SPECIFICATION
FOR
APPROVAL

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

Title	15.4” WXGA+ TFT LCD

Customer	Apple
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LP154WP4
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.

APPROVED BY	SIGNATURE
J. K. Kim / S.Manager	
REVIEWED BY	
K. T. Moon / Manager	
PREPARED BY	
I. Y. Jung / Engineer	

Products Engineering Dept.
LG Display Co., Ltd

Contents

RECORD OF REVISIONS

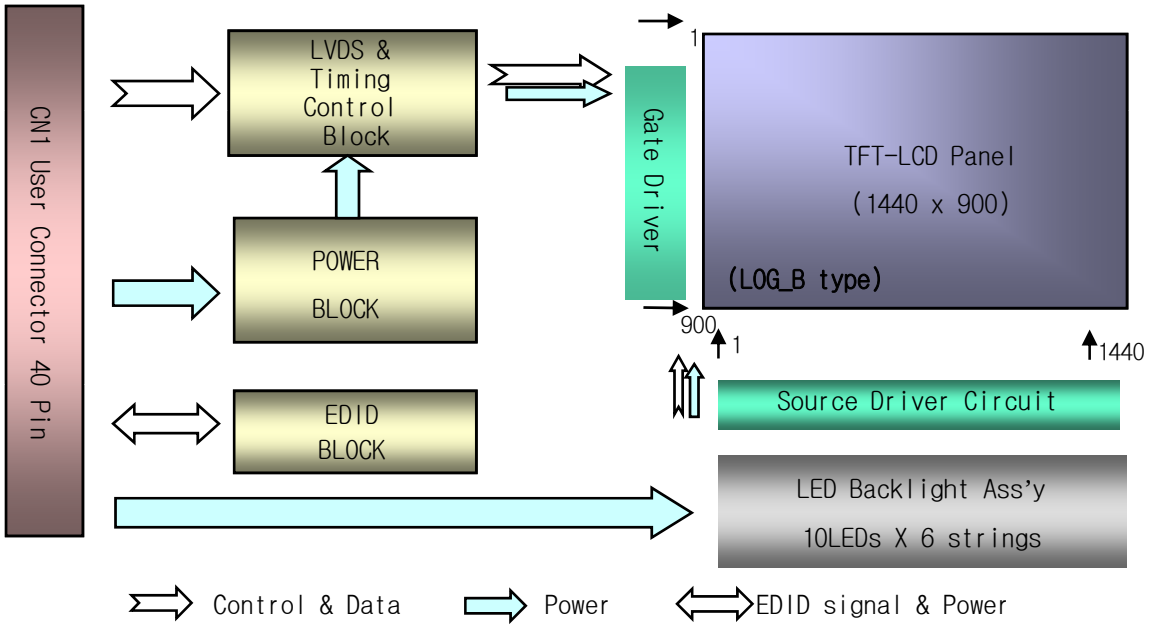
Revision No	Revision Date	Page	Description	EDID ver
0.0	Feb. 12. 2009	-	First Draft	0.1
0.1	Mar. 18. 2009	4, 19	Weight Changed : 450g (max.) → 440g (max.)	0.1
0.2	Apr. 07. 2009	21	Drawing changed (Label)	0.1

1. General Description

The LP154WP4 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 15.4 inches diagonally measured active display area with WXGA+ resolution(1440 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 LP154WP4 has been designed to apply the interface method that enables low power, high speed, low EMI.

The LP154WP4 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 LP154WP4 characteristics provide an excellent flat display for office automation products such as Notebook PC.



General Features

Active Screen Size	15.4 inches diagonal
Outline Dimension	342.85(H) × 220.84(V) × 4.03(D, Max.) mm
Pixel Pitch	0.2301 mm × 0.2301 mm
Pixel Format	1440 horiz. by 900 vert. Pixels RGB strip arrangement
Color Depth	6-bit, 262,144 colors
Luminance, White	330 cd/m^2(Typ., @I_{LED}=20mA) , 160 points Average
Power Consumption	Total 5.06 Watt @ LCM circuit 1.1 Watt (Typ. Mosaic pattern), B/L 3.96 Watt
Weight	440g (Max.)
Display Operating Mode	Transmissive mode, normally white
Surface Treatment	Hard coating (glare) & Anti-Reflection treatment of the Front polarizer

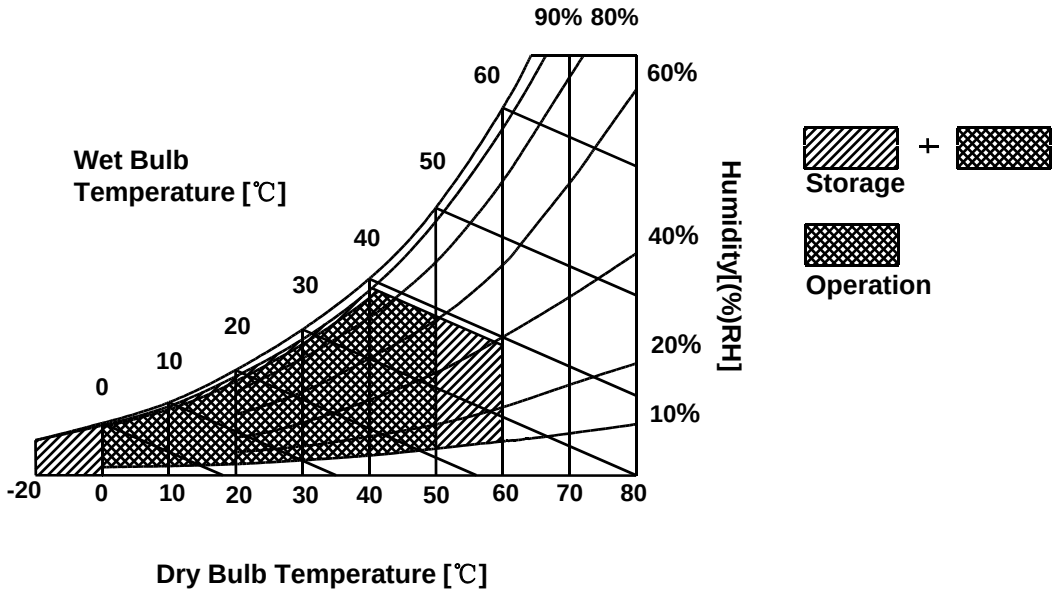
2. Absolute Maximum Ratings

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

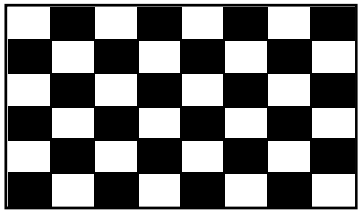
The LP154WP4 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input which powers the LED BL.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
MODULE :						
Power Supply Input Voltage	VCC	3.0	3.3	3.6	V_{DC}	
Power Supply Input Current	I_{CC} Mosaic	-	355	380	mA	1
Power Consumption	Pc	-	1.15	1.25	Watt	1
Differential Impedance	Zm	90	100	110	Ohm	2
Inrush Current	I_{RUSH}	-	-	1.5	A	3
LED Backlight :						
Operating Voltage	V_{LED}	-	30		V	
Operating Current per string	I_{LED}	-	20	-	mA	4
Power Consumption	P_{BL}	-	3.96		Watt	5
Life Time		10,000	-	-	Hrs	6

Note)

1. The specified 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 inrush current is measured under a maximum or minimum Vcc in black pattern.
4. The typical operating current is for the typical surface luminance (L_{WH}) in optical characteristics. I_{LED} is the current of each LEDs' string, LED backlight has 6 strings on it.
5. The LED power consumption shown above does not include power of external LED driver circuit for typical current condition.
6. The life time is determined as the time at which brightness of LED is 50% compare to that of initial value at the typical LED current.

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.
The electronics interface connector is a model 20474-040E-12 manufactured by I-PEX.

Table 3. MODULE CONNECTOR PIN CONFIGURATION (CN1)

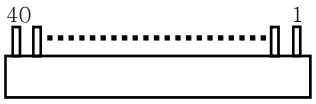
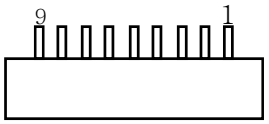
Pin	Symbol	Description	Notes
1	GND	Ground	[LVDS Receiver] Magna chip, D10D40T642L [Connector] 20474-040E-12(I-PEX), 40pin [Connector pin arrangement] LCD rear view 
2	VCC	Power Supply, 3.3V Typ.	
3	VCC	Power Supply, 3.3V Typ.	
4	V EEDID	DDC 3.3V power	
5	Vsync	Vsync (GSP)	
6	Clk EEDID	DDC Clock	
7	DATA EEDID	DDC Data	
8	RA1-	Negative LVDS differential data input	
9	RA1+	Positive LVDS differential data input	
10	GND	Ground	
11	RB1-	Negative LVDS differential data input	
12	RB1+	Positive LVDS differential data input	
13	GND	Ground	
14	RC1-	Negative LVDS differential data input	
15	RC1+	Positive LVDS differential data input	
16	GND	Ground	
17	RCLK1-	Negative LVDS differential data input	
18	RCLK1+	Positive LVDS differential data input	
19	GND	Ground	
20	RA2-	Negative LVDS differential data input	
21	RA2+	Positive LVDS differential data input	
22	GND	Ground	
23	RB2-	Negative LVDS differential data input	
24	RB2+	Positive LVDS differential data input	
25	GND	Ground	
26	RC2-	Negative LVDS differential data input	
27	RC2+	Positive LVDS differential data input	
28	GND	Ground	
29	RCLK2-	Negative LVDS differential data input	
30	RCLK2+	Positive LVDS differential data input	
31	Vdc1	LED Cathode (Negative)	
32	Vdc2	LED Cathode (Negative)	
33	Vdc3	LED Cathode (Negative)	
34	Vdc4	LED Cathode (Negative)	
35	Vdc5	LED Cathode (Negative)	
36	Vdc6	LED Cathode (Negative)	
37	NC	No Connection	
38	Vdc(123456)	LED Anode (Positive)	
39	Vdc(123456)	LED Anode (Positive)	
40	Vdc(123456)	LED Anode (Positive)	

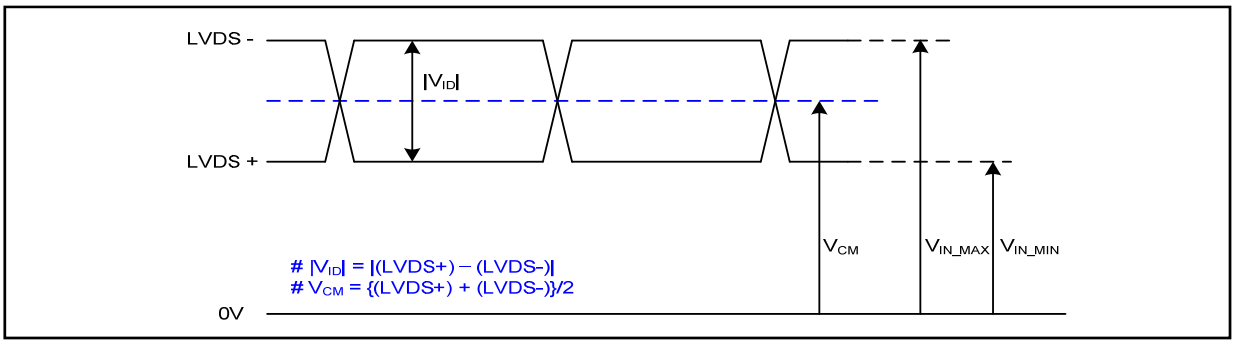
Table 4. BACKLIGHT CONNECTOR PIN CONFIGURATION (CN2)

The LED backlight connector is a model TF12-9S-0.5H, manufactured by Hirose.

Pin	Symbol	Description	Notes
1	Vdc(1,2,3,4,5,6)	LED Anode(Positive)	
2	Vdc(1,2,3,4,5,6)	LED Anode(Positive)	
3	NC	No Connection	
4	Vdc1	LED Cathode (Negative)	
5	Vdc5	LED Cathode (Negative)	
6	Vdc3	LED Cathode (Negative)	
7	Vdc4	LED Cathode (Negative)	
8	Vdc5	LED Cathode (Negative)	
9	Vdc6	LED Cathode (Negative)	

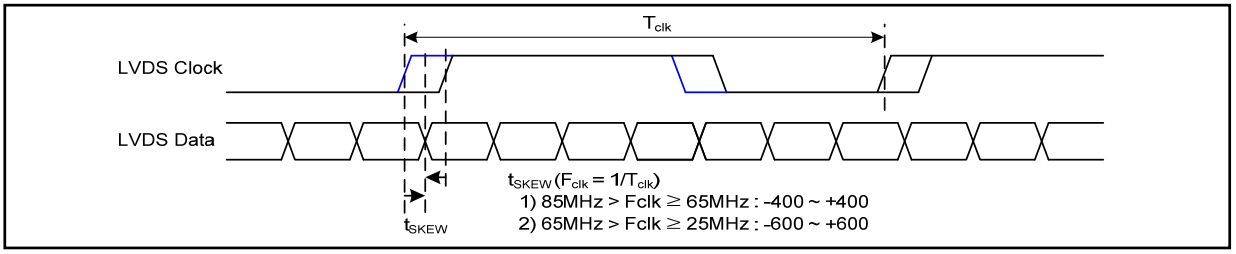
3-3. LVDS Signal Timing Specifications

3-3-1. DC Specification

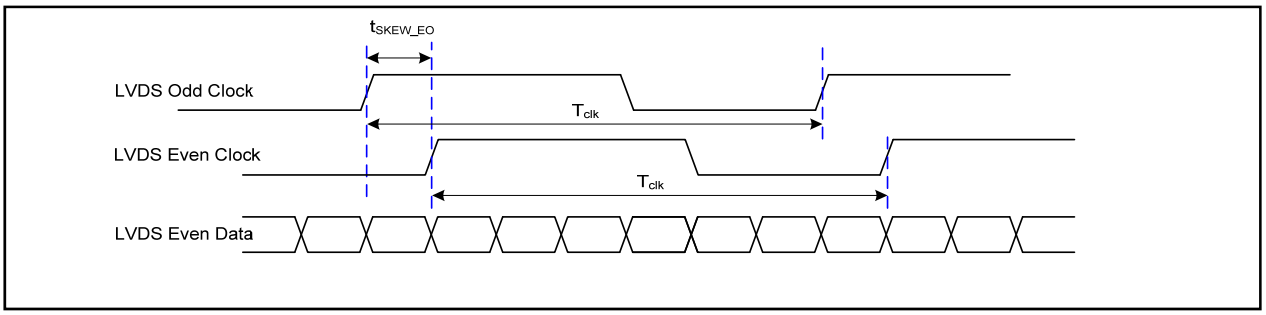


Description	Symbol	Min	Max	Unit	Notes
LVDS Differential Voltage	$\|V_{ID}\|$	100	600	mV	-
LVDS Common mode Voltage	V_{CM}	0.6	1.8	V	-
LVDS Input Voltage Range	V_{IN}	0.3	2.1	V	-

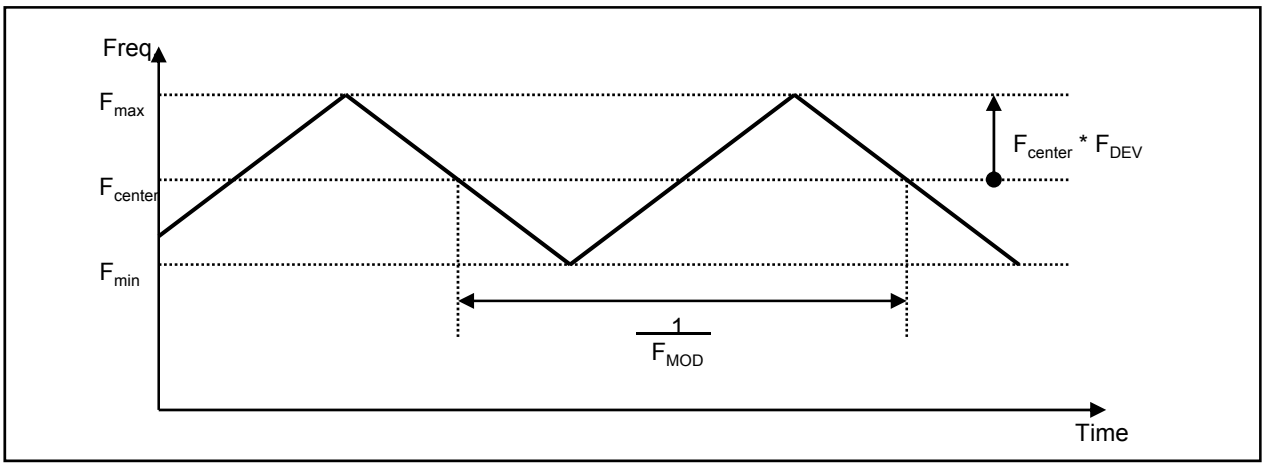
3-3-2. AC Specification



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	-



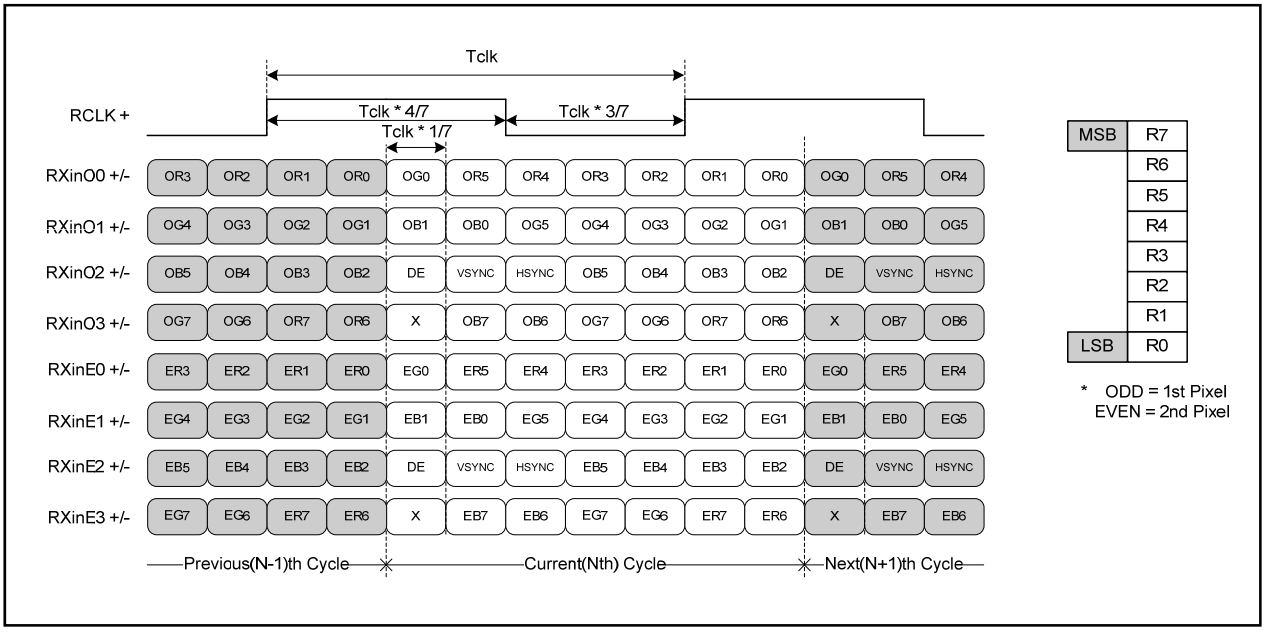
< Clock skew margin between channel >



< Spread Spectrum >

3-3-3. Data Format

☐ LVDS 2 Port



< LVDS Data Format >

3-4. Signal Timing Specifications

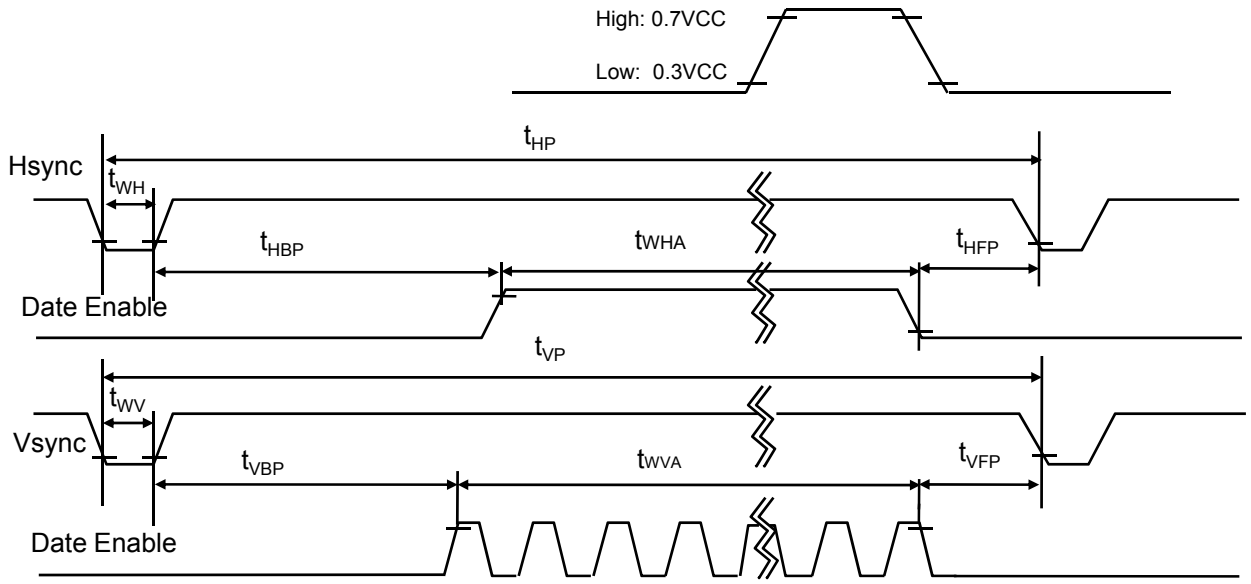
This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications and specifications of LVDS Tx/Rx for its proper operation.

Table 5. TIMING TABLE

ITEM	Symbol		Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	f_{CLK}	-	88.750	-	MHz	
Hsync	Active	tw_{HA}	1440	1440	1440	tCLK	
	Period	t_{HP}	1520	1600	1680		
	Width-Active	t_{WH}	24	32	40		
Vsync	Active	tw_{VA}	900	900	900	tHP	
	Period	t_{VP}	911	926	938		
	Width-Active	t_{WV}	2	6	10		
Data Enable	Horizontal back porch	t_{HBP}	48	80	144	tCLK	
	Horizontal front porch	t_{HFP}	8	48	56		
	Vertical back porch	t_{VBP}	7	17	23	tHP	
	Vertical front porch	t_{VFP}	2	3	6		

3-5. Signal Timing Waveforms

Condition : V_{CC} =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 6. 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

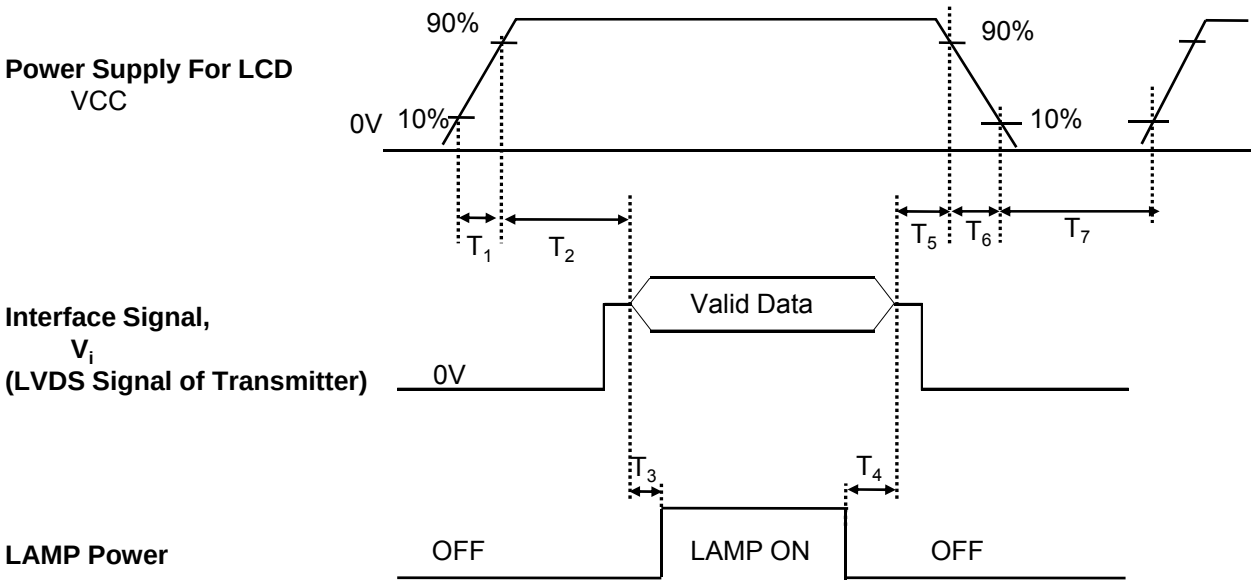


Table 7. POWER SEQUENCE TABLE

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

Note)
1. Valid Data is Data 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. Lamp power must be turn on after power supply for LCD and interface signal are valid.

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

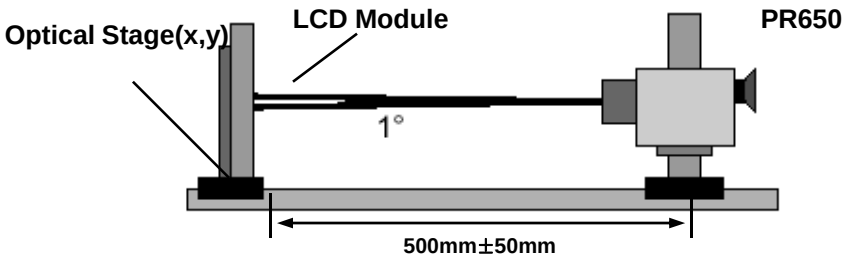


Table 8. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, fv=60Hz, f_{CLK}=88.75MHz, ILED = 20mA

Parameter		Symbol	Condition	Values			Units	Notes
				Min	Typ	Max		
Average Luminance		L_{AVE}	160 Points (I_{LED}= 18mA)	280	330		cd/㎡	Fig 2
Luminance variation		%	160 points	60	70		-	Fig 2
C/R		-	Center 1 Point	600	800		-	
Response time		$Tr_R + Tr_D$	-	-	16	25	ms	Fig 3
Viewing angle	Horizontal	Θ	ϕx(Left,Right)	±65	±70	-	°	Fig 4
	Vertical	Θ	ϕyu(Up)	50	60	-		
		Θ	ϕyd(Down)	50	60	-		
Worst neighbor Brightness uniformity		%		70				
White chromaticity deviation (W.R.T center)			d u'v'	-	-	0.008		
White chromaticity deviation (Over panel)			d u'v'	-	-	0.0084		
White chromaticity deviation (Worst neighbor)			d u'v'	-	-	0.0025		
Cross Talk		D_{SHA}	-	-	-	4.0	%	Fig 5
Gray Scale		-	-	-				

Table 9. RGB Color Chromaticity

	White		Red		Green		Blue	
	Wx	Wy	Rx	Ry	Gx	Gy	Bx	By
Max.	0.343	0.359	TBD	TBD	TBD	TBD	TBD	TBD
Typ.	0.313	0.329	TBD	TBD	TBD	TBD	TBD	TBD
Min.	0.283	0.299	TBD	TBD	TBD	TBD	TBD	TBD

Notes)

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. 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.

3. 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.

4. Gray scale specification * f_V=60Hz

Gray Level	Luminance [%] (Typ)
L0	0.00
L7	0.80
L15	4.25
L23	10.9
L31	21.0
L39	34.8
L47	52.5
L55	74.2
L63	100

5. Average Luminance

Ave. = SUM(L1:L160) / 160

where L1 to L160 are the luminance values measured at point #1 to #160.

6. Luminance Uniformity

Luminance Uniformity:

U = 100% - (Lmax-Lmin)/Lmax

where, Lmax = max {Luminance values at 160 points},

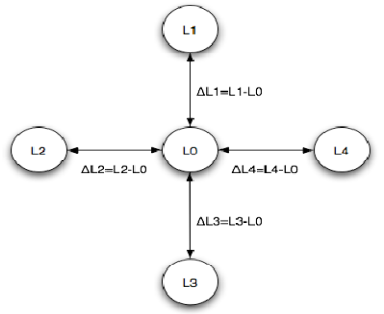
Lmin = min {Luminance values at 160 points}

7. Worst neighbor Luminance Uniformity

Worst Neighbor Luminance Uniformity (The 4 points that are closest to the test point)

WNU=100%-Max(ΔL1, ΔL2, ΔL3, ΔL4)/L0

Global WNU = min (WNU1, …WNU160)



8. White chromaticity deviation – with respect to center

Center color coordinate is defined as the Average of points: 72, 73, 88, 89.

9. White chromaticity deviation – over panel

Maximum delta u'v' between any two measured points over the 160 points

10. White chromaticity deviation – worst neighbor

Maximum delta u'v' between any two neighboring points on the panel

11. White Chromaticity

Average (72, 73, 88, 89 Points)

12. RGB Chromaticity

Center Point

FIG. 2 Luminance

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

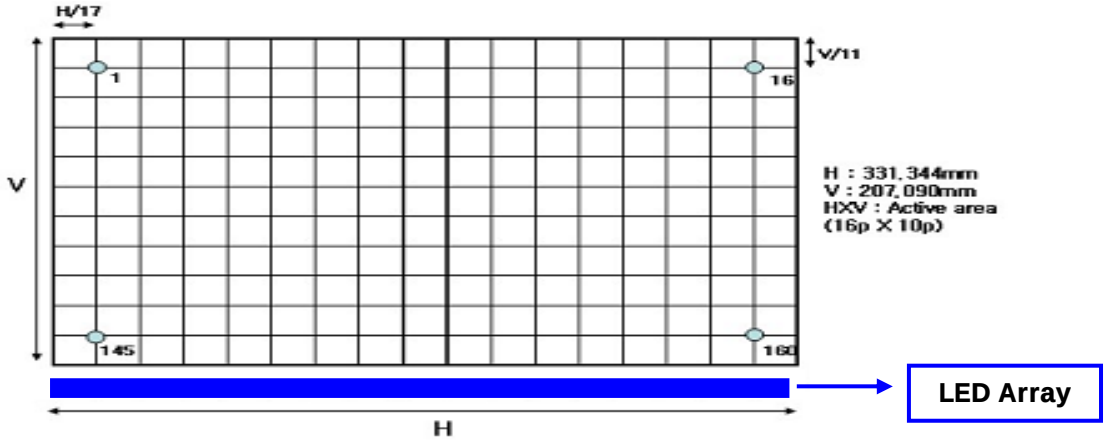


FIG. 3 Response Time

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

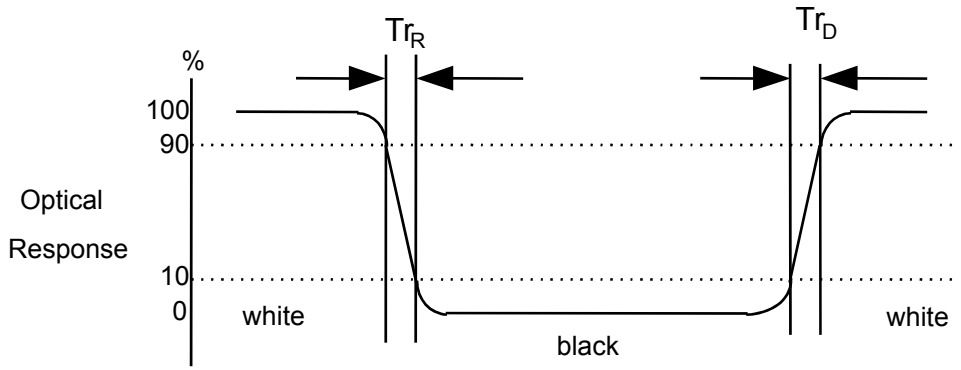


FIG. 4 Viewing angle

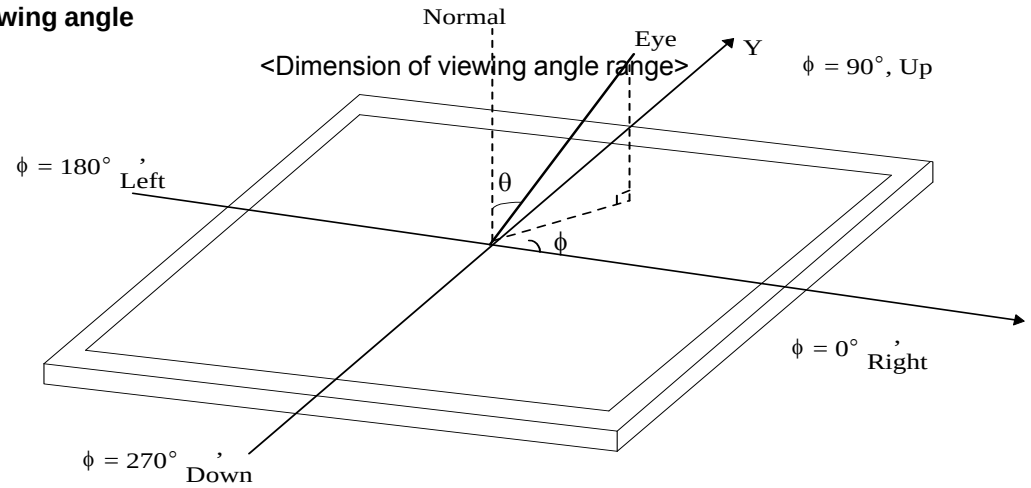


FIG. 5 Cross talk

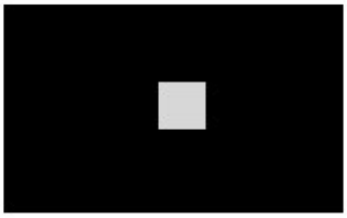
No visual cross-talk will be allowed. Two luminance values are measured at center spot with 50 x 50 pixels. The cross-talk, D_{SHA}, is defined as,

$$D_{SHA} = (L_B - L_A)/L_B \cdot 100\%,$$

Where, L_A = Luminance in Pattern A

L_B = Luminance in Pattern B.

Pattern A



Pattern A
Gray Scale = 31 in center
Black in surrounding area

Pattern B

Pattern B
Gray Scale = 31 full screen

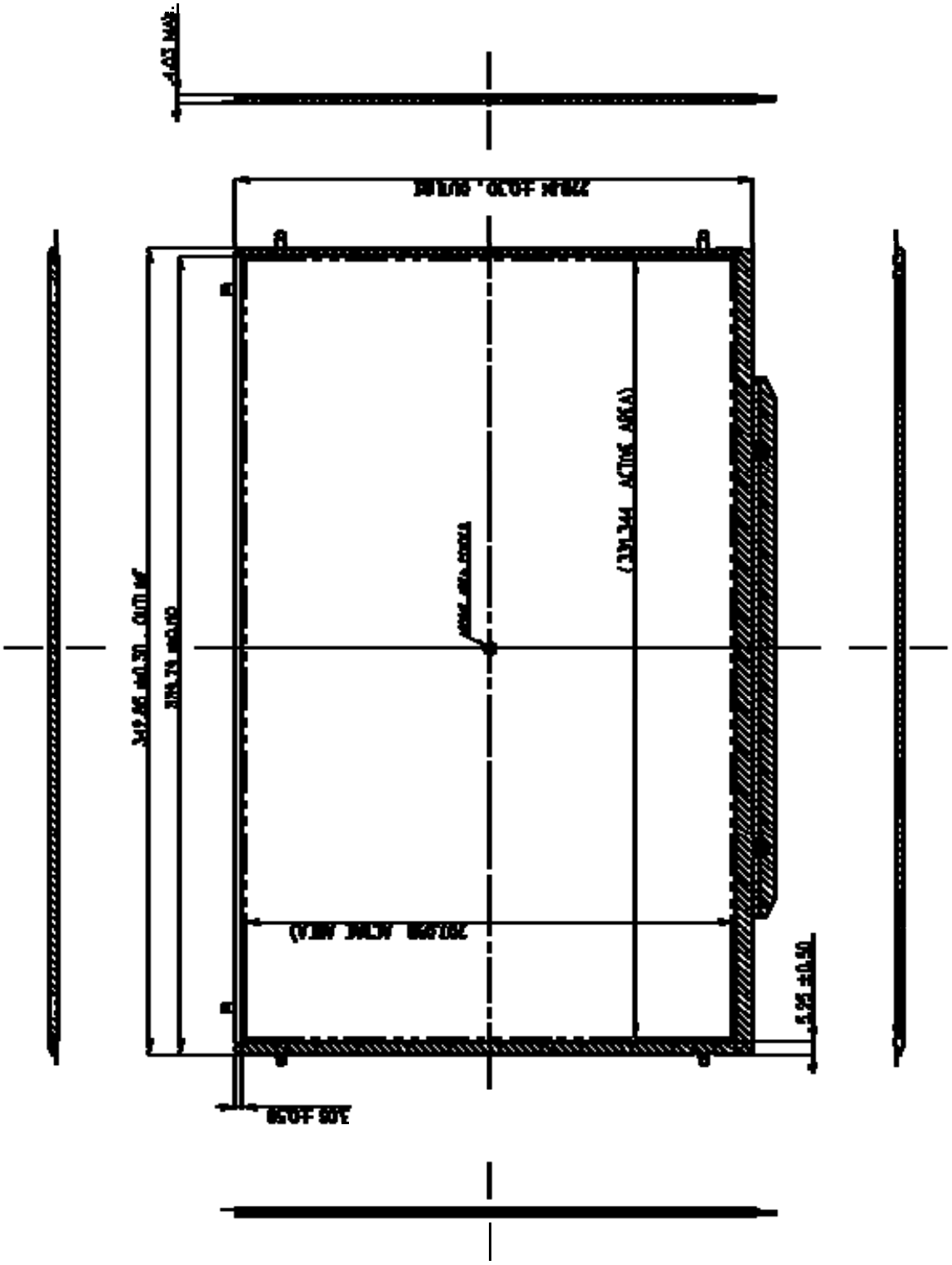
5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LP154WP4.
In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal	342.85 ± 0.30mm
	Vertical	220.84 ± 0.30mm
	Depth	4.03mm(Max)
Polarizer Area	Horizontal	334.54mm
	Vertical	210.29mm
Active Display Area	Horizontal	331.344mm
	Vertical	207.090mm
Weight	440g (Max.)	
Surface Treatment	Hard coating (glare) & Anti-Reflection treatment of the Front polarizer	

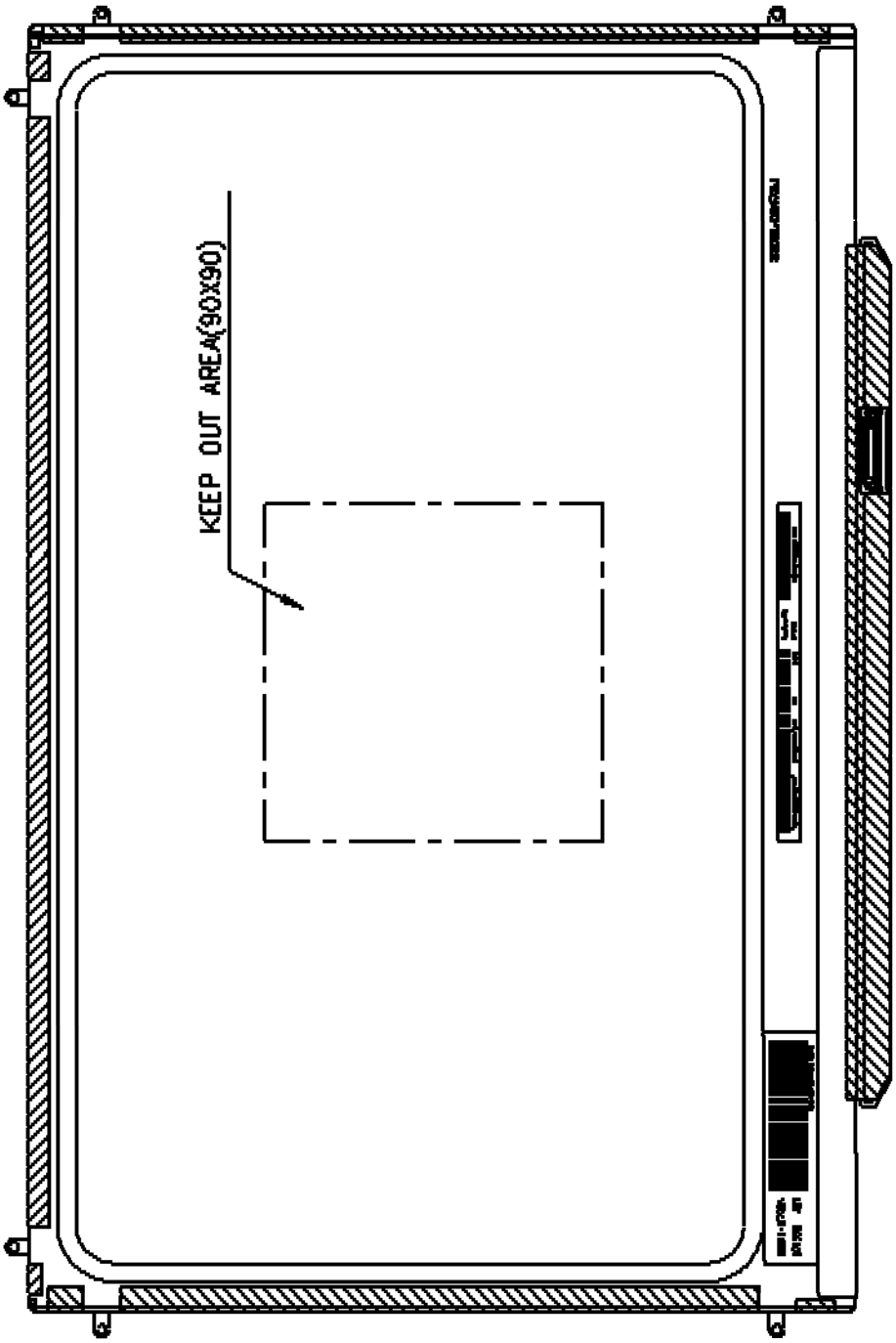
<FRONT VIEW>

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 1950 Third Edition, Underwriters Laboratories, Inc. Jan. 28, 1995.
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.
b) CAN/CSA C22.2 No. 950-95 Third Edition, Canadian Standards Association, Jan. 28, 1995.
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.
c) EN 60950 : 1992+A1: 1993+A2: 1993+A3: 1995+A1: 1997+A11: 1997
IEC 950 : 1991+A1: 1992+A2: 1993+A3: 1995+A1: 1996
European Committee for Electrotechnical Standardization(CENELEC)
EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical Business Equipment.

7-2. EMC

a) ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHZ to 40GHz. “American National Standards Institute(ANSI), 1992
b) C.I.S.P.R “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.“ International Special Committee on Radio Interference.
c) EN 55022 “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.“ European Committee for Electrotechnical Standardization.(CENELEC), 1998

8. Packing

8-1. Designation of Lot Mark

a) Lot Mark

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

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

Note

1. YEAR

Year	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 : 20pcs

b) Box Size : 480mm × W370mm × H296mm

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

	Byte (dec)	Byte (hex)	Field Name and Comments	Value (hex)	Value (binary)
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**	EISA manufacture code (3 Character ID) APP	**06**	00000110
	9	**09**	EISA manufacture code (Compressed ASCII)	**10**	00010000
	10	**0A**	Panel Supplier Reserved - Product Code 9ca3	**A3**	10100011
	11	**0B**	(Hex. LSB first)	**9C**	10011100
	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 year	**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) = 33 cm	**21**	00100001
	22	**16**	Max V image size (Rounded cm) = 21 cm	**15**	00010101
	23	**17**	Display gamma = (gamma*100)-100 = Example:(2.2*100)-100=120 = 2.2 Gamma	**78**	01111000
	24	**18**	Feature Support (no_DPMS, no_Active Off/Very Low Power, RGB color display, Timing BLK 1,no_ GTF)	**0A**	00001010
Panel Color Coordinates	25	**19**	Red/Green Low Bits (RxRy/GxGy)	**F5**	11110101
	26	**1A**	Blue/White Low Bits (BxBy/WxWy)	**95**	10010101
	27	**1B**	Red X Rx = 0.640	**A3**	10100011
	28	**1C**	Red Y Ry = 0.335	**55**	01010101
	29	**1D**	Green X Gx = 0.310	**4F**	01001111
	30	**1E**	Green Y Gy = 0.610	**9C**	10011100
	31	**1F**	Blue X Bx = 0.150	**26**	00100110
	32	**20**	Blue Y By = 0.060	**0F**	00001111
	33	**21**	White X Wx = 0.313	**50**	01010000
	34	**22**	White Y Wy = 0.329	**54**	01010100
Established Timin	35	**23**	Established timing 1 (00h if nt used)	**00**	00000000
	36	**24**	Established timing 2 (00h if nt used)	**00**	00000000
	37	**25**	Manufacturer's timings (00h if nt 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 (binary)
Timing Descriptor #1	54	**36**	Pixel Clock/10,000 (LSB)	88.75 MHz @ 60Hz	**AB**	11010010
	55	**37**	Pixel Clock/10,000 (MSB)		**22**	100101
	56	**38**	Horizontal Active (lower 8 bits)	1440 Pixels	**A0**	10100000
	57	**39**	Horizontal Blanking(Thp-HA) (lower 8 bits)	160 Pixels	**A0**	111000
	58	**3A**	Horizontal Active / Horizontal Blanking(Thp-HA) (upper 4:4bits)		**50**	01010001
	59	**3B**	Vertical Avtive	900 Lines	**84**	10000100
	60	**3C**	Vertical Blanking (Tvp-HA) (DE Blanking typ.for DE only panels)	26 Lines	**1A**	10111
	61	**3D**	Vertical Active : Vertical Blanking (Tvp-HA) (upper 4:4bits)		**30**	00110000
	62	**3E**	Horizontal Sync. Offset (Thfp)	48 Pixels	**30**	01000000
	63	**3F**	Horizontal Sync Pulse Width (HSPW)	32 Pixels	**20**	00100000
	64	**40**	Vertical Sync Offset(Tvfp) : Sync Width (VSPW)	3 Lines : 6 Lines	**36**	00110011
	65	**41**	Horizontal Vertical Sync Offset/Width (upper 2bits)		**00**	00000000
	66	**42**	Horizontal Image Size (mm)	331 mm	**4B**	01001011
	67	**43**	Vertical Image Size (mm)	207 mm	**CF**	11001111
	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)		**18**	00011000
Timing Descriptor #2	72	**48**	Flag		**00**	00000000
	73	**49**	Flag		**00**	00000000
	74	**4A**	Flag		**00**	00000000
	75	**4B**	Data Type Tag (Descriptor Defined by manufacturer)		**01**	00000001
	76	**4C**	Flag (Version)		**00**	00000000
	77	**4D**	Descriptor Defined by manufacturer (Apple EDID signature)	APP	**06**	00000110
	78	**4E**	Descriptor Defined by manufacturer (Apple EDID signature)		**10**	00010000
	79	**4F**	Descriptor Defined by manufacturer (Link Type)		**30**	00110000
	80	**50**	Descriptor Defined by manufacturer (Pixel and link component format_6bit panel interface)		**00**	00000000
	81	**51**	Descriptor Defined by manufacturer (Panel feature_Inverter NA, no Inverter)		**00**	00000000
	82	**52**	Descriptor Defined by manufacturer		**00**	00000000
	83	**53**	Descriptor Defined by manufacturer		**00**	00000000
	84	**54**	Descriptor Defined by manufacturer		**00**	00000000
	85	**55**	Descriptor Defined by manufacturer		**00**	00000000
	86	**56**	Descriptor Defined by manufacturer		**00**	00000000
	87	**57**	Descriptor Defined by manufacturer		**00**	00000000
	88	**58**	Descriptor Defined by manufacturer		**0A**	00001010
	89	**59**	Descriptor Defined by manufacturer		**20**	00100000
Timing Descriptor #3	90	**5A**	Flag		**00**	00000000
	91	**5B**	Flag		**00**	00000000
	92	**5C**	Flag		**00**	00000000
	93	**5D**	Data Type Tag (ASCII String)		**FE**	11111110
	94	**5E**	Flag		**00**	00000000
	95	**5F**	ASCII String	L	**4C**	01001100
	96	**60**	ASCII String	P	**50**	01010000
	97	**61**	ASCII String	1	**31**	00110001
	98	**62**	ASCII String	5	**35**	00110101
	99	**63**	ASCII String	4	**34**	00110100
	100	**64**	ASCII String	W	**57**	01010111
	101	**65**	ASCII String	P	**50**	01010000
	102	**66**	ASCII String	4	**34**	00110100
	103	**67**	ASCII String	-	**2D**	00101101
	104	**68**	ASCII String	T	**54**	01010100
	105	**69**	ASCII String	L	**4C**	01001100
	106	**6A**	ASCII String	A	**41**	01000001
	107	**6B**	ASCII String	1	**31**	00110001

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

	Byte (dec)	Byte (hex)	Field Name and Comments	Value (HEX)	Value (binary)
Timing Descriptor #4	108	**6C**	Flag	**00**	00000000
	109	**6D**	Flag	**00**	00000000
	110	**6E**	Flag	**00**	00000000
	111	**6F**	Data Type Tag (ASCII String)	**FE**	11111110
	112	**70**	Flag	**00**	00000000
	113	**71**	ASCII String C	**43**	01000011
	114	**72**	ASCII String o	**6F**	01101111
	115	**73**	ASCII String l	**6C**	01101100
	116	**74**	ASCII String o	**6F**	01101111
	117	**75**	ASCII String r	**72**	01110010
	118	**76**	ASCII String	**20**	00100000
	119	**77**	ASCII String L	**4C**	01001100
	120	**78**	ASCII String C	**43**	01000011
	121	**79**	ASCII String D	**44**	01000100
	122	**7A**	ASCII String	**0A**	00001010
	123	**7B**	ASCII String	**20**	00100000
	124	**7C**	ASCII String	**20**	00100000
	125	**7D**	ASCII String	**20**	00100000
Chec	126	**7E**	Extension flag (# f 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)	**00**	11000101