
6	Shock test (non-operating)	- No functional or cosmetic defects following a shock to all 6 sides delivering at least 180 G in a half sine pulse no longer than 2 ms to the display module - No functional defects following a shock delivering at least 200 g in a half sine pulse no longer than 2 ms to each of 6 sides. Each of the 6 sides will be shock tested with one each display, for a total of 6 displays
7	Altitude operating storage / shipment	0 ~ 10,000 feet (3,048m) 24Hr 0 ~ 40,000 feet (12,192m) 24Hr
8	ESD	± 8kV for contact discharge ± 15kV for air discharge

[Result Evaluation Criteria]

1. Comparing the initial functional FOS status, there should be no major change which might affect the practical display function when the display reliability test is conducted.

2. After conduct reliability tests, LGD guarantees only functional FOS quality.

3. In the Reliability Test, Confirm performance after leaving in room temp.

4. In the standard condition, there shall be no practical problems that may affect the display function 24 hours later after reliability test. After the reliability test, we can guarantee the product only when the corrosion is causing its malfunction. The corrosion causing no functional defect can not be guaranteed.

※ Remark: MTBF (Excluding the LED) 50,000 hours with a confidence level 90%
(Based on 60℃, 1,000 hours Reliability Test with 10pcs LCM)

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7. International Standards

7-1. Safety

a) IEC 62368-1, The International Electro-technical Commission(IEC).
Audio/video, Information and Communication Technology Equipment - Safety - Safety Requirements.
b) EN 62368-1, European Committee for Electro-technical Standardization (CENELEC)
Audio/video, Information and Communication Technology Equipment - Safety Requirements
c) UL 62368-1, UL LLC.
Audio/video, Information and Communication Technology Equipment - Safety Requirements
d) CAN/CSA C22.2 No.62368-1, Canadian Standards Association (CSA).
Audio/video, Information and Communication Technology Equipment - Safety Requirements
e) IEC 60950-1, The International Electro technical Commission (IEC).
Information Technology Equipment - Safety - Part 1 : General Requirements

7-2. Environment

a) RoHS, Directive 2011/65/EU of the European Parliament and of the council of 8 June 2011

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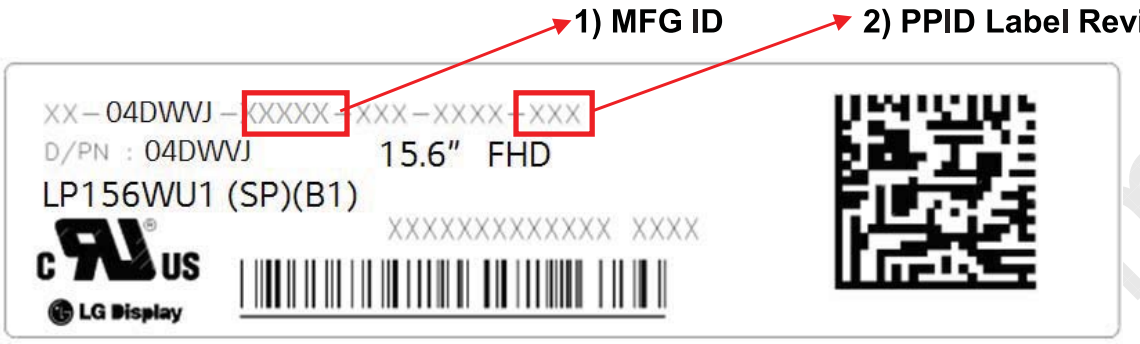
[DETAIL INFORMATION OF PPID LABEL AND REVISION CODE]



1) MFG ID :

It is subject to change with BLU assembly company.
Please refer to the below table for detail.

BLU assembly company	MFG ID
NJ Heesung	HMNLG
NJ Starion	ZSNLG
King display	KBBLG

2) PPID Label Revision :

It is subject to change with Dell event. Please refer to the below table for detail.

Classification	No Change	1st Revision	2nd Revision	…	9th Revision	…
SST(WS)	X00	X01	X02	…	X09	…
PT(ES)	X10	X11	X12	…	X19	…
ST(CS)	X20	X21	X22	…	X29	…
XB(MP)	A00	A01	A02	…	A09	…

Country of Origin	Factory ID
CN: China	LGDNJ
KR: Korea	-

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8. Packing

8-1. Designation of Lot Mark

a) Lot Mark

A	B	C	D	E	F	G	H	I	J	K	L	M

A,B,C : SIZE(INCH)
D : YEAR
E : MONTH
F ~ M : SERIAL NO.

Note
1. YEAR

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Mark	K	L	M	N	P	R	S	T	U	V

2. MONTH

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

b) Location of Lot Mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing Form

a) Package quantity in one box : 28 pcs

b) Box Size : 427 x 327 x 328

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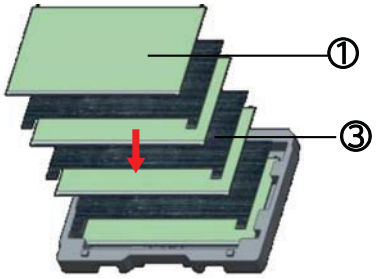
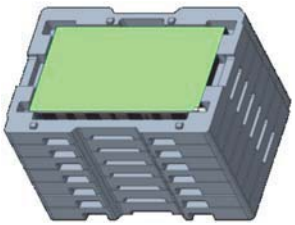
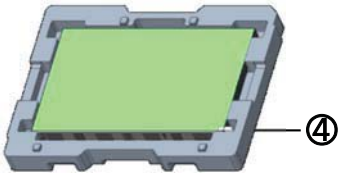
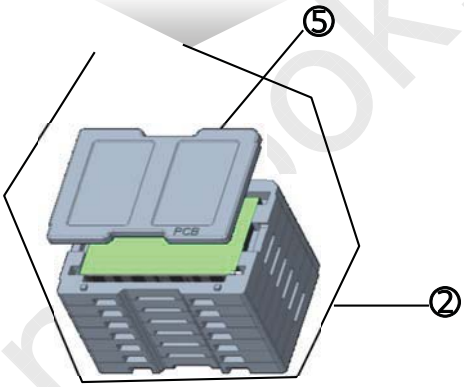
8-3. Packing Assembly

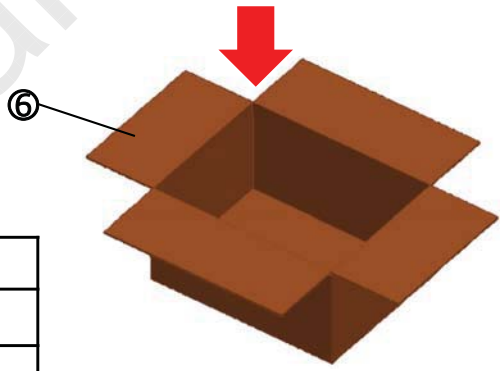


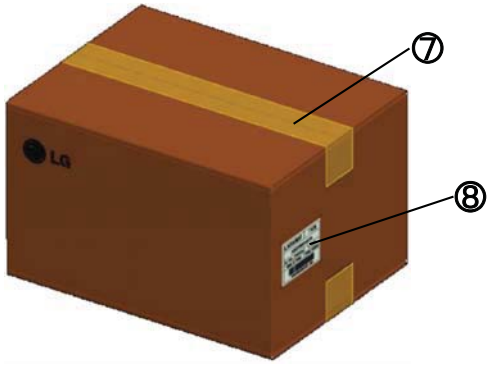




(Sheet + LCM) ×4







4 LCM / Tray

7 Tray / Box

28LCM/Box

2EA Desiccant in the box

NO.	DESCRIPTION	MATERIAL
1	LCD Module	
2	BAG	AL
3	Sheet	PE
4	Bottom Tray	EPO
5	Top Tray	EPO
6	BOX	SWR4
7	TAPE	OPP 70MMX300M
8	LABEL	ART 100X70

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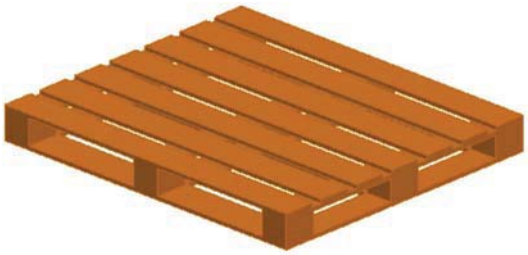
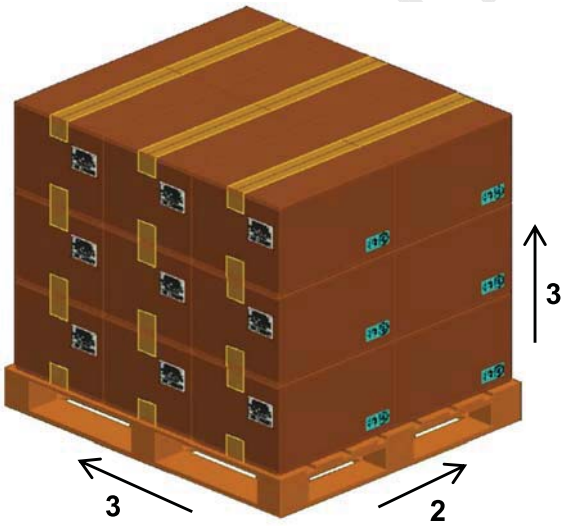
8-4. Pallet Assembly

1. Pallet Ready



2. 3 x 2 x 3 Box Pattern



3. Angle Packing & Taping

4. Banding

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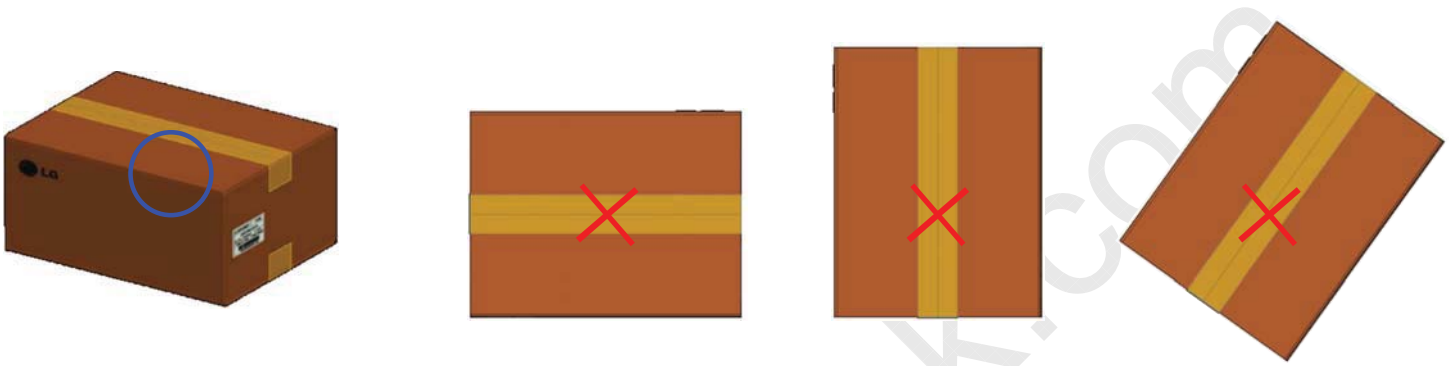
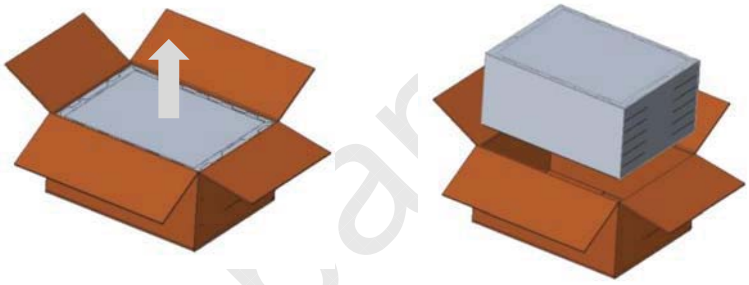
8-5 Precautions for unpacking the Box

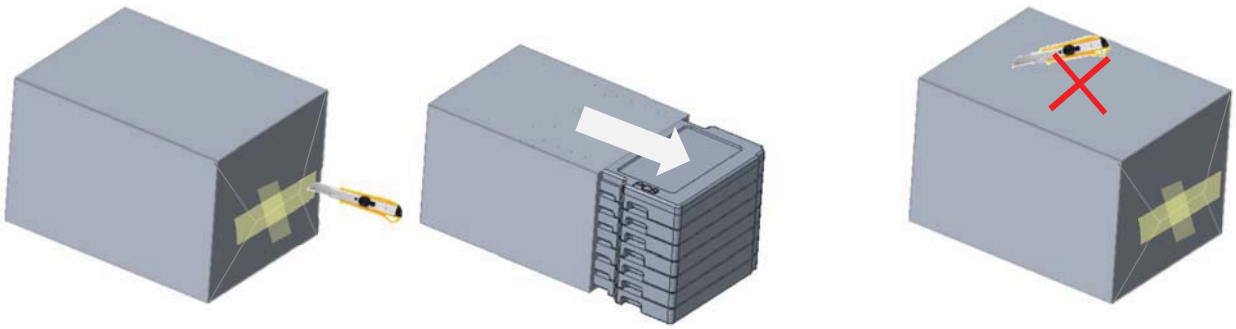
a.) Don't throw or tilt the box and put it on a flat surface.



b.) Place the box on a flat floor and Take out the AL bag vertically.



c.) Cut the tape on the side of the bag with a knife and Take out the tray horizontally.



Caution : Do not cut the top of the bag with a knife.
(The Knife can damage product)

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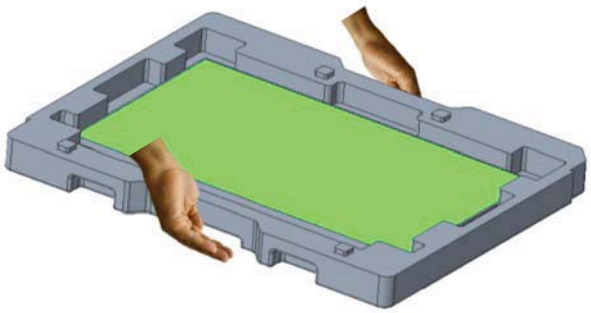
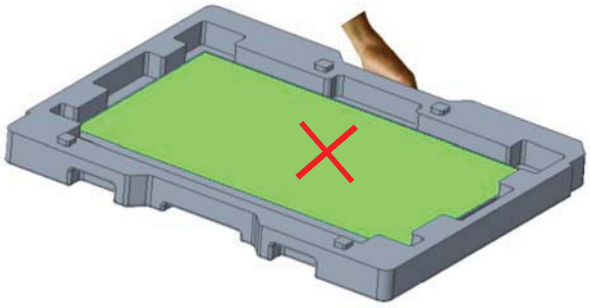
8-6. Precautions for Handling tray

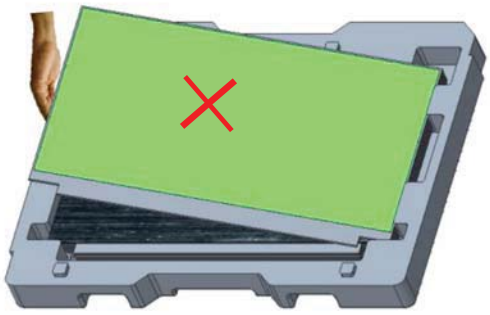
a.) Hold center of short or long side of the tray with both hands when handling one or more tryas.

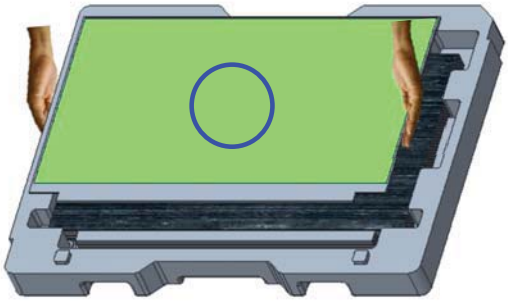




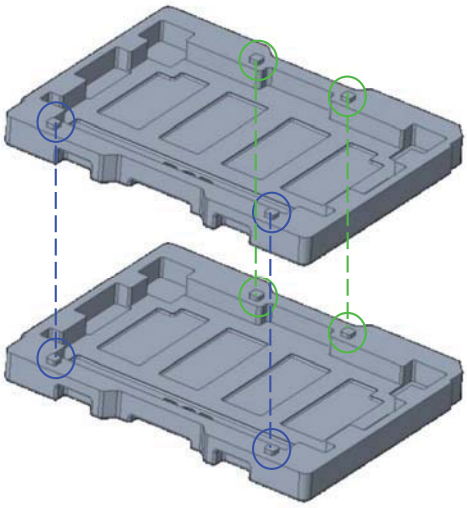
Caution : Do not handle with only one hand.

b.) Always place tray on flat surface and Don't tilt with one hand to take out.





c.) When stacking trays, Please align same position of the protrusion of each tray.



If not Aligned,
The tray may slip without being loaded.

d.) The maximum stacking quantity is equal to the number of loads per box.
- Recommended as above because heavier weight can cause muscular skeletal disease and operator handling errors.

※The packing shape may be different from the Image.

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9. PRECAUTIONS

Please pay attention to the followings when you use this TFT LCD module.

9-1. MOUNTING PRECAUTIONS

(1) You must mount a module using holes arranged in four corners or four sides.
(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.
(4) You should adopt radiation structure to satisfy the temperature specification.
(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental to the polarizer.)
(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(9) Do not open the case because inside circuits do not have sufficient strength.
(10) When handling the LCD module, it needs to handle with care not to give mechanical stress to the PCB and Mounting Hole area."

9-2. OPERATING PRECAUTIONS

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
V=± 200mV(Over and under shoot voltage)

(2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
(3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)
And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(6) 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 minimized the interference.

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9-3. ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

9-5. STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

9-6. HANDLING PRECAUTIONS FOR PROTECTION FILM

(1) When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
(2) The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt to remain on the polarizer.
Please carefully peel off the protection film without rubbing it against the polarizer.
(3) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
(4) You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

9-7. THE LGD QA RESPONSIBILITY WILL BE AVOIDED IN CASE OF BELOW

(1) When the customer attaches TSM(Touch Sensor Module) on LCM without Supplier's approval.
(2) When the customer attaches cover glass on LCM without Supplier's approval.
(3) When the LCMs were repaired by 3rd party without Supplier's approval.
(4) When the LCMs were treated like Disassemble and Rework by the Customer and/or Customer's representatives without supplier's approval.

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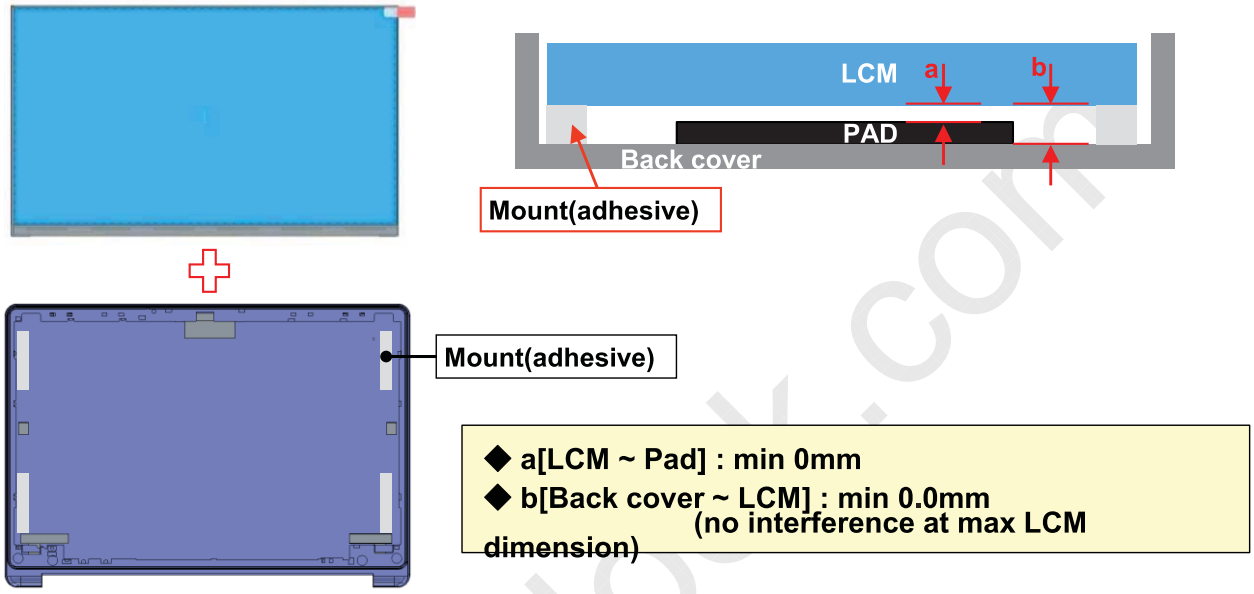
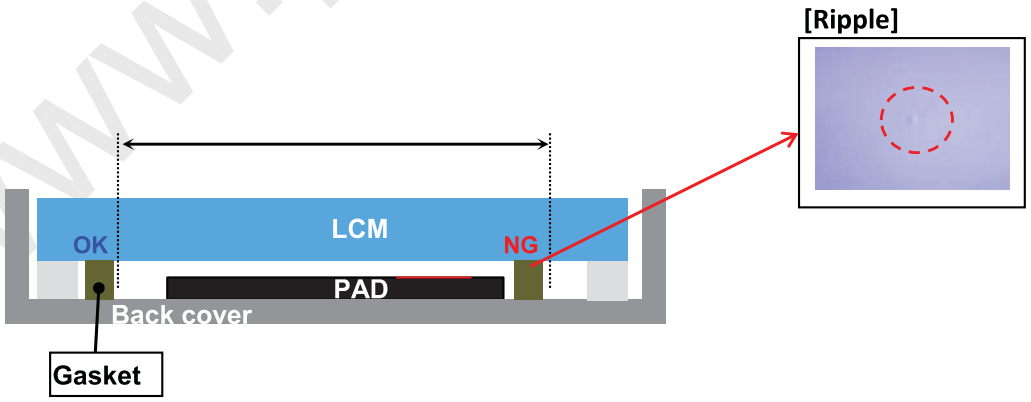
LGD Proposal for system cover design.(Appendix)

1	Gap check for securing the enough gap between LCM and System back cover.



Risk point	Rear side of LCM is sensitive against external stress, and previous check about interference is highly needed.
Suggestion	In case there is something from system cover comes into the boundary above,mechanical interference may cause the FOS defects. (ex: Ripple, White spot..)

2	Gasket position



Risk point	Ripple or white spot can be happened by interference between pad and LCM when gap is not enough.
Suggestion	It is recommended that gasket is posited out of active area .

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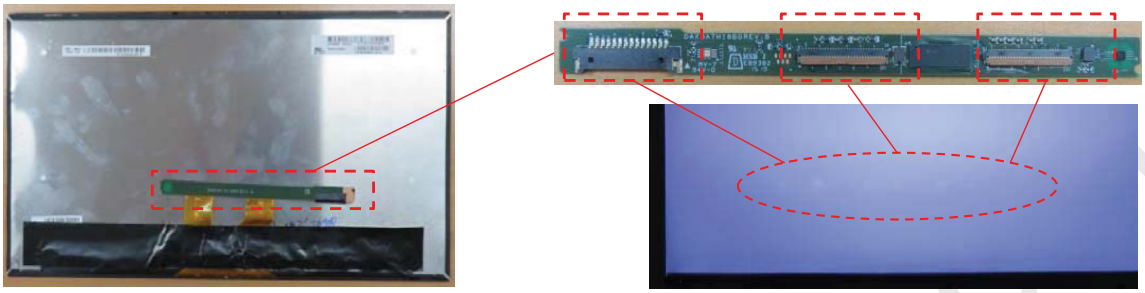
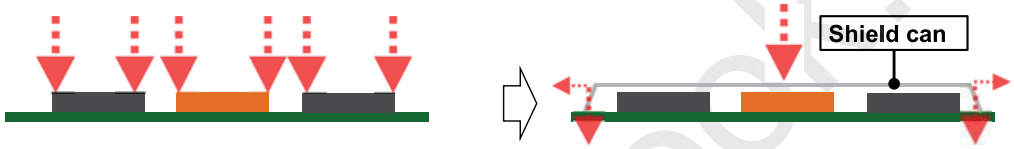
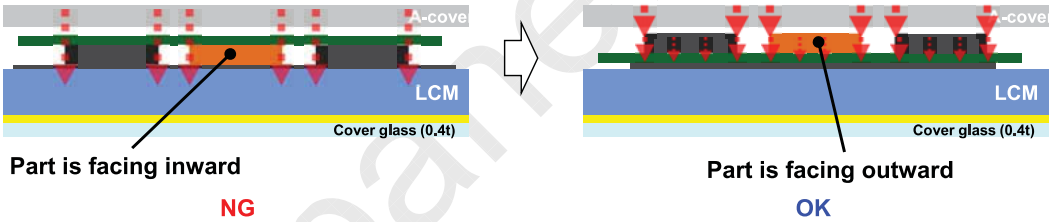
LGD Proposal for system cover design.(Appendix)

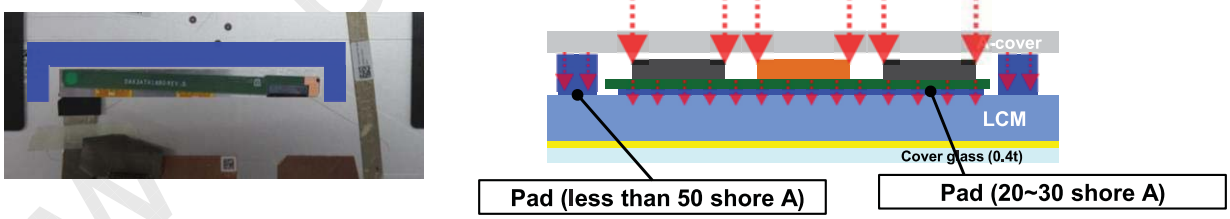
3	Touch control board



[Suggestion]







Risk point	Peak protrusion make concentrated stress. It is caused white spot, black spot, etc..
Suggestion	Place Touch control board out of screen (Active area).
	Cover with shied-can on the touch board.
	Position the parts on board so that they are facing out of LCM.
	Add pad to divide stress.

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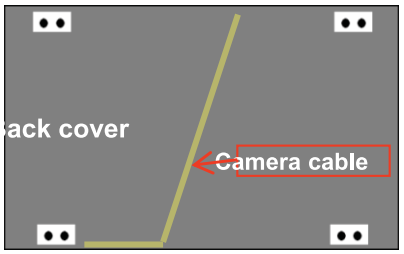
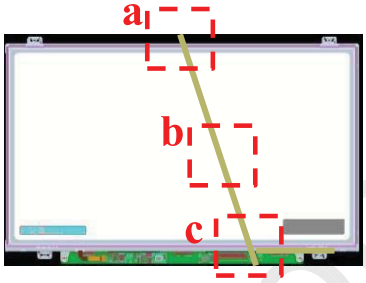
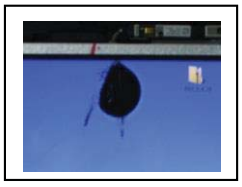
LGD Proposal for system cover design.(Appendix)

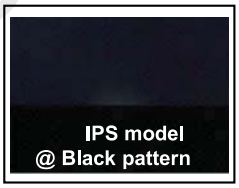
4	Checking the path of the System cables

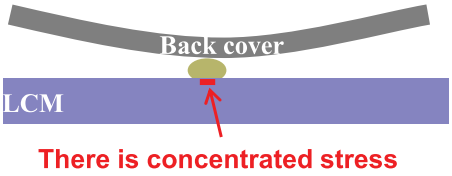




[Panel crack at "a"] [White spot at "b"] [Light leakage at "c"]



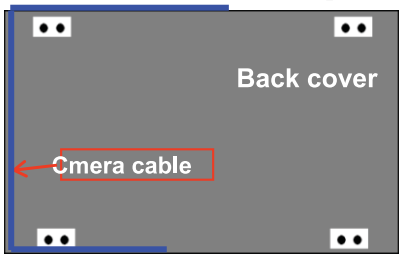


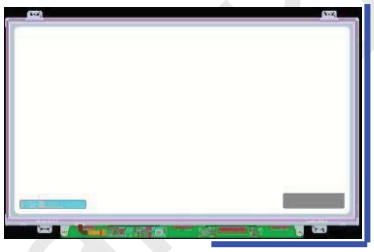


There is concentrated stress

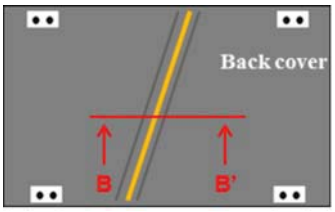
[Suggestion]

[Cable path]

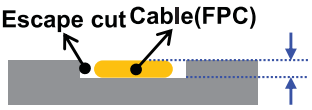




[Add cut]



<Secton B-B'>



Escape cut depth = Cable thickness

[Add pad]

Risk point	LCM is easily damage by camera cable when cable is protruded from back cover. It is caused panel crack or white spot by concentrated stress and light leakage by panel bending at IPS model.
Suggestion	It is recommended that camera cable path put outside of LCM. It is recommended that pad is added at both side of cable. If cable path must be cross middle area of system,@slim & narrow bezel 1) Cable type is recommended to use flexible (Use FPC type). 2) Add escape cut on back cover and add round at the edge of cut Depth of escape cut recommended to set the same as FPC thickness.

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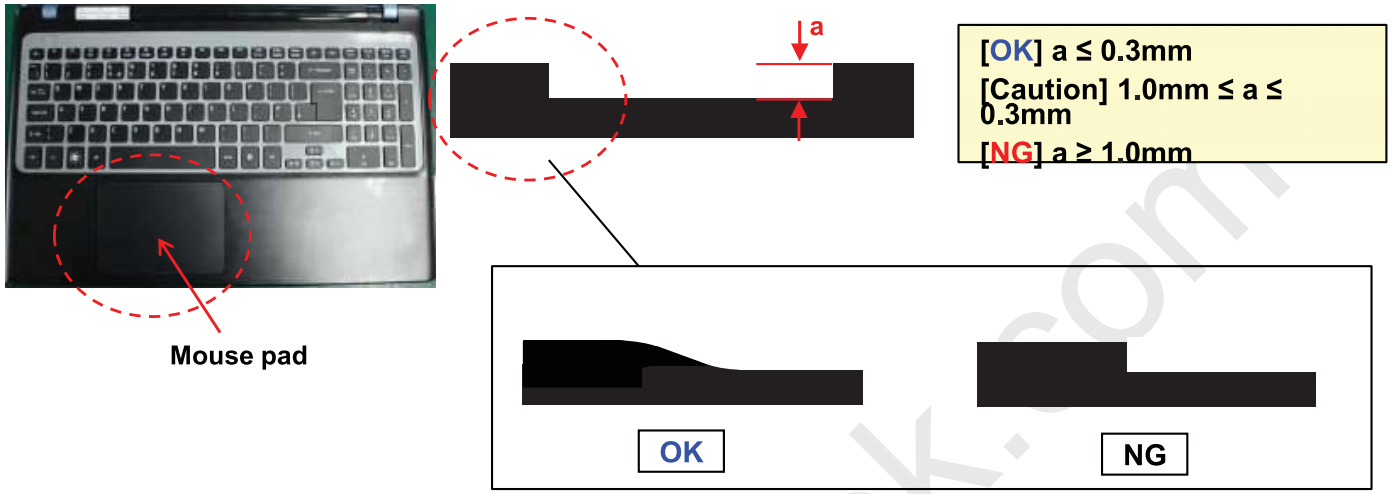
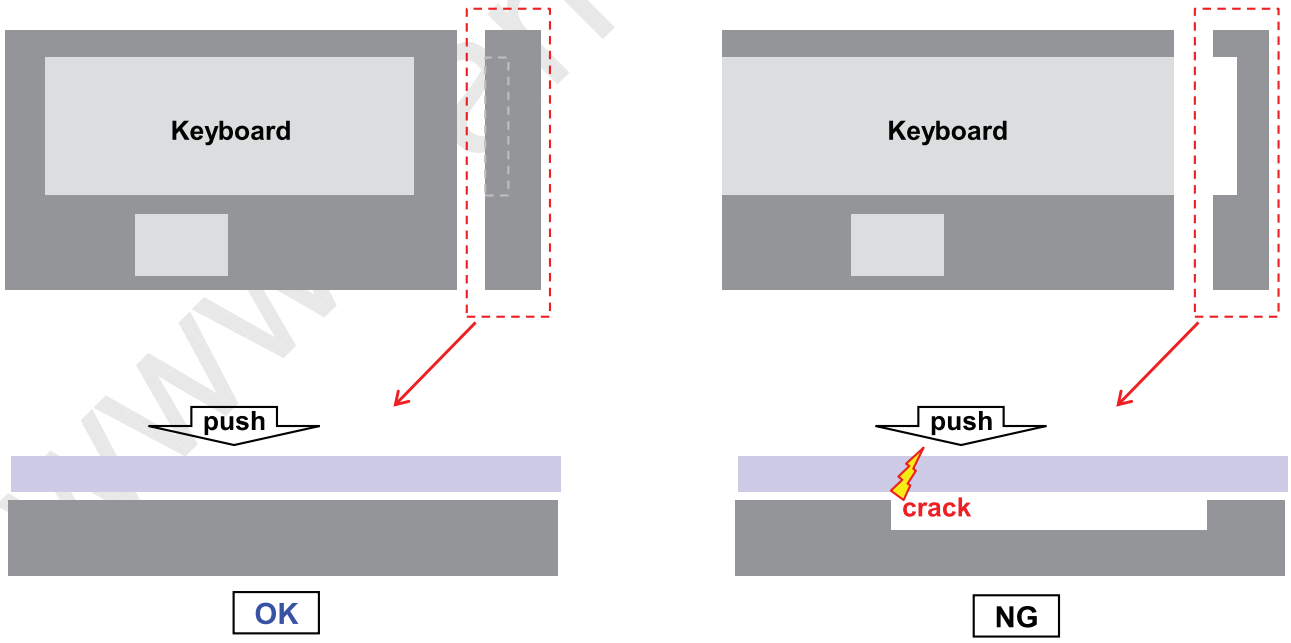
LGD Proposal for system cover design.(Appendix)

5	Check mouse pad (touch pad) depth and shape of edge



Risk point	Mouse pad step is deep, it is caused panel crack by external load.
Suggestion	The edge shape must be smooth.

6	Check the step of keyboard area



Risk point	The step of keyboard at the side edge of main body, it is caused panel crack
Suggestion	Keep to flat out side of keyboard.

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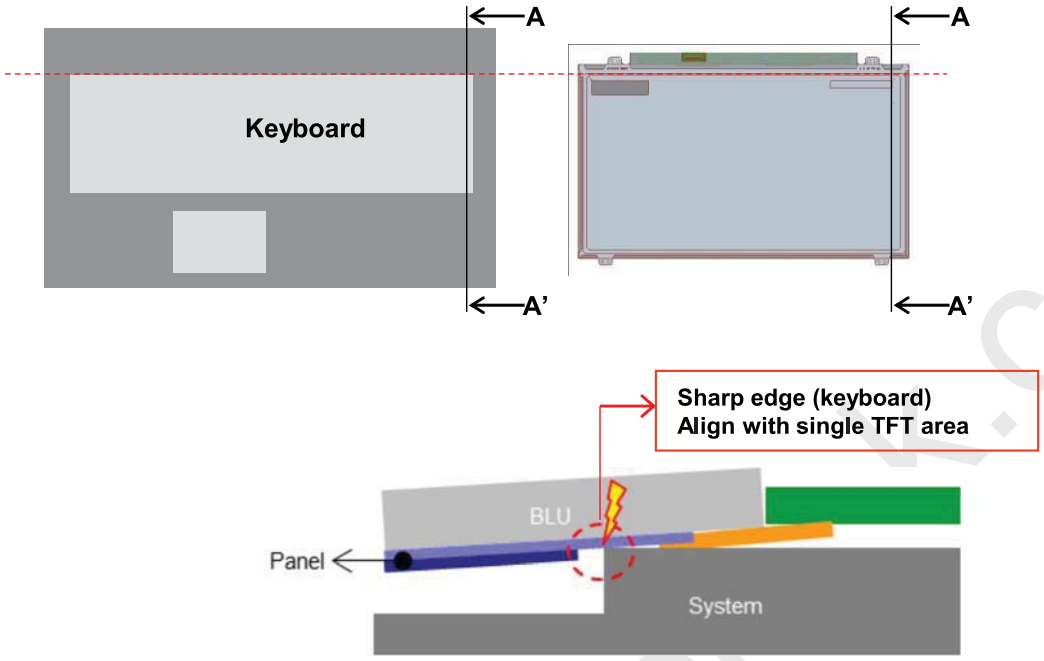
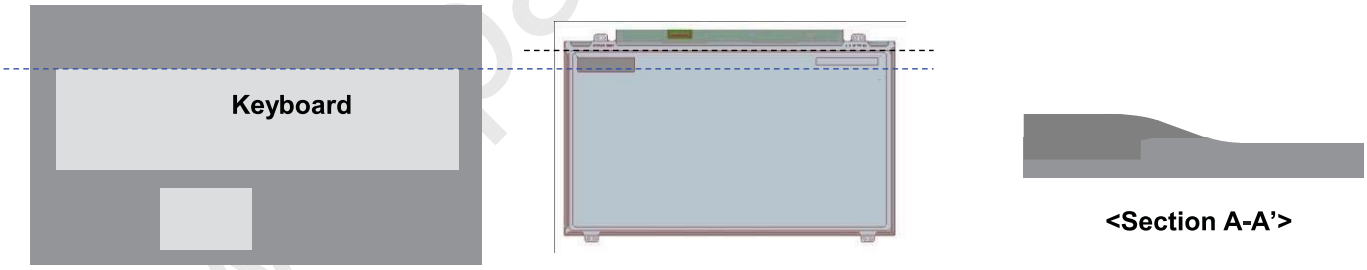
LGD Proposal for system cover design.(Appendix)

7	The position and shape of keyboard step



<Section A-A'>

[Suggestion]



<Section A-A'>

Risk point	Keyboard edge is sharp (a right angle), panel is get concentrated stress, by external force at this edge. Especially, keyboard edge is aligned with panel edge (single-TFT area), crack risk is seriously increase.
Suggestion	It is recommended that keyboard edge is posited to avoid single-TFT area. It is recommended that edge shape of touch pad is rounded.

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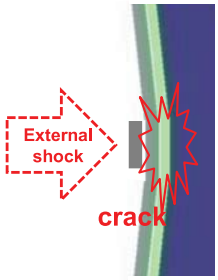
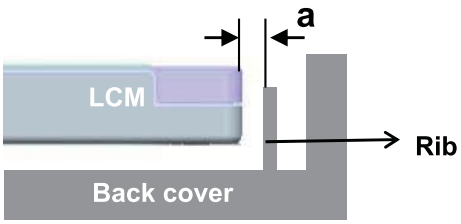
LGD Proposal for system cover design.(Appendix)

8	Back cover rib / wall (path & gap)

OK



NG



a ≥ 0.5mm [at max dimension of design]
a ≥ 1.0mm [at typical dimension of design]

Risk point	Gap is too small and rib is too short, panel is easily cracked by external stress.
Suggestion	Gap is must be kept more than 0.5mm(max dim.) and 1.0mm(typ dim.) . The figure of rib is continuous or fully long. “a” is not enough as narrow bezel type, add damper between LCM and system rib/wall

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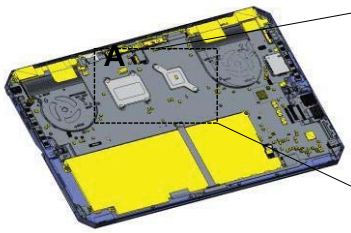
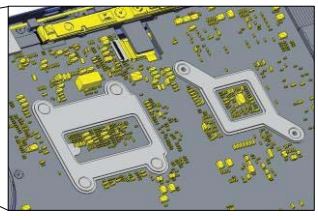
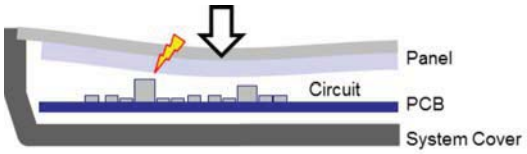
LGD Proposal for system cover design.(Appendix)

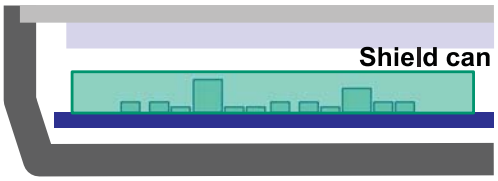
9	System protrusion and step for RGB eye





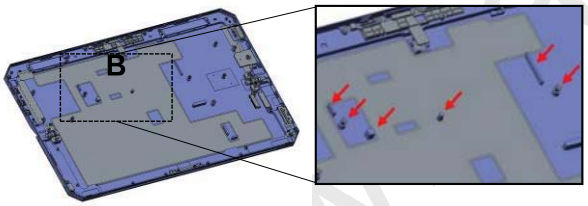


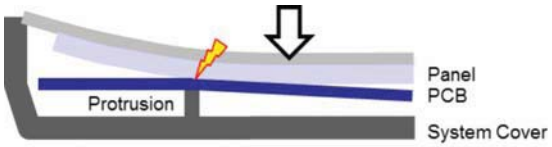
[Suggestion]



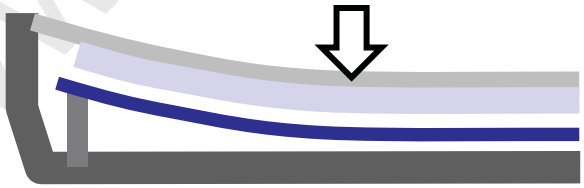
Risk point	The system PCB circuit is exposed at the front side, and LCM damage occurs due to direct contact with the back of the LCM
Suggestion	Apply shield can to circuit open area of PCB. Apply Middle frame to avoid LCM backside interference.

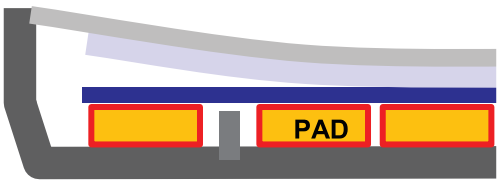
10	System protrusion and step for RGB eye





[Suggestion]





Risk point	System A-Cover ribs and screw bosses cause LCM damage due to stress concentration and bending inflection point.
Suggestion	Protrusions should be located outside the LCM. Apply level compensation structure around protrusions

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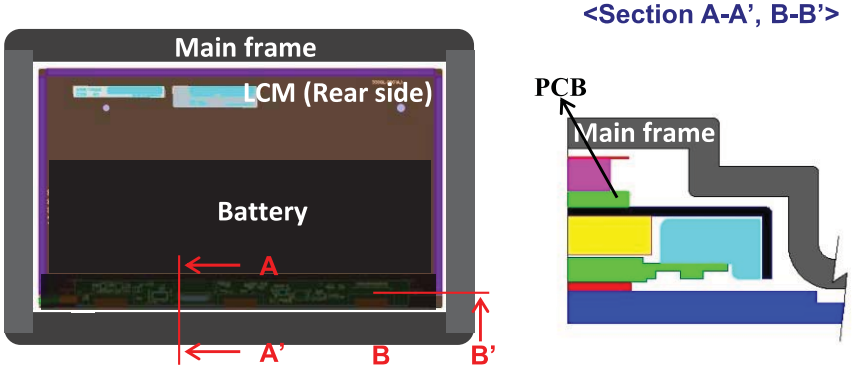
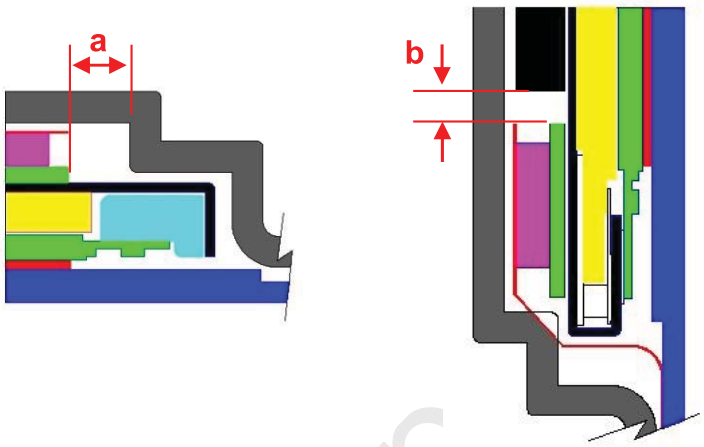
LGD Proposal for system cover design.(Appendix)

11	Gap [System frame ~ LCM]



[Suggestion]



a ≥ 1.5mm [at max PCB dimension]
b ≥ 1.5mm [at max tolerance of dimension]

Risk point	The assemble tolerance of PCB, Battery is comparatively large. It is easily interfered each parts, and happened matching problem. (Assemble NG, Yellowish, etc.)
Suggestion	It is recommended that the gap ("a") is keep as above.

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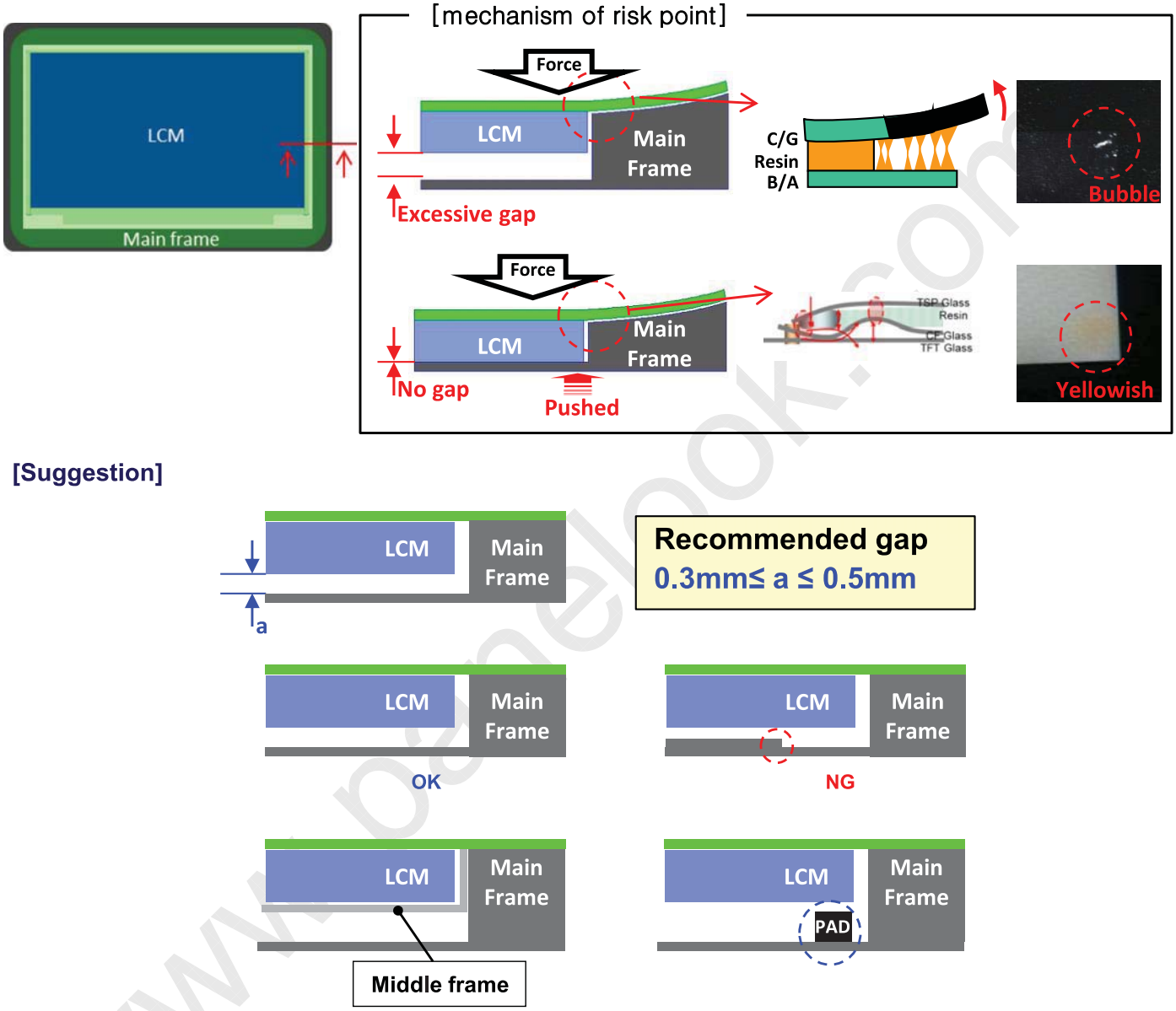
LGD Proposal for system cover design.(Appendix)

12	Gap[System ~ LCM] at corner



Risk point	If there is no gap, too large gap or not flat between LCM and system main body, it is easily caused ripple, yellowish, bubble and so on.
Suggestion	It is recommended to keep 0.3~0.5mm gap between LCM and system main keep at LCM corner
	It is recommended to keep flatness of system frame
	If there is not frame between LCM and system, add frame at LCM edge or add pad on back cover (LCM edge position).
	Use good strength material against bending

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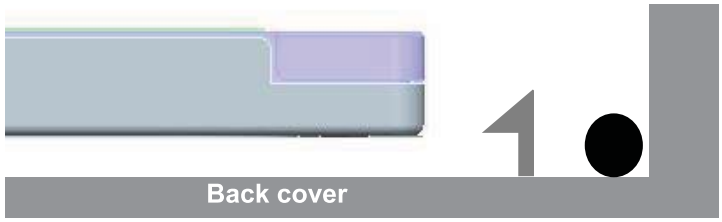
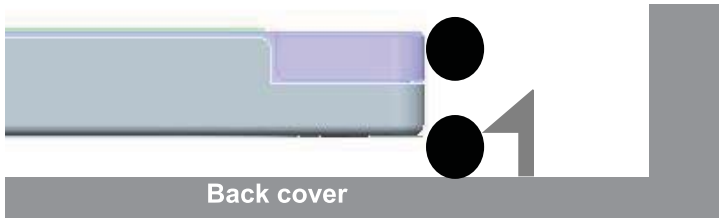
LGD Proposal for system cover design.(Appendix)

13	Check the wire position(path)
 OK  NG	
Risk point	It is necessary that wire is posited out of hook, not posited near hook,.
Suggestion	If wire is posited near hook, it can be happened assemble error and panel crack during assemble front cover

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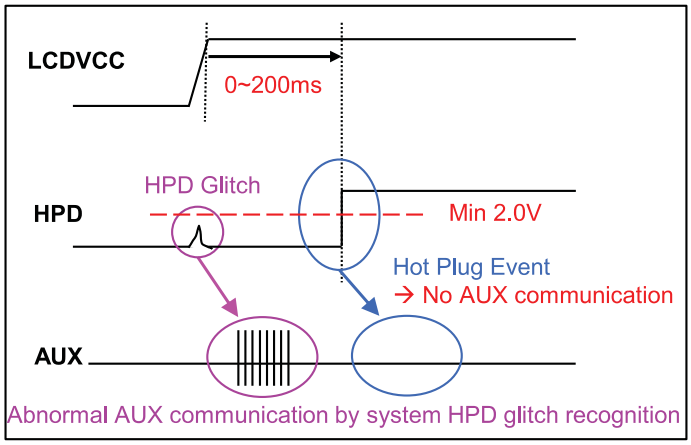
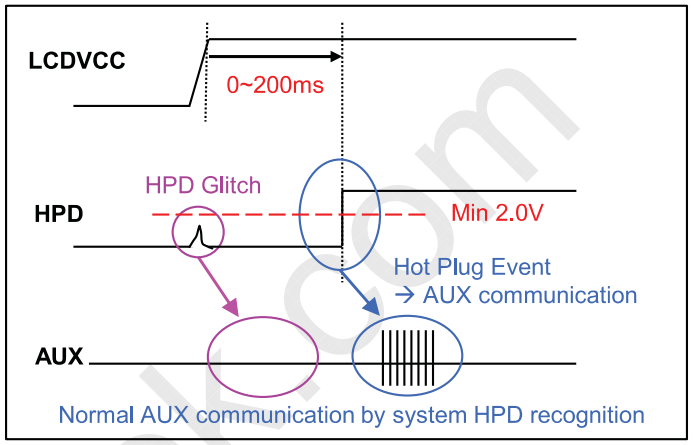
APPENDIX B. LGD Proposal for eDP Interface Design Guide

1	HPD Signal recognition



[Abnormal Communication By HPD Glitch]

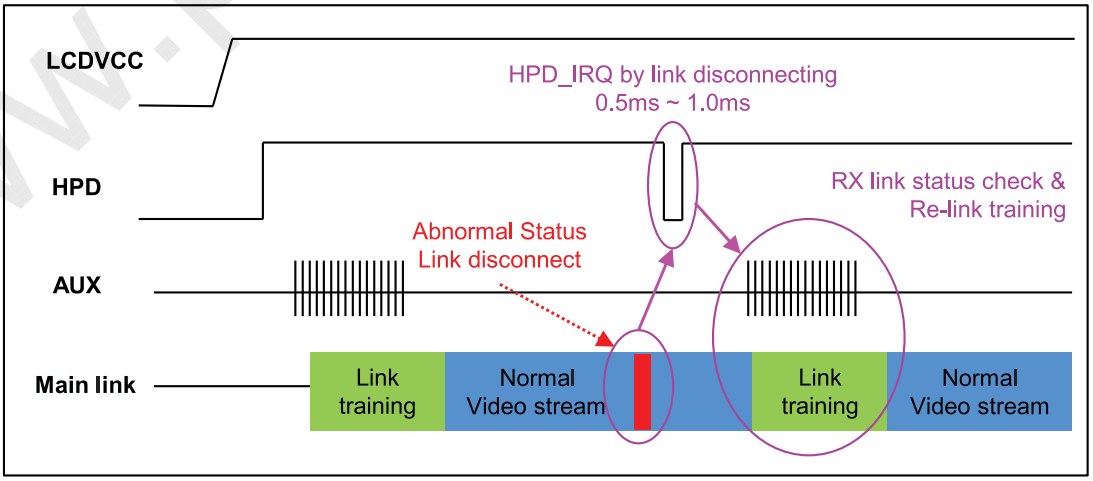


[Normal Communication By HPD Signal]

Define	1. Hot Plug Detection (HPD) Threshold level of Source Device is minimum 2.0V
	2. HPD Unplug : HPD pulse stays low longer than 2ms. DP Tx shall wait for HPD signal to go high again.
	3. "HPD High" is confirmed only after HPD has been asserted continuously for 100msec.

2	IRQ (Interrupt Request) HPD Pulse Definition

Ex) HPD Pulse



Define	Upon detection this "HPD IRQ Event"(0.5ms ~ 1ms) ,the source device must read the link / sink status field of the DPCD and take corrective action.

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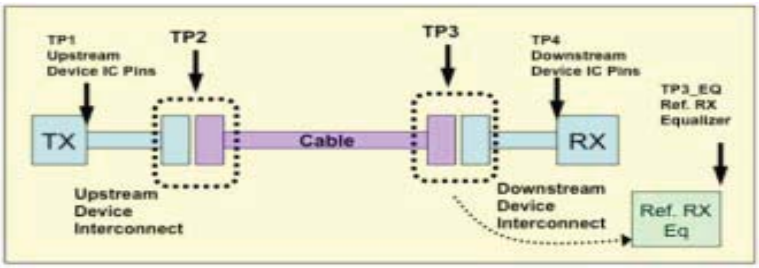
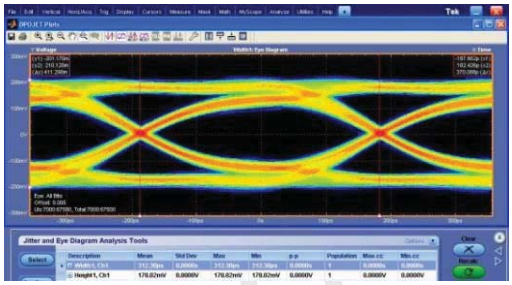
APPENDIX B. LGD Proposal for eDP Interface Design Guide

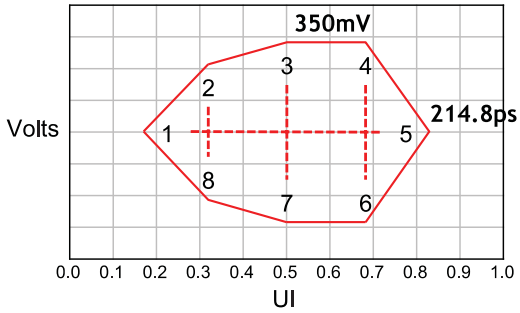
3 Main Link EYE Diagram



*Note : In PCBA side, LGD measured TP3 on LCD connector

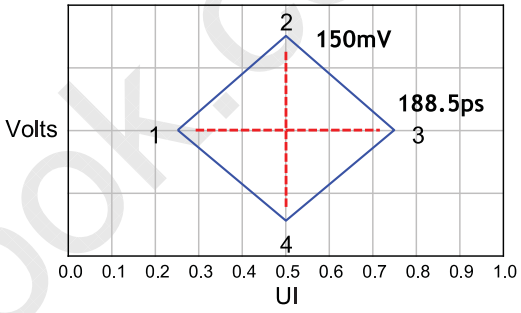


[EYE Diagram]



Point	UI	Voltage (Volts)
1	0.210	0.000
2	0.355	0.140
3	0.500	0.175
4	0.645	0.175
5	0.790	0.000
6	0.645	-0.175
7	0.500	-0.175
8	0.355	-0.140

[EYE Vertices for TP2 at HBR]



Point	UI	Voltage (Volts)
1	0.246	0.000
2	0.500	0.075
3	0.755	0.000
4	0.500	-0.075

[EYE Vertices for TP3 at HBR]

Define	Main Link EYE Diagram should meet TP2 and TP3 point

4 Cable Impedance management

Segment	Differential Impedance	Maximum Tolerance
Connector	90 Ω	+/- 10%
Wire management	90 Ω	
Cable	90 Ω	+/- 10%

Define	Cable Impedance 90 Ω +/- 10% (81Ω ~ 99Ω)

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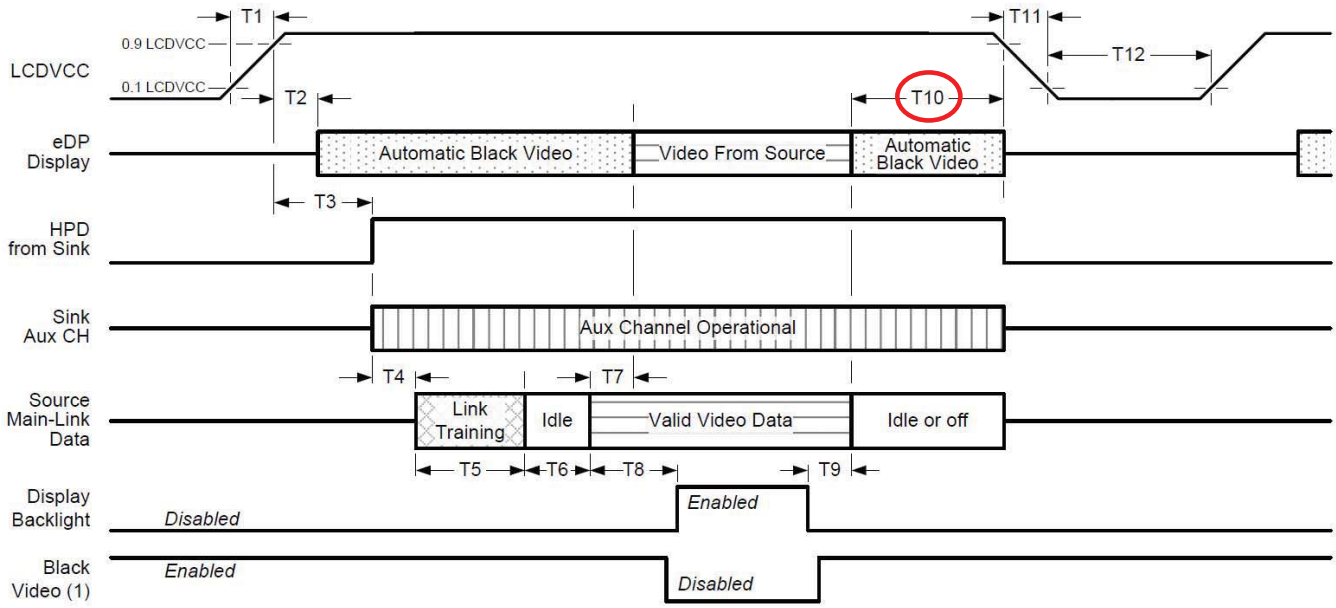
5	Main Link Off vs. LCD Power Off at Non-PSR



Timing Parameter	Description	Required By	Min	Max
T10	Delay from end of valid video from Source to Power Off	Source	0ms	500ms

* LGD recommend that Source must power off the LCDVCC if Main Link off like below.

[Case1. Resolution Change]

[Case2. Close the Lid]

Define	If Main Link off signal from Source, then LCDVCC must be Power Off within T10 period at Non-PSR mode

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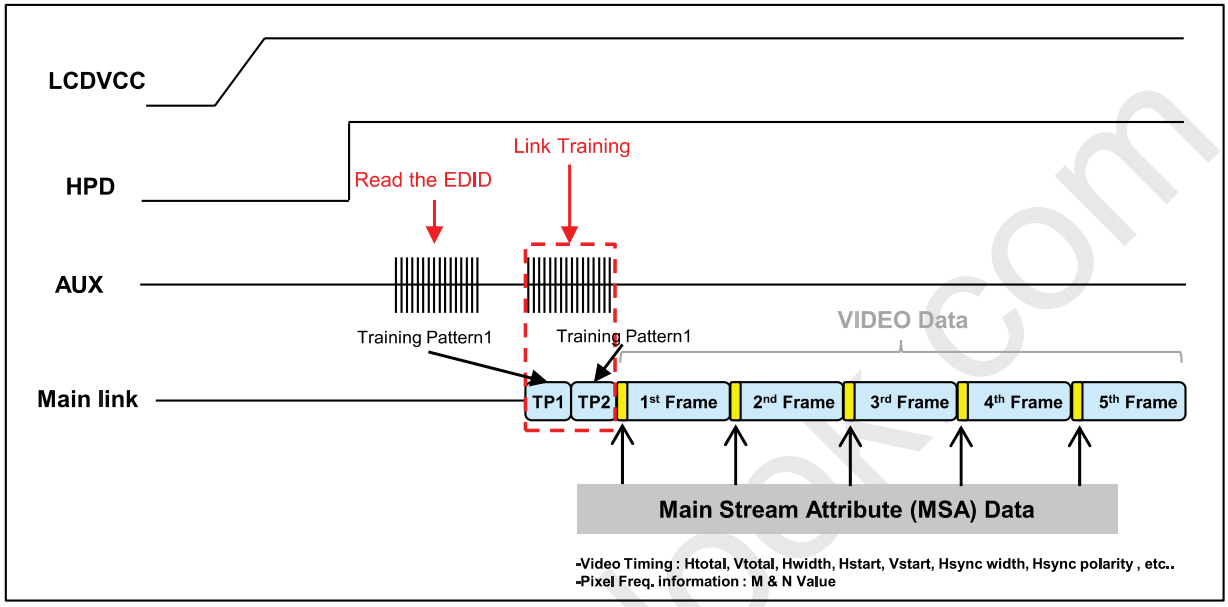
6	Main Link M & N value of MSA data



Define	It need to fix M& N value of MSA data output to prevent the initial abnormal M& N Value from incoming after power on.

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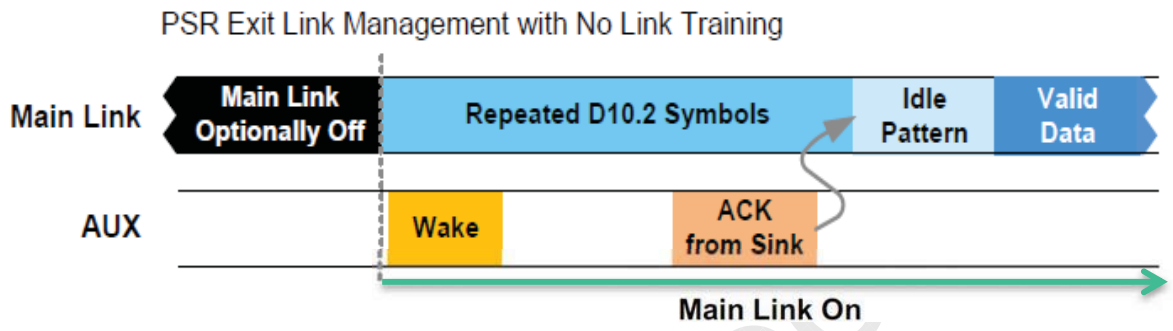
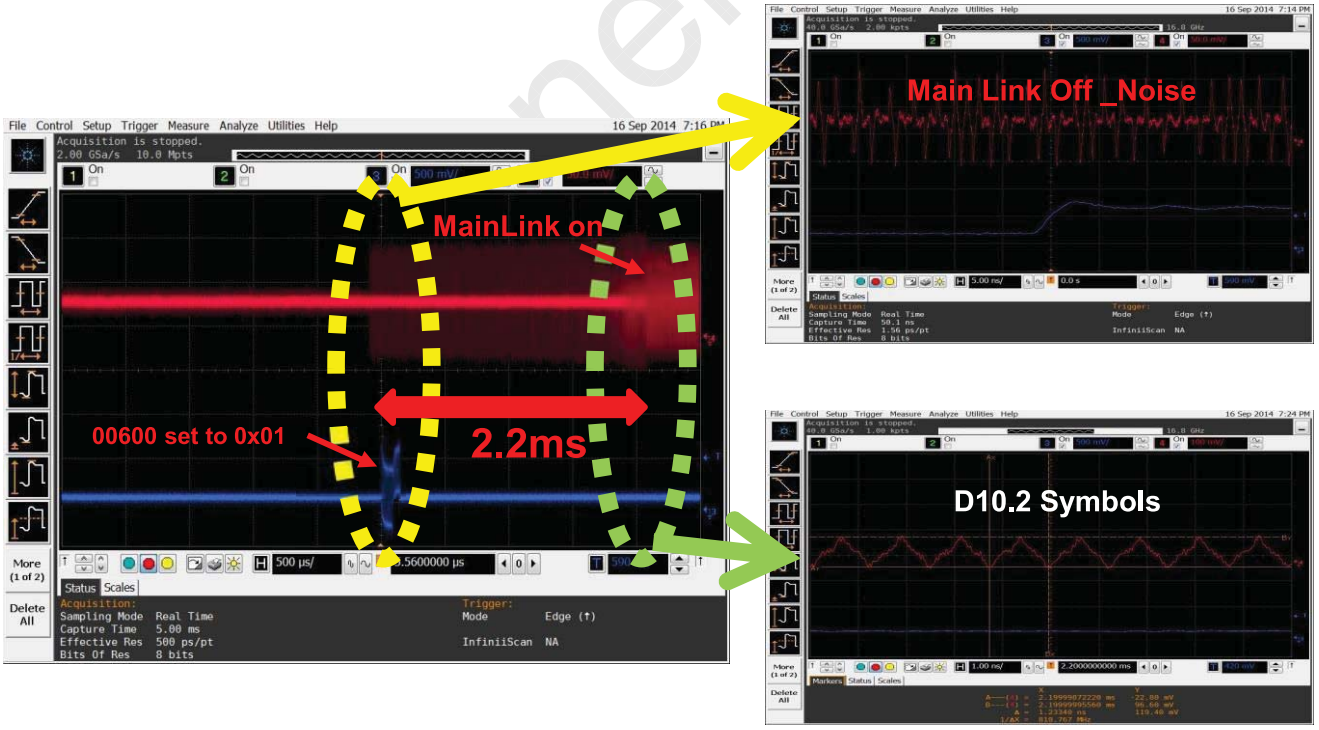
APPENDIX B. LGD Proposal for eDP Interface Design Guide

7	PSR Exit

If link training is not required, the Source must begin transmitting data on the Main Link prior to the wake AUX command which occurs through writing 01h to the SET_POWER & SET_DP_PWR_VOLTAGE register (DPCD Address 00600h; see *DP v1.2a*), as illustrated in the upper portion of Figure 6-9. This transmitted data must be a repetition of D10.2 symbols (which is the same as Link Training Pattern 1). Note the requirement above to transmit five repeats of the Idle Pattern after receiving ACK from the Sink.



-. The below waveform is the issued case.



Define	If link training is not required, the source must begin transmitting data on the ML prior to the wake AUX wake-up command.

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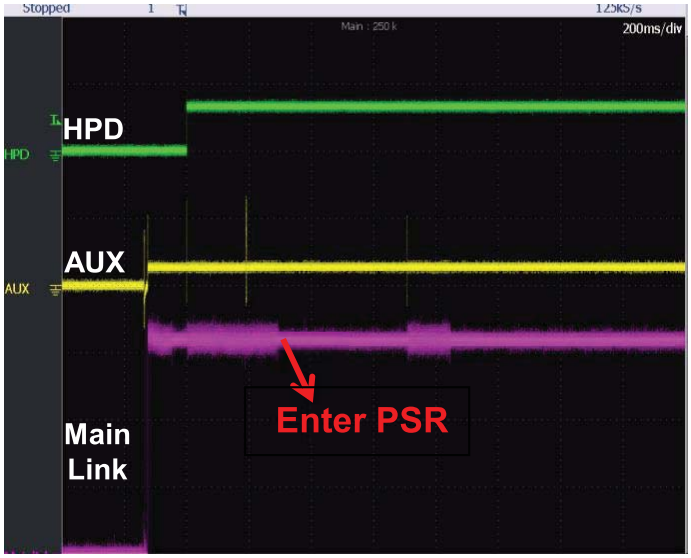
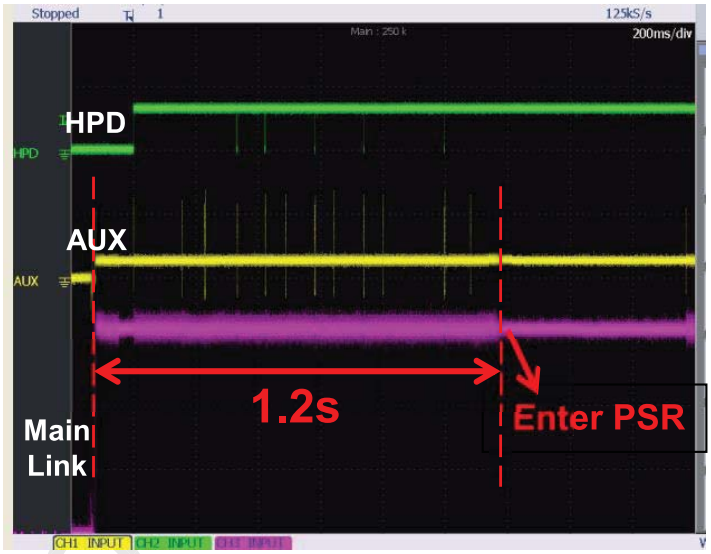
8	1st time PSR Entry after Power on



< Issue waveform >



< solution waveform >

1. It is found that with solution , the TCON enter the PSR timing is 1.2s delay from VCC on which avoid TCON capture the wrong data from DP link(poor link quality) and enter the BIST mode + PSR mode(black screen).
2. **According to test, link is stable 800ms after VCC on.**

Define	After power(Vcc) on, the DP link is not stable, so the source try to PSR entry at 800ms after Power(Vcc) on..

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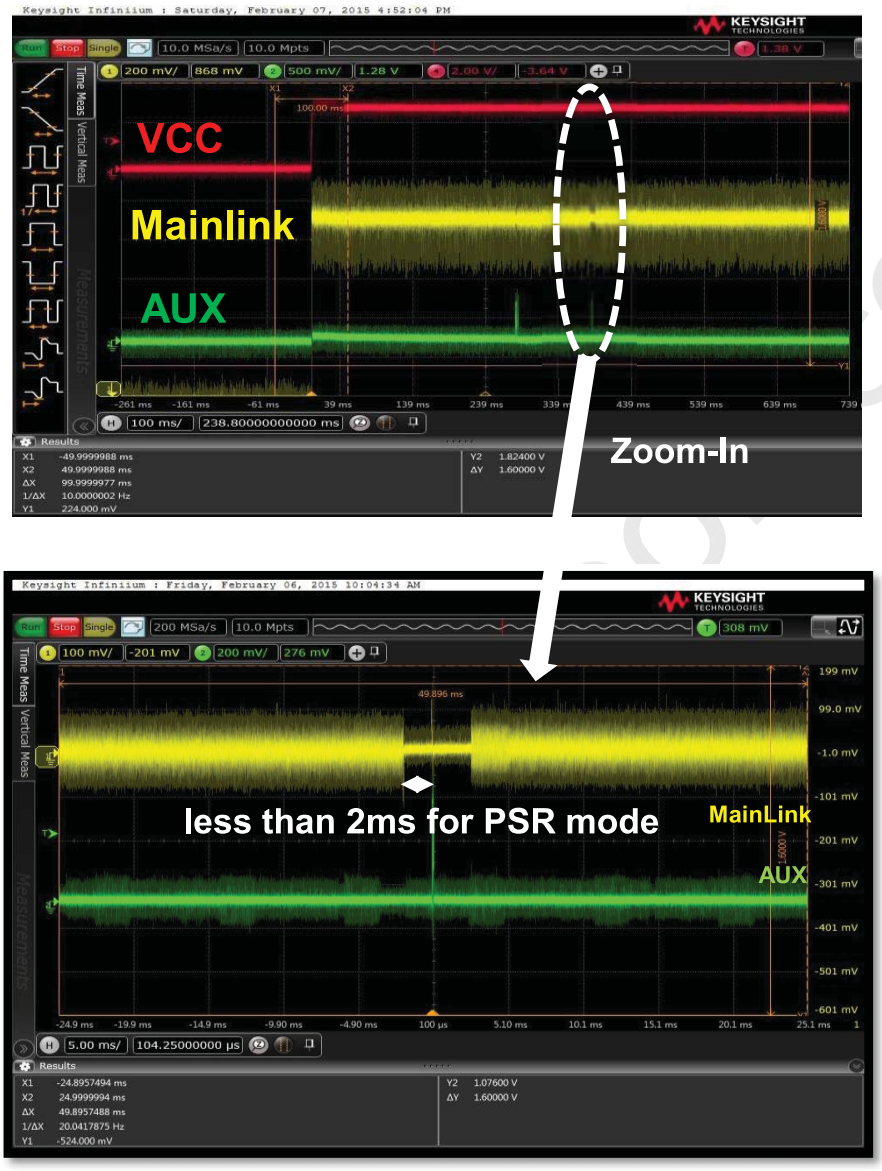
9	PSR Period Issue



1. When issue is happened, system go to PSR mode for very short time.
2. If PSR active period is shorter than 1frame(16.67ms), T-Con can not go to the standby mode for PSR exit.

Define	When GPU go to the PSR mode, the source must hold the main link off over than 1frame.

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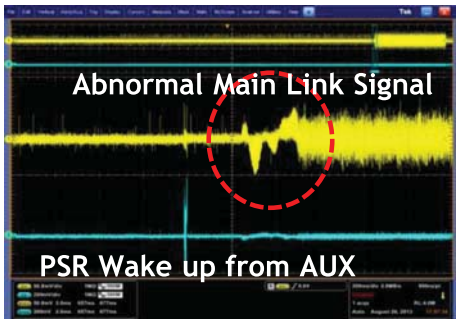
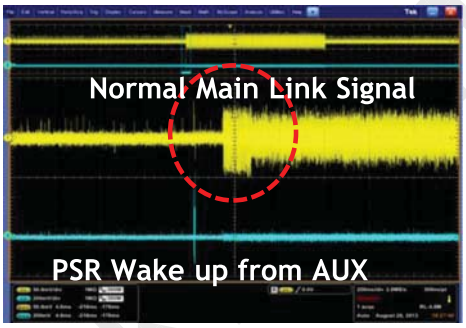
APPENDIX B. LGD Proposal for eDP Interface Design Guide

10	Main Link Noise at PSR Exit



[Abnormal Main Link Noise]



[Normal Main Link Signal]

Define	Main Link Noise at PSR Exit mode can be a cause abnormal display.

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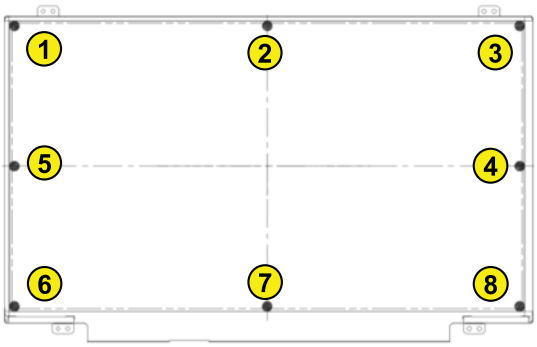
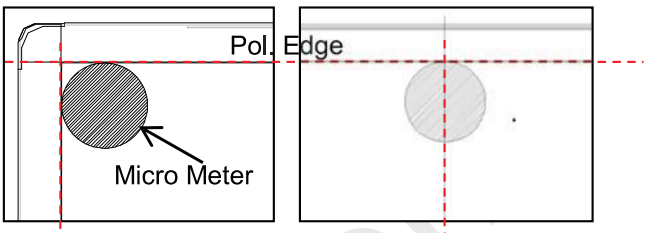
APPENDIX C. LGD Proposal for Measurement Method

1	LCM Thickness
Point	  Pol. Edge (①,③,⑥,⑧) LCM Center (②,④,⑤,⑦)
Measure Tool	Micro Meter  
Guide	✓ Measure the thickness between Polarizer surface and M-Chassis on the rear of LCM ✓ Subtract Pol. protect film thickness from LCM thickness

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APPENDIX D. Enhanced Extended Display Identification Data (EEDID™) 1/3

	Byte (Dec)	Byte (Hex)	Field Name and Comments	Value (Hex)	Value (Bin)
Header	0	00	Header	00	00000000
	1	01	Header	FF	11111111
	2	02	Header	FF	11111111
	3	03	Header	FF	11111111
	4	04	Header	FF	11111111
	5	05	Header	FF	11111111
	6	06	Header	FF	11111111
	7	07	Header	00	00000000
Vendor / Product EDID Version	8	08	ID Manufacture Name LGD	30	00110000
	9	09	ID Manufacture Name	E4	11100100
	10	0A	ID Product Code 06B3h	B3	10110011
	11	0B	Feature Support [Display Power Management(DPM) : Standby Mode is not supported, Suspend Mode is not supported, Active Off = Very Low Power is not supported, Supportted Color Encoding Formats : RGB 4:4:4 ,Other	06	00000110
	12	0C	ID Serial No. - Optional ("00h" If not used, Number Only and LSB First)	00	00000000
	13	0D	ID Serial No. - Optional ("00h" If not used, Number Only and LSB First)	00	00000000
	14	0E	ID Serial No. - Optional ("00h" If not used, Number Only and LSB First)	00	00000000
	15	0F	ID Serial No. - Optional ("00h" If not used, Number Only and LSB First)	00	00000000
	16	10	Week of Manufacture - Optinal 00 weeks	00	00000000
	17	11	Year of Manufacture 2021 years	1F	00011111
	18	12	EDID structure version # = 1	01	00000001
	19	13	EDID revision # = 4	04	00000100
Display Parameters	20	14	Video input Definition = Input is a Digital Video signal Interface , Colo Bit Depth : 8 Bits per Primary Color , Digital Video Interface Standard Supported: DisplayPort is supported	A5	10100101
	21	15	Horizontal Screen Size (Rounded cm) = 34 cm	22	00100010
	22	16	Vertical Screen Size (Rounded cm) = 21 cm	15	00010101
	23	17	Display Transfer Characteristic (Gamma) = (gamma*100)-100 = Example:(2.2*100)-100=120	78	01111000
	24	18	Feature Support [Display Power Management(DPM) : Standby Mode is not supported, Suspend Mode is not supported, Active Off = Very Low Power is not supported ,Supportted Color Encoding Formats : RGB 4:4:4 ,Other Feature Support Flags : sRGB, Preferred Timing Mode, No_Display is continuous frequency (Multi-mode_Base EDID and Extension Block).]	06	00000110
Panel Color Coordinates	25	19	Red/Green Low Bits (RxRy/GxGy)	A2	10100010
	26	1A	Blue/White Low Bits (BxBy/WxWy)	05	00000101
	27	1B	Red X Rx = 0.650	A6	10100110
	28	1C	Red Y Ry = 0.330	54	01010100
	29	1D	Green X Gx = 0.285	49	01001001
	30	1E	Green Y Gy = 0.635	A2	10100010
	31	1F	Blue X Bx = 0.145	25	00100101
	32	20	Blue Y By = 0.055	0E	00001110
	33	21	White X Wx = 0.313	50	01010000
	34	22	White Y Wy = 0.329	54	01010100
Established Timings	35	23	Established timing 1 (Optional_00h if not used)	00	00000000
	36	24	Established timing 2 (Optional_00h if not used)	00	00000000
	37	25	Manufacturer's timings (Optional_00h if not used)	00	00000000
Standard Timing ID	38	26	Standard timing ID1 (Optional_01h if not used)	01	00000001
	39	27	Standard timing ID1 (Optional_01h if not used)	01	00000001
	40	28	Standard timing ID2 (Optional_01h if not used)	01	00000001
	41	29	Standard timing ID2 (Optional_01h if not used)	01	00000001
	42	2A	Standard timing ID3 (Optional_01h if not used)	01	00000001
	43	2B	Standard timing ID3 (Optional_01h if not used)	01	00000001
	44	2C	Standard timing ID4 (Optional_01h if not used)	01	00000001
	45	2D	Standard timing ID4 (Optional_01h if not used)	01	00000001
	46	2E	Standard timing ID5 (Optional_01h if not used)	01	00000001
	47	2F	Standard timing ID5 (Optional_01h if not used)	01	00000001
	48	30	Standard timing ID6 (Optional_01h if not used)	01	00000001
	49	31	Standard timing ID6 (Optional_01h if not used)	01	00000001
	50	32	Standard timing ID7 (Optional_01h if not used)	01	00000001
	51	33	Standard timing ID7 (Optional_01h if not used)	01	00000001
	52	34	Standard timing ID8 (Optional_01h if not used)	01	00000001
	53	35	Standard timing ID8 (Optional_01h if not used)	01	00000001

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APPENDIX D. Enhanced Extended Display Identification Data (EEDID™) 2/3

	Byte (Dec)	Byte (Hex)	Field Name and Comments	Value (Hex)	Value (Bin)
Timing Descriptor #1	54	**36**	Pixel Clock/10,000 (LSB) 154 MHz @ 60 Hz	**28**	00101000
	55	**37**	Pixel Clock/10,000 (MSB)	**3C**	00111100
	56	**38**	Horizontal Active (HA) (lower 8 bits) 1920 pixels	**80**	10000000
	57	**39**	Horizontal Blanking (HB) (lower 8 bits) 160 pixels	**A0**	10100000
	58	**3A**	Horizontal Active (HA) / Horizontal Blanking (HB) (upper 4:4bits)	**70**	01110000
	59	**3B**	Vertical Avtive (VA) 1200 lines	**B0**	10110000
	60	**3C**	Vertical Blanking (VB) (DE Blanking typ.for DE only panels) 35 lines	**23**	00100011
	61	**3D**	Vertical Active (VA) / Vertical Blanking (VB) (upper 4:4bits)	**40**	01000000
	62	**3E**	Horizontal Front Porch in pixels (HF) (lower 8 bits) 48 pixels	**30**	00110000
	63	**3F**	Horizontal Sync Pulse Width in pixels (HS) (lower 8 bits) 32 pixels	**20**	00100000
	64	**40**	Vertical Front Porch in lines (VF) : Vertical Sync Pluse Width in lines (VS) (lower 4 bits) 3 lines : 6 lines	**36**	00110110
	65	**41**	Horizontal Front Porch/ Sync Pulse Width/ Vertical Front Porch/ Sync Pulse Width (upper 2bits)	**00**	00000000
	66	**42**	Horizontal Vedio Image Size (mm) (lower 8 bits) 336 mm	**50**	01010000
	67	**43**	Vertical Vedio Image Size (mm) (lower 8 bits) 210 mm	**D2**	11010010
	68	**44**	Horizontal Image Size / Vertical Image Size (upper 4 bits)	**10**	00010000
	69	**45**	Horizontal Border = 0 (Zero for Notebook LCD)	**00**	00000000
	70	**46**	Vertical Border = 0 (Zero for Notebook LCD)	**00**	00000000
	71	**47**	Non-Interlace, Normal display, no stereo, Digital Separate [Vsync_NEG, Hsync_POS (outside of V-sync)]	**1A**	00011010
Timing Descriptor #2	72	**48**	Pixel Clock/10,000 (LSB) 123.2 MHz @ 48 Hz	**20**	00100000
	73	**49**	Pixel Clock/10,000 (MSB)	**30**	00110000
	74	**4A**	Horizontal Active (HA) (lower 8 bits) 1920 pixels	**80**	10000000
	75	**4B**	Horizontal Blanking (HB) (lower 8 bits) 160 pixels	**A0**	10100000
	76	**4C**	Horizontal Active (HA) / Horizontal Blanking (HB) (upper 4:4bits)	**70**	01110000
	77	**4D**	Vertical Avtive (VA) 1200 lines	**B0**	10110000
	78	**4E**	Vertical Blanking (VB) (DE Blanking typ.for DE only panels) 35 lines	**23**	00100011
	79	**4F**	Vertical Active (VA) / Vertical Blanking (VB) (upper 4:4bits)	**40**	01000000
	80	**50**	Horizontal Front Porch in pixels (HF) (lower 8 bits) 48 pixels	**30**	00110000
	81	**51**	Horizontal Sync Pulse Width in pixels (HS) (lower 8 bits) 32 pixels	**20**	00100000
	82	**52**	Vertical Front Porch in lines (VF) : Vertical Sync Pluse Width in lines (VS) (lower 4 bits) 3 lines : 6 lines	**36**	00110110
	83	**53**	Horizontal Front Porch/ Sync Pulse Width/ Vertical Front Porch/ Sync Pulse Width (upper 2bits)	**00**	00000000
	84	**54**	Horizontal Vedio Image Size (mm) (lower 8 bits) 336 mm	**50**	01010000
	85	**55**	Vertical Vedio Image Size (mm) (lower 8 bits) 210 mm	**D2**	11010010
	86	**56**	Horizontal Image Size / Vertical Image Size (upper 4 bits)	**10**	00010000
	87	**57**	Horizontal Border = 0 (Zero for Notebook LCD)	**00**	00000000
	88	**58**	Vertical Border = 0 (Zero for Notebook LCD)	**00**	00000000
	89	**59**	Non-Interlace, Normal display, no stereo, Digital Separate [Vsync_NEG, Hsync_POS (outside of V-sync)]	**1A**	00011010
Timing Descriptor #3	90	**5A**	Flag	**00**	00000000
	91	**5B**	Flag	**00**	00000000
	92	**5C**	Flag	**00**	00000000
	93	**5D**	Data Type Tag : Alphanumeric Data String (ASCII String)	**FE**	11111110
	94	**5E**	Flag	**00**	00000000
	95	**5F**	Dell P/N 1st Character = 4	**34**	00110100
	96	**60**	Dell P/N 2nd Character = D	**44**	01000100
	97	**61**	Dell P/N 3rd Character = W	**57**	01010111
	98	**62**	Dell P/N 4th Character = V	**56**	01010110
	99	**63**	Dell P/N 5th Character = J	**4A**	01001010
	100	**64**	EDID Revision Build Name = MP(X-Build) , Revision # = A00	**80**	10000000
	101	**65**	Manufacturer P/N = 1	**31**	00110001
	102	**66**	Manufacturer P/N = 5	**35**	00110101
	103	**67**	Manufacturer P/N = 6	**36**	00110110
	104	**68**	Manufacturer P/N = W	**57**	01010111
	105	**69**	Manufacturer P/N = U	**55**	01010101
	106	**6A**	Manufacturer P/N = 1	**31**	00110001
	107	**6B**	Manufacturer P/N (If < 13 char, then terminate with ASCⅡ code 0Ah,set remaining char = 20h)	**0A**	00001010

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APPENDIX D. Enhanced Extended Display Identification Data (EEDID™) 3/3

	Byte (Dec)	Byte (Hex)	Field Name and Comments	Value (Hex)	Value (Bin)
Timing Descriptor #4	108	6C	Flag	00	00000000
	109	6D	Flag	00	00000000
	110	6E	Flag	00	00000000
	111	6F	Data Type Tag : Descriptor Defined by manufacturer	00	00000000
	112	70	Flag	00	00000000
	113	71	Color Management [No +2 FRC Support, True Color Depth : 8 bit]	02	00000010
	114	72	Panel Type [WLED] , Configuration [Single light bar], Number Lamp or LED Light Bar [one]	41	01000001
	115	73	Frame Rate Details [Minimum Frame Rate : 40Hz, Maximum Frame Rate : 65Hz , Tcon provides native Intel DRRS / sDRRS support]	31	00110001
	116	74	Controller Interface and Maximum Luminance [PWM type, 500 nit]	B2	10110010
	117	75	Front Surface / Polarizer [Anti-Glare, No Transflective] , Pixel Structure [RGB v-stripe]	00	00000000
	118	76	Multi-Media Features [Color Management : NTSC and sRGB, Dynamic Backlight Control : Type 1]	11	00010001
	119	77	Multi-Media Features [Motion Blur : No support , Active Gamma Control : No support]	00	00000000
	120	78	Special Features [Wireless Enhancement Hardware : No support , In-Cell Scanner : No support]	00	00000000
	121	79	Special Features [Number of LVDS channels or eDP lanes : two , Overdrive : No ,Interface : eDP , In-Cell Touch Support : No]	0A	00001010
	122	7A	Special Features [BIST Support : yes , Electronic Privacy : No electronic privacy hardware support , 3-D Support : No]	01	00000001
	123	7B	(If<13 char--> 0Ah, then terminate with ASCⅡ code 0Ah,set remaining char = 20h)	0A	00001010
	124	7C	(If<13 char--> 0Ah, then terminate with ASCⅡ code 0Ah,set remaining char = 20h)	20	00100000
	125	7D	(If<13 char--> 0Ah, then terminate with ASCⅡ code 0Ah,set remaining char = 20h)	20	00100000
Checksum	126	7E	Extension flag (# of optional 128 panel ID extension block to follow, Typ = 0)	00	00000000
	127	7F	Check Sum (The 1-byte sum of all 128 bytes in this panel ID block shall = 0)	AE	10101110

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