SPECIFICATION
FOR
APPROVAL

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

Title	15.6” HD TFT LCD

Customer	HP
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LP156WHU
Suffix	TLA1

*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.

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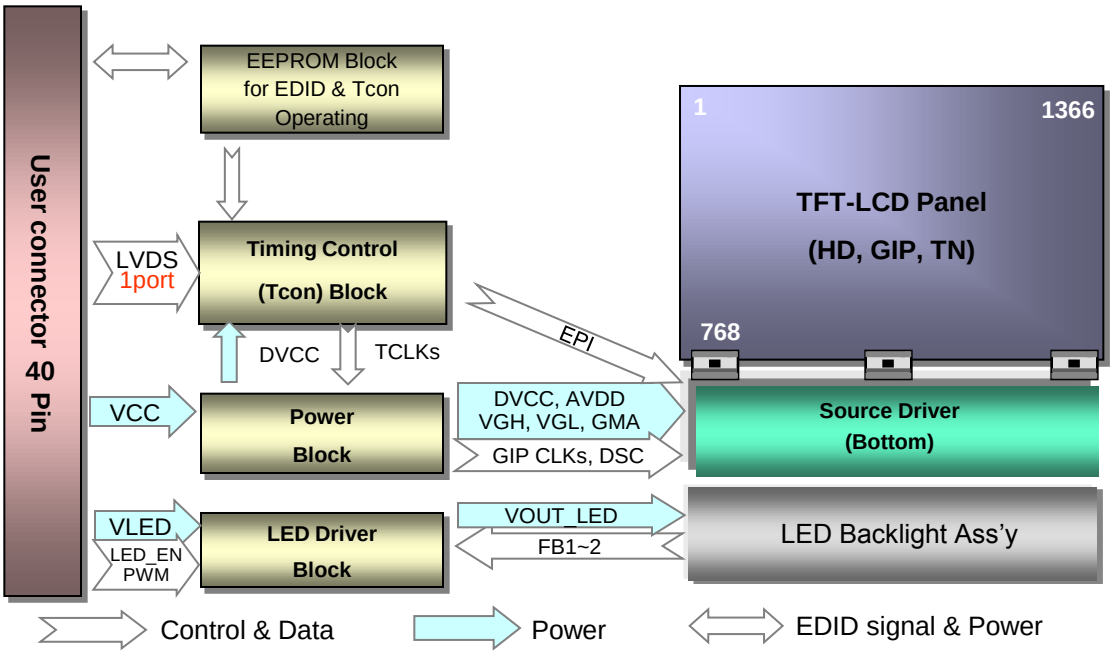
Contents

RECORD OF REVISIONS

Revision No	Revision Date	Page	Description	EDID ver
0.0	Sep. 20. 2012	-	First Draft (Preliminary Specification)	-

1. General Description

The LP156WHU 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 (1366 horizontal by 768 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 LP156WHU has been designed to apply the interface method that enables low power, high speed, low EMI. The LP156WHU 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 LP156WHU 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	359.5(H, Typ.) × 217.2(V, Typ.) × 3.2(D, Max.) [mm] (with PCB Board)
Pixel Pitch	0.252mm X 0.252 mm
Pixel Format	1366 horiz. by 768 vert. Pixels RGB strip arrangement
Color Depth	6-bit, 262,144 colors
Luminance, White	200 cd/m^2(Typ.)
Power Consumption	Total 3.5W (Typ.) Logic : 0.7W (Typ.@ Mosaic), B/L : 2.8W (Typ.@ VLED 12V)
Weight	370 g (Max.)
Display Operating Mode	Transmissive mode, normally white
Surface Treatment	Glare treatment (3H) of the front Polarizer
RoHS Compliance	Yes
BFR / PVC / As Free	Yes for all

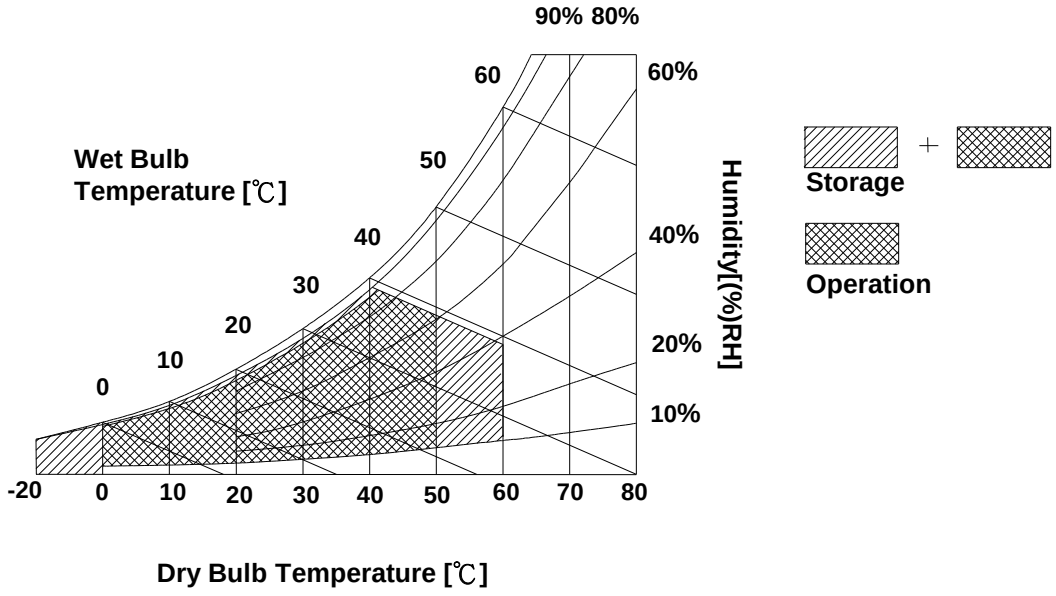
2. Absolute Maximum Ratings

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	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

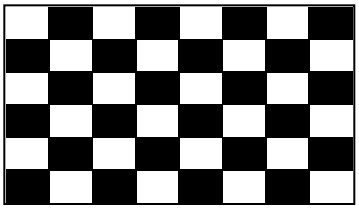
The LP156WHU requires two power inputs. The first logic is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second backlight is the input about LED BL with LED Driver.

Table 2. ELECTRICAL CHARACTERISTICS

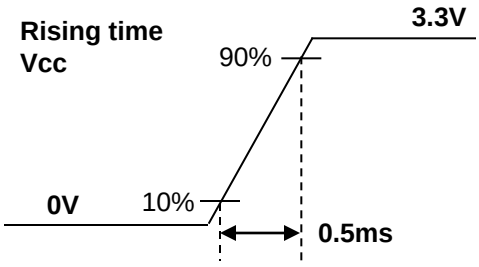
Parameter		Symbol	Values			Unit	Notes
			Min	Typ	Max		
LOGIC :							
Power Supply Input Voltage		V_{CC}	3.0	3.3	3.6	V	1
Power Supply Input Current	Mosaic	I_{CC}	-	210	245	mA	2
Power Consumption		P_{CC}	-	0.7	0.8	W	2
Power Supply Inrush Current		I_{CC_P}	-	-	1500	mA	3
LVDS Impedance		Z_{LVDS}	90	100	110	Ω	4
BACKLIGHT : (with LED Driver)							
LED Power Input Voltage		V_{LED}	6.5	12.0	21.0	V	5
LED Power Input Current		I_{LED}	-	235	250	mA	6
LED Power Consumption		P_{LED}	-	2.8	3.0	W	6
LED Power Inrush Current		I_{LED_P}	-	-	2000	mA	7
PWM Duty Ratio			5	-	100	%	8
PWM Jitter		-	0	-	0.2	%	9
PWM Impedance		Z_{PWM}	20	40	60	kΩ	
PWM Frequency		F_{PWM}	200	-	1000	Hz	10
PWM High Level Voltage		V_{PWM_H}	3.0	-	3.6	V	
PWM Low Level Voltage		V_{PWM_L}	0	-	0.3	V	
LED_EN Impedance		Z_{PWM}	20	40	60	kΩ	
LED_EN High Voltage		$V_{LED\_EN\_H}$	3.0	-	3.6	V	
LED_EN Low Voltage		$V_{LED\_EN\_L}$	0	-	0.3	V	
Life Time			15,000	-	-	Hrs	11

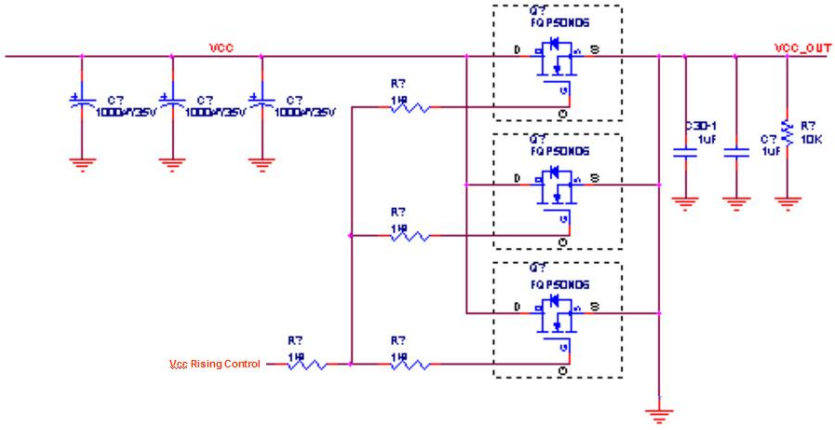
Note)

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 and Mosaic pattern.

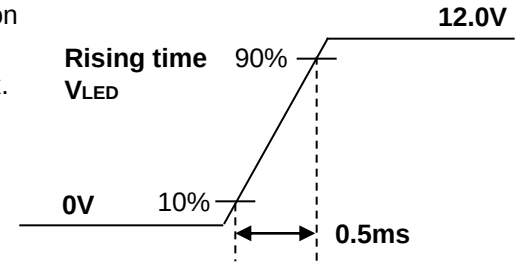


3. This Spec. is the max load condition for the cable impedance designing.
4. The below figures are the measuring Vcc condition and the Vcc control block LGD used. The Vcc condition is same as the minimum of T1 at Power on sequence.





5. This impedance value is needed for proper display and measured form LVDS Tx to the mating connector.
6. The measuring position is the connector of LCM and the test conditions are under 25℃.
7. The current and power consumption with LED Driver are under the Vled = 12.0V , 25℃, Dimming of Max luminance and White pattern with the normal frame frequency operated(60Hz).
8. The below figures are the measuring Vled condition and the Vled control block LGD used. VLED control block is same with Vcc control block.

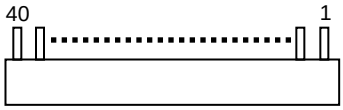


9. The operation of LED Driver below minimum dimming ratio may cause flickering or reliability issue.
10. If Jitter of PWM is bigger than maximum, it may induce flickering.
11. This Spec. is not effective at 100% dimming ratio as an exception because it has DC level equivalent to 0Hz. In spite of acceptable range as defined, the PWM Frequency should be fixed and stable for more consistent brightness control at any specific level desired.
12. 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.

3-2. Interface Connections

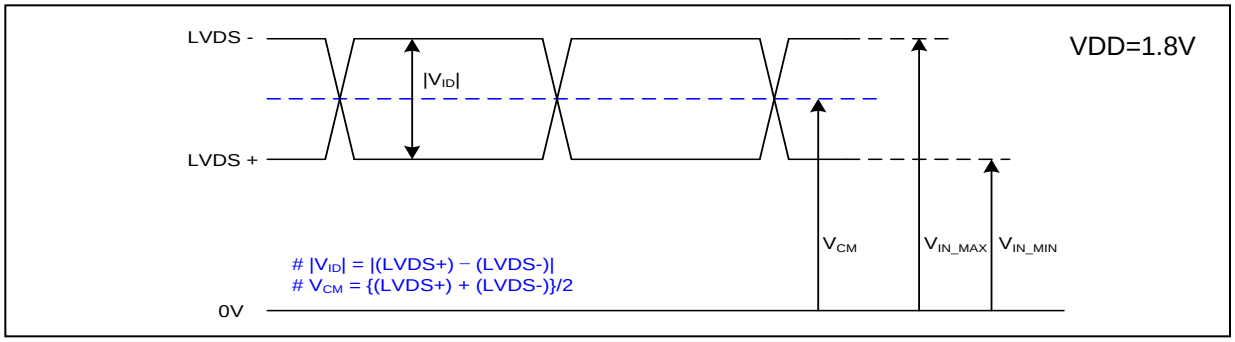
This LCD employs two interface connections, a 40 pin connector used for the module electronics interface and the other connector used for the integral backlight system.

Table 3. MODULE CONNECTOR PIN CONFIGURATION (CN1)

Pin	Symbol	Description	Notes
1	NC	No Connection	**[Interface Chip]** 1. LCD : TLI, TL2356 (LCD Controller) Including LVDS Receiver. 2. System : LVDSRx or equivalent * Pin to Pin compatible with LVDS **[Connector]** KN38-40S-0.5H or equivalent **[Connector pin arrangement]**  [LCD Module Rear View]
2	VCC	LCD Logic and driver power (3.3V Typ.)	
3	VCC	LCD Logic and driver power (3.3V Typ.)	
4	V EEDID	DDC Power (3.3V)	
5	NC	No Connection	
6	Clk EEDID	DDC Clock	
7	DATA EEDID	DDC Data	
8	ORX0-	Negative LVDS differential data input	
9	ORX0+	Positive LVDS differential data input	
10	GND	High Speed Ground	
11	ORX1-	Negative LVDS differential data input	
12	ORX1+	Positive LVDS differential data input	
13	GND	High Speed Ground	
14	ORX2-	Negative LVDS differential data input	
15	ORX2+	Positive LVDS differential data input	
16	GND	High Speed Ground	
17	ORXC-	Negative LVDS differential clock input	
18	ORXC+	Positive LVDS differential clock input	
19	GND	High Speed Ground	
20	NC	No Connection	
21	NC	No Connection	
22	GND	High Speed Ground	
23	NC	No Connection	
24	NC	No Connection	
25	GND	High Speed Ground	
26	NC	No Connection	
27	NC	No Connection	
28	GND	High Speed Ground	
29	NC	No Connection	
30	NC	No Connection	
31	GND	LED Backlight Ground	
32	GND	LED Backlight Ground	
33	GND	LED Backlight Ground	
34	NC	No Connection	
35	PWM	System PWM Signal input for dimming	
36	LED_EN	LED Backlight On/Off	
37	NC	No Connection	
38	VLED	LED Backlight Power (7V-21V)	
39	VLED	LED Backlight Power (7V-21V)	
40	VLED	LED Backlight Power (7V-21V)	

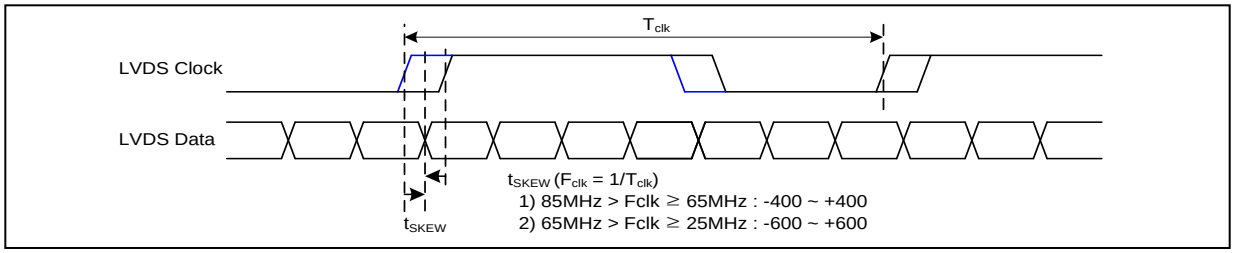
3-3. LVDS Signal Timing Specifications

3-3-1. DC Specification

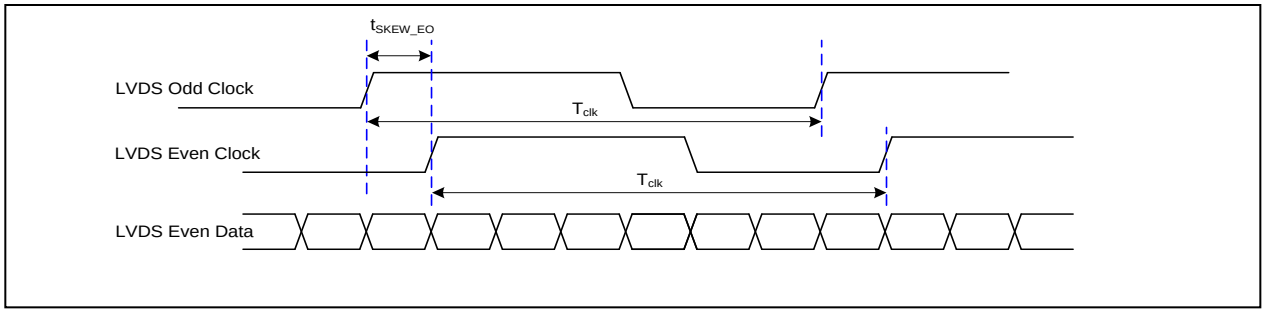


Description	Symbol	Min	Typ	Max	Unit	Notes
LVDS Differential Voltage	$\|V_{ID}\|$	100	-	600	mV	-
LVDS Common mode Voltage	V_{CM}	$\|V_{ID}\|$ /2	1.2	VDD- $\|V_{ID}\|$/2	V	-
LVDS Input Voltage Range	V_{IN}	0.3	-	VDD	V	-

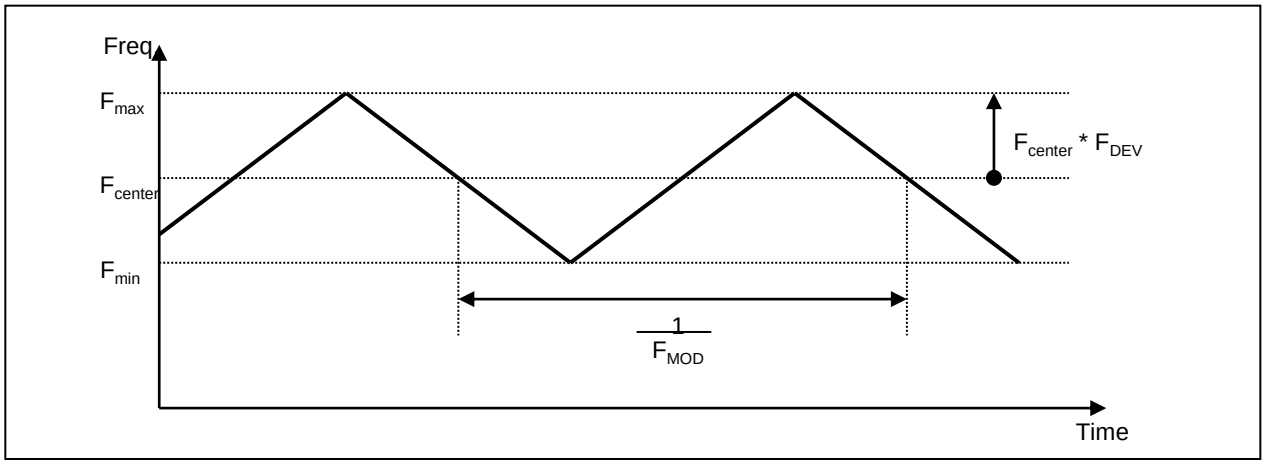
3-3-2. AC Specification



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	-



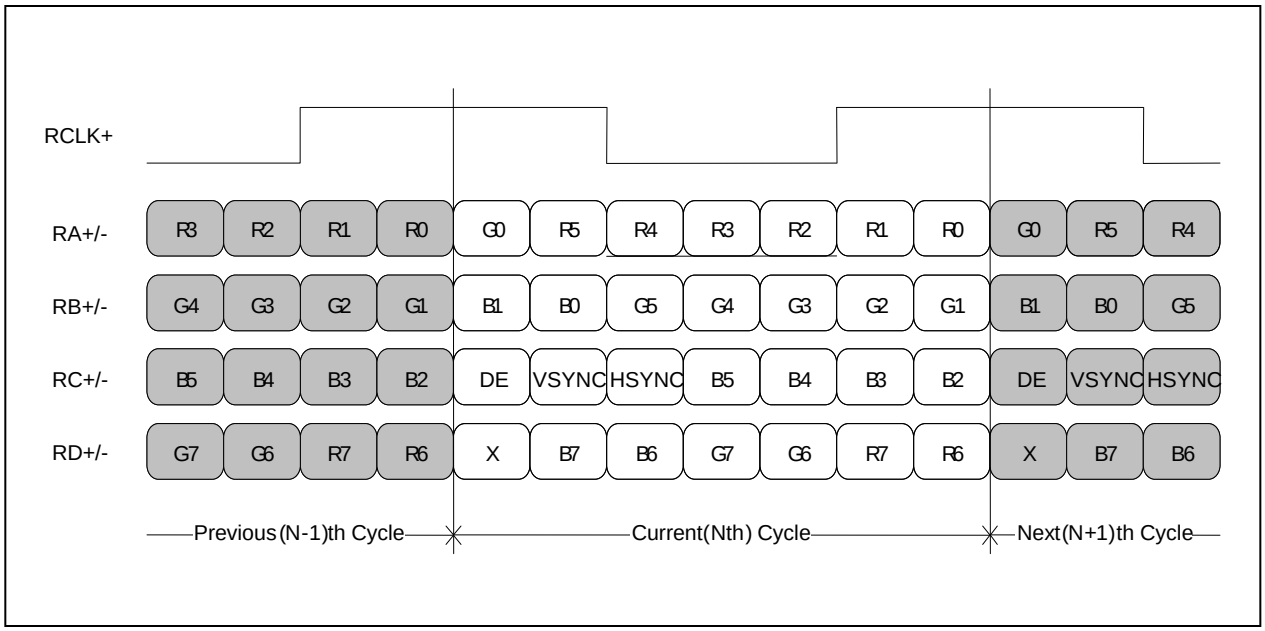
< Clock skew margin between channel >



< Spread Spectrum >

3-3-3. Data Format

1) LVDS 1 Port



< LVDS Data Format >

3-4. Signal Timing Specifications

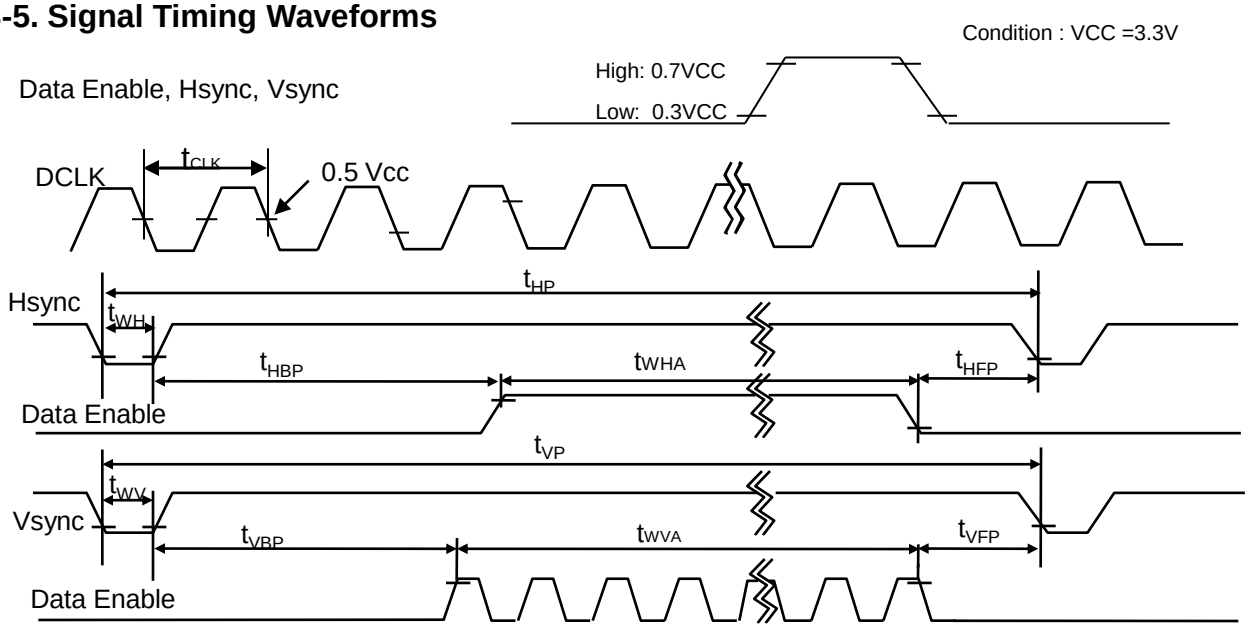
This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications and specifications of LVDS Tx/Rx for its proper operation.

Table 4. TIMING TABLE

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Frequency	f_{CLK}	-	76.3	-	MHz	
Hsync	Period	t_{HP}	1586	1610	1634	tCLK	
	Width	t_{WH}	24	32	40		
	Width-Active	t_{WHA}	1366	1366	1366		
Vsync	Period	t_{VP}	788	790	796	tHP	
	Width	t_{WV}	2	3	4		
	Width-Active	t_{WVA}	768	768	768		
Data Enable	Horizontal back porch	t_{HBP}	172	180	188	tCLK	
	Horizontal front porch	t_{HFP}	24	32	40		
	Vertical back porch	t_{VBP}	14	14	18	tHP	
	Vertical front porch	t_{VFP}	4	5	6		

Appendix) all reliabilities are specified for timing specification based on refresh rate of 60Hz. However, LP156WHU has a good actual performance even at lower refresh rate (e.g. 40Hz or 50Hz) for power saving mode, whereas LP156WHU 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).

3-5. Signal Timing Waveforms



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 5. 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

Power Supply Input
VCC

Interface Signal, V_i
LVDS

LED BL
On/Off Control Signal
LED_EN

LED BL
Dimming Control Signal
PWM

LED Driver Input Voltage
VLED

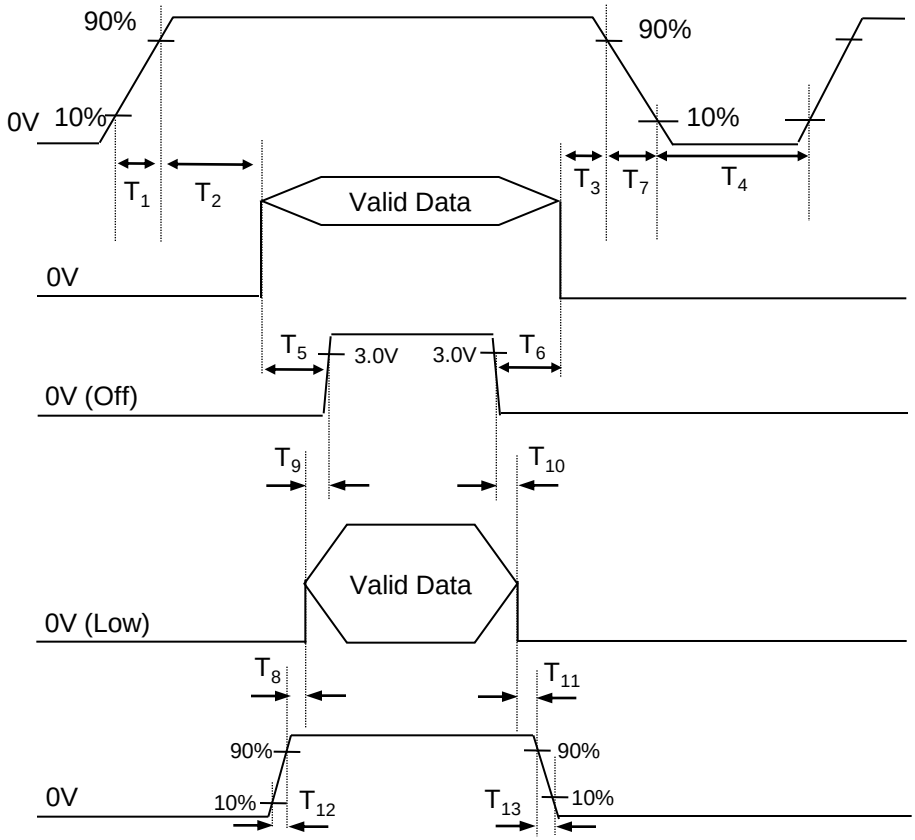


Table 6. POWER SEQUENCE TABLE

Logic Parameter	Value			Units
	Min.	Typ.	Max.	
T_1	0.5	-	10	ms
T_2	0	-	50	ms
T_3	0	-	50	ms
T_4	400	-	-	ms
T_5	200	-	-	ms
T_6	200	-	-	ms
T_7	3	-	10	ms

LED Parameter	Value			Units
	Min.	Typ.	Max.	
T_8	10	-	-	ms
T_9	0	-	-	ms
T_{10}	0	-	-	ms
T_{11}	10	-	-	ms
T_{12}	0.5	-	-	ms
T_{13}	0	-	5000	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 be on 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 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

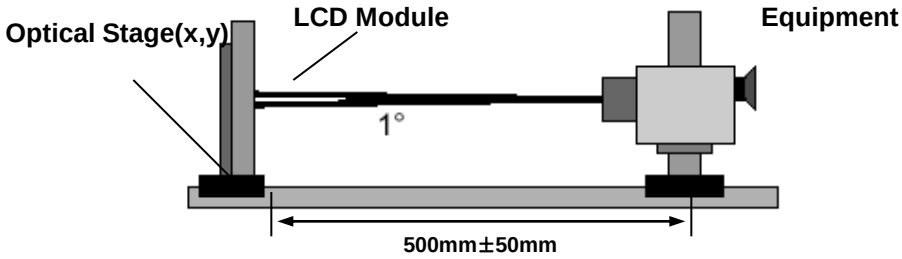


Table 7. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, f_V=60Hz, f_{CLK}= 76.3MHz

Parameter	Symbol	Values			Units	Notes
		Min	Typ	Max		
Contrast Ratio	CR	400	500	-		1
Surface Luminance, white	L_{WH}	170	200	-	cd/m²	2
Luminance Variation	δ_{WHITE}	-	1.4	1.6	%	3
Response Time	$Tr_R + Tr_D$	-	16	25	ms	4
Color Coordinates						
RED	RX	0.548	0.578	0.608		
	RY	0.314	0.344	0.374		
GREEN	GX	0.307	0.337	0.367		
	GY	0.541	0.571	0.601		
BLUE	BX	0.129	0.159	0.189		
	BY	0.090	0.120	0.150		
WHITE	WX	0.283	0.313	0.343		
	WY	0.299	0.329	0.359		
Viewing Angle						5
x axis, right(Φ=0°)	Θr	40	-	-	degree	
x axis, left (Φ=180°)	Θl	40	-	-	degree	
y axis, up (Φ=90°)	Θu	10	-	-	degree	
y axis, down (Φ=270°)	Θd	30	-	-	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 1 point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 1.

$$LWH = \text{Average}(L1, L2, \ldots L5)$$

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

$$\delta \text{ WHITE} = \frac{\text{Maximum}(L1, L2, \ldots L13)}{\text{Miniimum}(L1, L2, \ldots L13)}$$

4. Response time is the time required for the display to transition from white to black (rise time, TrR) and from black to white(Decay Time, TrD). For additional information see FIG 3.

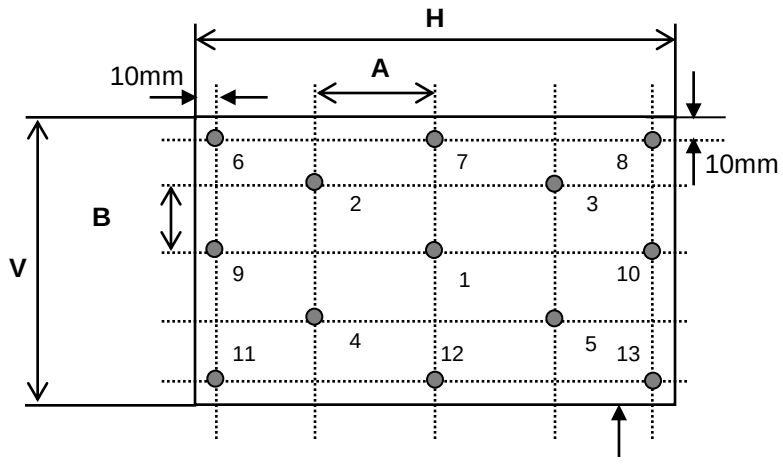
5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.

6. Gray scale specification * fV = 60Hz

Gray Level	Luminance [%] (Typ)
L0	0.15
L7	1.24
L15	4.97
L23	11.4
L31	20.6
L39	34.4
L47	53.0
L55	75.7
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”.

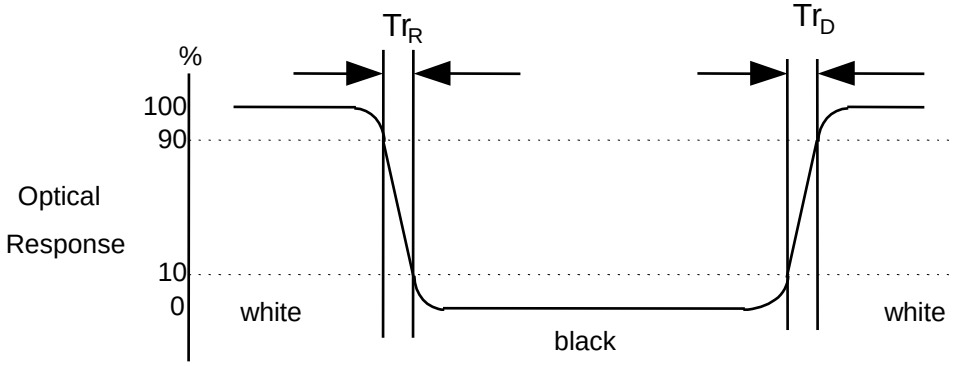
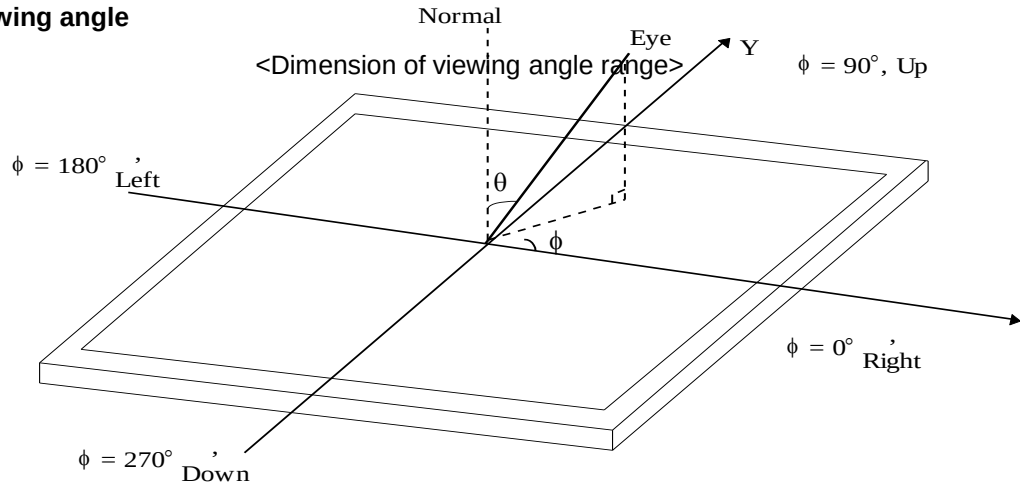


FIG. 4 Viewing angle

<Dimension of viewing angle range>



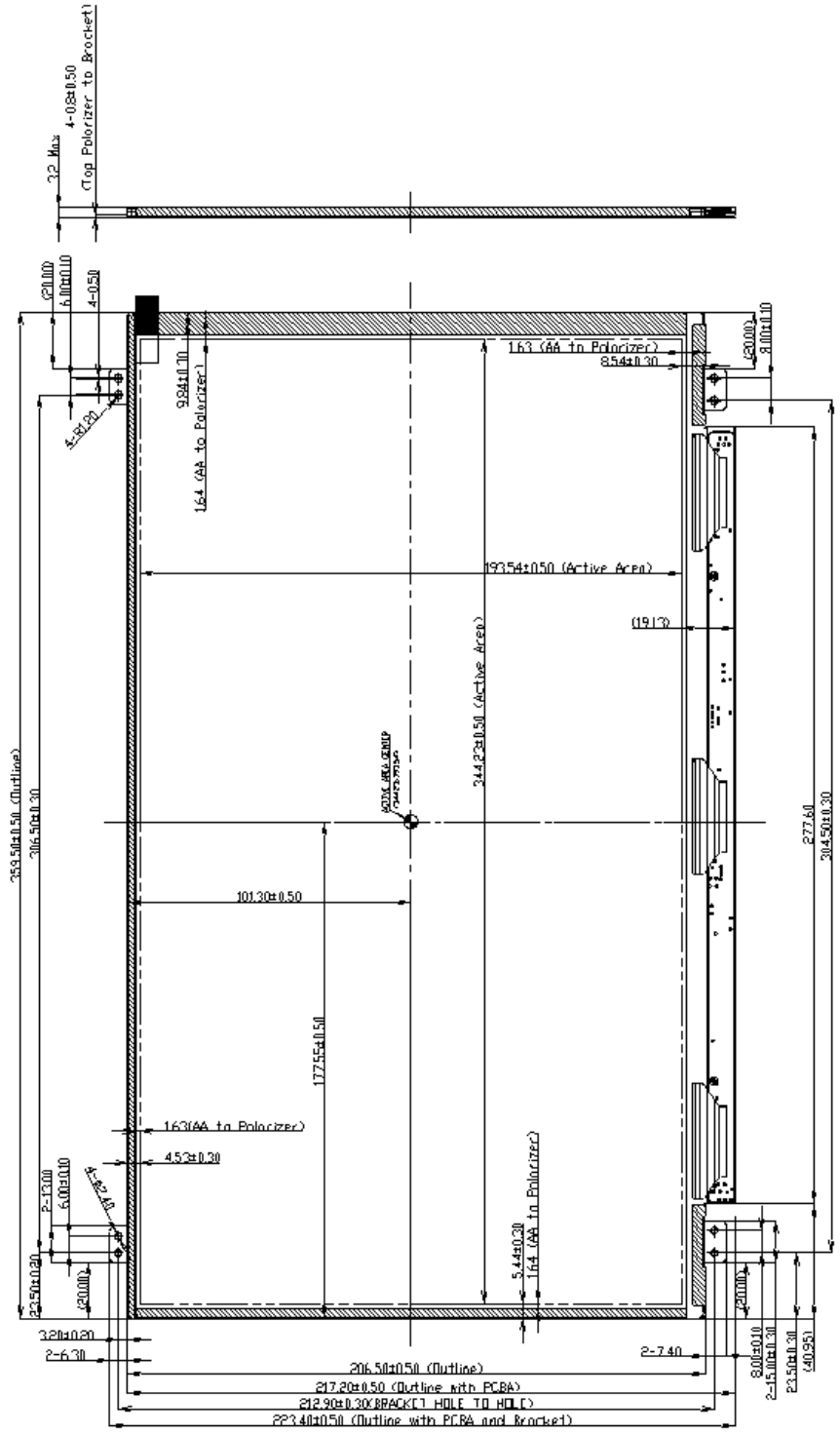
5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LP156WHU. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal	359.5 ± 0.5mm
	Vertical	217.2 ± 0.5mm
	Thickness	3.2mm (max)
Bezel Area	Horizontal	347.5 ± 0.5mm
	Vertical	196.8 ± 0.5mm
Active Display Area	Horizontal	344.23 mm
	Vertical	193.54 mm
Weight	370 g (Max.)	
Surface Treatment	Hard Coating(3H), Anti Glare treatment of the front polarizer	

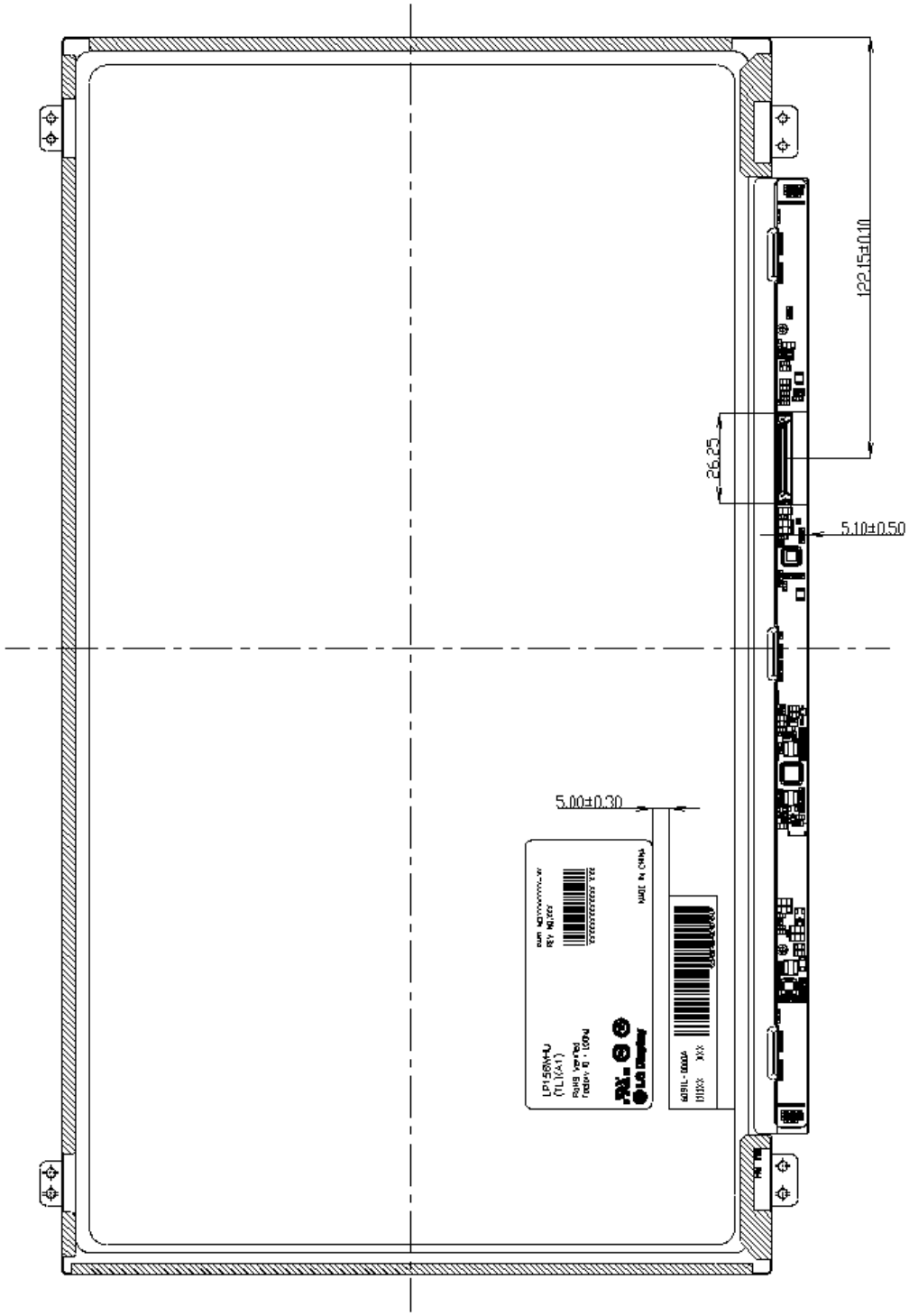
<FRONT VIEW>

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



<REAR VIEW>

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



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, 5 ~ 150Hz, 1.5G, 0.37oct/min 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.

7. International Standards

7-1. 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 Electrotechnical Standardization (CENELEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.

d) IEC 60950-1, 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	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.

8-2. Packing Form

a) Package quantity in one box : 20pcs

b) Box Size : 478mm X 365mm X 328mm

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.

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

	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 03C4h	**C4**	11000100
	11	**0B**	(Hex. LSB first)	**03**	00000011
	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 2012 years	**16**	00010110
	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 : 6 Bits per Primary Color , Digital Video Interface Standard Supported: DisplayPort is supported	**95**	10010101
	21	**15**	Horizontal Screen Size (Rounded cm) = 35 cm35 cm	**23**	00100011
	22	**16**	Vertical Screen Size (Rounded cm) = 19 cm19 cm	**13**	00010011
	23	**17**	Display Transfer Characteristic (Gamma) = (gamma*100)-100 = Example:(2.2*100)-100=120 = 2.2 Gamma	**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 & YCrCb 4:4:4 ,Other Feature Support Flags : No_sRGB, Preferred Timing Mode, No_Display is continuous frequency (Multi-mode_Base EDID and Extension Block).]	**0A**	00001010
Panel Color Coordinates	25	**19**	Red/Green Low Bits (RxRy/GxGy)	**00**	00000000
	26	**1A**	Blue/White Low Bits (BxBy/WxWy)	**05**	00000101
	27	**1B**	Red X Rx = 00	**00**	00000000
	28	**1C**	Red Y Ry = 00	**00**	00000000
	29	**1D**	Green X Gx = 00	**00**	00000000
	30	**1E**	Green Y Gy = 00	**00**	00000000
	31	**1F**	Blue X Bx = 00	**00**	00000000
	32	**20**	Blue Y By = 00	**00**	00000000
	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

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) 76.3 MHz @ 60Hz	**CE**	11001110
	55	**37**	Pixel Clock/10,000 (MSB)	**1D**	00011101
	56	**38**	Horizontal Active (lower 8 bits) 1366 Pixels	**56**	01010110
	57	**39**	Horizontal Blanking(Thp-HA) (lower 8 bits) 244 Pixels	**F4**	11110100
	58	**3A**	Horizontal Active / Horizontal Blanking(Thp-HA) (upper 4:4bits)	**50**	01010000
	59	**3B**	Vertical Avtive 768 Lines	**00**	00000000
	60	**3C**	Vertical Blanking (Tvp-HA) (DE Blanking typ.for DE only panels) 22 Lines	**16**	00010110
	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_POS (outside of V-sync)]	**1B**	00011011
Timing Descriptor #2	72	**48**	Pixel Clock/10,000 (LSB) 50.87 MHz @ 40Hz	**DF**	11011111
	73	**49**	Pixel Clock/10,000 (MSB)	**13**	00010011
	74	**4A**	Horizontal Active (lower 8 bits) 1366 Pixels	**56**	01010110
	75	**4B**	Horizontal Blanking(Thp-HA) (lower 8 bits) 244 Pixels	**F4**	11110100
	76	**4C**	Horizontal Active / Horizontal Blanking(Thp-HA) (upper 4:4bits)	**50**	01010000
	77	**4D**	Vertical Avtive 768 Lines	**00**	00000000
	78	**4E**	Vertical Blanking (Tvp-HA) (DE Blanking typ.for DE only panels) 22 Lines	**16**	00010110
	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_POS (outside of V-sync)]	**1B**	00011011
Timing Descriptor #3	90	**5A**	Blank for nvDPS	**00**	00000000
	91	**5B**	Blank for nvDPS	**00**	00000000
	92	**5C**	Blank for nvDPS	**00**	00000000
	93	**5D**	Blank for nvDPS	**00**	00000000
	94	**5E**	Blank for nvDPS	**00**	00000000
	95	**5F**	Blank for nvDPS	**00**	00000000
	96	**60**	Blank for nvDPS	**00**	00000000
	97	**61**	Blank for nvDPS	**00**	00000000
	98	**62**	Blank for nvDPS	**00**	00000000
	99	**63**	Blank for nvDPS	**00**	00000000
	100	**64**	Blank for nvDPS	**00**	00000000
	101	**65**	Blank for nvDPS	**00**	00000000
	102	**66**	Blank for nvDPS	**00**	00000000
	103	**67**	Blank for nvDPS	**00**	00000000
	104	**68**	Blank for nvDPS	**00**	00000000
	105	**69**	Blank for nvDPS	**00**	00000000
	106	**6A**	Blank for nvDPS	**00**	00000000
	107	**6B**	Blank for nvDPS	**00**	00000000

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**	Detailed Timing Descriptions #4	**00**	00000000
	109	**6D**	Flag	**00**	00000000
	110	**6E**	Reserved	**00**	00000000
	111	**6F**	For Brightness Table and Power consumption	**02**	00000010
	112	**70**	Flag	**00**	00000000
	113	**71**	PWM % [7:0] @ Step 0 5 % @ 10 nit	**0C**	00001100
	114	**72**	PWM % [7:0] @ Step 5 30 % @ 60 nit	**4C**	01001100
	115	**73**	PWM % [7:0] @ Step 10 100 % @ 200 nit	**FF**	11111111
	116	**74**	Nits [7:0] @ Step 0	**0A**	00001010
	117	**75**	Nits [7:0] @ Step 5	**3C**	00111100
	118	**76**	Nits [7:0] @ Step 10	**64**	01100100
	119	**77**	Panel Electronicx Power @ 32 x 32 Chess Pattern = 600 mW	**0F**	00001111
	120	**78**	Backlight Power @ 60 nits = 750 mW	**13**	00010011
	121	**79**	Backlight Power @ Step 10 = 2500 mW	**1F**	00011111
	122	**7A**	Nits @ 100% PWM Duty = 200 nit	**64**	01100100
	123	**7B**	Flag	**00**	00000000
	124	**7C**	Flag	**00**	00000000
	125	**7D**	Flag	**00**	00000000
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)	**2F**	00101111