SPECIFICATION
FOR
APPROVAL

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

Title	14.0” HD TFT LCD
Customer	SONY
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LP140WH2
Suffix	TLN1

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

APPROVED BY	SIGNATURE
/	
/	
/	

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

APPROVED BY	SIGNATURE
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Contents

RECORD OF REVISIONS

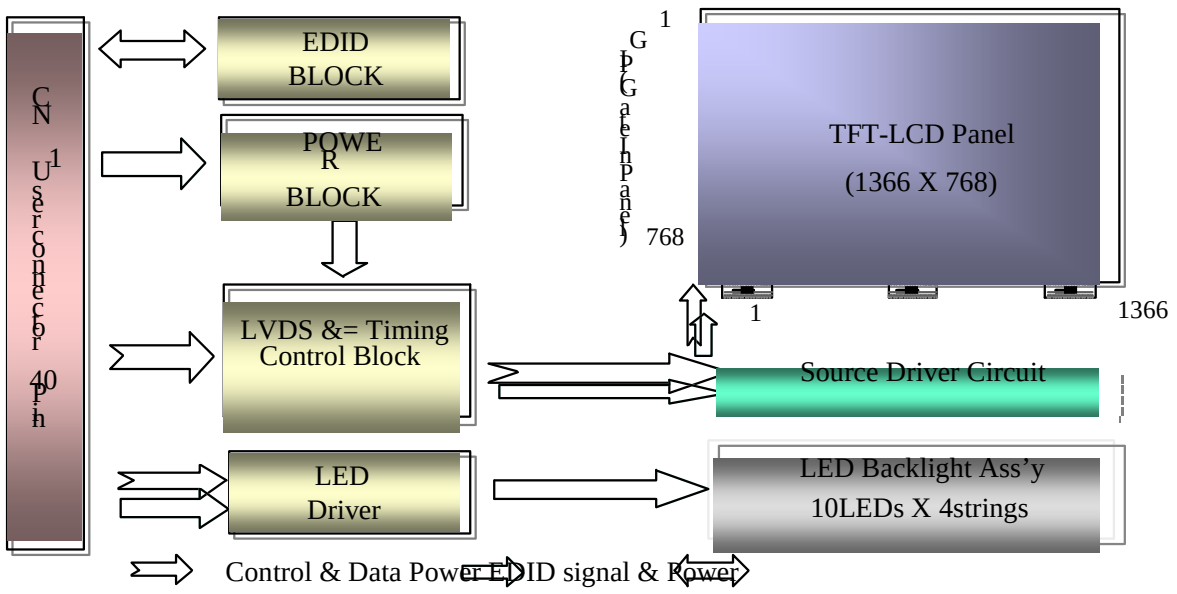
Revision No	Revision Date	Page	Description	EDID ver
0.0	Apr. 06. 2009	-	First Draft (Preliminary Specification)	0.0
0.1	Jul. 02. 2009	6	Change PWM Duty (Min.) : 12.5% > 5.0%	
1.0	Jul. 20. 2009	6	Change LE D Backlig ht Life time (10,000Hrs>12,000Hrs)	
		6	Update electrical characteristics (Update TBD items)	
		14~15	Update optical specification (Update TBD items)	

1. General Description

The LP140WH2 is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode (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(768 vertical by 1366 horizontal 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 LP140WH2 has been designed to apply the interface method that enables low power, high speed, low EMI.

The LP140WH2 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 LP140WH2 characteristics provide an excellent flat display for office automation products such as Notebook PC.



General Features

Active Screen Size	14.0 inches diagonal
Outline Dimension	322.3(H, typ) 198.1(V, typ) 3.6(D,max) [mm] (with PCB Board)
Pixel Pitch	0.2265mm 0.2265 mm
Pixel Format	1366 horiz. B y 768 vert. Pixels RGB strip arrangement
Color Depth	6-bit, 262,144 colors
Luminance, White	200 cd/m2 (Typ.5 point)
Po wer Consumption	Total 4.3 Watt(Typ.) @ LCM circuit 1.3 Watt (Typ._Mosaic), B/L 3.0Watt(Typ.)
Weight	320g (Max.)
Displa y Operating Mode	Transmissive mode, normally white
Surface Treatment	Hard Coating(3H), Glare treatment of the front polarizer
RoHS Comply	Yes

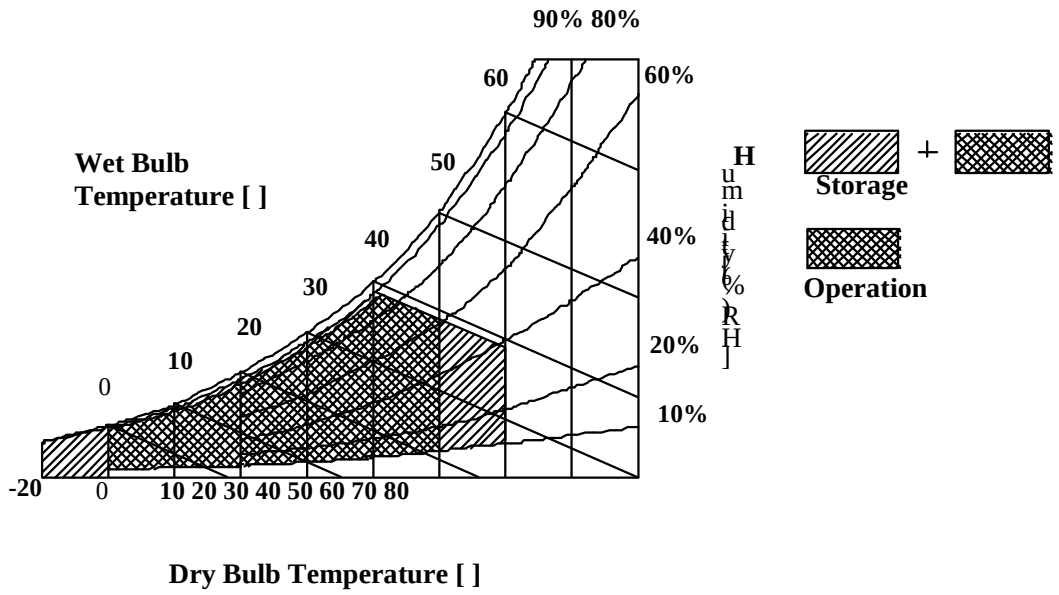
2. Absolute Maximum Ratings

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

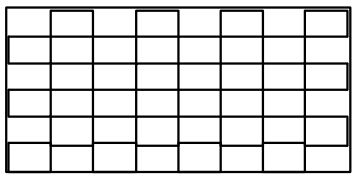
The LP140WH2 requires two power inputs. The first logic is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second backlight is the input about LED BL.with LED Driver.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter Symbol		Values			Unit	Notes
		Min	Typ	Max		
LOGIC :						
Power Supply Input Voltage	VCC	3.0	3.3	3.6	V	
Power Supply Input Current	ICC Mosaic	330	390	450	mA	1
	ICC Black	390	460	530		
Power Consumption	PC	-	1.3	1.5	W	1
Power Supply Inrush Current	ICC_P	-	-	1500	mA	
LVDS Impedance	ZLVDS	90	100	110		2
BACKLIGHT : (with LED Driver)						
LED Power Input Voltage	VLED	7.0	12.0	20.0	V	
LED Power Input Current	ILED	-	20.0	21.0	mA	3
LED Power Consumption	PLED	-	3.0	3.2	W	3
LED Power Inrush Current	IL_ED_P	-	-	1000	mA	
PWM Dimming (Duty) Ratio	-	5	-	100	%	4
PWM Impedance	ZPWM	20	40	60	k	
PWM Frequency	FPWM	200	-	2000	Hz	5
PWM High Level Voltage	VPWM_H	3.0	-	5.5	V	
PWM Low Level Voltage	VPWM_L	0	-	0.5	V	
LED_EN High Voltage	VLED_EN_H	3.0	-	5.5	V	
LED_EN Low Voltage	VLED_EN_L	0	-	0.5	V	
Life Time		12,000	-	-	Hrs	6

Note)

1. 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.

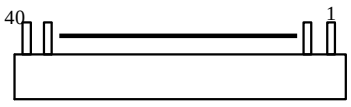


2. This impedance value is needed to proper display and measured form LVDS Tx to the mating connector.
3. The specified LED current and power consumption are under the Vled = 12.0V , 25 , Dimming of Max luminance whereas White pattern is displayed and fv is the frame frequency.
4. The operation of LED Driver below minimum dimming ratio may cause flickering or reliability issue.
5. 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.
6. The life time is determined as the time at which brightness of LCD at the typical LED current is 50% compare to that of minimum value specified in table 7. under general user condition.

3-2. Interface Connections

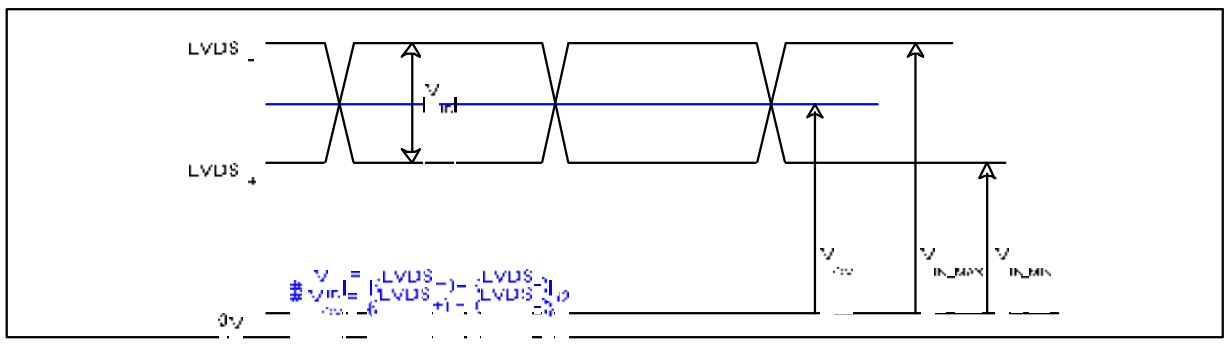
This LCD employs one interface connections, a 40 pin connector is used for the module electronics interface and LED Driver.
The electronics interface connector is a model IS050-L40B-C1 manufactured by I-PEX.

Table 3. MODULE CONNECTOR PIN CONFIGURATION (CN1)

Pin	Symbol	Description	Notes
1	NC	No connection	1, Interface chips 1.1 LCD : SW, SW0624 (LCD Controller) including LVDS Receiver 1.2 System : THC63LVDF823A or equivalent * Pin to Pin compatible with LVDS 2. Connector 2.1 LCD:CABLINE-VS RECE ASS'Y, I-PEX GT05Q-40S-H10, LSM IS050-L40B-C10, UJU or equivalent 2.2 Mating : CABLINE-VS PLUG CABLE ASS'Y or equivalent 2.3 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	NC	No Connection	
6	Clk EEDID	DDC Clock	
7	DATA EEDID	DDC Data	
8	Odd_RIN 0-	Negative LVDS differential data input	
9	Odd_RIN 0+	Positive LVDS differential data input	
10	GND	Ground	
11	Odd_RIN 1-	Negative LVDS differential data input	
12	Odd_RIN 1+	Positive LVDS differential data input	
13	GND	Ground	
14	Odd_RIN 2-	Negative LVDS differential data input	
15	Odd_RIN 2+	Positive LVDS differential data input	
16	GND	Ground	
17	Odd_CLKIN-	Negative LVDS differential clock input	
18	Odd_CLKIN+	Positive LVDS differential clock input	
19	GND	Ground	
20	NC	No Connection	
21	NC No Connection		
22	GND	Ground	
23	NC	No Connection	
24	NC	No Connection	
25	GND	Ground	
26	NC	No Connection	
27	NC	No Connection	
28	GND	Ground	
29	NC	No Connection	
30	NC	No Connection	
31	VLED_GND	LED Ground	
32	VLED_GND	LED Ground	
33	VLED_GND	LED Ground	
34	NC	No Connection	
35	BLIM	PWM for Luminance control	
36	LED_EN	Backlight On/Off Control	
37	NC	No Connection (Reserved)	
38	VLED	LED Power Supply (7V-20V)	
39	VLED	LED Power Supply (7V-20V)	
40	VLED	LED Power Supply (7V-20V)	

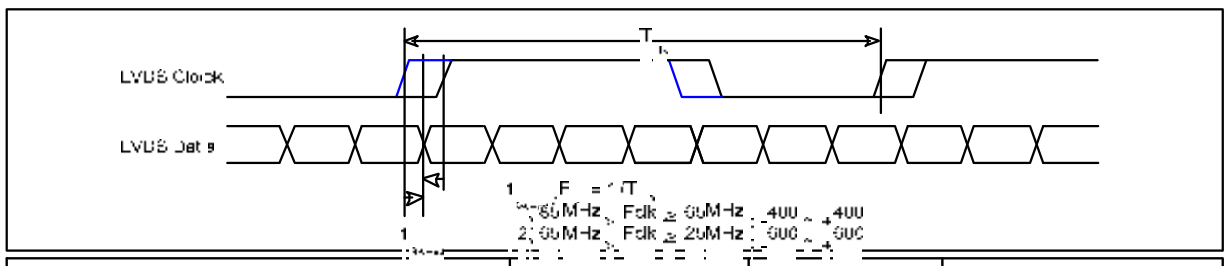
3-3. LVDS Signal Timing Specifications

3-3-1. DC Specification

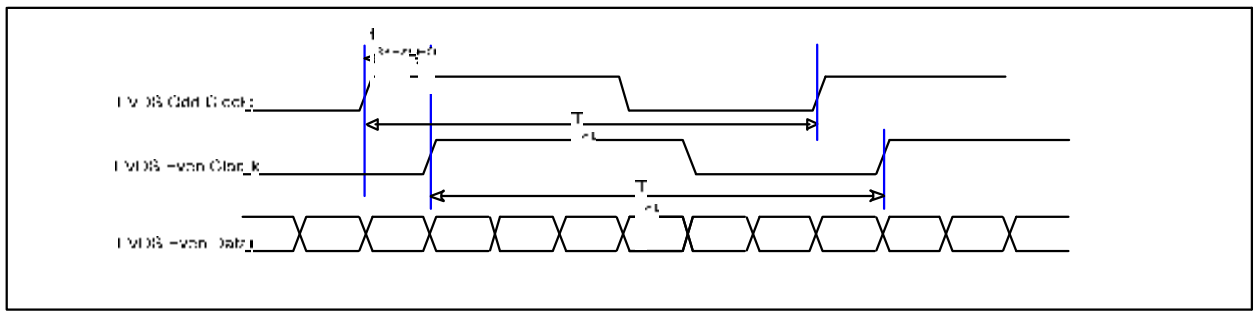


Description	Symbol	Min	Max	Unit	Notes
LVDS Differential Voltage	|VID|	100	600	mV	-
LVDS Common mode Voltage	VCM	0.6	1.8	V	-
LVDS Input Voltage Range	VIN	0.3	2.1	V	-

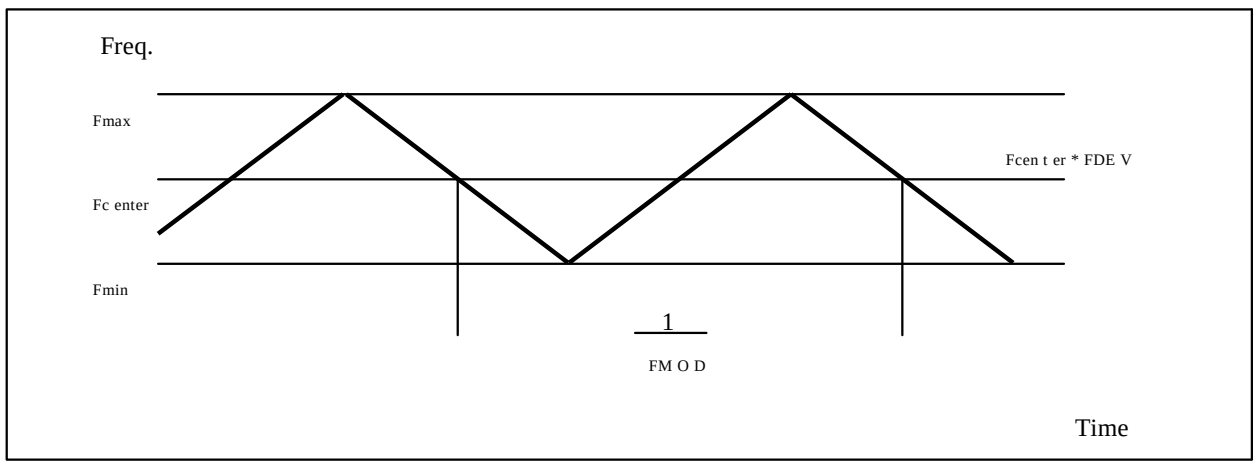
3-3-2. AC Specification



Description	Symbol	Min	Max	Unit	Notes
LVDS Clock to Data Skew Margin	tSKEW	- 400	+ 400	ps	85MHz > Fclk 65MHz
	tSKEW	- 600	+ 600	ps	65MHz > Fclk 25MHz
LVDS Clock to Clock Skew Margin (Even to Odd)	tSKEW_EO	-1/7	+ 1/7	Tclk	-
Maximum deviation of input clock frequency during SSC	FDEV	-	± 3	%	-
Maximum modulation frequency of input clock during SSC	FMOD	-	200	KHz	-



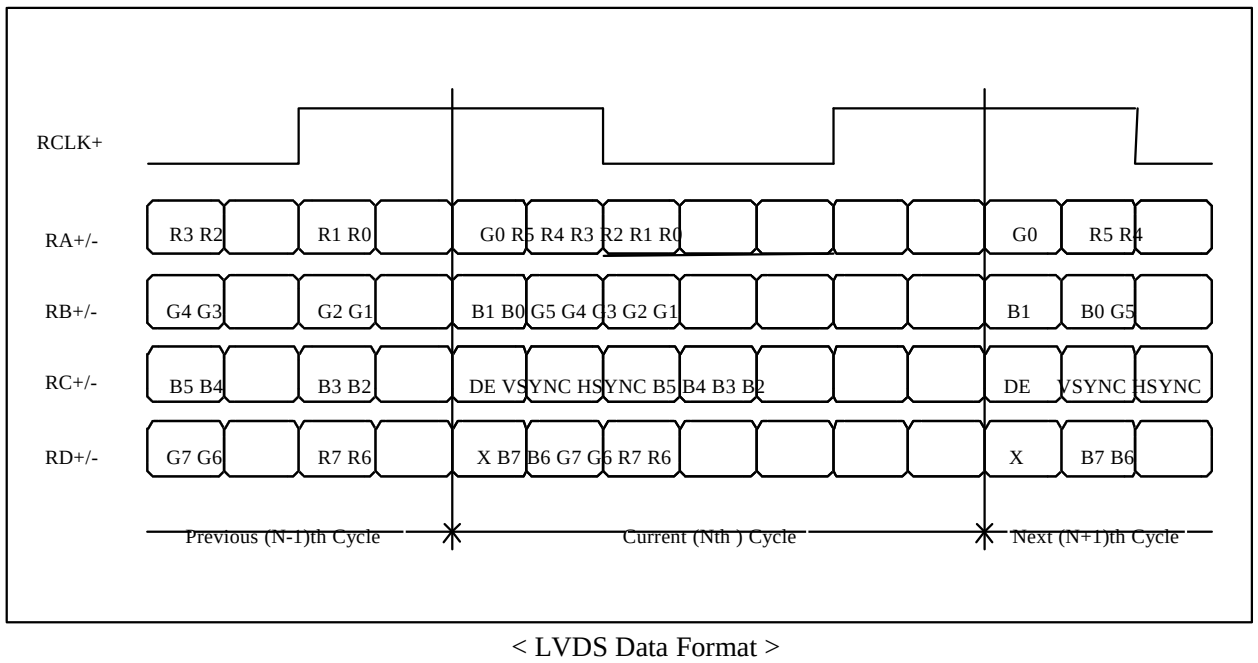
< Clock skew margin between channel >



< Spread Spectrum >

3-3-3. Data Format

1) LVDS 1 Port



< LVDS Data Format >

3-4. Signal Timing Specifications

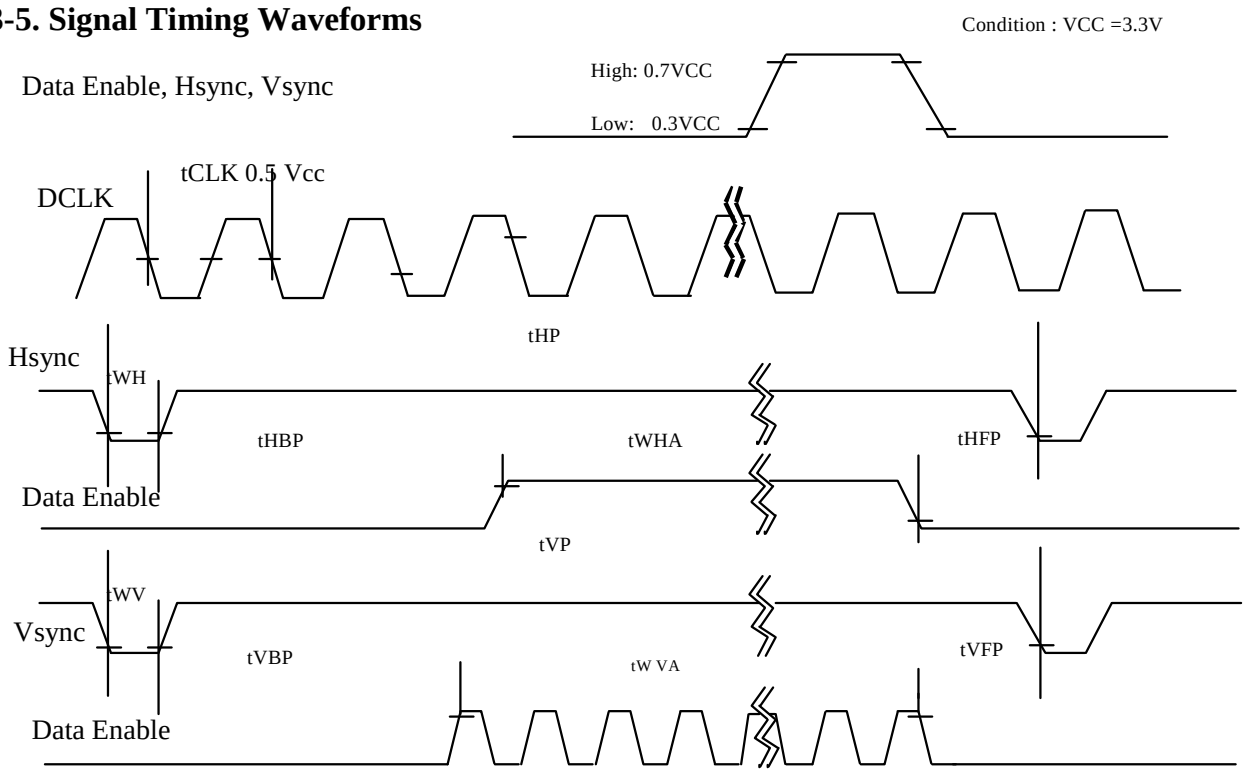
This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications and specifications of LVDS Tx/Rx for its proper operation.

Table 4. TIMING TABLE

ITEM	Symbol		Min.	Typ.	Max.	Unit	Note
Dclk	Frequency	fCLK	66.5	72.3	76.2	MHz	
Hsync	Period	tHP	1430	1526	1586	tCLK	
	Blank	tHFP + tWHA + tVBP	64	160	220		
	Active	tWH	1366	1366	1366		
Vsync	Period	tHFP + tWHA + tVBP	775	790	801	tHP	
	Blank	tVP	7	22	33		
	Active	tWH	768	768	768		

DE Mode Only

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
	Yello w	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

3-7-1. Logic Power and LVDS Signal Sequence

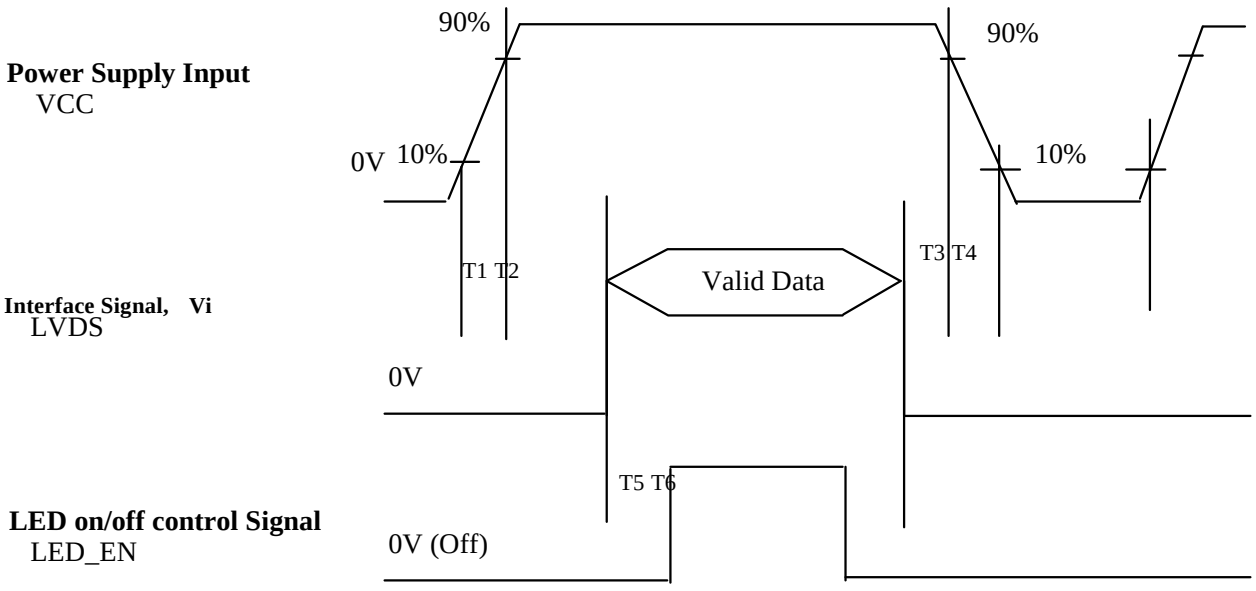


Table 6. POWER SEQUENCE TABLE

Parameter	Value			Units
	Min.	Typ.	Max.	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	400	-	-	ms
T5	200	-	-	ms
T6	200	-	-	ms

Note)
1. Valid Data has to meet “3-3. LVDS Signal Timing Specifications”
2. Please avoid floating state of interface signal at invalid period.
3. When the interface signal is invalid, be sure to pull down the power supply for LCD VCC to 0V.
4. LED power must be turn on after power supply for LCD and interface signal are valid.

3-7-2. LED_EN , PWN and LED Power Sequence

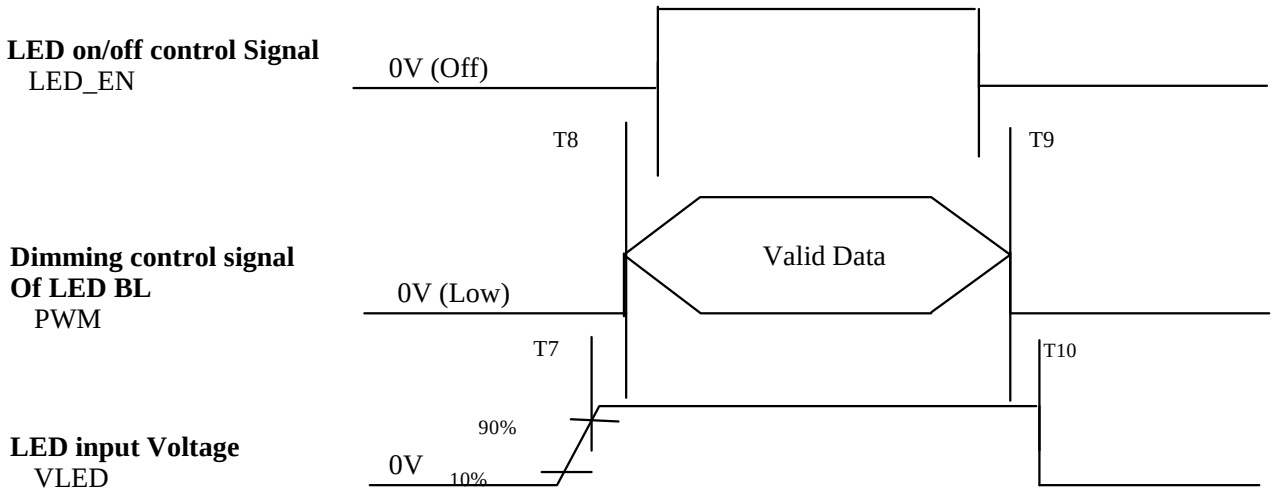


Table 7. LED POWER SEQUENCE TABLE

Parameter	Value			Units
	Min.	Typ.	Max.	
T7	10	-	-	ms
T8	0	-	-	ms
T9	0	-	-	ms
T10	10	-	-	ms

Note)
1. Valid Data of Control signal has to meet “3-1. Electrical Characteristics”

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 and equal to 0°.
FIG. 1 presents additional information concerning the measurement equipment and method.

FIG. 1 Optical Characteristic Measurement Equipment and Method

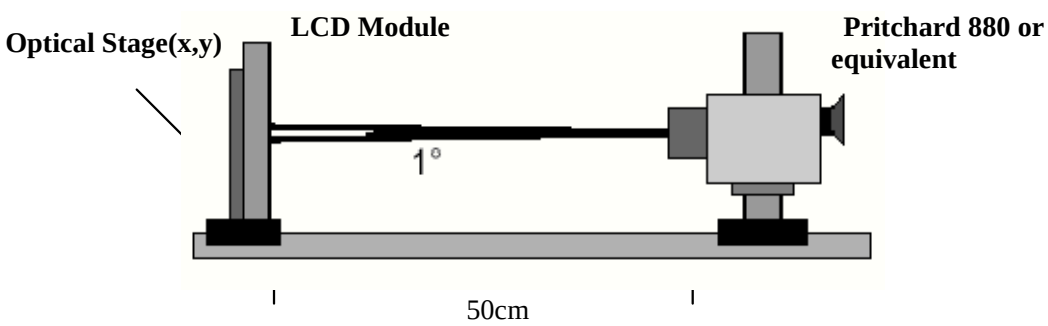


Table 8. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, fV=60Hz, fCL K = 72.3MHz

Parameter S ymbol			Values			Units	Notes
			Min	Typ	Max		
Contrast Ratio		CR	400	500	-		1
Surface Luminance, white		LW H	170	200	-	cd/m2	2
Luminance Variation		W HI T E	60	-	-	%	3
Response Time			-	16	25	ms	4
Color Coordinates		TrR + TrD					
	RED	RX	0.562	0.592	0.622		
		RY	0.311	0.341	0.371		
	GREEN	GX	0.290	0.320	0.350		
		GY	0.507	0.537	0.567		
	BLUE	BX	0.122	0.152	0.182		
		BY	0.112	0.142	0.172		
	WHITE	WX	0.283	0.313	0.343		
		WY	0.299	0.329	0.359		
Viewing Angle							5
	x axis, right(=0°)	r	40	-	-	degree	
	x axis, left (=180°)	l	40	-	-	degree	
	y axis, up (=90°)	u	10	-	-	degree	
	y axis, down (=270°)	d	30	-	-	degree	
Color Gamut		%	-	45	-		
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 ac ross the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 1.

LWH = Average(L1,L2, … L5)

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

$$\text{WHITE} = \frac{\text{Minimum (L1,L2, … L13)}}{\text{Maximum (L1,L2, … L13)}} \times 100$$

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.

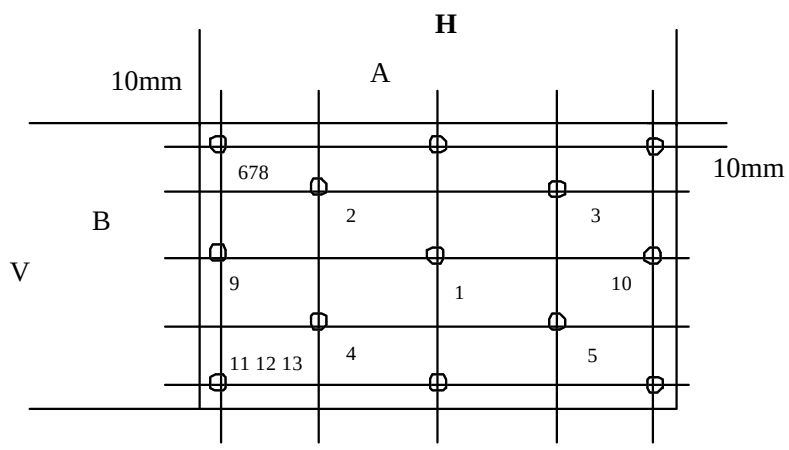
6. Gray scale spec ification

* fV = 60Hz

Gray Level	Luminance [%] (Typ)
L0	0.18
L7	1.70
L15	6.14
L23	12.9
L31	21.7
L39	34.8
L47	52.4
L55	73.8
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 **Active Area**

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

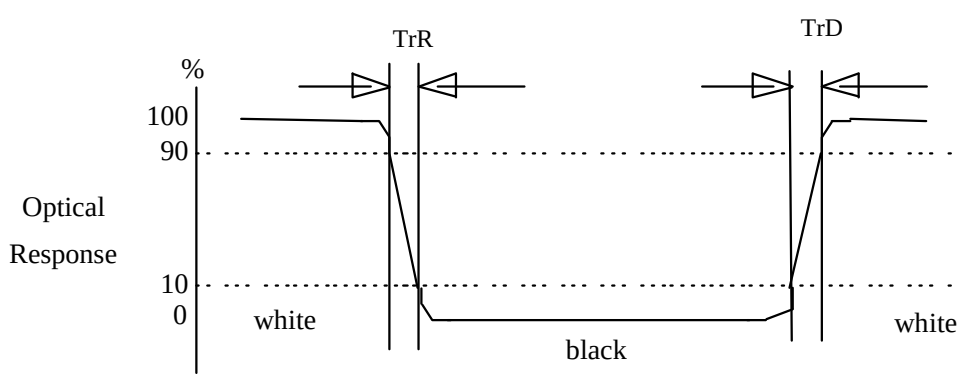


FIG. 4 Viewing angle

<Dimens ion of viewing angle range>