SPECIFICATION
FOR
APPROVAL

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

Title	15.6” HD+ TFT LCD

Customer	lenovo
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LP156WD1
Suffix	TLB2

*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
K. J. Kwon / S.Manager	
REVIEWED BY	
S. R. Kim / Manager	
PREPARED BY	
C. J. Park / Engineer	

Products Engineering Dept.
LG Display Co., Ltd

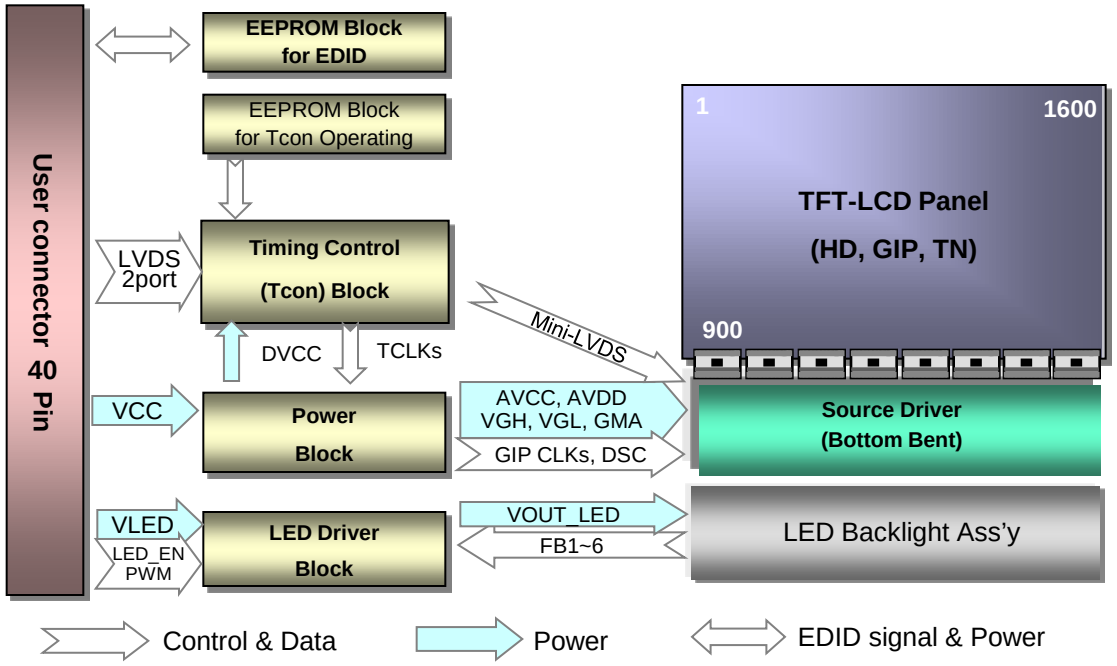
Contents

RECORD OF REVISIONS

Revision No	Revision Date	Page	Description	EDID ver
0.0	Feb. 26. 2009	-	First Draft (Preliminary Specification)	0.0
0.1	Mar. 10, 2009	6	Update Life Time	
		13, 14	Update Luminance Variation and note	
		17~19	Update Mechanical Dimension	
		26	Add Label Information	
0.2	Jun. 10, 2009	4	Update General Description	
		6,7	Update Electrical Characteristics	
		8	Update Interface Connections	
		13	Update Power Sequence	
		14	Update Color Coordinates, Surface Luminance (min)	
		19	Update Mechanical Dimension	
0.3	Oct. 9, 2009	6,7	Update min duty (5%→1%) and min PWM Frequency(200→150)	
		25	Update International Standards	
		30~32	Update EDID (check sum "FD"→"E2" for change Dclk)	0.2
0.4	Oct. 29, 2009	6	Delete Black Input Current Spec. and change PWM, LED_EN High Level Voltage Spec. (3.0→2.2)	
		8	Update LED Power Supply(20V→21V)	
		11	Update Timing Specifications(for change Dclk) and Add Appendix	
		13	Update Power Sequence(T3: max 50 -> max -, T4: min 400 -> min 150, T6:min200 -> min 0, T7:min 3 -> min 0, T8,T11: min 10 -> min 0)	
		14	Update Uniformity(5point) and change Uniformity(13point, max 60% -> min 60%) and add spec (typ.) of viewing angle	
		15	Change Gray scale L55 (85.56→74.17)	
		18	Update Front metal width size and Metal frame edge to Active area edge size and Bezel opening tolerance (0.5→0.3)	
		20	Update Torque max 2.5 → min 2.3, max 2.5	
1.0	Nov. 12, 2009	-	Final Draft	
		6	Delete "Mosaic" because duplicate next page.	
		8	Delete statements about connector and Update 2.1	
		14	Add CR Typ. Spec.(400)	

1. General Description

The LP156WD1 is a Color Active Matrix Liquid Crystal Display with an integral LED backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. This TFT-LCD has 15.6 inches diagonally measured active display area with HD+ resolution (1600 horizontal by 900 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 LP156WD1 has been designed to apply the interface method that enables low power, high speed, low EMI. The LP156WD1 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 LP156WD1 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	359.3(H, typ.) × 209.5(V, typ.) × 5.7(D,max) [mm]
Pixel Pitch	0.2151 mm x 0.2151 mm
Pixel Format	1600 horiz. By 900 vert. Pixels RGB strip arrangement
Color Depth	6-bit, 262,144 colors
Luminance, White	220 cd/m^2(Typ.5 point)
Power Consumption	Total 6.7Watt(Typ.)@ Logic 1.5Watt(Typ.), B/L input 5.2 Watt (Typ.)
Weight	470g (Max.) / 450g (Typ.)
Display Operating Mode	Transmissive mode, normally white
Surface Treatment	Anti-Glare treatment of the front polarizer (3H)
RoHS Comply	Yes
BFR / PVC / As Free	Yes all.

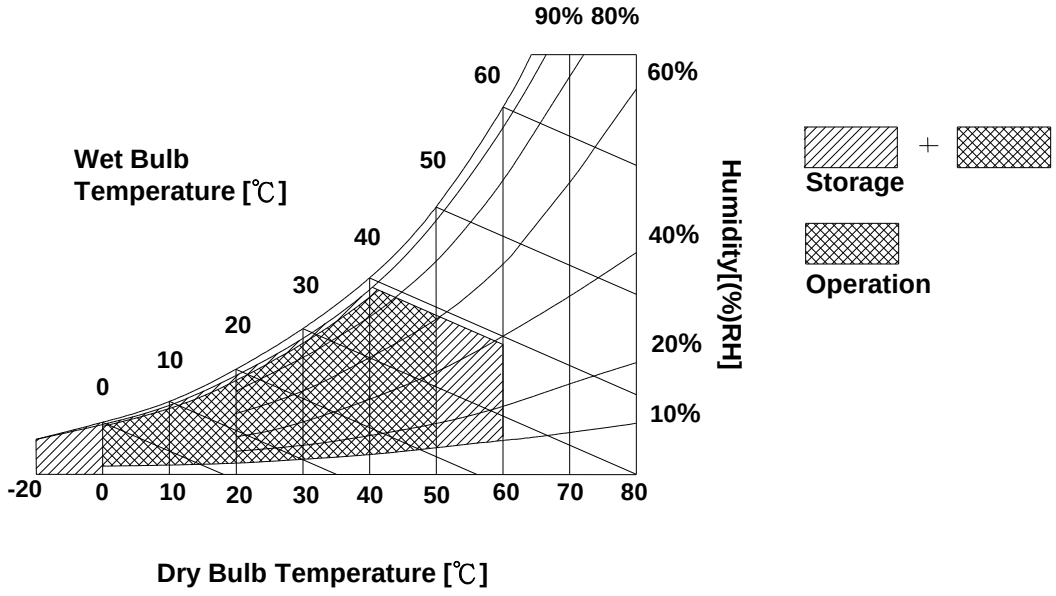
2. Absolute Maximum Ratings

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	Vdc	at 25 ± 5°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.



3. Electrical Specifications

3-1. Electrical Characteristics

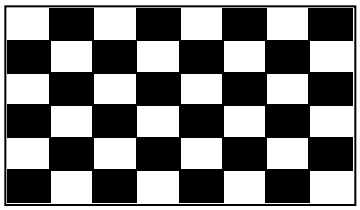
The LP156WD1 requires two power inputs. The first logic is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second backlight is the input about LED BL with LED Driver.

Table 2. ELECTRICAL CHARACTERISTICS

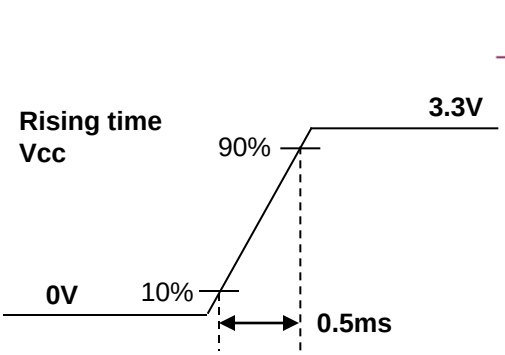
Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
LOGIC :						
Power Supply Input Voltage	V_{CC}	3.0	3.3	3.6	V	1
Power Supply Input Current	I_{CC}	-	455	525	mA	2
Power Consumption	P_{CC}	-	1.5	1.73	W	2
Power Supply Inrush Current	I_{CC_P}	-	700	1500	mA	3
LVDS Impedance	Z_{LVDS}	90	100	110	Ω	4
BACKLIGHT : (with LED Driver)						
LED Power Input Voltage	V_{LED}	7.0	12.0	21.0	V	5
LED Power Input Current	I_{LED}	-	434	500	mA	6
LED Power Consumption	P_{LED}	-	5.2	6.0	W	6
LED Power Inrush Current	I_{LED_P}	-	900	1500	mA	7
PWM Duty Ratio		1	-	100	%	8
PWM Jitter	-	0	-	0.2	%	9
PWM Impedance	Z_{PWM}	20	40	60	kΩ	
PWM Frequency	F_{PWM}	150	-	1000	Hz	10
PWM High Level Voltage	V_{PWM_H}	2.2	-	5.3	V	
PWM Low Level Voltage	V_{PWM_L}	0	-	0.5	V	
LED_EN Impedance	Z_{PWM}	20	40	60	kΩ	
LED_EN High Voltage	$V_{LED\_EN\_H}$	2.2	-	5.3	V	
LED_EN Low Voltage	$V_{LED\_EN\_L}$	0	-	0.5	V	
Life Time		12,000	-	-	Hrs	11

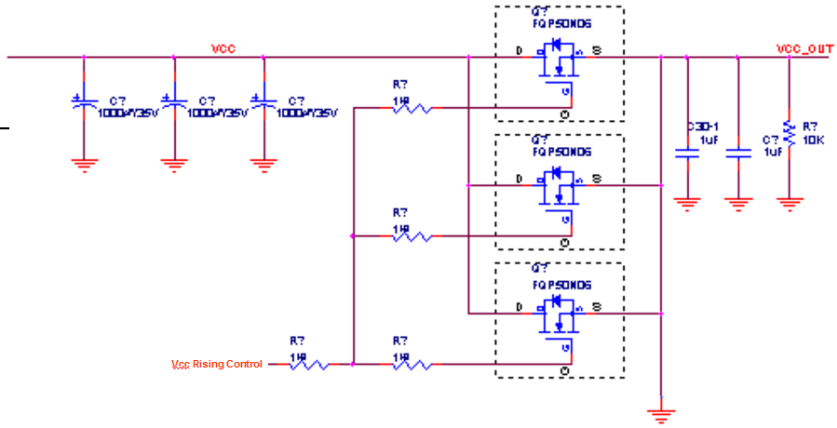
Note)

1. The measuring position is the connector of LCM and the test conditions are under 25℃, fv = 60Hz, Black pattern.
2. The specified Icc current and power consumption are under the Vcc = 3.3V , 25℃, fv = 60Hz condition whereas Mosaic pattern is displayed and fv is the frame frequency.(Power consumption of window pattern is same with one of Mosaic pattern)

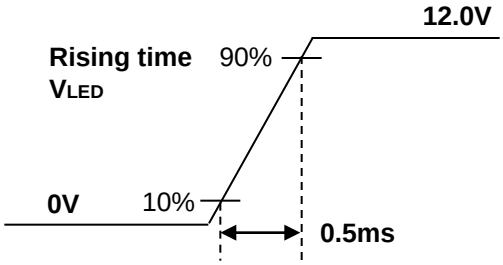


3. The below figures are the measuring Vcc condition and the Vcc control block LGD used. The Vcc condition is same the minimum of T1 at Power on sequence.





4. This impedance value is needed to proper display and measured form LVDS Tx to the mating connector.
5. The measuring position is the connector of LCM and the test conditions are under 25℃.
6. The current and power consumption with LED Driver are under the Vled = 12.0V , 25℃, Dimming of Max luminance whereas White pattern is displayed and fv is the frame frequency.
7. The below figures are the measuring Vled condition and the Vled control block LGD used. VLED control block is same with Vcc control block.

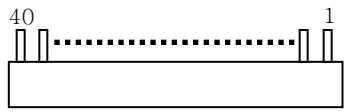


8. The operation of LED Driver below minimum dimming ratio may cause flickering or reliability issue. Min. Duty 1% through apply Direct PWM function is not wavy noise free.
9. If Jitter of PWM is bigger than maximum. It may cause flickering.
10. This Spec. is not effective at 100% dimming ratio as an 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.
11. The life time is determined as the time at which the typical brightness of LCD is 50% compare to that of initial value at the typical LED current. These LED backlight has 6 strings on it and the typical current of LED's string is base on 20mA.

3-2. Interface Connections

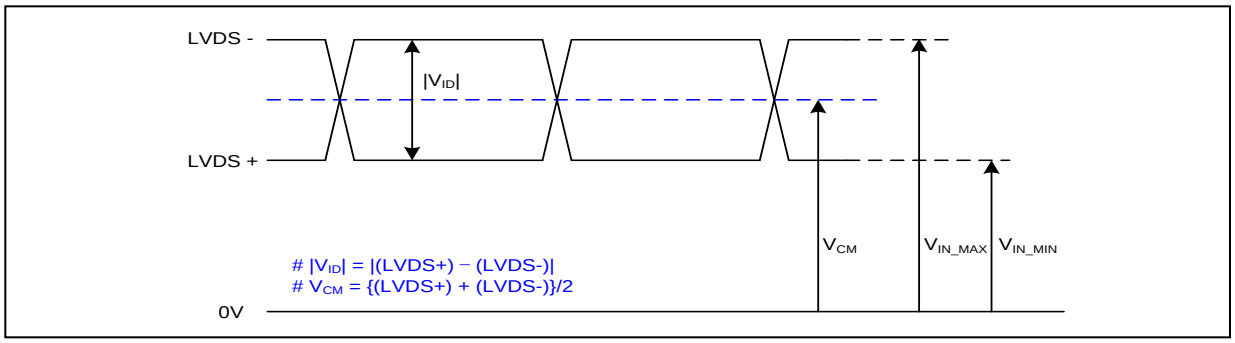
This LCD employs two interface connections, a 40 pin connector is used for the module electronics interface and the other connector is used for the integral backlight system.

Table 3. MODULE CONNECTOR PIN CONFIGURATION (CN1)

Pin	Symbol	Description	Notes
1	NC	Reserved	1, Interface chips 1.1 LCD : SW, ST2_BS (LCD Controller) including LVDS Receiver 1.2 System : THC63LVDF823A or equivalent * Pin to Pin compatible with LVDS 2. Connector 2.1 LCD : 20455-040E-x2, I-PEX 2.2 Connector pin arrangement  [LCD Module Rear View]
2	VCC	Power Supply, 3.3V Typ.	
3	VCC	Power Supply, 3.3V Typ.	
4	V EEDID	DDC 3.3V power	
5	BIST	Built-In Self Test	
6	Clk EEDID	DDC Clock	
7	DATA EEDID	DDC Data	
8	Odd_Rin0-	Negative LVDS differential data input	
9	Odd_Rin0+	Positive LVDS differential data input	
10	VSS1	Ground	
11	Odd_Rin1-	Negative LVDS differential data input	
12	Odd_Rin1+	Positive LVDS differential data input	
13	VSS2	Ground	
14	Odd_Rin2-	Negative LVDS differential data input	
15	Odd_Rin2+	Positive LVDS differential data input	
16	VSS3	Ground	
17	Odd_ClkIN-	Negative LVDS differential clock input	
18	Odd_ClkIN+	Positive LVDS differential clock input	
19	VSS4	Ground	
20	Even_Rin0-	Negative LVDS differential data input	
21	Even_Rin0+	Positive LVDS differential data input	
22	VSS5	Ground	
23	Even_Rin1-	Negative LVDS differential data input	
24	Even_Rin1+	Positive LVDS differential data input	
25	VSS6	Ground	
26	Even_Rin2-	Negative LVDS differential data input	
27	Even_Rin2+	Positive LVDS differential data input	
28	VSS7	Ground	
29	Even_ClkIN-	Negative LVDS differential clock input	
30	Even_ClkIN+	Positive LVDS differential clock input	
31	VLED_GND	LED Ground	
32	VLED_GND	LED Ground	
33	VLED_GND	LED Ground	
34	NC	Reserved	
35	BLIM	PWM for Luminance control	
36	BL_On	Backlight On/Off Control	
37	NC	No Connection	
38	VLED	LED Power Supply (7V-21V)	
39	VLED	LED Power Supply (7V-21V)	
40	VLED	LED Power Supply (7V-21V)	

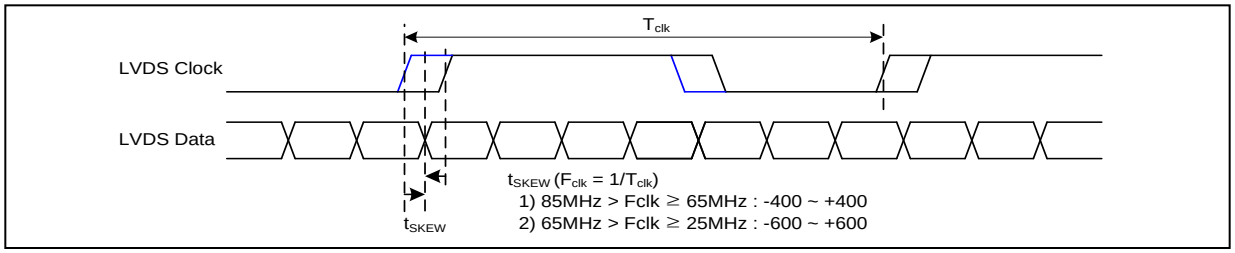
3-3. LVDS Signal Timing Specifications

3-3-1. DC Specification

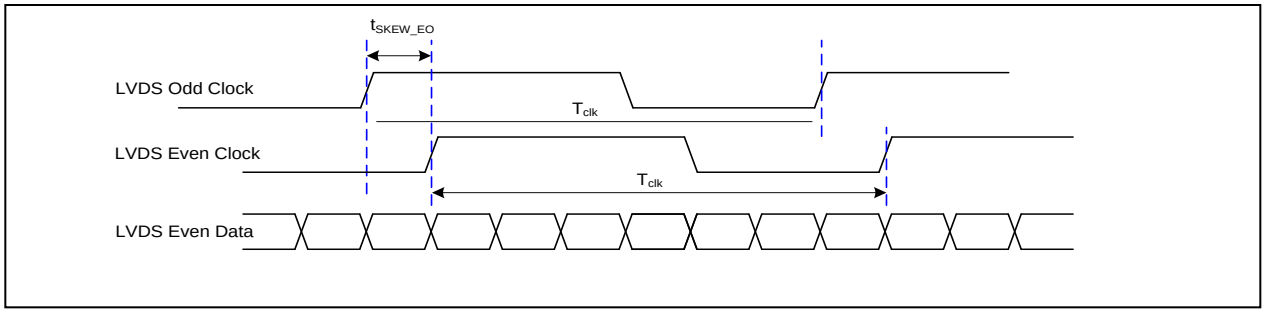


Description	Symbol	Min	Max	Unit	Notes
LVDS Differential Voltage	$\|V_{ID}\|$	100	600	mV	-
LVDS Common mode Voltage	V_{CM}	0.6	1.8	V	-
LVDS Input Voltage Range	V_{IN}	0.3	2.1	V	-

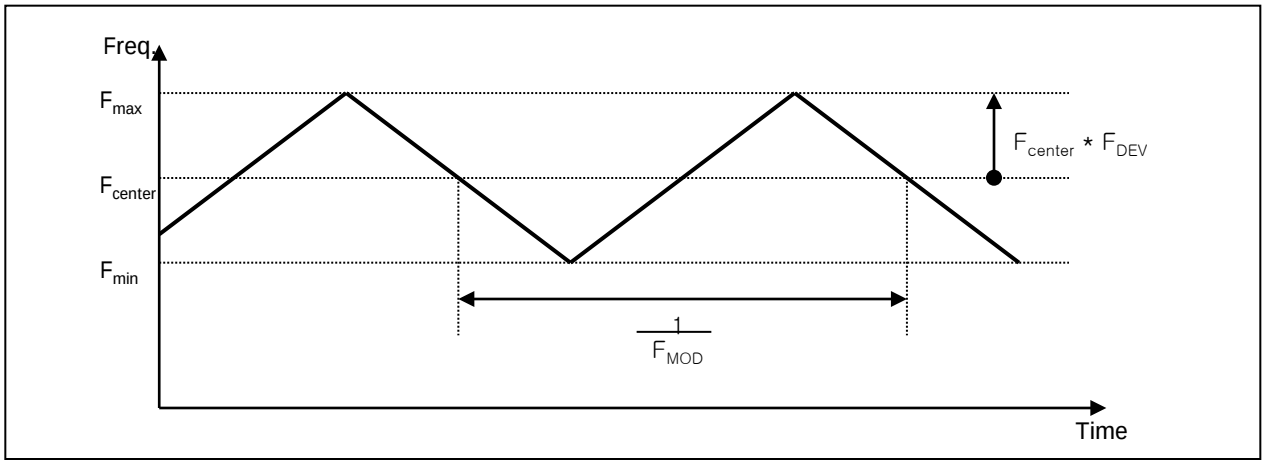
3-3-2. AC Specification



Description	Symbol	Min	Max	Unit	Notes
LVDS Clock to Data Skew Margin	t_{SKEW}	- 400	+ 400	ps	85MHz > Fclk ≥ 65MHz
	t_{SKEW}	- 600	+ 600	ps	65MHz > Fclk ≥ 25MHz
LVDS Clock to Clock Skew Margin (Even to Odd)	t_{SKEW_EO}	- 1/7	+ 1/7	T_{clk}	-
Maximum deviation of input clock frequency during SSC	F_{DEV}	-	± 3	%	-
Maximum modulation frequency of input clock during SSC	F_{MOD}	-	200	KHz	-



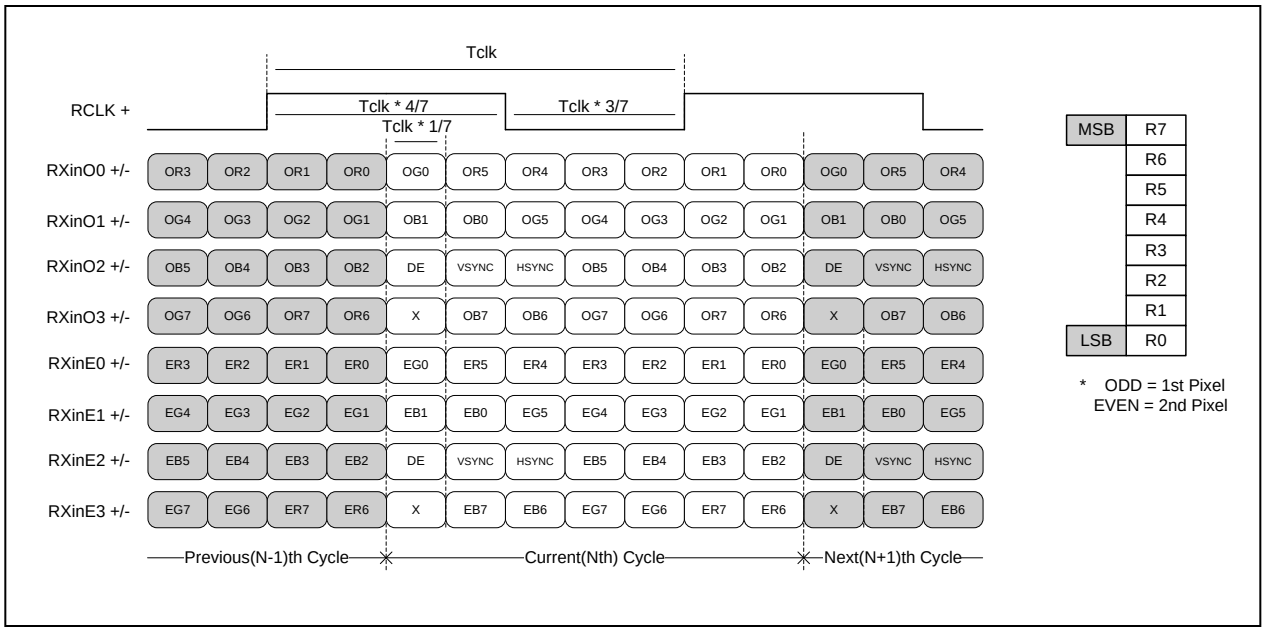
< Clock skew margin between channel >



< Spread Spectrum >

3-3-3. Data Format

1) LVDS 2 Port



< LVDS Data Format >

3-4. 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 LVDS Tx/Rx for its proper operation.

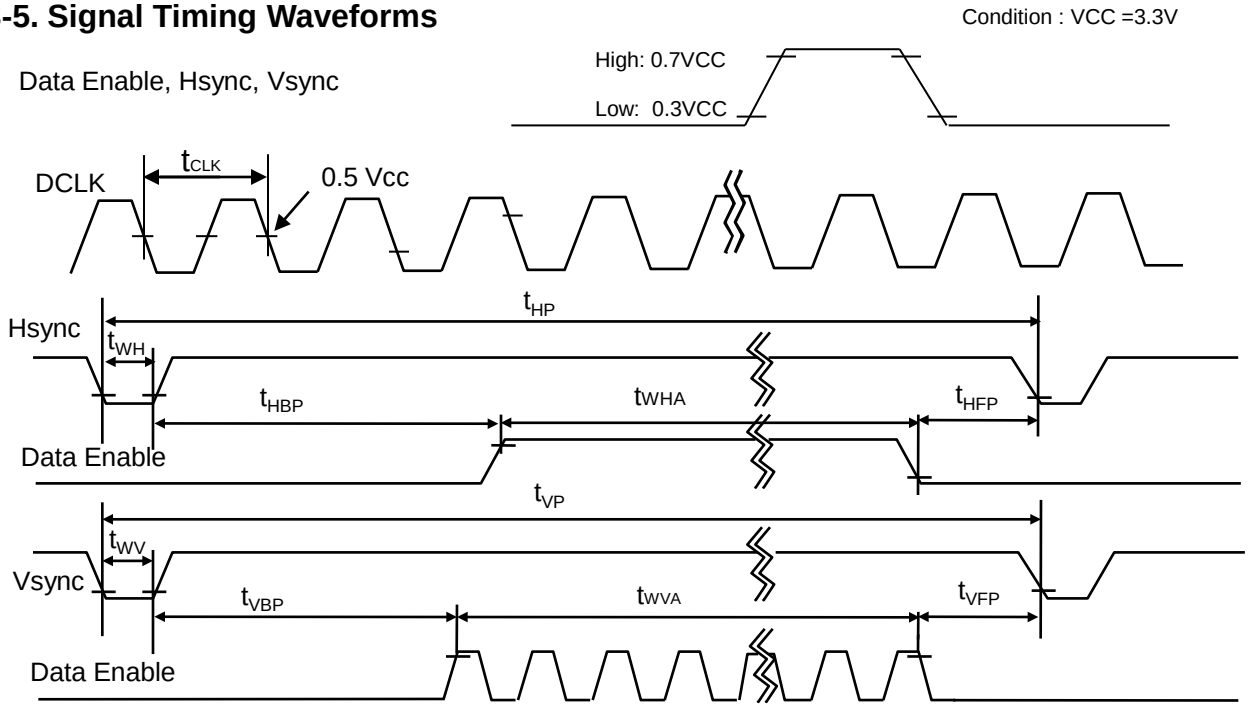
Table 6. TIMING TABLE

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Frequency	f_{CLK}	-	54.25	-	MHz	LVDS 2port
Hsync	Period	t_{HP}	914	960	988	tCLK	
	Width	t_{WH}	16	16	16		
	Width-Active	t_{WHA}	800	800	800		
Vsync	Period	t_{VP}	928	942	942	tHP	
	Width	t_{WV}	5	5	5		
	Width-Active	t_{WVA}	900	900	900		
Data Enable	Horizontal back porch	t_{HBP}	78	120	144	tCLK	
	Horizontal front porch	t_{HFP}	20	24	28		
	Vertical back porch	t_{VBP}	21	34	33	tHP	
	Vertical front porch	t_{VFP}	2	3	4		

Appendix) All reliabilities are specified for timing specification based on refresh rate of 60 Hz.
Even though actual performance in 50Hz and 40Hz for low power is displayed normally,
remark and inform to user that display quality in 40 Hz and 50 Hz is out of guarantee range.

3-5. Signal Timing Waveforms

Condition : VCC =3.3V



3-6. 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 7. COLOR DATA REFERENCE

Color		Input Color Data																	
		RED						GREEN						BLUE					
		MSB					LSB	MSB					LSB	MSB					LSB
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	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
	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

3-7. Power Sequence

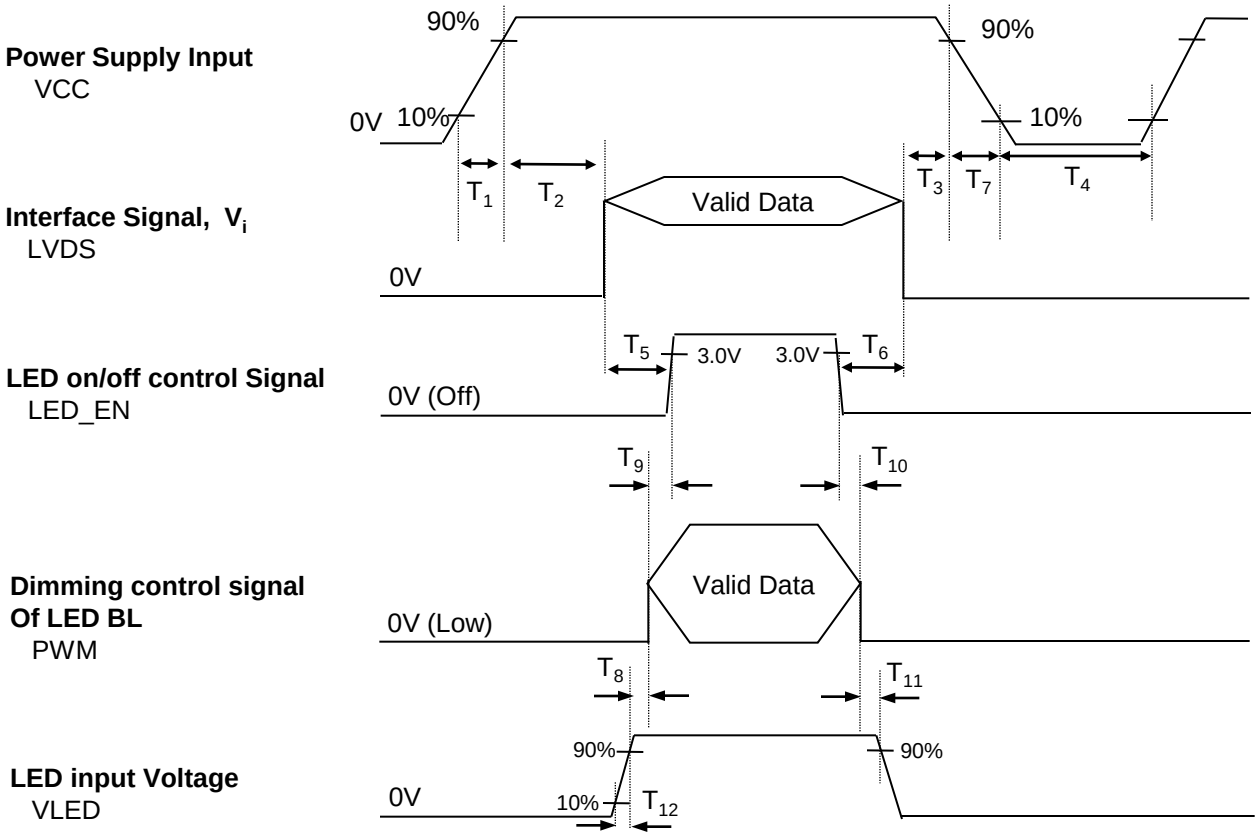


Table 6. POWER SEQUENCE TABLE

Logic Parameter	Value			Units
	Min.	Typ.	Max.	
T_1	0.5	-	10	ms
T_2	0	-	50	ms
T_3	0	-	-	ms
T_4	150	-	-	ms
T_5	200	-	-	ms
T_6	0	-	-	ms
T_7	0	-	10	ms

LED Parameter	Value			Units
	Min.	Typ.	Max.	
T_8	0	-	-	ms
T_9	0	-	-	ms
T_{10}	0	-	-	ms
T_{11}	0	-	-	ms
T_{12}	0.5	-	-	ms

Note)
1. Do not insert the mating cable when system turn on.
2. Valid Data have to meet "3-3. LVDS Signal Timing Specifications"
3. LVDS, LED_EN and PWM need to pull-down condition on invalid status.
4. LGD recommend the rising sequence of VLED after the Vcc and valid status of LVDS turn on.

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 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

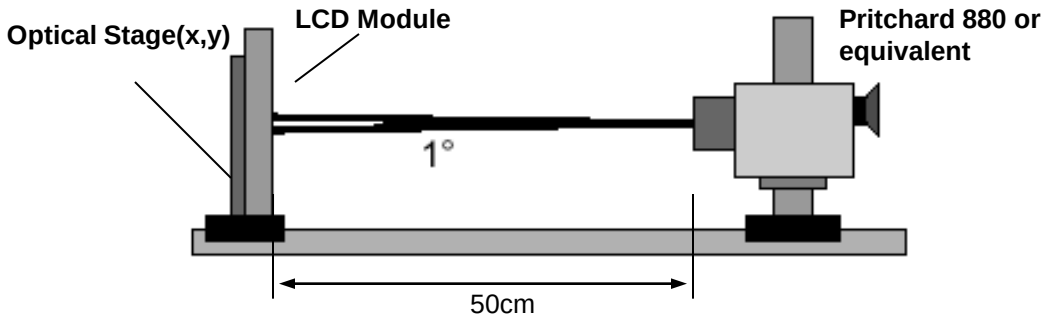


Table 9. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, fv=60Hz, f_{CLK}= 48.87MHz, I_{LED}= 20mA(typ)

Parameter	Symbol	Values			Units	Notes
		Min	Typ	Max		
Contrast Ratio	CR	300	400	-		1
Surface Luminance, white	L_{WH}	190	220	-	cd/m²	2
Luminance Variation (5point)	δ_{WHITE}	70	-	-	%	
Luminance Variation (13point)	δ_{WHITE}	60	-	-	%	3
Response Time	$Tr_R + Tr_D$	-	8	-	ms	4
Color Coordinates						
RED	RX	0.587	0.617	0.647		
	RY	0.319	0.349	0.379		
GREEN	GX	0.284	0.314	0.344		
	GY	0.567	0.597	0.627		
BLUE	BX	0.121	0.151	0.181		
	BY	0.027	0.057	0.087		
WHITE	WX	0.283	0.313	0.343		
	WY	0.299	0.329	0.359		
Viewing Angle						5
x axis, right(Φ=0°)	Θr	60	65	-	degree	
x axis, left (Φ=180°)	Θl	60	65	-	degree	
y axis, up (Φ=90°)	Θu	50	55	-	degree	
y axis, down (Φ=270°)	Θd	50	55	-	degree	
Gray Scale						6

Note)

1. Contrast Ratio(CR) is defined mathematically as

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

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 1.

$$L_{WH} = \text{Average}(L_1, L_2, \ldots L_5)$$

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

$$\delta_{WHITE} = \frac{\text{Minimum}(L_1, L_2, \ldots L_{13})}{\text{Maximum}(L_1, L_2, \ldots L_{13})} * 100$$

4. Response time is the time required for the display to transition from white to black (rise time, Tr_R) and from black to white(Decay Time, Tr_D). 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.

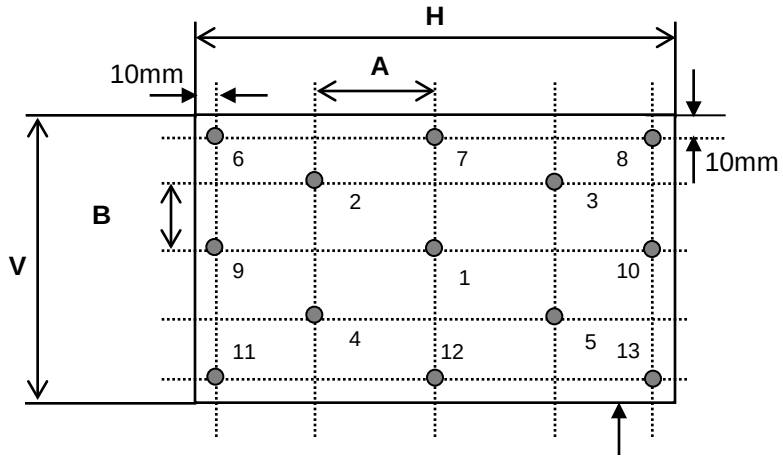
6. Gray scale specification

* f_V = 60Hz

Gray Level	Luminance [%] (Typ)
L0	0
L7	1.00
L15	4.25
L23	10.90
L31	21.01
L39	34.82
L47	52.49
L55	74.17
L63	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”.

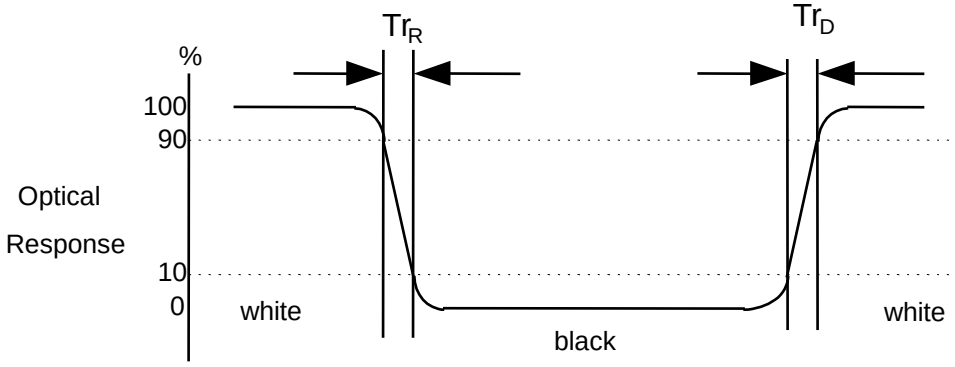
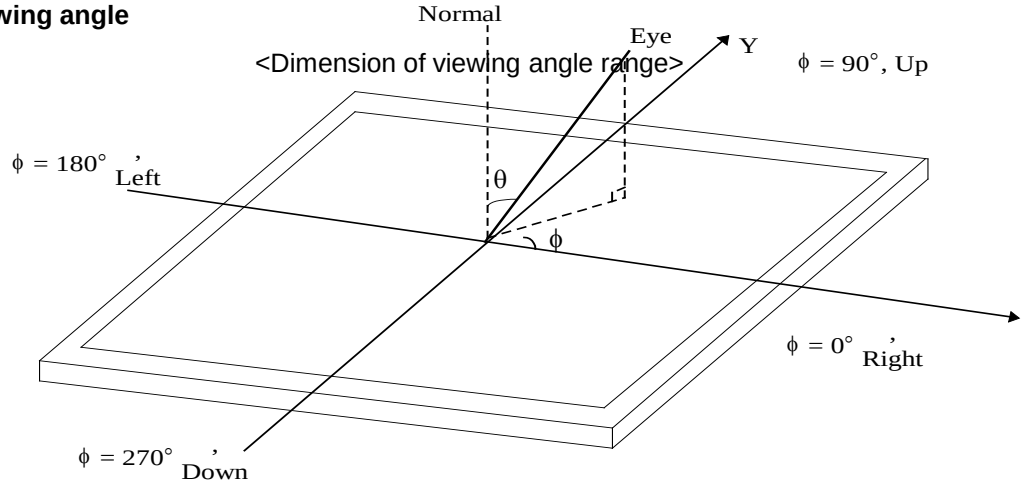


FIG. 4 Viewing angle

<Dimension of viewing angle range>



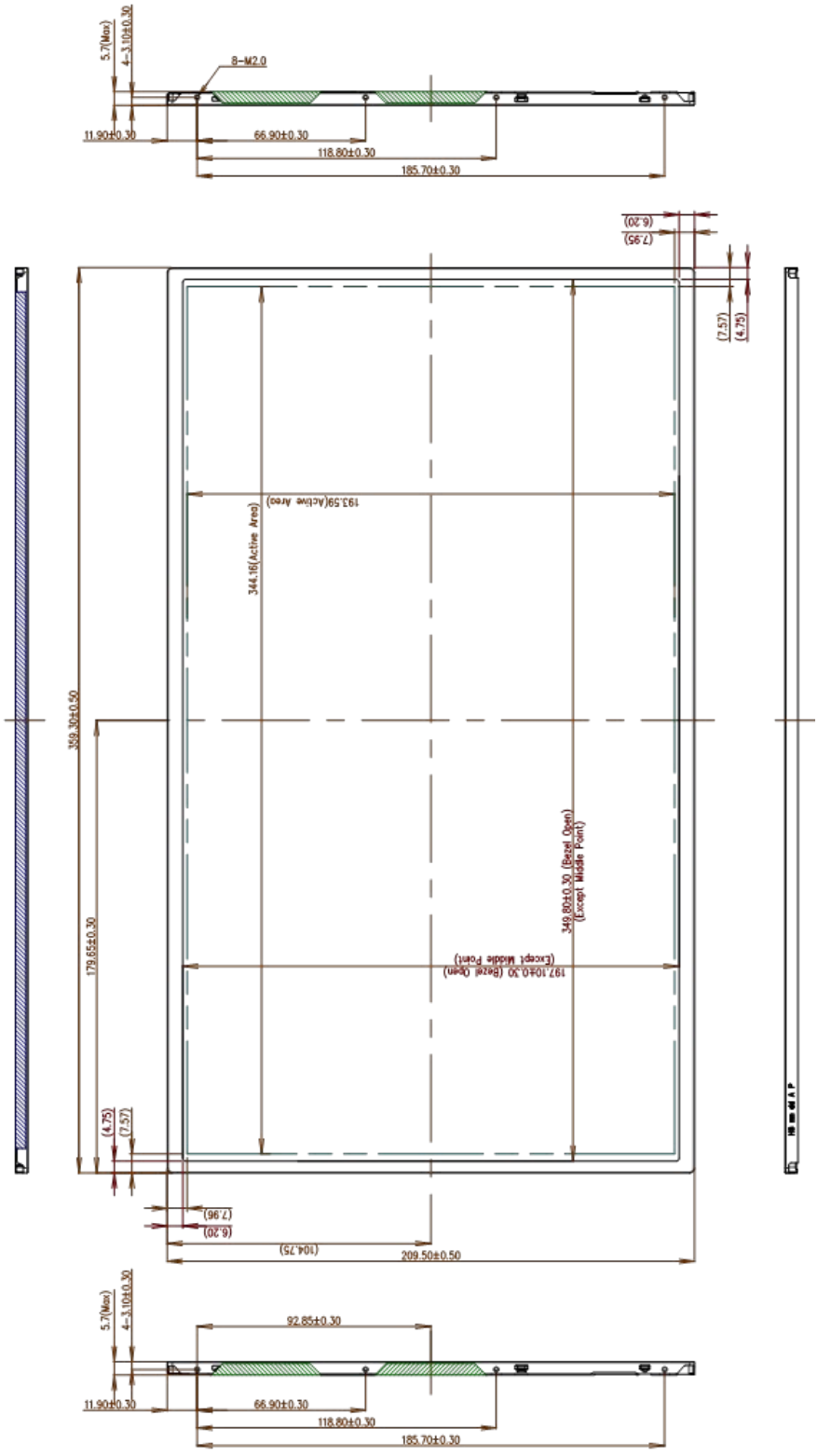
5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LP156WD1. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal	359.3 ± 0.5mm
	Vertical	209.5 ± 0.5mm
	Thickness	5.7mm (max)
Bezel Area	Horizontal	349.8 ± 0.5mm
	Vertical	197.1 ± 0.5mm
Active Display Area	Horizontal	344.16 ± 0.3 mm
	Vertical	193.59 ± 0.3 mm
Weight	470g (Max.) / 450g (Typ.)	
Surface Treatment	Hard Coating(3H), Anti-Glare treatment of the front polarizer	

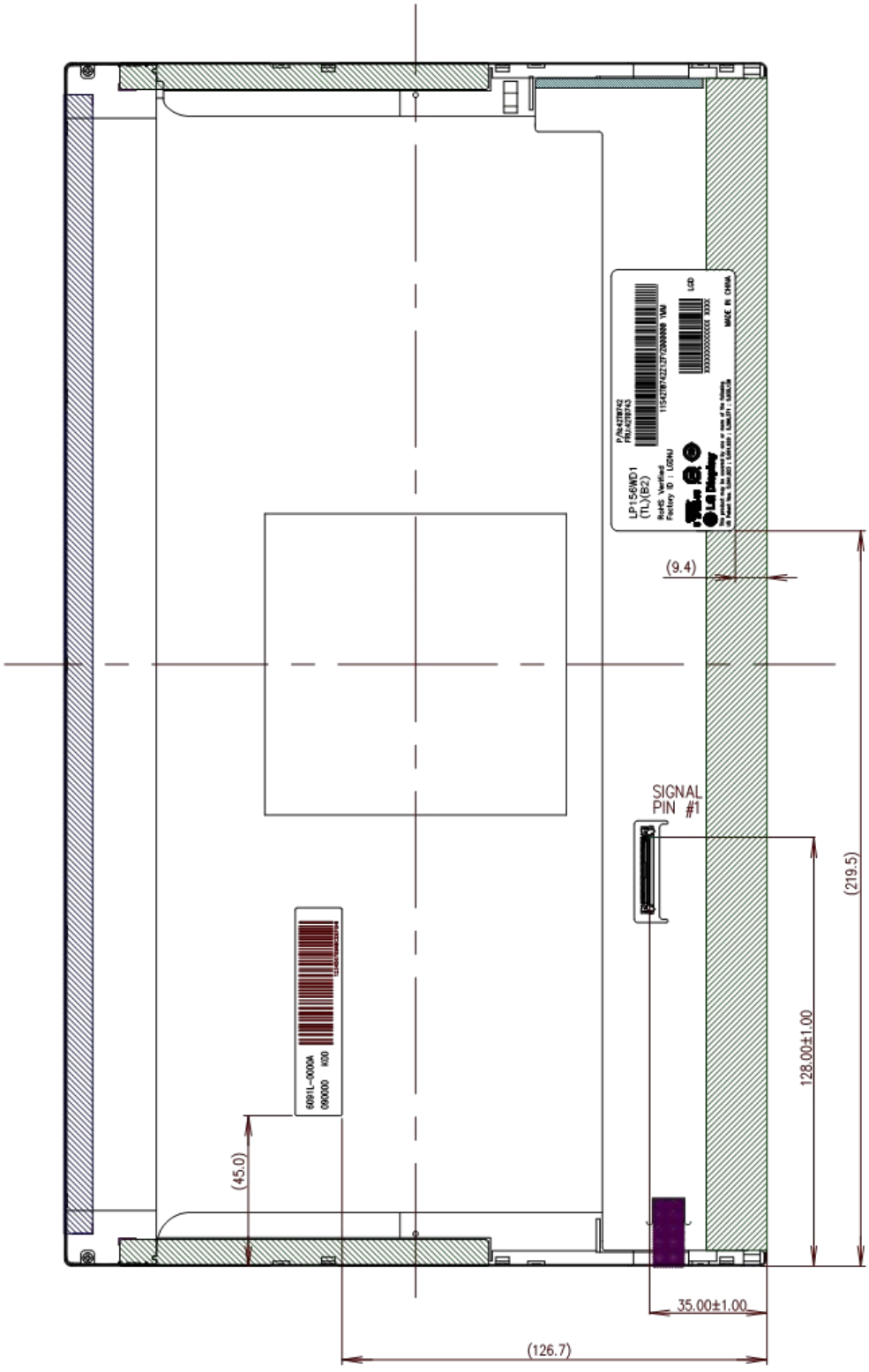
<FRONT VIEW>

Note) Unit:[mm], General tolerance: ± 0.5mm

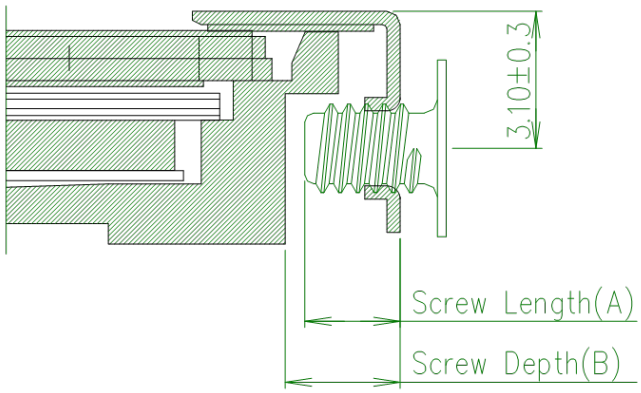


<REAR VIEW>

Note) Unit:[mm], General tolerance: ± 0.5mm



[DETAIL DESCRIPTION OF SIDE MOUNTING SCREW]

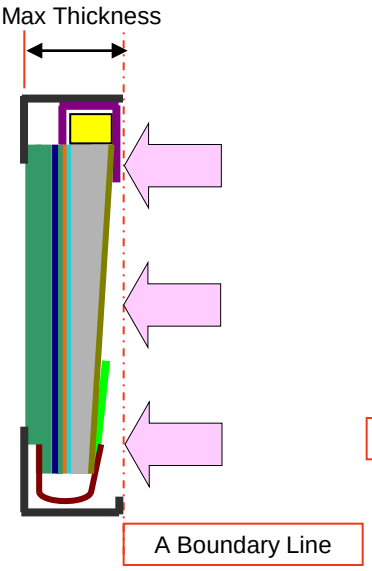


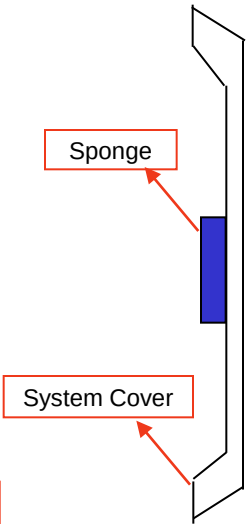
*Mounting Screw Length (A)
= 2.0(Min) / 2.5(Max)
*Mounting Screw Hole Depth (B)
= 2.5(Min)
*Mounting Hole Location : 3.10(typ.)
*Torque : 2.5 kgf.cm(Max)/ 2.3 kgf.cm(Min)
(Measurement gauge : torque meter)

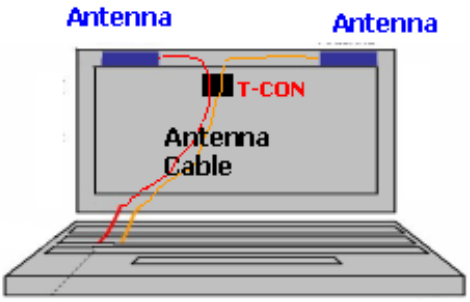
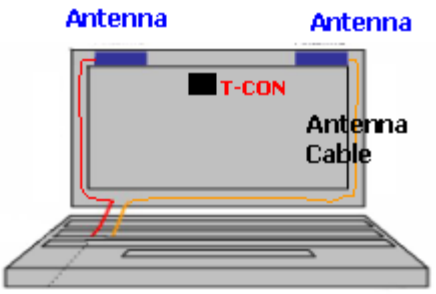
Notes : 1. Screw plated through the method of non-electrolytic nickel plating is preferred to reduce possibility that results in vertical and/or horizontal line defect due to the conductive particles from screw surface.

LPL Proposal for system cover design.(Appendix)

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

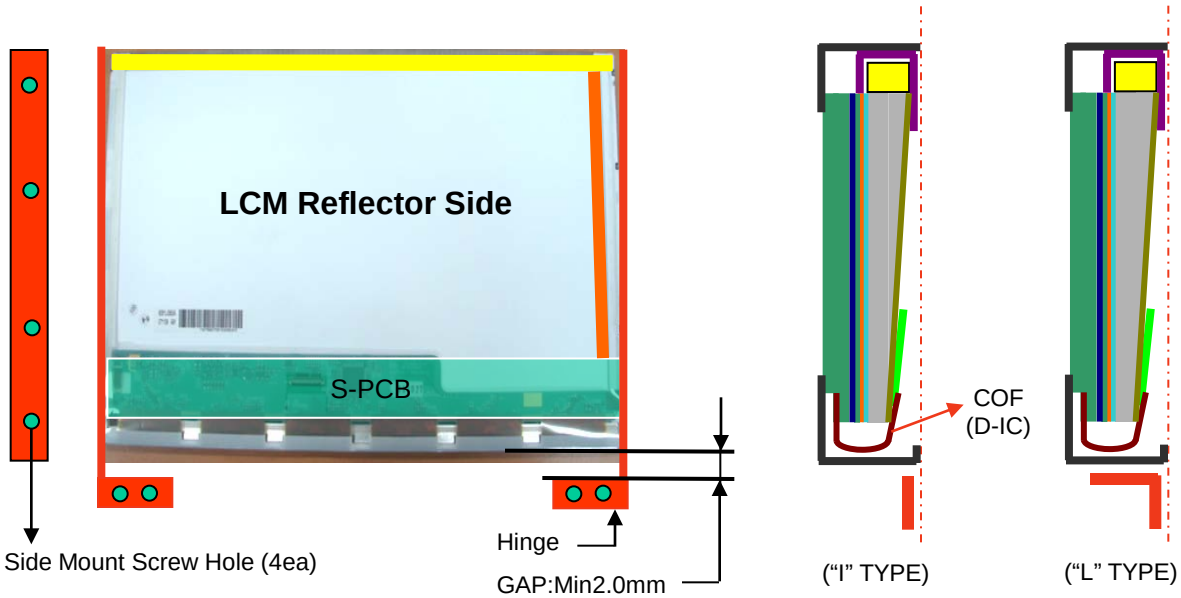


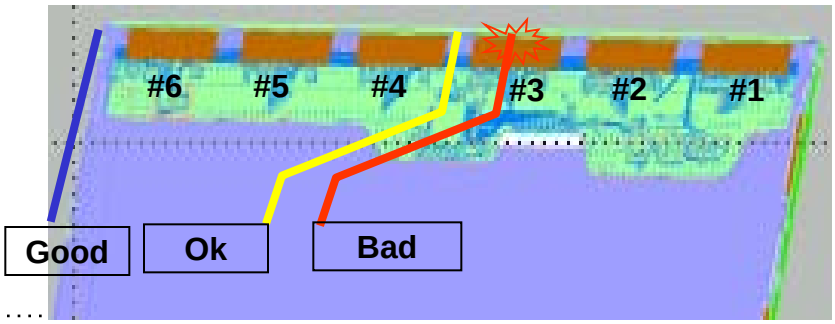


Define	1.Rear side of LCM is sensitive against external stress,and previous check about interference is highly needed. 2.In case there is something from system cover comes into the boundary above,mechanical interference may cause the FOS defects. (Eg: Ripple, White spot..)
2	Check if antenna cable is sufficiently apart from T-CON of LCD Module.
Define	 NO GOOD  GOOD
	1.If system antenna is overlapped with T-CON,it might be cause the noise.

LPL Proposal for system cover design.

3	Gap check for securing the enough gap between LCM and System hinge.	

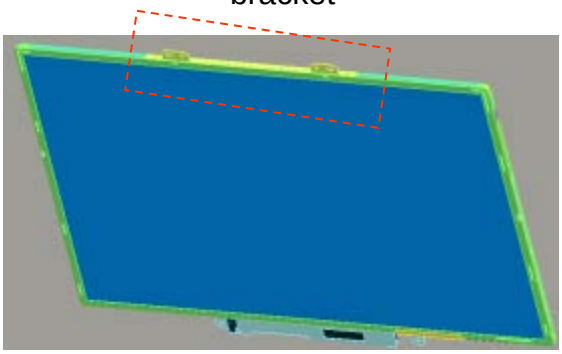


Define	1.At least 2.0mm of gap needs to be secured to prevent the shock related defects. 2."L" type of hinge is recommended than "I" type under shock test.
4	Checking the path of the System wire.
	
Define	1.COF area needs to be handled with care. 2.GOOD ➔Wire path design to system side. OK➔ Wire path is located between COFs. BAD➔Wire path overlapped with COF area.

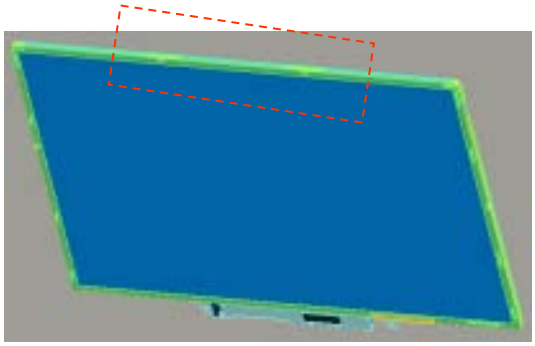
LPL Proposal for system cover design.

5	Using a bracket on the top of LCM is not recommended.	

bracket

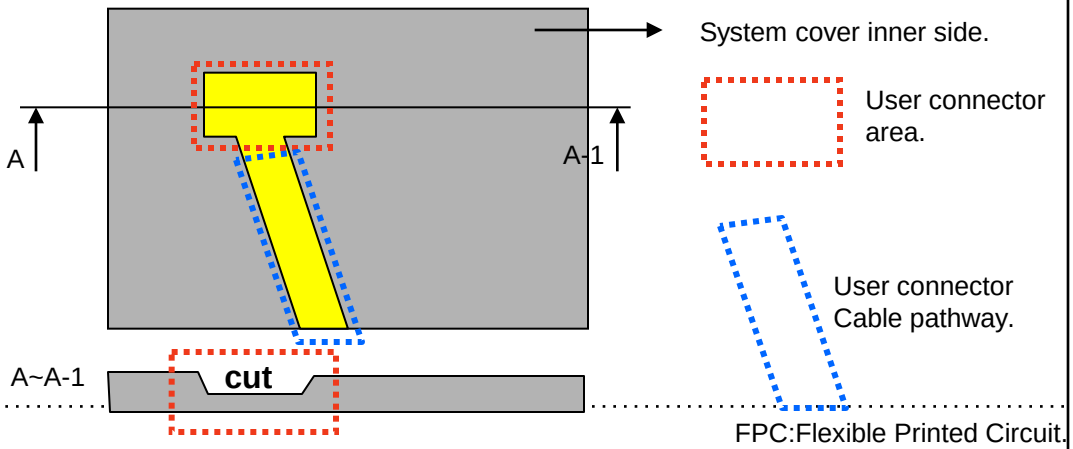


With bracket



Without bracket

Define	1.Condition without bracket is good for mechanical noise,and can minimize the light leakage from deformation of bracket. 2.The results shows that there is no difference between the condition with or without bracket.
6	Securing additional gap on CNT area..



Define	1.CNT area is specially sensitive against external stress,and additional gap by cutting on system cover will be helpful on removing the Ripple. 2.Using a thinner CNT will be better. (eg: FPC type)

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)	Sine wave, 10 ~ 500 ~ 10Hz, 1.5G, 0.37oct/min 3 axis, 1hour/axis
6	Shock test (non-operating)	Half sine wave, 180G, 2ms one shock of each six faces(I.e. run 180G 2ms for all six faces)
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.

7. International Standards

7-1. Safety

a) UL 60950-1, Second Edition, Underwriters Laboratories Inc.
Information Technology Equipment - Safety - Part 1 : General Requirements.

b) CAN/CSA C22.2 No.60950-1-07, Second Edition, Canadian Standards Association.
Information Technology Equipment - Safety - Part 1 : General Requirements.

c) EN 60950-1:2006 + A11:2009, European Committee for Electrotechnical Standardization (CENELEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.

d) IEC 60950-1:2005, Second Edition, The International Electrotechnical Commission (IEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.

7-2. EMC

a) ANSI C63.4 “American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.” American National Standards Institute (ANSI), 2003.

b) CISPR 22 “Information technology equipment – Radio disturbance characteristics – Limit and methods of measurement." International Special Committee on Radio Interference (CISPR), 2005.

c) CISPR 13 “Sound and television broadcast receivers and associated equipment – Radio disturbance characteristics – Limits and method of measurement." International Special Committee on Radio Interference (CISPR), 2006.

7-3. Environment

a) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27 January 2003

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)
E : MONTH
D : YEAR
F ~ M : SERIAL NO.

Note

1. YEAR

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Mark	1	2	3	4	5	6	7	8	9	0

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

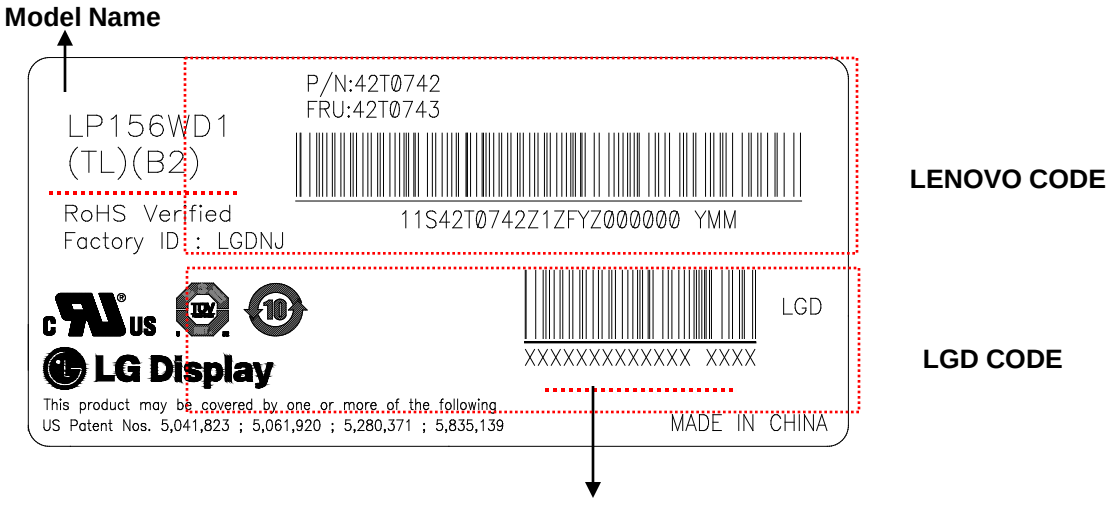
Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing Form

a) Package quantity in one box : 20 pcs

b) Box Size : 482 x 390 x 275

8-3. Label Description



LPL Code

(1) Model Name : **L P 1 5 6 W D 1 - T L B 2**

- Revision Code
- Product Type
- Display Mode
- Basic Model Serial No.
- Resolution : HD+
- Size (inch) : 15.6”
- Application : NBPC
- LGPL Brand Initial: L

(2) Lot Mark : **1 5 6 8 4 C 1 5 0 0 0 0 1**

- SERIAL NO.
- MONTH
- YEAR
- SIZE

Lenovo Code

1)P/N : 42T0742

2)FRU : 42T0743

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.

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.

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.

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

EDID Data for Lenovo _LP156WD1-TLB2_ ver. 0.2

2009.09.02

	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
EDID Vendor / Product Version	8	**08**	EISA manufacture code (3 Character ID) LEN	**30**	00110000
	9	**09**	EISA manufacture code (Compressed ASCII)	**AE**	10101110
	10	**0A**	Panel Supplier Reserved - Product Code 40B1h	**B1**	10110001
	11	**0B**	(Hex. LSB first) (15.6 HD+ 1600x900 , LED B/L)	**40**	01000000
	12	**0C**	LCD Module Serial No - Preferred but Optional ("0" If not used)	**00**	00000000
	13	**0D**	LCD Module Serial No - Preferred but Optional ("0" If not used)	**00**	00000000
	14	**0E**	LCD Module Serial No - Preferred but Optional ("0" If not used)	**00**	00000000
	15	**0F**	LCD Module Serial No - Preferred but Optional ("0" If not used)	**00**	00000000
	16	**10**	Week of Manufacture 00 weeks	**00**	00000000
	17	**11**	Year of Manufacture 2009 years	**13**	00010011
	18	**12**	EDID structure version # = 1	**01**	00000001
	19	**13**	EDID revision # = 3	**03**	00000011
Display Parameters	20	**14**	Video input Definition = Digital signal	**80**	10000000
	21	**15**	Max H image size (Rounded cm) = 35 cm	**23**	00100011
	22	**16**	Max V image size (Rounded cm) = 19 cm	**13**	00010011
	23	**17**	Display gamma = (gamma*100)-100 = Example:(2.2*100)-100=120 = 2.2 Gamma	**78**	01111000
	24	**18**	Feature Support (Standby, Suspend, Active Off/Very Low Power, RGB color display, Timing BLK 1,no_ GTF)	**EA**	11101010
Panel Color Coordinates	25	**19**	Red/Green Low Bits (RxRy/GxGy)	**43**	01000011
	26	**1A**	Blue/White Low Bits (BxBy/WxWy)	**C5**	11000101
	27	**1B**	Red X Rx = 0.610	**9C**	10011100
	28	**1C**	Red Y Ry = 0.348	**59**	01011001
	29	**1D**	Green X Gx = 0.316	**51**	01010001
	30	**1E**	Green Y Gy = 0.589	**96**	10010110
	31	**1F**	Blue X Bx = 0.151	**26**	00100110
	32	**20**	Blue Y By = 0.066	**11**	00010001
	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 (00h if not used)	**00**	00000000
	36	**24**	Established timing 2 (00h if not used)	**00**	00000000
	37	**25**	Manufacturer's timings (00h if not used)	**00**	00000000
Standard Timing ID	38	**26**	Standard timing ID1 (01h if not used)	**01**	00000001
	39	**27**	Standard timing ID1 (01h if not used)	**01**	00000001
	40	**28**	Standard timing ID2 (01h if not used)	**01**	00000001
	41	**29**	Standard timing ID2 (01h if not used)	**01**	00000001
	42	**2A**	Standard timing ID3 (01h if not used)	**01**	00000001
	43	**2B**	Standard timing ID3 (01h if not used)	**01**	00000001
	44	**2C**	Standard timing ID4 (01h if not used)	**01**	00000001
	45	**2D**	Standard timing ID4 (01h if not used)	**01**	00000001
	46	**2E**	Standard timing ID5 (01h if not used)	**01**	00000001
	47	**2F**	Standard timing ID5 (01h if not used)	**01**	00000001
	48	**30**	Standard timing ID6 (01h if not used)	**01**	00000001
	49	**31**	Standard timing ID6 (01h if not used)	**01**	00000001
	50	**32**	Standard timing ID7 (01h if not used)	**01**	00000001
	51	**33**	Standard timing ID7 (01h if not used)	**01**	00000001
	52	**34**	Standard timing ID8 (01h if not used)	**01**	00000001
	53	**35**	Standard timing ID8 (01h if not used)	**01**	00000001

APPENDIX A. 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) 108.5 MHz @ 60Hz	**62**	01100010
	55	**37**	Pixel Clock/10,000 (MSB)	**2A**	00101010
	56	**38**	Horizontal Active (lower 8 bits) 1600 Pixels	**40**	01000000
	57	**39**	Horizontal Blanking(Thp-HA) (lower 8 bits) 320 Pixels	**40**	01000000
	58	**3A**	Horizontal Active / Horizontal Blanking(Thp-HA) (upper 4:4bits)	**61**	01100001
	59	**3B**	Vertical Avtive 900 Lines	**84**	10000100
	60	**3C**	Vertical Blanking (Tvp-HA) (DE Blanking typ.for DE only panels) 42 Lines	**2A**	00101010
	61	**3D**	Vertical Active : Vertical Blanking (Tvp-HA) (upper 4:4bits)	**30**	00110000
	62	**3E**	Horizontal Sync. Offset (Thfp) 48 Pixels	**30**	00110000
	63	**3F**	Horizontal Sync Pulse Width (HSPW) 32 Pixels	**20**	00100000
	64	**40**	Vertical Sync Offset(Tvfp) : Sync Width (VSPW) 3 Lines : 5 Lines	**35**	00110101
	65	**41**	Horizontal Vertical Sync Offset/Width (upper 2bits)	**00**	00000000
	66	**42**	Horizontal Image Size (mm) 345 mm	**59**	01011001
	67	**43**	Vertical Image Size (mm) 194 mm	**C2**	11000010
	68	**44**	Horizontal Image Size / Vertical Image Size	**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_NEG), DE only note : LSB is set to '1' if panel is DE-timing only. H/V can be ignored.	**19**	00011001
Timing Descriptor #2	72	**48**	Pixel Clock/10,000 (LSB) 90.43 MHz @ 50Hz	**53**	01010011
	73	**49**	Pixel Clock/10,000 (MSB)	**23**	00100011
	74	**4A**	Horizontal Active (lower 8 bits) 1600 Pixels	**40**	01000000
	75	**4B**	Horizontal Blanking(Thp-HA) (lower 8 bits) 320 Pixels	**40**	01000000
	76	**4C**	Horizontal Active / Horizontal Blanking(Thp-HA) (upper 4:4bits)	**61**	01100001
	77	**4D**	Vertical Avtive 900 Lines	**84**	10000100
	78	**4E**	Vertical Blanking (Tvp-HA) (DE Blanking typ.for DE only panels) 42 Lines	**2A**	00101010
	79	**4F**	Vertical Active : Vertical Blanking (Tvp-HA) (upper 4:4bits)	**30**	00110000
	80	**50**	Horizontal Sync. Offset (Thfp) 48 Pixels	**30**	00110000
	81	**51**	Horizontal Sync Pulse Width (HSPW) 32 Pixels	**20**	00100000
	82	**52**	Vertical Sync Offset(Tvfp) : Sync Width (VSPW) 3 Lines : 5 Lines	**35**	00110101
	83	**53**	Horizontal Vertical Sync Offset/Width (upper 2bits)	**00**	00000000
	84	**54**	Horizontal Image Size (mm) 345 mm	**59**	01011001
	85	**55**	Vertical Image Size (mm) 194 mm	**C2**	11000010
	86	**56**	Horizontal Image Size / Vertical Image Size	**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_NEG), DE only note : LSB is set to '1' if panel is DE-timing only. H/V can be ignored.	**19**	00011001
Timing Descriptor #3	90	**5A**	Flag	**00**	00000000
	91	**5B**	Flag	**00**	00000000
	92	**5C**	Flag	**00**	00000000
	93	**5D**	Data Type Tag : Descriptor Defined by manufacturer	**0F**	00001111
	94	**5E**	Flag	**00**	00000000
	95	**5F**	(Horizontal active pixel /8)-31 169 (1600 pixels)	**A9**	10101001
	96	**60**	Image Aspect Ratio(16:9) 16:9	**09**	00001001
	97	**61**	Low Refresh Rate #1(50Hz) 50 Hz	**32**	00110010
	98	**62**	(Horizontal active pixel /8)-31 169 (1600 pixels)	**A9**	10101001
	99	**63**	Image Aspect Ratio(16:9) 16:9	**09**	00001001
	100	**64**	Low Refresh Rate #2(40Hz) 40 Hz	**28**	00101000
	101	**65**	Brightness(1/10nit) 220 nits	**16**	00010110
	102	**66**	Feature flag (TN Technology ,LED Backlight)	**09**	00001001
	103	**67**	Reserved 00h	**00**	00000000
	104	**68**	EISA manufacturer code(3 Character ID) LGD	**30**	00110000
	105	**69**	Compressed ASCII	**E4**	11100100
	106	**6A**	Panel Supplier Reserved - Product code 0200	**00**	00000000
	107	**6B**	(Hex, LSB first)	**02**	00000010

APPENDIX A. 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 : Data String (ASCII String)		**FE**	11111110
	112	**70**	Flag		**00**	00000000
	113	**71**	Panel supplier P/N #1 =	L	**4C**	01001100
	114	**72**	Panel supplier P/N #2 =	P	**50**	01010000
	115	**73**	Panel supplier P/N #3 =	1	**31**	00110001
	116	**74**	Panel supplier P/N #4 =	5	**35**	00110101
	117	**75**	Panel supplier P/N #5 =	6	**36**	00110110
	118	**76**	Panel supplier P/N #6 =	W	**57**	01010111
	119	**77**	Panel supplier P/N #7 =	D	**44**	01000100
	120	**78**	Panel supplier P/N #8 =	1	**31**	00110001
	121	**79**	Panel supplier P/N #9 =	-	**2D**	00101101
	122	**7A**	Panel supplier P/N #10 =	T	**54**	01010100
	123	**7B**	Panel supplier P/N #11 =	L	**4C**	01001100
	124	**7C**	Panel supplier P/N #12 =	B	**42**	01000010
	125	**7D**	Panel supplier P/N #13 =	2	**32**	00110010
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)		**E2**	11100010