HY-LINE®
COMPUTER COMPONENTS

TFT-DISPLAY DATENBLATT

LG Display
Modell: LP156WF7-SLA1

KURZDATEN:

Hersteller	LG Display
Diagonale	15,6"
Format	16:9
Auflösung	1920 x 1080
Backlight	LED / 220 cd/m²
Interface	eDP
Touchscreen	ja
Temperatur	0...+50 °C (Betrieb)

SPECIFICATION
FOR
APPROVAL

(◆) **Preliminary Specification**

(   ) **Final Specification**

Title	15.6" FHD TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LP156WF7
Suffix	TBD

*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
J. S. Park / Manager	
REVIEWED BY	
N. K. Jo / Manager	
PREPARED BY	
T. Y. Kim / Engineer	
S. Y. Kim / Engineer	

Product Engineering Dept.
LG Display Co., Ltd

Contents

RECORD OF REVISIONS

Revision No	Revision Date	Page	Description	EDID version
0.0	Mar. 23, 2015	-	First Draft (Preliminary Specification)	-

1. General Description

The LP156WF7 is a Color Active Matrix Liquid Crystal Display with Advanced In-cell Touch System. The matrix employs a-Si 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 FHD resolution (1920 horizontal by 1080 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 6-bit gray scale signal for each dot, thus, presenting a palette of more than 262,144 colors. The LP156WF7 has been designed to apply the interface method that enables low power, high speed, low EMI. The LP156WF7 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 LP156WF7 characteristics provide an excellent flat display for office automation products such as Notebook PC.
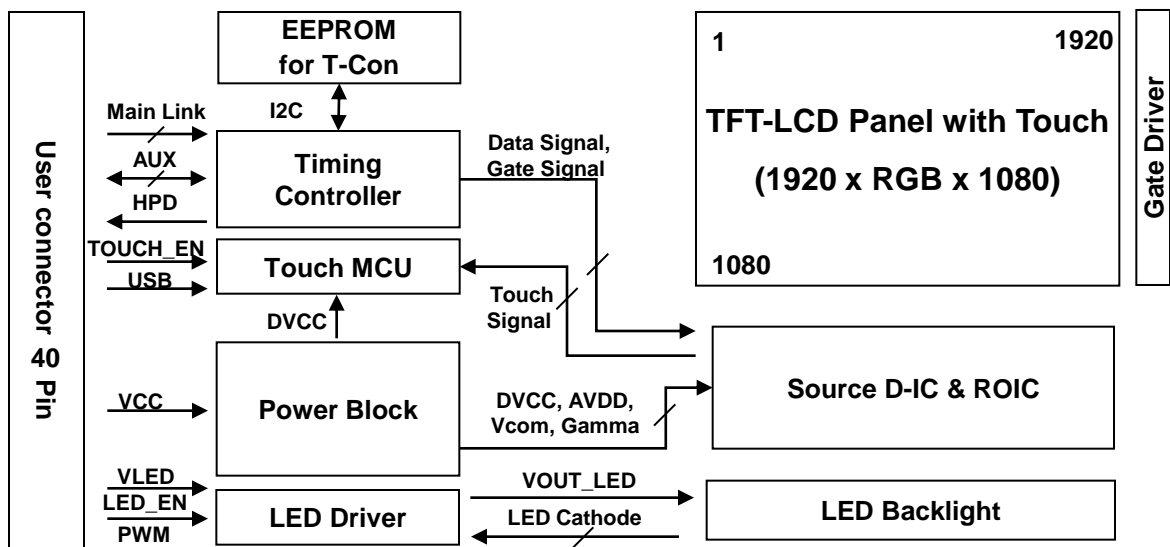
General Features

|	
Active Screen Size	15.6 inches diagonal
Outline Dimension	395.5mm(H, Typ.) x 223.8mm(V, Typ.) x 3.3mm(D, Max), with PCBA
Pixel Pitch	0.179mm x 0.179mm
Pixel Format	1920 horiz. by 1080 vert. Pixels RGB strip arrangement
Color Depth	6-bit, 262,144 colors
Luminance, White	220 cd/m^2(Typ.)
Power Consumption	Total TBDW (Typ.) Logic : TBDW (Typ. @ Mosaic), B/L : TBDW (Typ.)
Weight	370g (Max.)
Display Operating Mode	Normally Black
Surface Treatment	Glare treatment of the front Polarizer (3H)
RoHS Compliance	Yes
BFR / PVC / As Free	Yes for all

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 $\pm$ 2°C
Operating Temperature	TOP	0	50	°C	1
Storage Temperature	HST	-20	60	°C	1
Operating Ambient Humidity	HOP	10	90	%RH	1
Storage Humidity	HST	10	90	%RH	1

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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Product Specification
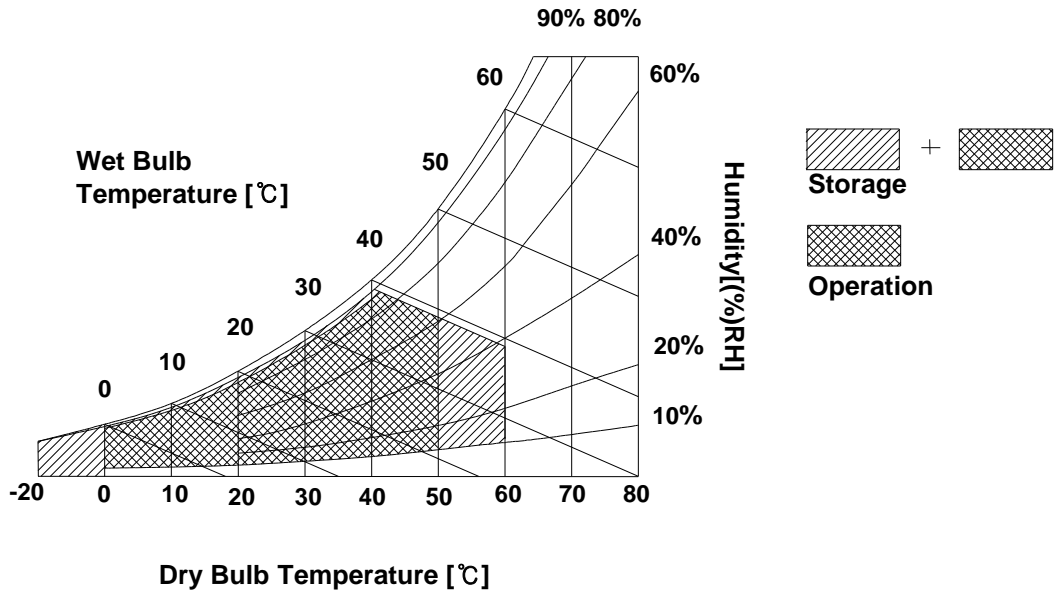
3. Electrical Specifications

3-1. LCD Electrical Characteristics

Table 2. LCD ELECTRICAL CHARACTERISTICS

Parameter		Symbol	Values			Unit	Notes
			Min	Typ	Max		
Power Supply Input Voltage		Vcc	3.0	3.3	3.6	V	1
Permissive Power Supply Input Ripple		VCCrp	-	-	100	mV$_{p-p}$	
Power Supply Input Current	Mosaic	Icc	-	TBD	TBD	mA	2
Power Consumption		Pcc	-	TBD	TBD	W	
Power Supply Inrush Current		Icc_P	-	-	1.5	A	3
Differential Impedance		ZeDP	90	100	110	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 pattern.
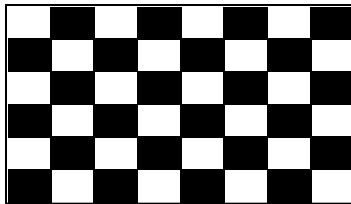
3. The V_{CC} rising time is same as the minimum of T1 at Power on sequence.

Product Specification
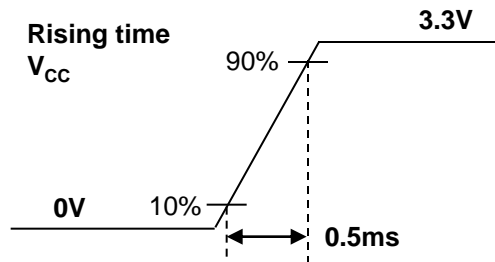
3-2. LED Backlight Electrical Characteristics

Table 3. LED B/L ELECTRICAL CHARACTERISTICS

| Parameter		Symbol	Values			Unit	Notes
			Min	Typ	Max		
LED Power Input Voltage		V_{LED}	7.0	12.0	21.0	V	1
LED Power Input Current		I_{LED}	-	TBD	TBD	mA	2
LED Power Consumption		P_{LED}	-	TBD	TBD	W	
LED Power Inrush Current		I_{LED_P}	-	-	1.5	A	3
PWM Duty Ratio			5	-	100	%	4
PWM Jitter			0	-	0.2	%	5
PWM Frequency		F_{PWM}	200	-	1000	Hz	6
PWM	High Level Voltage	V_{PWM_H}	2.5	-	3.6	V	
	Low Level Voltage	V_{PWM_L}	0	-	0.3	V	
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			12,000	-	-	Hrs	7

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.
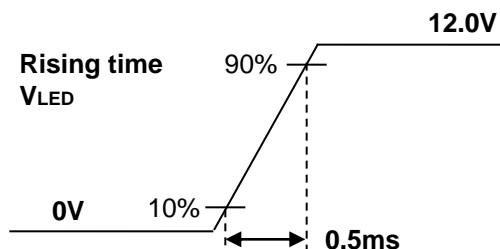
4. The operation of LED Driver below minimum dimming ratio may cause flickering or reliability issue.

5. If Jitter of PWM is bigger than maximum, it may induce flickering.

6. 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.

7. 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.

3-3. Interface Connections
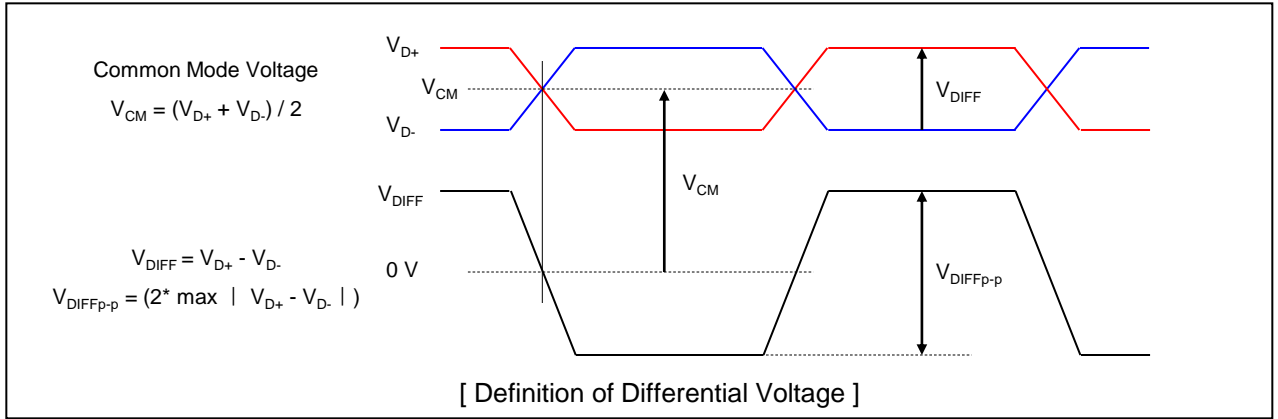
Table 4. MODULE CONNECTOR PIN CONFIGURATION (CN1)

Pin	Symbol	Description	Notes
1	NC Reserved	Reserved for LCD manufacturer's use	
2	GND	High Speed Ground	
3	Lane1_N	Complement Signal Link Lane 1	
4	Lane1_P	True Signal Link Lane 1	
5	GND	High Speed Ground	
6	Lane0_N	Complement Signal Link Lane 0	
7	Lane0_P	True Signal Link Lane 0	
8	GND	High Speed Ground	
9	AUX_CH_P	True Signal Auxiliary Channel	
10	AUX_CH_N	Complement Signal Auxiliary Channel	
11	GND	High Speed Ground	
12	VCC	LCD logic and driver power	[Connector]
13	VCC	LCD logic and driver power	I-PEX, 20474-040E-12
14	LCD Self Test or NC	LCD Panel Self Test Enable (Optional)	or equivalent
15	GND	LCD logic and driver ground	
16	GND	LCD logic and driver ground	
17	HPD	HPD signal pin	
18	BL_GND	LED Backlight ground	[Connector pin arrangement]
19	BL_GND	LED Backlight ground	
20	BL_GND	LED Backlight ground	
21	BL_GND	LED Backlight ground	
22	BL ENABLE	LED Backlight control on/off control	
23	BL PWM	System PWM signal input for dimming	
24	NC Reserved	Reserved for LCD manufacture's use	
25	NC Reserved	Reserved for LCD manufacture's use	
26	VLED	LED Backlight power (12V Typical)	
27	VLED	LED Backlight power (12V Typical)	[LGD P-Vcom using information]
28	VLED	LED Backlight power (12V Typical)	1. Pin for P-Vcom : #24, #25
29	VLED	LED Backlight power (12V Typical)	2. P-Vcom Address : 0101000x
30	NC Reserved	Reserved for LCD manufacture's use	
31	NC Reserved	Reserved for LCD manufacture's use	
32	Touch_EN	Touch Enable (Low : Touch Report Stop)	
33	NC Reserved	Reserved for LCD manufacture's use	
34	NC Reserved	Reserved for LCD manufacture's use	
35	NC Reserved	Reserved for LCD manufacture's use	
36	NC Reserved	Reserved for LCD manufacture's use	
37	GND	High Speed (USB) Ground	
38	DM	USB Device port data (-)	
39	DP	USB Device port data (+)	
40	GND	High Speed (USB) Ground	

Pin 40   Pin 1

G LG Display

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 Connector Pins]

[EYE Mask at Sink Connector Pins]
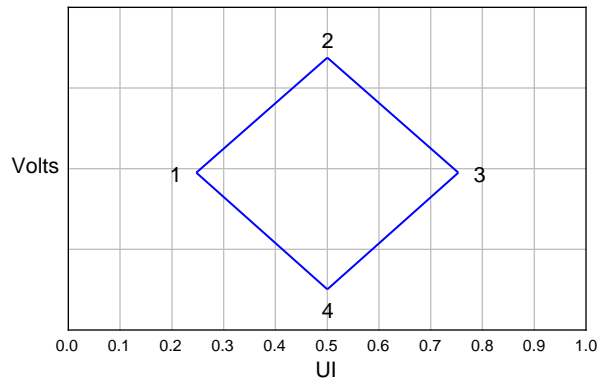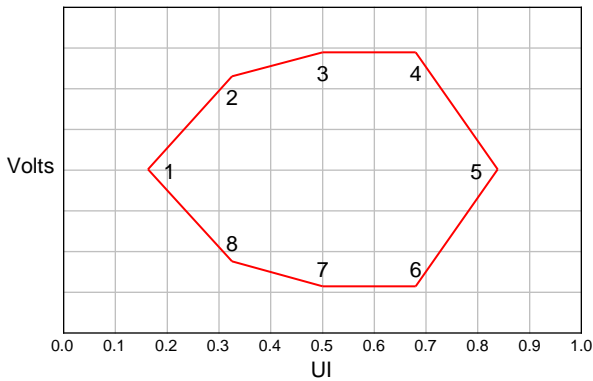
Point	Reduced Bit Rate		High Bit Rate	
	Time(UI)	Voltage(V)	Time(UI)	Voltage(V)
1	0.127	0.000	0.210	0.000
2	0.291	0.160	0.355	0.140
3	0.500	0.200	0.500	0.175
4	0.709	0.200	0.645	0.175
5	0.873	0.000	0.790	0.000
6	0.709	-0.200	0.645	-0.175
7	0.500	-0.200	0.500	-0.175
8	0.291	-0.160	0.355	-0.140

[EYE Mask Vertices at Source Connector Pins]

Point	Reduced Bit Rate		High Bit Rate	
	Time(UI)	Voltage(V)	Time(UI)	Voltage(V)
1	0.375	0.000	0.246	0.000
2	0.500	0.023	0.500	0.075
3	0.625	0.000	0.755	0.000
4	0.500	-0.023	0.500	-0.075

[EYE Mask Vertices at Sink Connector Pins]

Point	Reduced Bit Rate		High Bit Rate	
	Time(UI)	Voltage(V)	Time(UI)	Voltage(V)
1	0.270	0.000	0.246	0.000
2	0.500	0.068	0.500	0.075
3	0.731	0.000	0.755	0.000
4	0.500	-0.068	0.500	-0.075

[EYE Mask Vertices at embedded DP Sink Connector Pins]

Product Specification

3-4-3. eDP Main Link Signal

[Main Link Differential Pair]
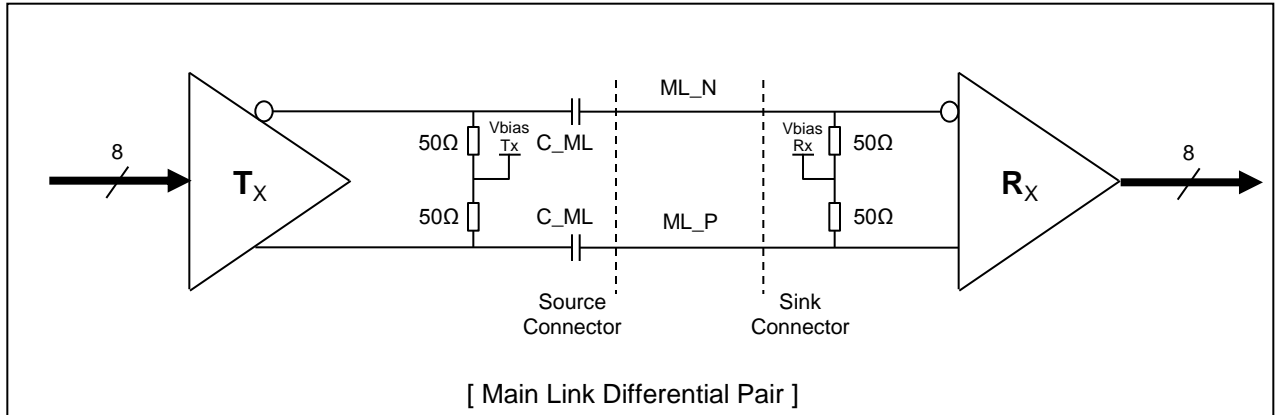
Parameter	Symbol	Min	Typ	Max	Unit	Notes
Unit Interval for high bit rate (2.7Gbps / lane)	UI_HBR	-	370	-	ps	
Unit Interval for reduced bit rate (1.62Gbps / lane)	UI_RBR	-	617	-	ps	
Link Clock Down Spreading	Amplitude	0	-	0.5	%	
	Frequency	30		33	kHz	
Differential peak-to-peak voltage at Source side connector	$V_{TX-DIFFp-p}$	350	-	-	mV	For HBR(2.7Gbps)
		400	-	-		For RBR(1.62Gbps)
EYE width at Source side connector	$T_{TX-EYE-CONN}$	0.58	-	-	UI	For HBR(2.7Gbps)
		0.75	-	-	UI	For RBR(1.62Gbps)
Differential peak-to-peak voltage at Sink side connector	$V_{RX-DIFFp-p}$	150	-	-	mV	For HBR(2.7Gbps)
		136	-	-		For RBR(1.62Gbps)
EYE width at Sink side connector	$T_{RX-EYE-CONN}$	0.51	-	-	UI	For HBR(2.7Gbps)
		0.46	-	-	UI	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.

3-4-4. eDP AUX Channel Signal

[Recommended eDP AUX Channel Differential Pair]
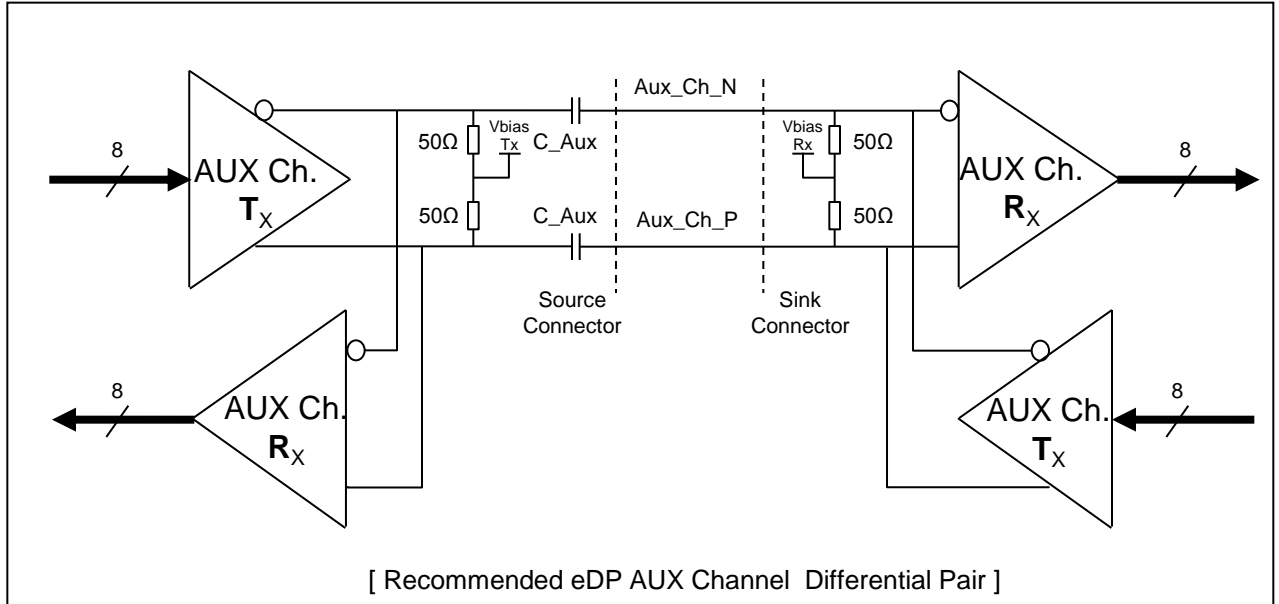
Parameter	Symbol	Min	Typ	Max	Unit	Notes
AUX Unit Interval	UI	0.4	-	0.6	us	
AUX Jitter at Tx IC Package Pins	T_{jitter}	-	-	0.04	UI	Equal to 24ns
AUX Jitter at Rx IC Package Pins		-	-	0.05	UI	Equal to 30ns
AUX Peak-to-peak voltage at Connector Pins of Receiving	$V_{AUX-DIFFp-p}$	0.39	-	1.38	V	
AUX Peak-to-peak 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. $V_{AUX-DIFFp-p} = 2* \mid V_{AUXP}-V_{AUXN} \mid$

3-4-5. eDP HPD Signal

[HPD Events]
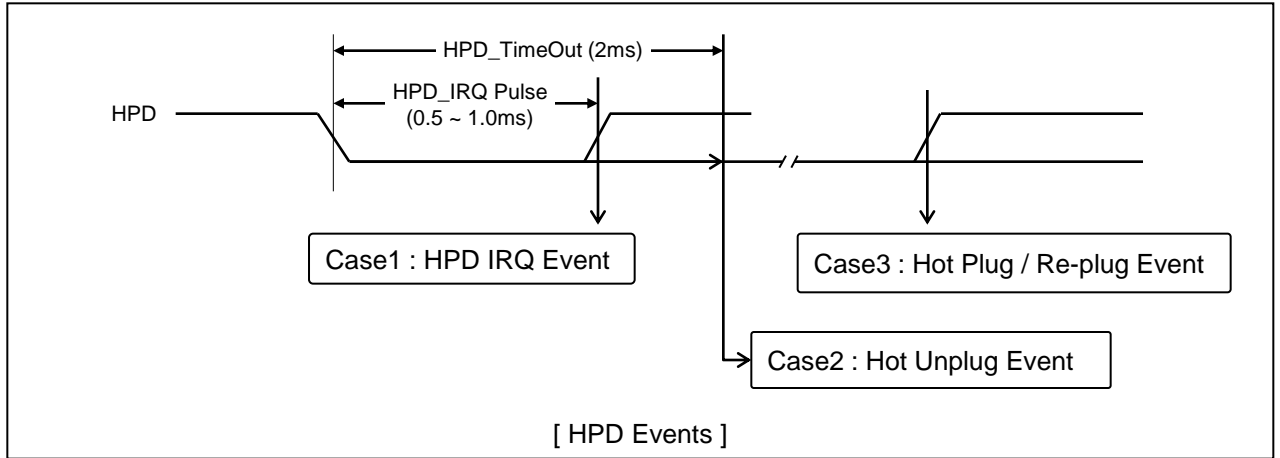
Parameter	Symbol	Min	Typ	Max	Unit	Notes
HPD Voltage	HPD	2.25	-	3.6	V	Sink side Driving
Hot Plug Detection Threshold		2.0	-	-	V	Source side Detecting
Hot Unplug Detection Threshold		-	-	0.8	V	
HPD_IRQ Pulse Width	HPD_IRQ	0.5	-	1.0	ms	
HPD_TimeOut		2.0	-	-	ms	HPD Unplug Event

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

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}	-	138.7	-	MHz	
Hsync	Period	t_{HP}	2072	2080	2088	t_{CLK}	
	Width	t_{WH}	32	32	32		
	Width-Active	t_{WHA}		1920			
Vsync	Period	t_{VP}	1108	1111	1114	t_{HP}	
	Width	t_{WV}	5	5	5		
	Width-Active	t_{WVA}		1080			
Data Enable	Horizontal back porch	t_{HBP}	72	80	88	t_{CLK}	
	Horizontal front porch	t_{HFP}	48	48	48		
	Vertical back porch	t_{VBP}	20	23	24	t_{HP}	
	Vertical front porch	t_{VFP}	3	3	5		

Notice. all reliabilities are specified for timing specification based on refresh rate of 60Hz. However, LP156WF7 has a good actual performance even at lower refresh rate (e.g. 40Hz or 50Hz) for power saving Mode, whereas LP156WF7 is secured only for function under lower refresh rate. 60Hz at Normal mode, 50Hz, 40Hz at Power save mode. Don't care Flicker level, Touch Report Rate (Power save mode).

3-6. Signal Timing Waveforms
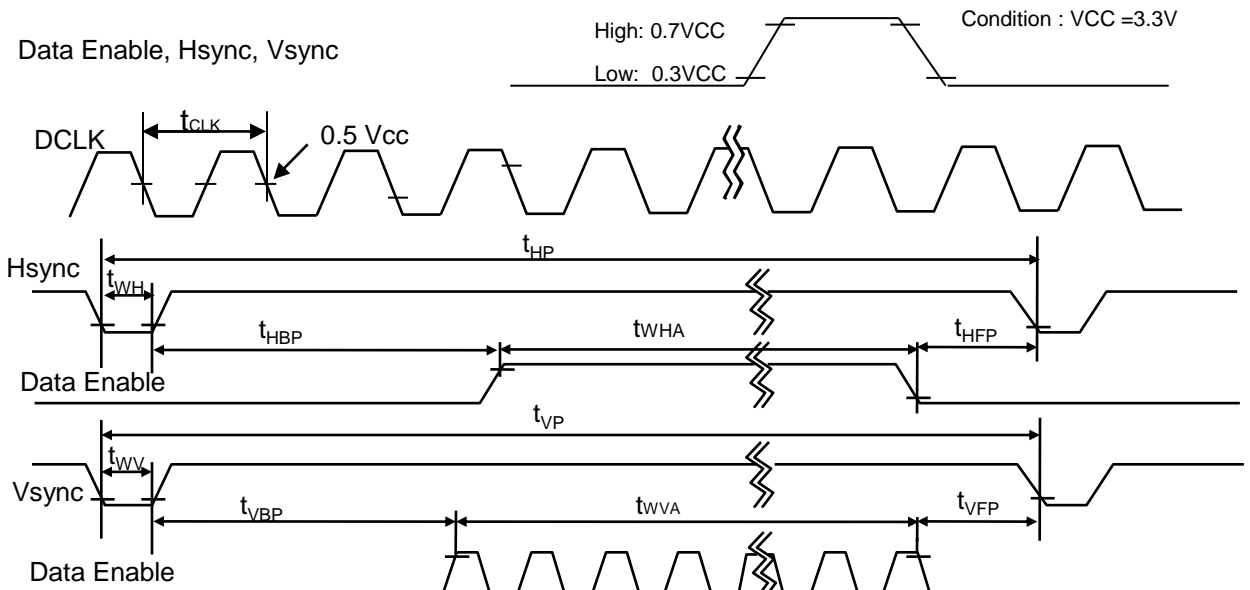
3-7. Color Input Data Reference

The brightness of each primary color (red, green and blue) is based on the 6-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**
		R 5	R 4	R 3	R 2	R 1	R 0	G 5	G 4	G 3	G 2	G 1	G 0	B 5	B 4	B 3	B 2	B 1	B 0
Basic Color	Black	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	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
RED	RED (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (01)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	…			…						…						…			
	RED (62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (01)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	...			…						…						…			
	GREEN (62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN (63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
BLUE	BLUE (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE (01)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	…			…						…						…			
	BLUE (62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Product Specification

3-8. Power Sequence
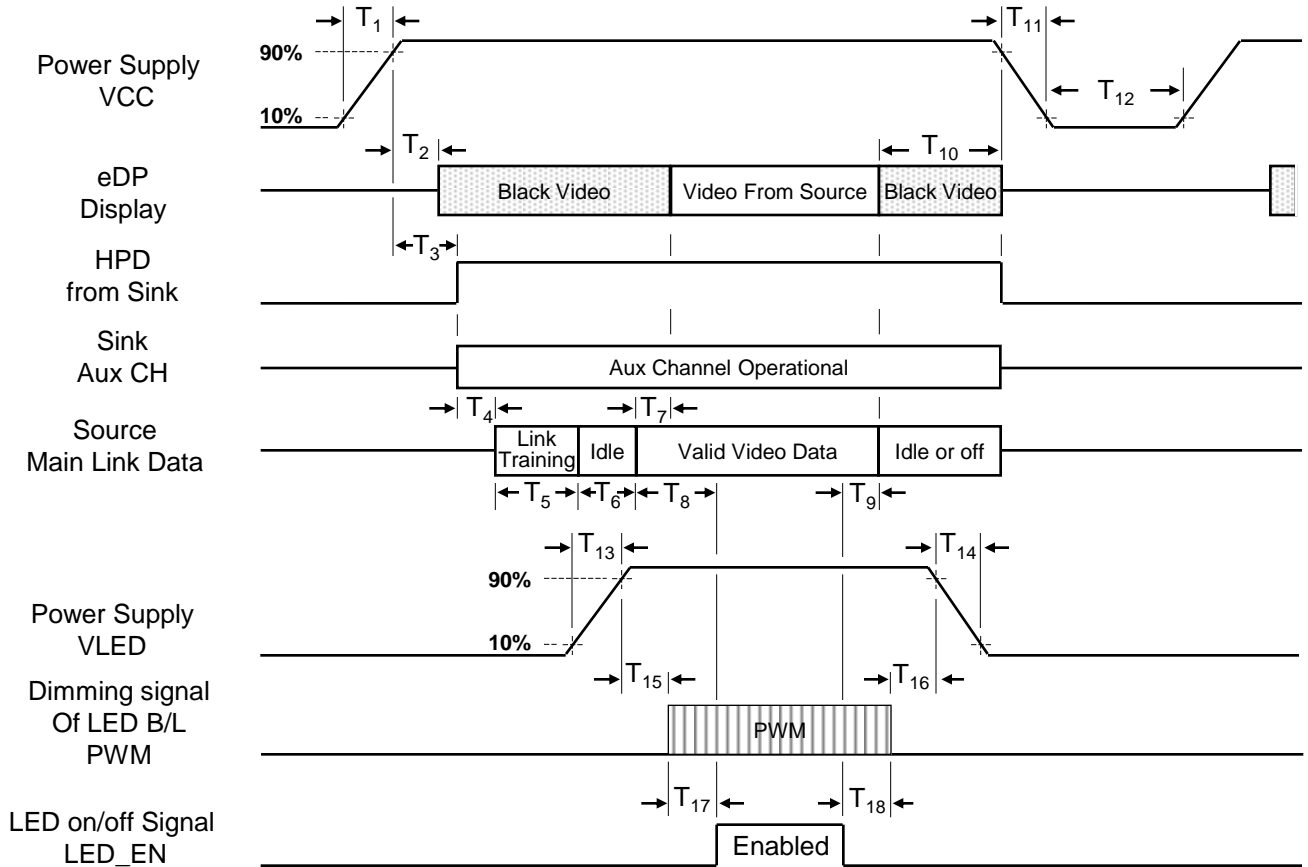
Table 6. POWER SEQUENCE TABLE

Symbol	Required By	Limits Min	Limits Max	Units	Notes	Symbol	Required By	Limits Min	Limits Max	Units	Notes
T_1	Source	0.5	10	ms	-	T_{10}	Source	0	500	ms	-
T_2	Sink	0	200	ms	-	T_{11}	Source	-	10	ms	-
T_3	Sink	0	200	ms	-	T_{12}	Source	500	-	ms	
T_4	Source	-	-	ms	-	T_{13}	Source	0.5	10	ms	-
T_5	Source	-	-	ms	-	T_{14}	Source	0.5	10	ms	-
T_6	Source	-	-	ms	-	T_{15}	Source	10	-	ms	-
T_7	Sink	0	50	ms	-	T_{16}	Source	10	-	ms	-
T_8	Source	-	-	ms	LGD recommend Min 200ms	T_{17}	Source	0	-	ms	-
T_9	Source	-	-	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.

4. Touch Specifications

4-1. General Specifications

The contents provide general characteristics for the model LP156WF7.

	Item		Spec	Notes
General Specification	System		Projected Capacitive type	
	Multi Touch Points		10 points	
	Active touch area		Same as LCD A/A	
	Sensor	Type.	Advanced In-Cell Touch	
		Sensor Channel Pitch	4.1mm (X) x 4.3mm (Y)	
	Touch IC Information	IC	LD3001A	Melfas
		Firmware	TBD	
		PID	TBD	
		THQA	TBD	
	Number of Sensor Channel		84ea (X) x 45ea (Y)	
	Interface		USB	

4-2. Power Sequence for Touch
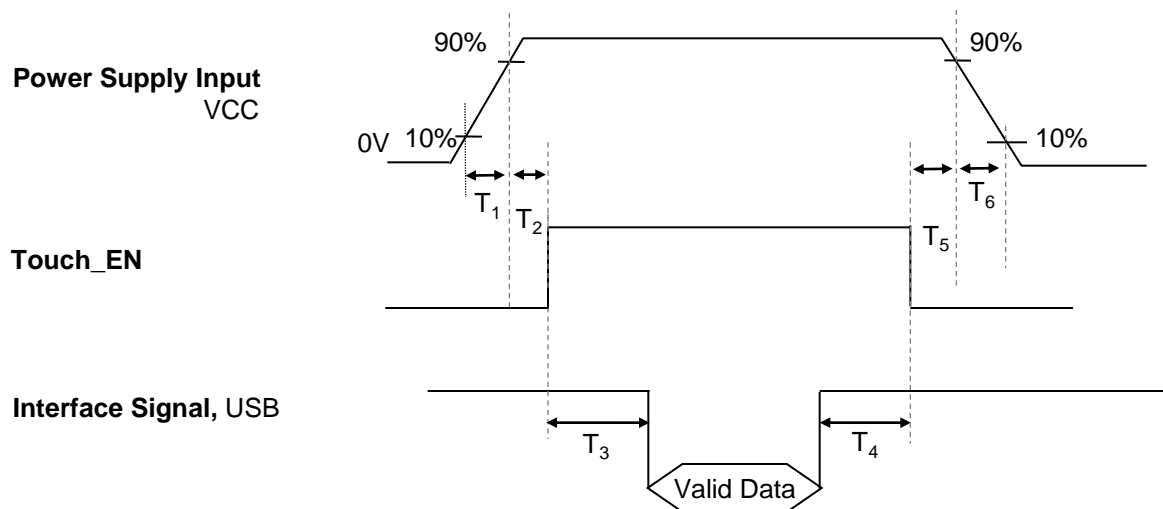
Table 9. POWER SEQUENCE TABLE

Parameter	Value			Units
	Min.	Typ.	Max.	
T_1	0.5	-	10	ms
T_2	TBD	-	-	ns
T_3	-	TBD	TBD	ms
T_4	-	-	TBD	ms
T_5	0	-	-	ns
T_6	-	-	10	ms

Product Specification

5. 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

Optical Stage(x,y) **LCD Module** **Equipment**

1°

500mm±50mm
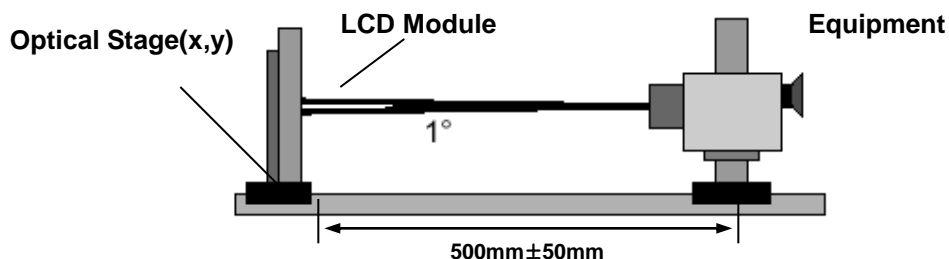
Table 7. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, fᵥ=60Hz

Parameter		Symbol	Values			Units	Notes
			Min	Typ	Max		
Contrast Ratio		CR	500	800	-		1
Surface Luminance, white		L_{WH}	187	220	-	cd/m²	2
Luminance Variation		δ WHITE (5P)	-	1.2	1.4	-	3
		δ WHITE(13P)	-	1.4	1.6		
Response Time		Tr + Tf	-	25	-	ms	4
Color Coordinates	RED	Rx			TBD		
		Ry			TBD		
	GREEN	Gx			TBD		
		Gy	Typical - 0.03		TBD	Typical + 0.03	
	BLUE	Bx			TBD		
		By			TBD		
	WHITE	Wx		0.313			
		Wy		0.319			
Viewing Angle	x axis, right(Φ=0°)	Θr	80	-	-	Degree	5
	x axis, left (Φ=180°)	Θl	80	-	-		
	y axis, up (Φ=90°)	Θu	80	-	-		
	y axis, down (Φ=270°)	Θd	80	-	-		
Gray Scale							6

Product Specification

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.

$$L_{WH} = \text{Average(1,2, … 5 Point)}$$

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.

$$\delta \text{ WHITE (5P)} = \frac{\text{Maximum (1,2, … 5 Point)}}{\text{Minimum (1,2, … 5 Point)}} \qquad \delta \text{ WHITE (13P)} = \frac{\text{Maximum (1,2, … 13 Point)}}{\text{Minimum (1,2, … 13 Point)}}$$

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. 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.

6. Gray scale specification

Gray Level	Luminance [%] (Typ)
L0	0.09
L31	0.81
L63	4.36
L95	10.99
L127	21.41
L159	36.81
L191	55.68
L223	77.83
L256	100

FIG. 2 Luminance

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

H,V : ACTIVE AREA
A : H/4 mm
B : V/4 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

<Dimension of viewing angle range>

6. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LP156WF7. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal	359.50 ± 0.5mm
	Vertical	223.80 ± 0.5mm
	Thickness	3.2mm (Max, w/o PCB) 3.3mm (Max. w. PCB)
Active Display Area	Horizontal	344.16 ± 0.3mm
	Vertical	193.59 ± 0.3mm
Bezel Open Area	Horizontal	347.45 ± 0.2mm
	Vertical	196.80 ± 0.2mm
Weight	Total 370g(max.)	
Surface Treatment	Glare treatment of the front Polarizer (3H)	

Product Specification

<FRONT VIEW>   Note) Unit:[mm], General tolerance: ± 0.5mm

Product Specification

<REAR VIEW>   Note) Unit:[mm], General tolerance: ± 0.5mm

PIN #1

5.90±1.00
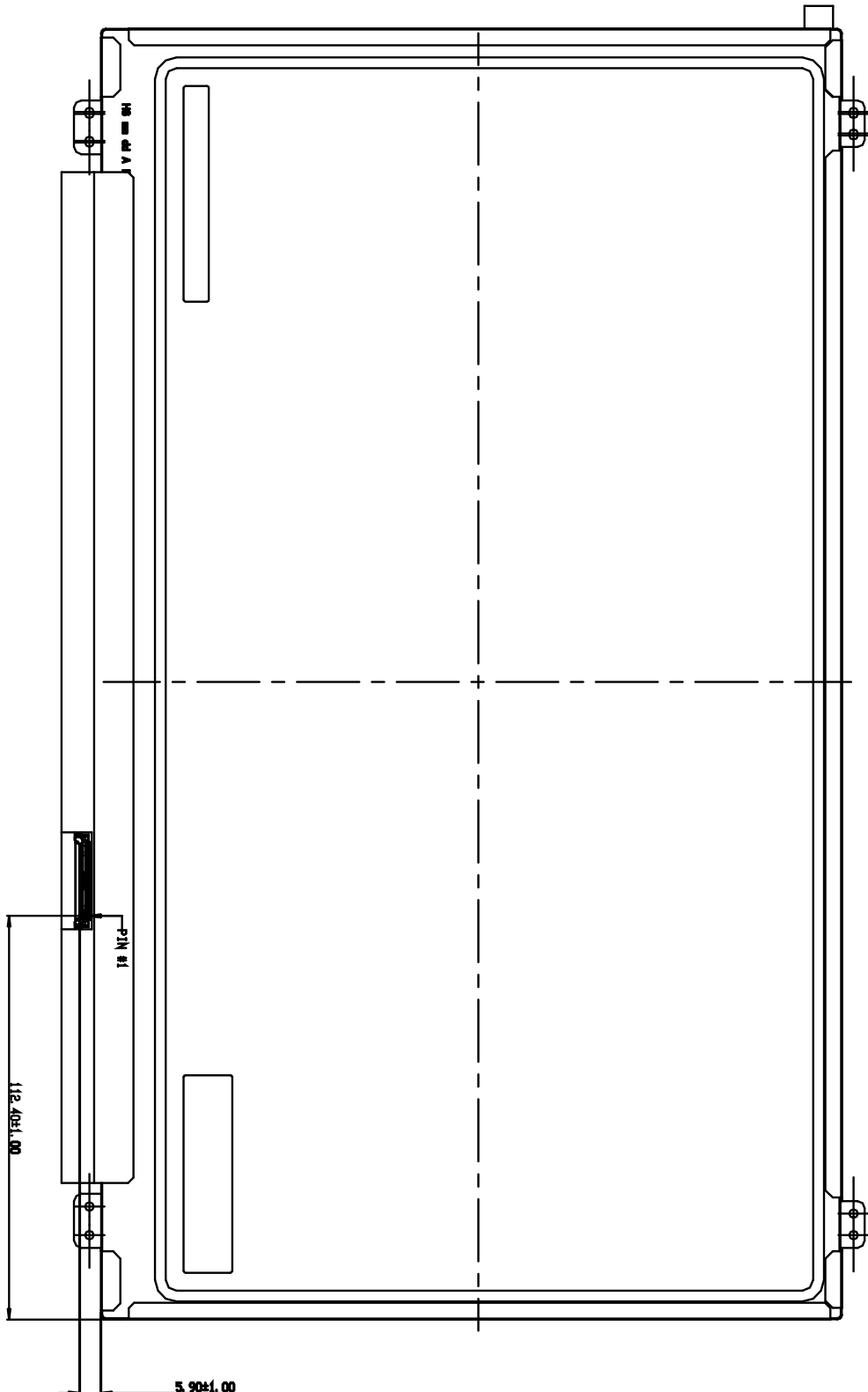
7. Reliability

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

{ Result Evaluation Criteria }
There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

8. International Standards

8-1. Safety

    a) UL 60950-1, Underwriters Laboratories Inc.
       Information Technology Equipment - Safety - Part 1 : General Requirements.
    b) CAN/CSA-C22.2 No. 60950-1-07, Canadian Standards Association.
       Information Technology Equipment - Safety - Part 1 : General Requirements.
    c) EN 60950-1, European Committee for Electro technical Standardization (CENELEC).
       Information Technology Equipment - Safety - Part 1 : General Requirements.
    d) IEC 60950-1, The International Electro technical Commission (IEC).
       Information Technology Equipment - Safety - Part 1 : General Requirements

8-2. Environment

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

9. Packing

9-1. 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.

LP156WH3
(TL)(S2)
RoHS Verified
Factory ID : LGDNJ

CT : CXXXX01XXXXXXX

XXXXXXXXXXXXX XXXX

➤**LGD Lot Mark**

MADE IN CHINA

Note
1. YEAR

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mark	A	B	C	D	E	F	G	H	J	K

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.

9-2. Packing Form

a) Package quantity in one box : 30ea

b) Box Size : 468 x 355 x 288 [mm]

10. PRECAUTIONS

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

10-1. 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.

10-2. 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.

10-3. 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.

10-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

10-5. 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.

10-6. 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.

10-7. THE LGD QA RESPONSIBILITY WILL BE AVOIDED IN CASE OF BELOW

(1) 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.
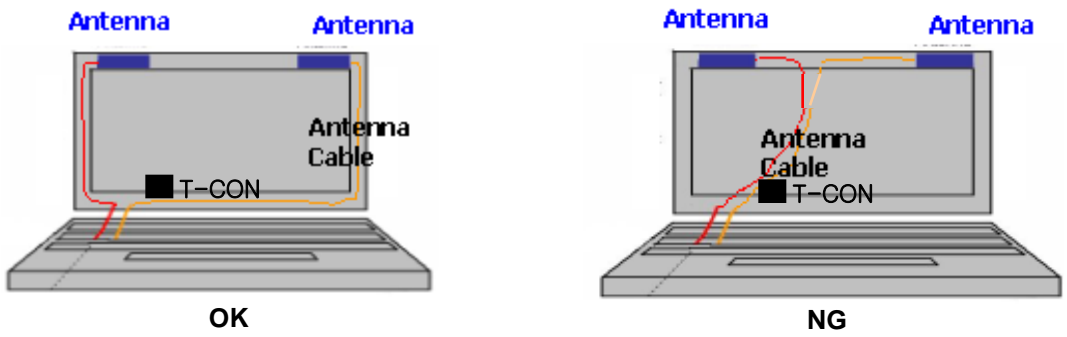
APPENDIX A. LGD Proposal for system cover design

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

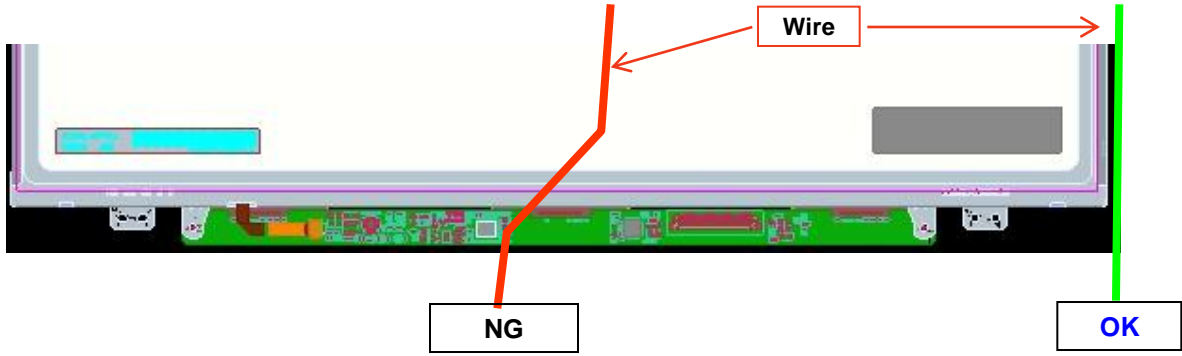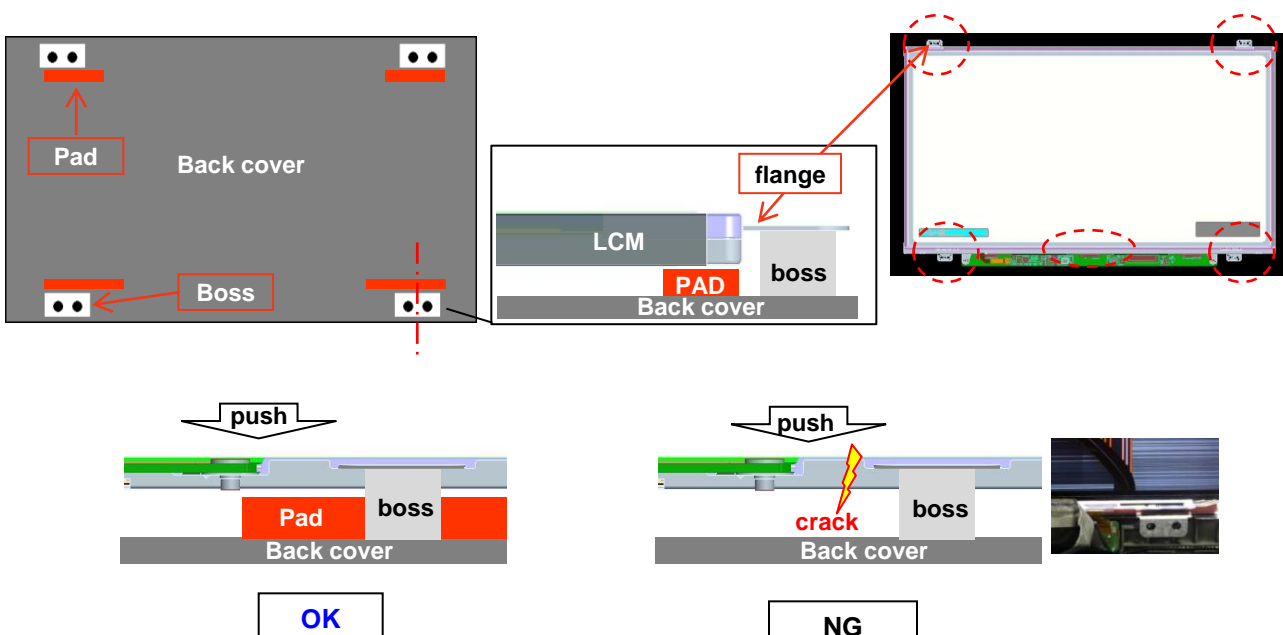**LCM** a b
PAD
Back cover
Boss

◆ a : min 0mm
◆ b : min 0.3mm, Max 1.0mm

Boss

PAD

Back cover
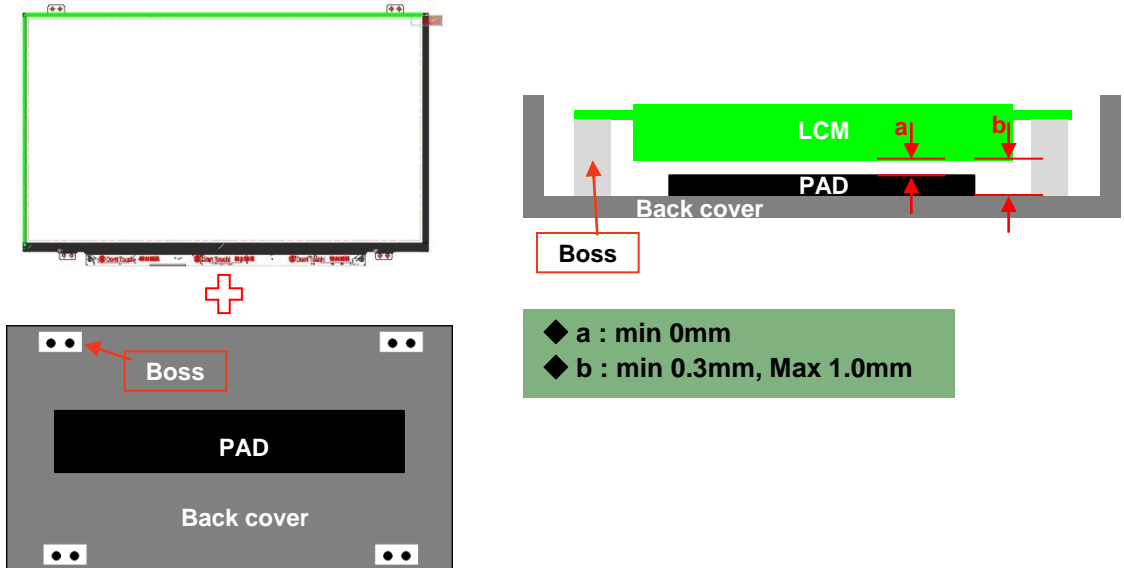
Define	1. Rear side of LCM is sensitive against external stress, and previous check about interference is highly needed.
	2. In case there is something from system cover comes into the boundary above, mechanical interference may cause the FOS defects. (e.g.. Ripple, White spot..)

2	Check if antenna cable is sufficiently apart from T-CON of LCD Module.

Antenna   Antenna

Antenna
Cable
■T−CON

OK

Antenna   Antenna

Antenna
Cable
■T−CON

NG

Define	If system antenna is overlapped with T-CON, It might be cause the noise

Product Specification

APPENDIX A. LGD Proposal for system cover design

3	Checking the path of the System wire

Wire

NG **OK**

Define	1. If Wire path overlapped with LCM, it is happened white spot. COF problem, etc.
	2. OK ➔ Wire path design to system side. NG ➔ Wire path overlapped with LCM.

4	Add pad to Prevent panel crack against external load (push)

Pad Back cover

Boss

flange

LCM

PAD

boss

Back cover

push push

Pad boss crack boss

Back cover Back cover

OK **NG**

Define	1. At flat type LCM, panel is easily cracked at flange area during push, assemble.
	2. Add pad, it prevent panel crack

Product Specification

APPENDIX A. LGD Proposal for system cover design

5	Check the rib or Bracket on back cover

LCM
Back cover
Rib
OK

LCM
Back cover
Bracket
OK

LCM
Back cover
NG

LCM
Back cover
CO

Define	1. It is necessary that the height of back cover rib or bracket is higher than LCM height. It can prevent direct compression of panel at LCM edge.
	2. "¬" shape bracket is stronger than "I" shape one.

6	Check the gap between front cover and LCM (glass)

a
Front cover
LCM
Back cover

[OK] a ≥ 0.3mm
[CO] 0.3mm ≥ a ≥ 0.1mm
[NG] a ≤ 0.1mm

Define	Ripple can be happened by little gap between glass and front cover.

APPENDIX A. LGD Proposal for system cover design

7	Check the rib or Bracket on back cover

Light leakage

Front cover

LCM

Back cover

OK

LCM

Back cover

NG
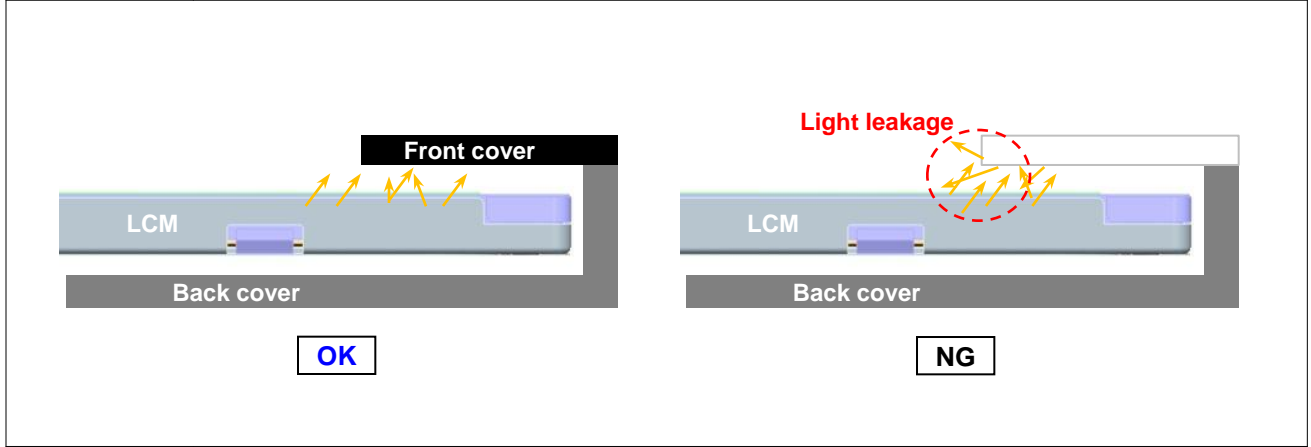
Define	1.If it is possible, shrink to apply front cover of white color.
	2. White color can caused light leakage
8	**Check the wire position(path)**

Back cover

OK

Back cover

NG
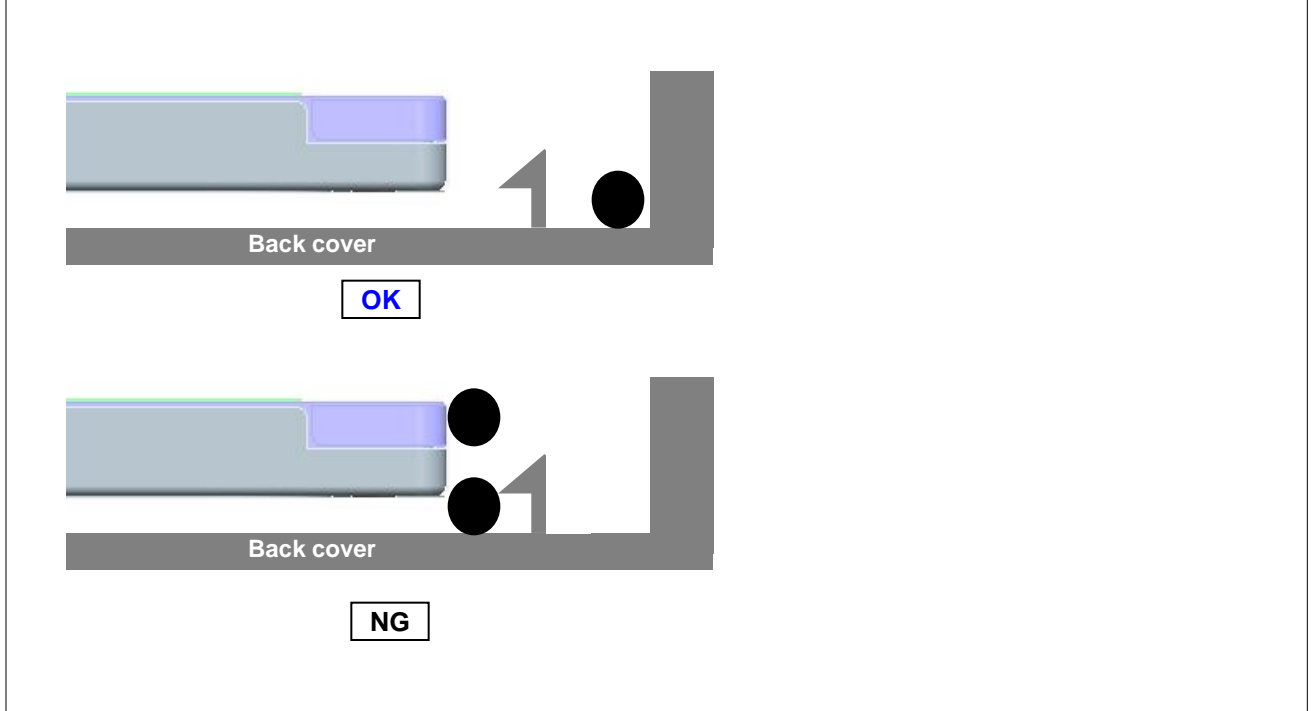
Define	1. It is necessary that wire is posited out of hook, not posited near hook,.
	2. If wire is posited near hook, it can be happened assemble error and panel crack during assemble front cover

APPENDIX A. LGD Proposal for system cover design

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

Mouse pad

[OK] a ≤ 0.3mm
[CO] 0.5mm ≥ a ≥ 0.3mm
[NG] a ≥ 0.5mm

| OK | NG |

Define	1.Mouse pad step is deep, it is caused panel crack by external load.
	2. The edge shape must be smooth.

10	Check the step of keyboard area

Keyboard
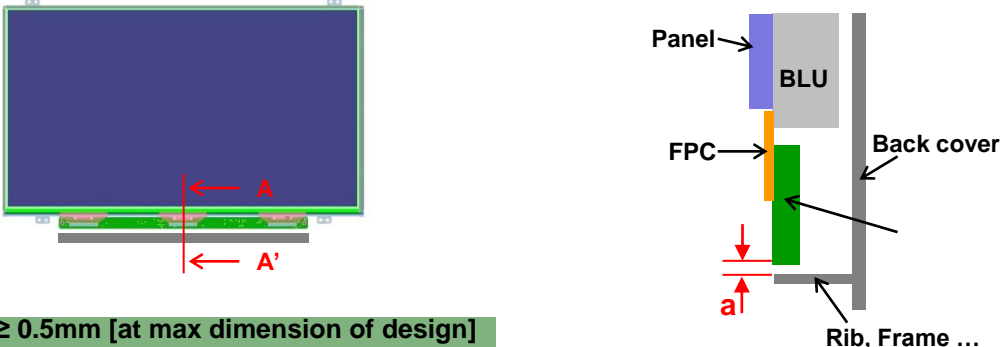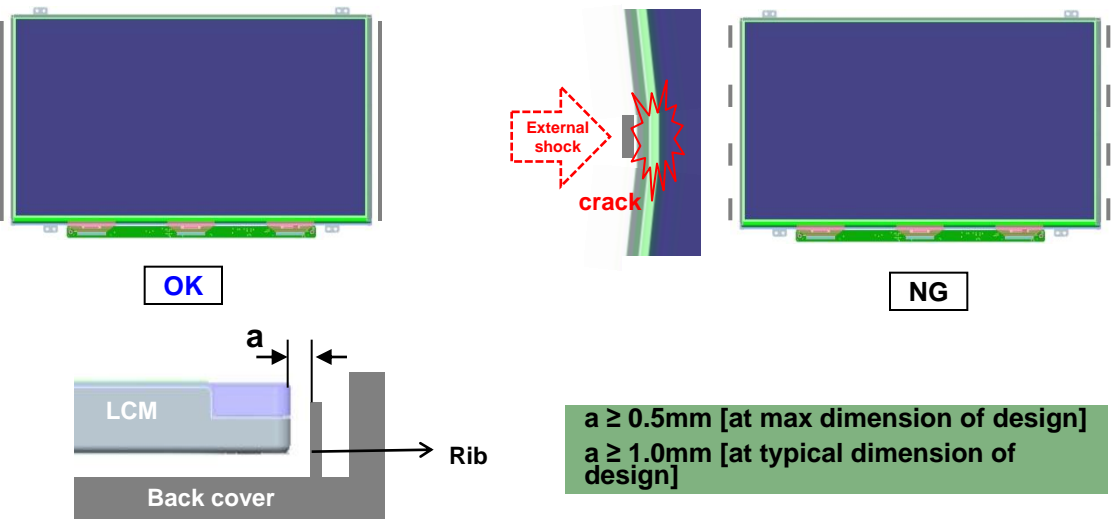
Keyboard

push

push

crack

| OK | NG |

Define	The step of keyboard at the side edge of main body, it is caused panel crack

Product Specification

APPENDIX A. LGD Proposal for system cover design

11	Check the gap [PCB ~ system]

Panel → **BLU**

FPC →

Back cover

a

Rib, Frame …

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

Define	1. Gap is too small, FPC is easily cracked by interference and repetitive bending. (circuit is opened) .
	2. Gap is must be kept more than 0.5mm(max dim.) and 1.0mm(typ dim.) .

12	System rib (on A cover)

External shock

crack

OK   **NG**

a

LCM

Rib

Back cover

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

Define	1. Gap is too small and rib is too short, panel is easily cracked by external stress.
	2. Gap is must be kept more than 0.5mm(max dim.) and 1.0mm(typ dim.) .
	3. The figure of rib is continuous or fully long.

APPENDIX B. LGD Proposal for eDP Interface Design Guide

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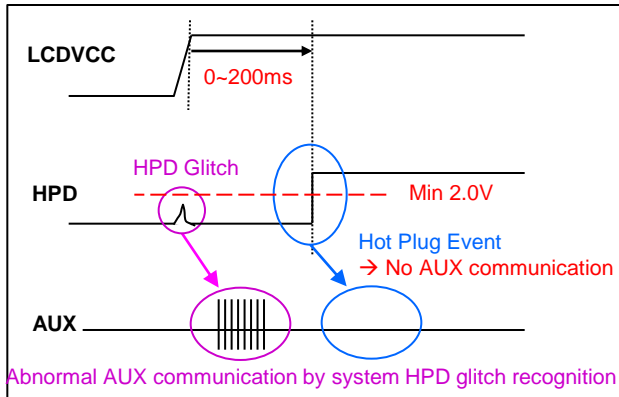
[Abnormal Communication By HPD Glitch]   **[Normal Communication By HPD Signal]**
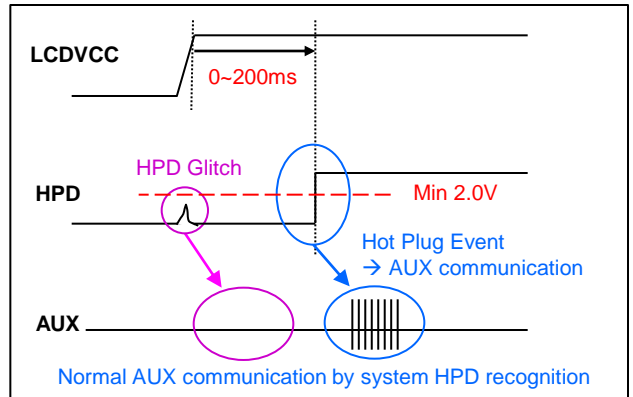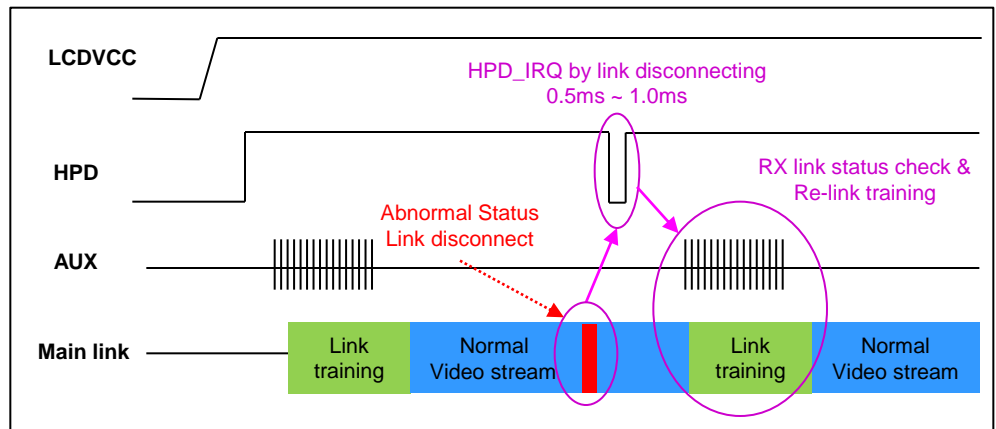
Define	1. Hot Plug Detection (HPD) Threshold level of Source Device is minimum 2.0V
	2. HPD Unplug : HPD pulse stays low longer than 2ms. DP Tx shall wait for HPD signal to go high again.
	3. "HPD High" is confirmed only after HPD has been asserted continuously for 100msec.

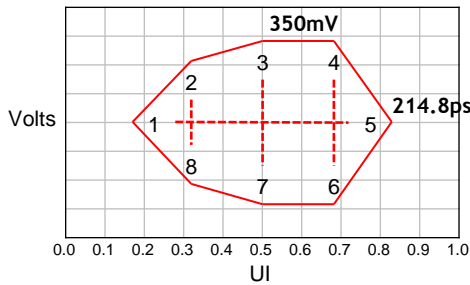| 2	IRQ (Interrupt Request) HPD Pulse Definition

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.

Product Specification

APPENDIX B. LGD Proposal for eDP Interface Design Guide

3	Main Link EYE Diagram
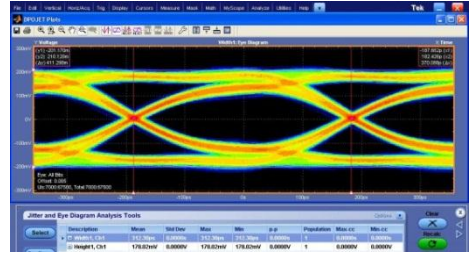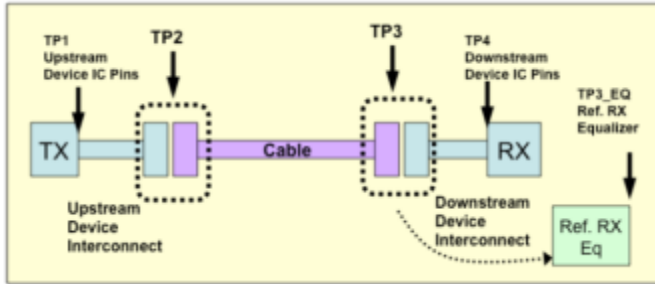
[EYE Diagram]

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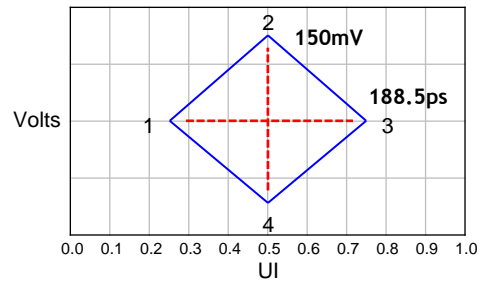
Point	UI	Voltage (Volts)
1	0.246	0.000
2	0.500	0.075
3	0.755	0.000
4	0.500	-0.075

[EYE Vertices for TP3 at HBR]

Define	Main Link EYE Diagram should meet TP2 and TP3 point

4	Cable Impedance management
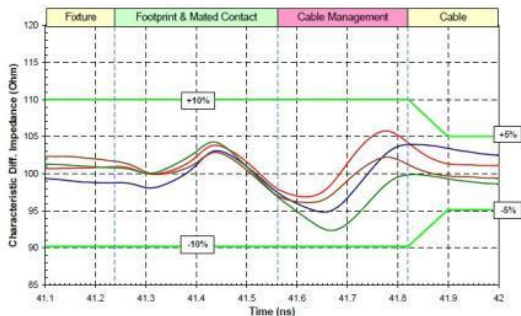
Segment	Differential Impedance	Maximum Tolerance
Fixture	100 Ω	
Connector	100 Ω	+/- 10%
Wire management	100 Ω	
Cable	100 Ω	+/- 5%

Define	Cable Impedance 100 Ω +/- 5% (95Ω ~ 105Ω)

LG Display

Product Specification

APPENDIX B. LGD Proposal for eDP Interface Design Guide

5	Main Link Off vs. LCD Power Off at Non-PSR
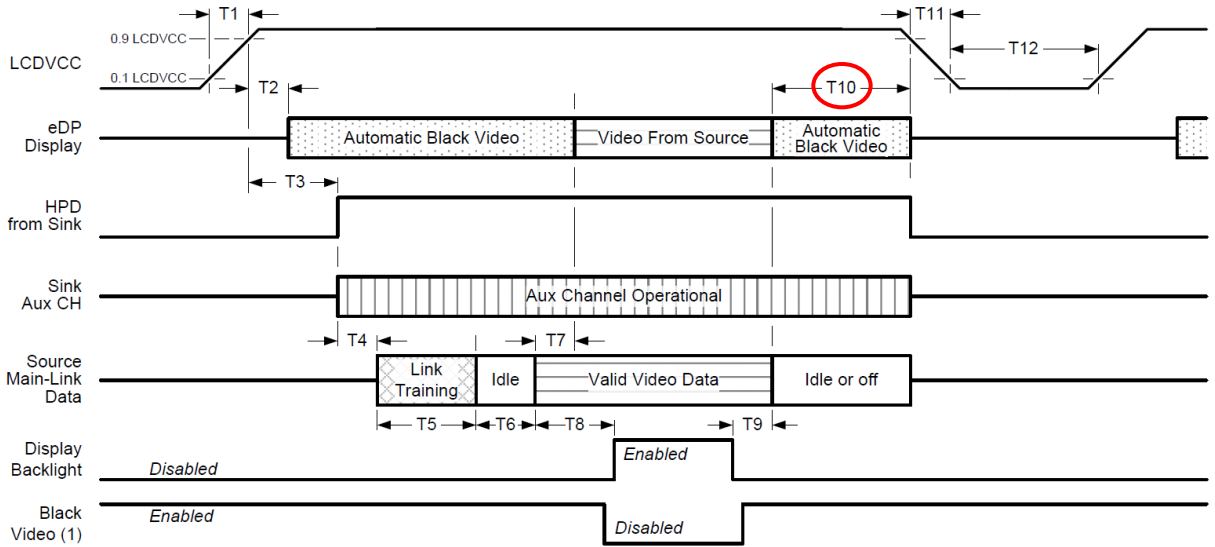
Timing Parameter	Description	Required By	Min	Max
T10	Delay from end of valid video from Source to Power Off	Source	0ms	500ms

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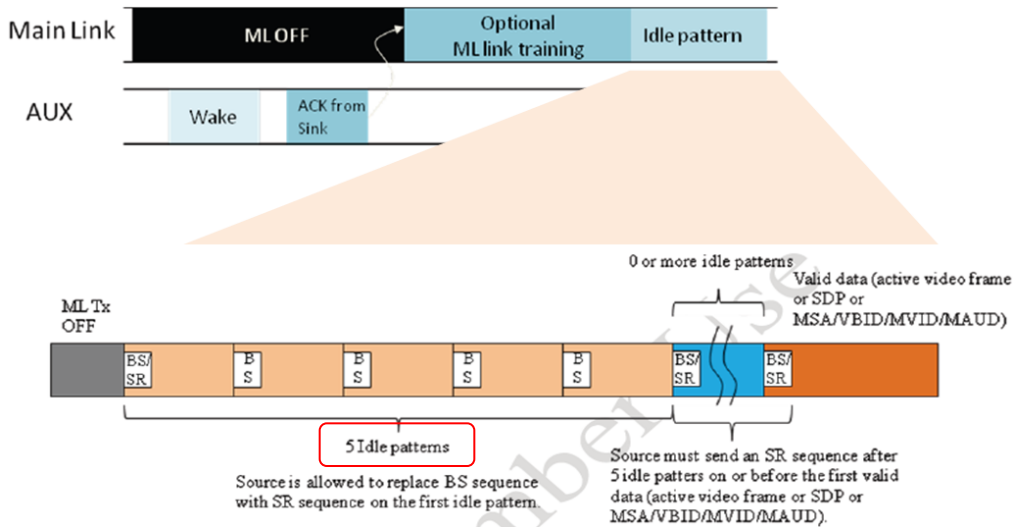

[Case1. Resolution Change]

[Case2. Close the Lid]

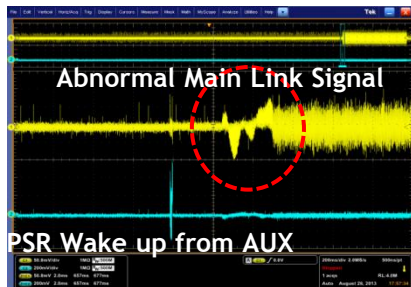| Define	If Main Link off signal from Source, then LCDVCC must be Power Off within T10 period at Non-PSR mode

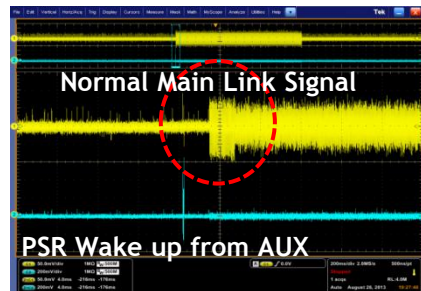## APPENDIX B. LGD Proposal for eDP Interface Design Guide

6	PSR Exit

Define	Source must send 5 or more idle patterns before the first valid data (active video frame or SDP or MSA/VBID/MVID/MAUD)

7	**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.

G LG Display

APPENDIX C. Enhanced Extended Display Identification Data (EEDID^{TM})   1/3

TBD

APPENDIX C. Enhanced Extended Display Identification Data (EEDID^{TM})   2/3

TBD

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

TBD