SPECIFICATION
FOR
APPROVAL

( ) Preliminary Specification
(◆) Final Specification

Title	15.4” WSXGA+ TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG.Philips LCD CO., Ltd.
*MODEL	LP154W02
SUFFIX	TL06

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

SIGNATURE	DATE
/	
/	
/	

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

APPROVED BY	DATE
J. H. Lee / S.Manager	
REVIEWED BY	
K.K. Jang / Manager	
PREPARED BY	
J.Y. Park / Engineer	

Product Engineering Dept.
LG. Philips LCD Co., Ltd

RECORDS OF REVISIONS

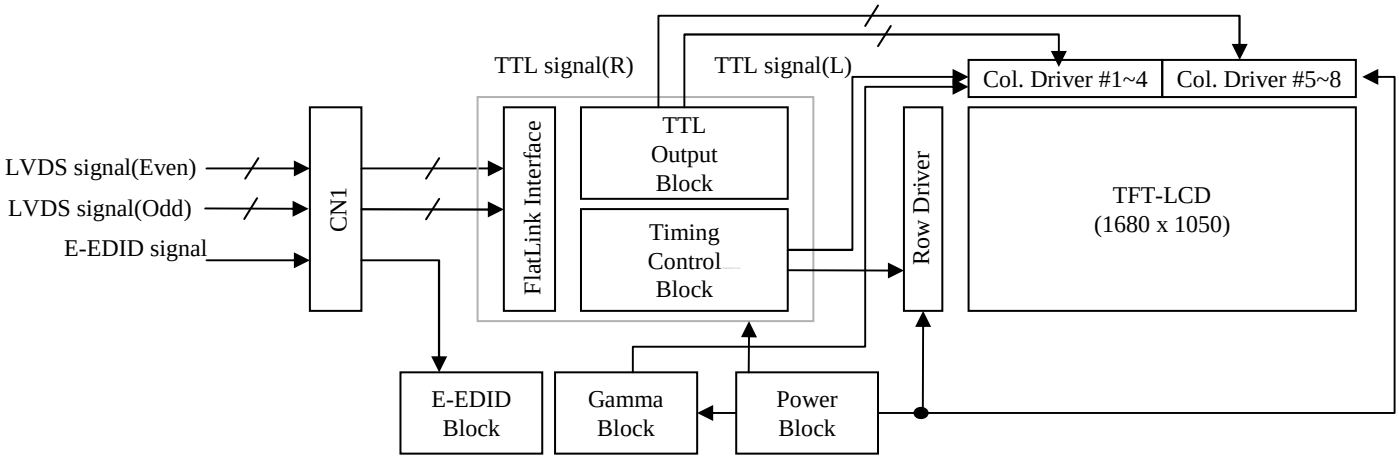
Revision No	Revision Date	Page	Description	EDID ver
0.0	Apr.14. 2005	-	First Draft	0.4
1.0	Aug. 09. 2005	4	General Specification is revised.	0.5
		6	Electrical Characteristics are updated.	
		13	Change of Power Sequence Spec(T4,T7)	
		14,15	Optical Specification is revised.	
		22	Shock test condition is revised.	
		23	International Standard is updated.	
		25	Label Description is added.	
		27-29	Appendix A is revised.	
		30	Appendix B is added.	
1.1	Feb.09.2006	19-21	Mechanical drawing is updated	0.5

1. General Description

The LP154W02(TL06) is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp(CCFL) 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 WSXGA+ resolution(1680 vertical by 1050 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 LP154W02(TL06) has been designed to apply the interface method that enables low power, high speed, low EMI. Flat Link must be used as a LVDS(Low Voltage Differential Signaling) chip.

The LP154W02(TL06) is intended to support applications where thin thickness, low power are critical factors and graphic display are important. In combination with the vertical arrangement of the sub-pixels, the LP154W02(TL06) 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	344.0(H)[typ.] x 222.0(V)[typ.] x 6.5(D) mm[Max.]
Pixel Pitch	0.19725 mm x 0.19725mm
Pixel format	1680 horiz. By 1050 vert. Pixels RGB stripes arrangement
Color depth	6-bit, 262,144 colors
Luminance, white	200nit(Center 1point)
Power Consumption	5.92W (Typ.)
Weight	550g (Typ), 565(Max)
Display operating mode	Transmissive mode, normally white
Surface treatments	Hard coating 2H,Anti-glare,Anti-reflection,Anti-electrostatic treatment of the front polarizer (Nitto Denko AG ARC 150T)
RoHS Comply panel	Yes

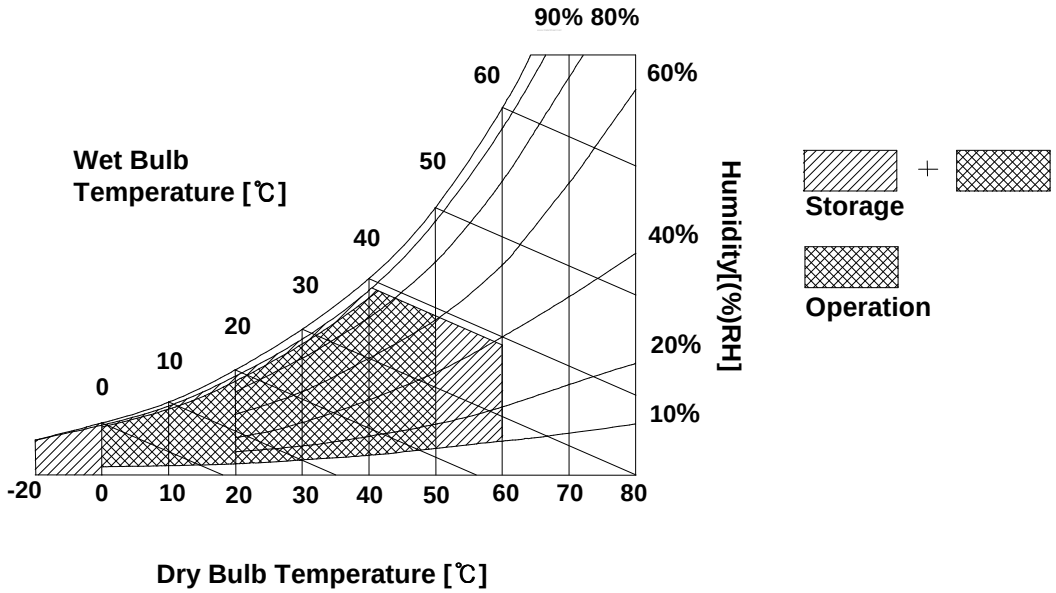
2. Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause operation or damage to the unit.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	symbol	Values		Units	Notes
		Min.	Max.		
Power Input Voltage	V_{CC}	-0.3	4.0	Vdc	At 25 ± 5°C
Operating Temperature	T_{OP}	0	50	°C	1
Storage Temperature	T_{ST}	-20	60	°C	1
Operating Ambient Humidity	H_{OP}	10	90	%RH	1
Storage Humidity	H_{ST}	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 LP154W02(TL06) 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 CCFL, is typically generated by an inverter. The inverter is an external unit to the LCD.

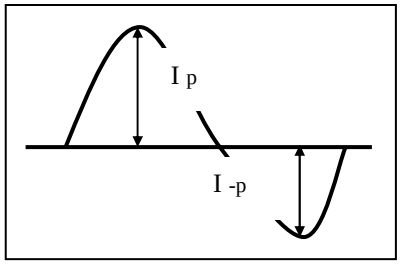
Table 2. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
MODULE						
Power Supply Input Voltage	V_{CC}	3.0	3.3	3.6	Vdc	
Power Supply Input Current	I_{CC}	-	530	610	mA	1
Differential Impedance	Zm	90	100	110	ohm	2
Power Consumption	P_C		1.75	2.01	Watts	1
LAMP						
Operating Voltage	V_{BL}	680	695	835	V_{RMS}	3
Operating Current	I_{BL}	3.0	6.0	6.5	mA	
Established Starting Voltage	V_S					4
at 25 °C		-	-	1170	V_{RMS}	
at 0 °C		-	-	1400	V_{RMS}	
Operating Frequency	f_{BL}	40	60	80	kHz	5
Discharge Stabilization Time	T_S			3	Minutes	6
Power Consumption	P_{BL}	-	4.17	4.42	Watts	7
Life Time		12,000	-	-	Hrs	8

Note : **The design of the inverter must have specification for the lamp in LCD Assembly.**
The performance of the Lamp in LCM, for example life time or brightness, is extremely influenced by the characteristics of the DC-AC inverter. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.
When you design or order the inverter, please make sure unwanted lighting caused by the mismatch of the lamp and the inverter(no lighting, flicker, etc) never occurs. When you confirm it, the LCD Assembly should be operated in the same condition as installed in you instrument.

1. The specified typical current and power consumption are under the V_{CC}=3.3V, 25°C,f_V=60Hz condition whereas window XP Bliss pattern is displayed and f_V is the frame frequency.
2. This impedance value is needed to proper display and measured from LVDS T_X to the mating connector.
3. The variance of the voltage is ± 10%.
4. The voltage above V_S should be applied to the lamps for more than 1 second for start-up. Otherwise, the lamps may not be turned on.

5. The output of the inverter must have symmetrical(negative and positive) voltage waveform and symmetrical current waveform.(Asymmetrical ratio is less than 10%) Please do not use the inverter which has asymmetrical voltage and asymmetrical current and spike wave.
   Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.
6. It is defined the brightness of the lamp after being lighted for 5 minutes as 100%.
   T_S is the time required for the brightness of the center of the lamp to be not less than 95%.
7. The lamp power consumption shown above does not include loss of external inverter.
   The used lamp current is the lamp typical current.
8. The life is determined as the time at which brightness of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at 25 ± 2°C.
9. Do not attach a conducting tape to lamp connecting wire.
   If the lamp wire attach to a conducting tape, TFT-LCD Module has a low luminance and the inverter has abnormal action. Because leakage current is occurred between lamp wire and conducting tape.
10. Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp, are following.
    It shall help increase the lamp lifetime and reduce leakage current.
    a. The asymmetry rate of the inverter waveform should be less than 10%.
    b. The distortion rate of the waveform should be within $\sqrt{2}$ ±10%.
    * Inverter output waveform had better be more similar to ideal sine wave.



* Asymmetry rate:

$| I_p - I_{-p} | / I_{rms} * 100\%$

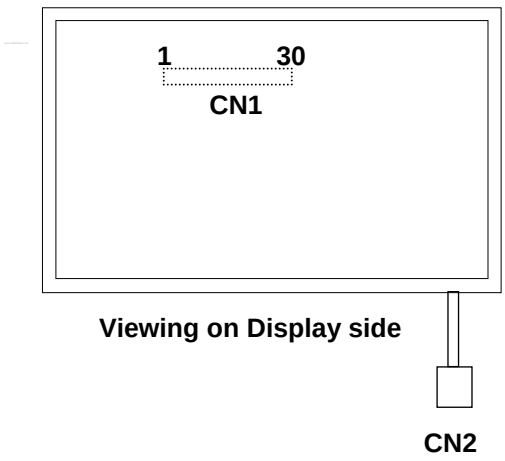
* Distortion rate

I_p (or I_{-p}) / I_{rms}

3-2. Interface Connections

Interface chip must be used FlatLink, part No. THC63LVDF823A(Transmitter made by Thine Inc or equivalence.)
This LCD employs two interface connections, a 30-pin-connector is used for the module electronics and the other connector is used for the integral backlight system.
The electronics interface connector is a model FI-XB30SR-HF11 manufactured by JAE.
The pin configuration for the connector is shown in the table below.

Table 3. MODULE CONNECTOR PIN CONFIGURATION(LVDS)

Pin	Symbol	Description	Notes
1	GND	Ground	1. Interface chips 1.1 LCD : KZ4E053G11(LCD Controller) including LVDS Receiver 1.2 System : THC63LVD823 or equivalent *Pin to Pin compatible with TI LVDS 2. Connector 2.1 LCD : FI-XB30SR-HF11,JAE 2.2 Mating : FI-X30M or equivalent. 2.3 Connector pin arrangement 
2	Vcc	Power(3.3V)	
3	Vcc	Power(3.3V)	
4	VEDID	DDC 3.3V Power	
5	NC	No connect	
6	CLKEDID	DDC clock	
7	DATAEDID	DDC data	
8	Odd_A1M	Differential Signal	
9	Odd_A1P	Differential Signal	
10	GND	Ground	
11	Odd_A2M	Differential Signal	
12	Odd_A2P	Differential Signal	
13	GND	Ground	
14	Odd_A3M	Differential Signal	
15	Odd_A3P	Differential Signal	
16	GND	Ground	
17	Odd_CLKM	Differential Signal	
18	Odd_CLKP	Differential Signal	
19	GND	Ground	
20	Even_A1M	Differential Signal	
21	Even_A1P	Differential Signal	
22	GND	Ground	
23	Even_A2M	Differential Signal	
24	Even_A2P	Differential Signal	
25	GND	Ground	
26	Even_A3M	Differential Signal	
27	Even_A3P	Differential Signal	
28	GND	Ground	
29	Even_CLKM	Differential Signal	
30	Even_CLKP	Differential Signal	

The backlight interface connector is a model BHSR-02VS-1, manufactured by JST or equivalent.
The mating connector part number is SM02B-BHSS-1 or equivalent.
The pin configuration for the connector is shown in the table below.

Table 4. BACKLIGHT CONNECTOR PIN CONFIGURATION

Pin	Symbol	Description	Notes
1	HV	Power supply for lamp (High voltage side)	1
2	LV	Power supply for lamp (Low voltage side)	1

Notes : 1. The high voltage side terminal is colored White. The low voltage side terminal is Yellow.

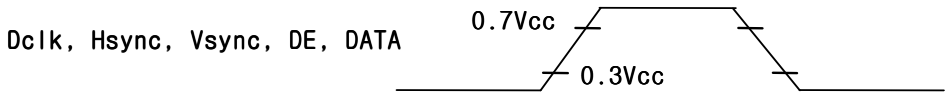
3-3. Signal Timing Specifications

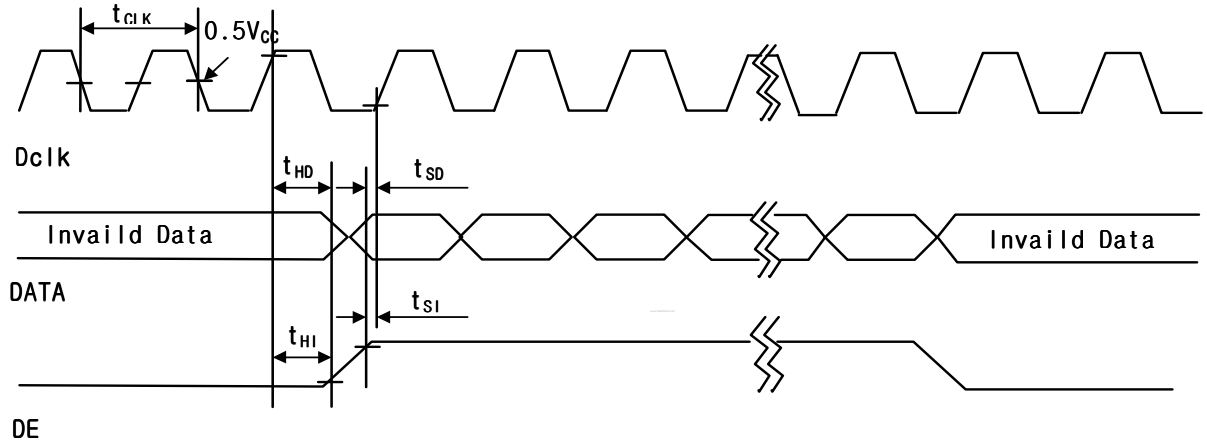
This is the signal timing required at the input of the LVDS Transmitter. All of the interface signal timing should be satisfied with the following specifications for its proper operation.

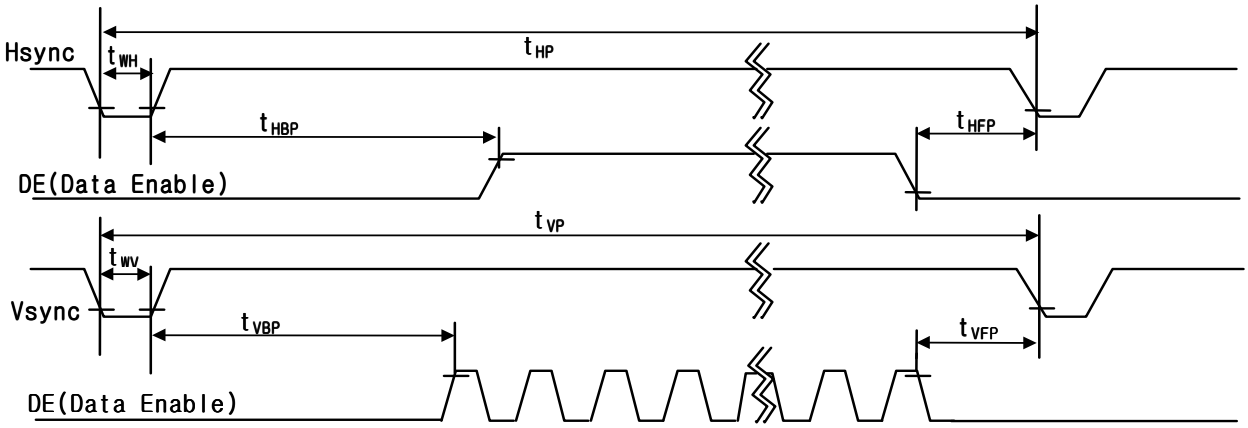
Table 6. Timing Table

ITEM		SYMBOL	MIN	TYP.	MAX.	UNIT	NOTES
Dclk	Frequency	f_{CLK}	55	61	67	MHz	
	Width-Low	t_{WCL}	3	-	-	ns	
	Width-High	t_{WCH}	3	-	-	ns	
	Duty	D	0.4	0.5	0.6		D= t_{CLKH} /t_{CLK}
Hsync	Period	t_{HP}	864	952	1288	t_{CLK}	
	Width	t_{WH}	8	-	-	t_{CLK}	
Vsync	Period	t_{VP}	1057	1066	1082	t_{HP}	
	Width active	t_{WV}	1		-	t_{HP}	
DE	Set up Time	t_{SI}	3	-	-	ns	For Dclk
	Hold Time	t_{HI}	3	-	-		
	Horizontal Back Porch	t_{HBP}	8	-	-	t_{CLK}	
	Horizontal Front Porch	t_{HFP}	8	-	-		
	Vertical Back Porch	t_{VBP}	5	-	-	t_{HP}	
	Vertical Front Porch	t_{VFP}	1	-	-		
DATA	Set up Time	t_{SD}	3	-	-	ns	For Dclk
	Hold Time	t_{HD}	3	-	-		
Input Voltage	High	t_{rH}	0.7Vcc				
	Low	t_{rL}			0.3Vcc		

3-4. Signal Timing Waveforms







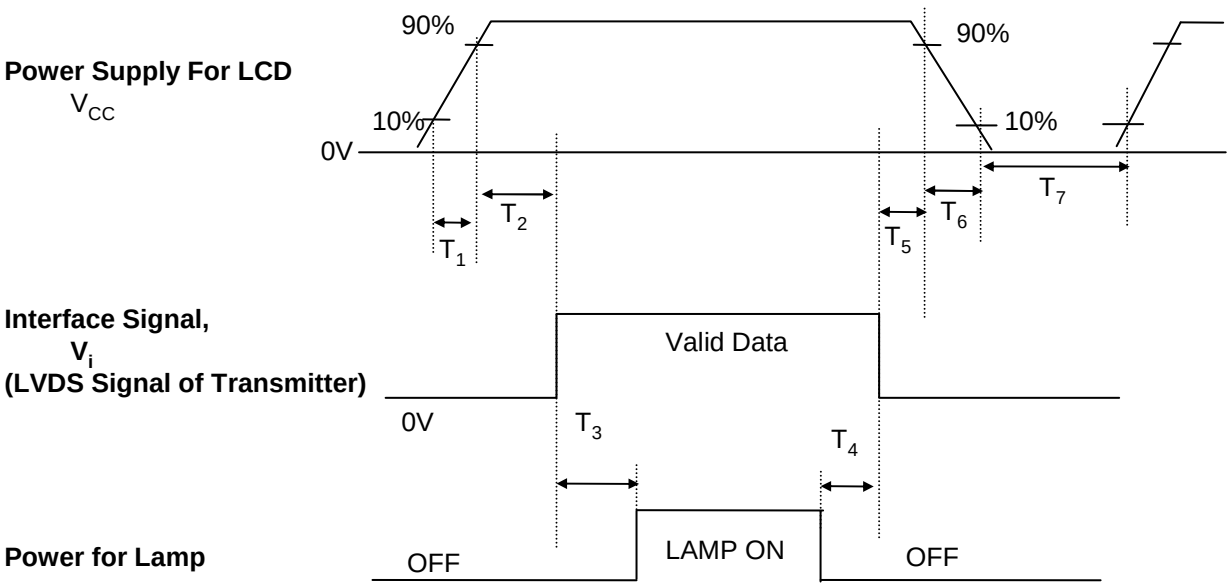
3-5. Color Input Data Reference

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 Colors	Black	0	0	0	0	0	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(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue(63)	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) Dark	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(02)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(61)	1	1	1	1	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) Bright	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green	Green(00)Dark	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(02)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(61)	0	0	0	0	0	0	1	1	1	1	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)Bright	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Blue	Blue(00) Dark	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(02)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63) Bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

3-6. Power Sequence



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

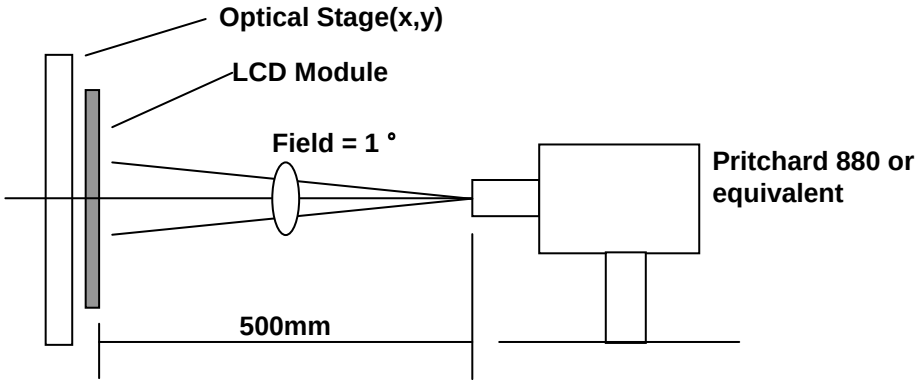
Notes : 1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for LCD V_{CC} to 0V.
3. Lamp power must be turn on after power supply for LCD and interface signal are valid.

4. Optical Specification

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



(Ta=25 °C, V_{CC}=3.3V, f_V=60Hz Dclk=60.9MHz, I_{BL}=6.0mA)

Table 8. OPTICAL CHARACTERISTICS

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
Contrast Ratio	CR	300	500	-		1
Surface Luminance, white	L_{WH}	170	200		cd/m^2	2
Luminance % uniformity	δ_{WHITE}	50	55	-	%	3
Response Time	Tr					4
Rise Time + Decay Time	$Tr_{R+}Tr_D$	-	25	40	ms	
CIE Color Coordinates						
Red	XR	0.559	0.589	0.619		±0.03
	YR	0.315	0.345	0.375		±0.03
Green	XG	0.297	0.327	0.357		±0.03
	YG	0.514	0.544	0.574		±0.03
Blue	XB	0.127	0.157	0.187		±0.03
	YB	0.111	0.141	0.171		±0.03
White	XW	0.285	0.313	0.341		±0.028
	YW	0.309	0.329	0.349		±0.020
Viewing Angle						
x axis, right(ϕ=0°)	θr	60	65			5
x axis, left (ϕ=180°)	θl	60	65			
y axis, up (ϕ=90°)	θu	40	50		degree	
y axis, down (ϕ=270°)	θd	50	50			
Gray Scale	-	-	2.2	-		6

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. Surface luminance is the center point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 2.
When I_{BL}= 6.0mA,

3. Luminance % uniformity is measured for 13 point For more information see FIG 2.
δ WHITE = (Mniimum(LN1,LN2, ….. LN13) ÷ Maximum(LN1,LN2, ….. LN13))x100%

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.

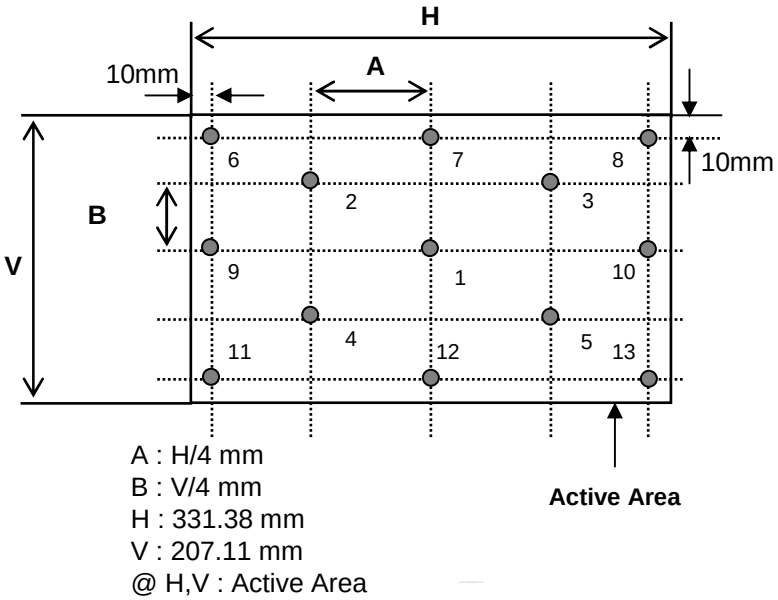
5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.

6. Gray scale specification * fV=60Hz

Gray Level	Luminance(%) (Typ.)
L0	0.0
L7	1.0
L15	5.0
L23	12.0
L31	21.0
L39	35.0
L47	52.0
L55	74.0
L63	100

FIG. 2 Luminance

<measuring point for luminance variation/surface luminance>



A : H/4 mm
B : V/4 mm
H : 331.38 mm
V : 207.11 mm
@ H,V : Active Area

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”.

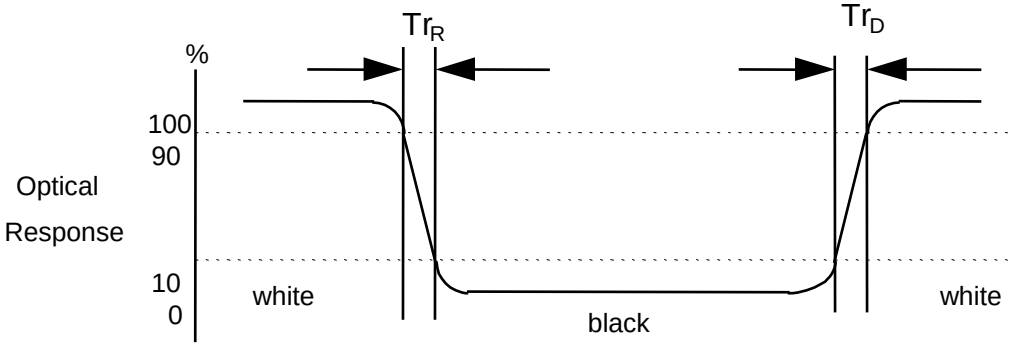
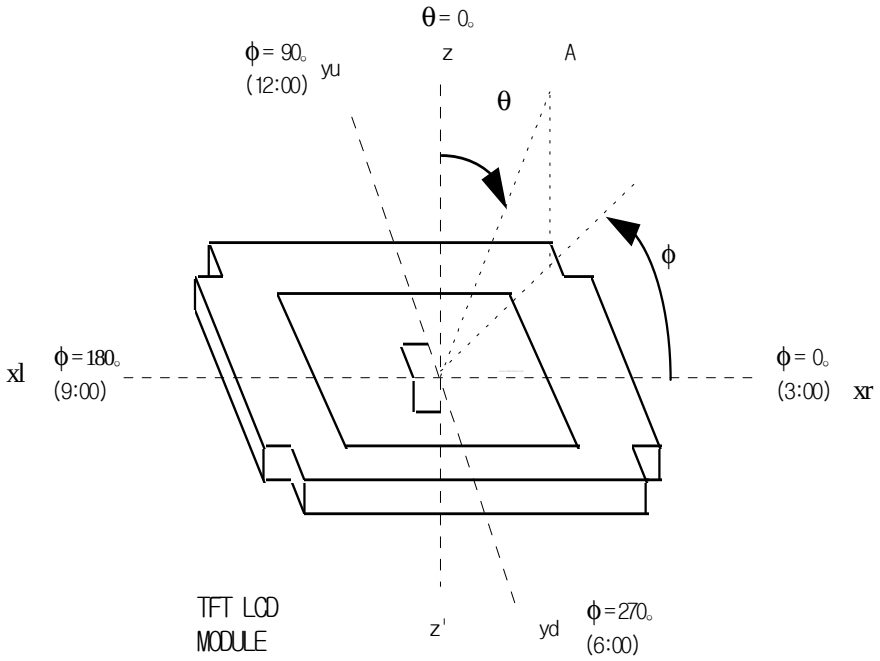


FIG. 4 Viewing angle

<dimension of viewing angle range>



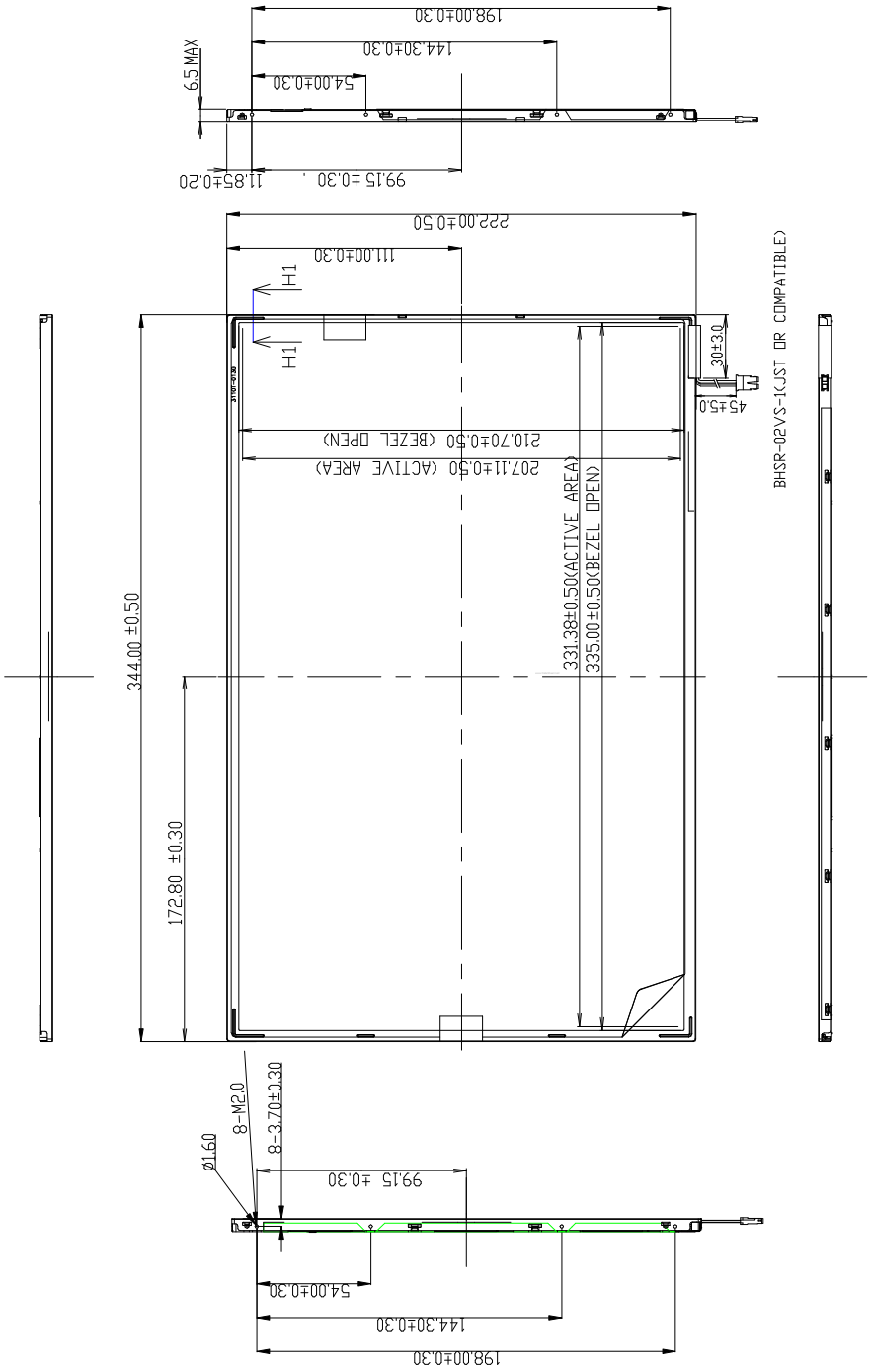
A : Eye of Observer

5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LP154W02(TL06). In addition the figures in the next page are detailed mechanical drawing of the LCD.

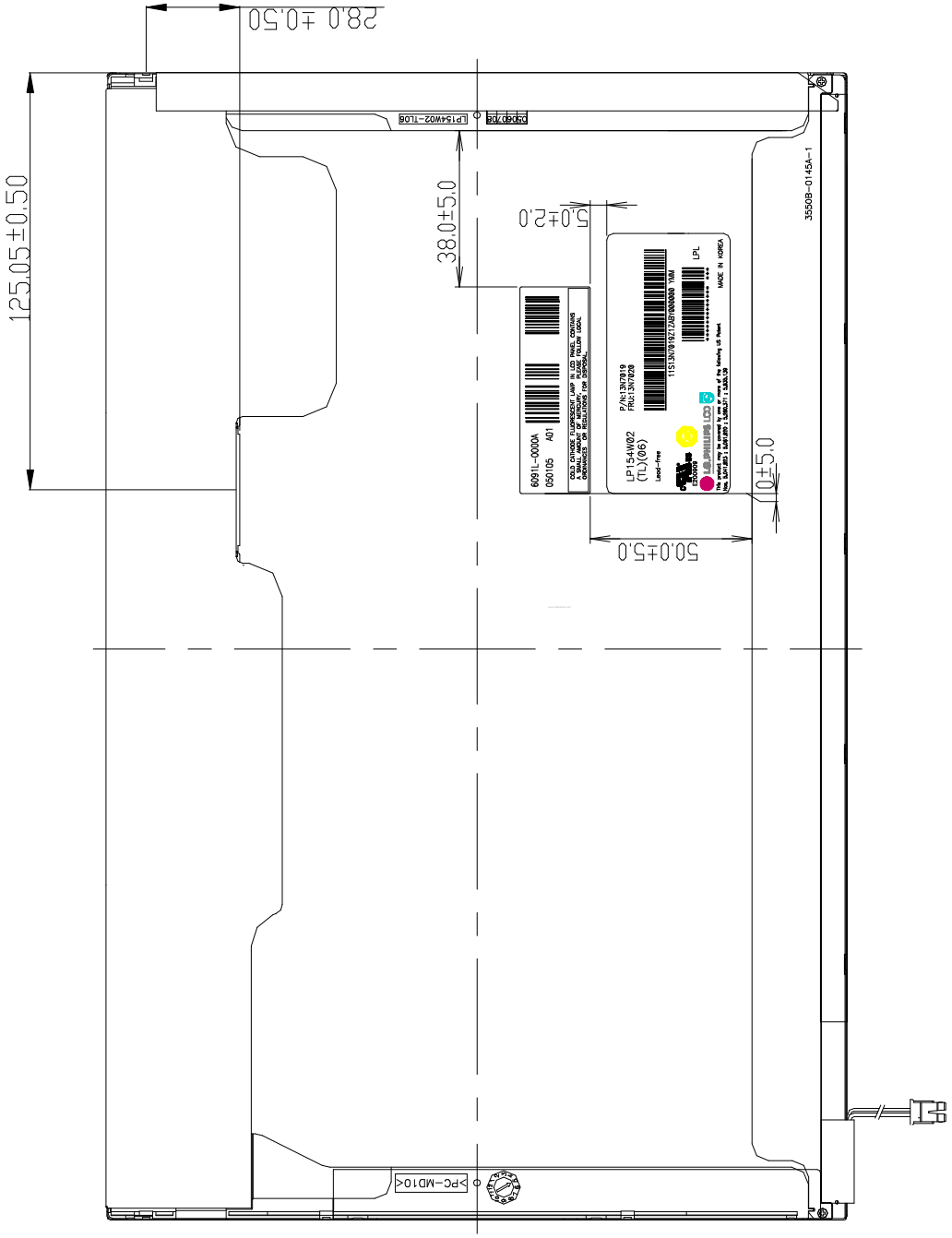
Outside dimensions	Horizontal	344.0 ± 0.5mm
	Vertical	222.0 ± 0.5mm
	Depth	6.2㎜(Typ), 6.5㎜(Max)
Bezel area	Horizontal	335.0± 0.5mm
	Vertical	210.7 ± 0.5mm
Active display area	Horizontal	331.38mm
	Vertical	207.11mm
Weight(approximate)	565g(Max)	
Surface Treatment	Hard coating 2H,Anti-glare,Anti-reflection, Anti-electrostatic treatment of the front polarizer (Nitto Denko AG ARC 150T)	

<FRONT VIEW>



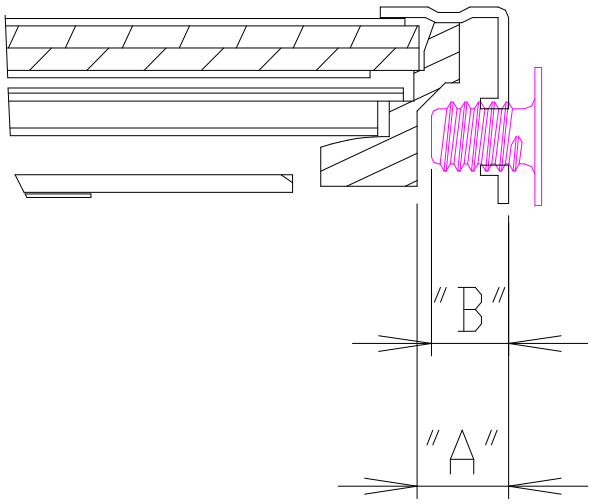
Note. unspecified dimensional tolerance are +/-0.5mm

<REAR VIEW>



Note. unspecified dimensional tolerance are +/-0.5mm

<DETAIL DESCRIPTION OF SIDE MOUNTING SCREW>



SECTION H1-H1

*SCREW(8EA) TORQUE : 2.5kgf.cm max
*Screw Hole Depth ("A"): min 2.5mm
*Screw Length("B") : max 2.5, min2.3 (LPL CAN'T CONTROL THIS DIMENSION.)

Note. unspecified dimensional tolerance are +/-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 60950-1:2003, First Edition, Underwriters Laboratories, Inc.,
Standard for Safety of Information Technology Equipment.
b) CAN/CSA C22.2, No. 60950-1-03 1st Ed. April 1, 2003, Canadian Standards Association,
Standard for Safety of Information Technology Equipment.
c) EN 60950-1:2001, First Edition,
European Committee for Electrotechnical Standardization(CENELEC)
European Standard for Safety of Information Technology 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
(Including A1: 2000)

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 : FACTORY CODE
G : ASSEMBLY CODE
H, I, J, K, L, 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

3. FACTORY CODE

Factory Code	LPL Gumi	LPL Nanjing	HEESUNG
Mark	K	C	D

4. SERIAL NO.

Mark	100001~199999, 200001~299999, 300001~399999, …., A00001~A99999, ….., Z00001~Z99999

b) Location of Lot Mark

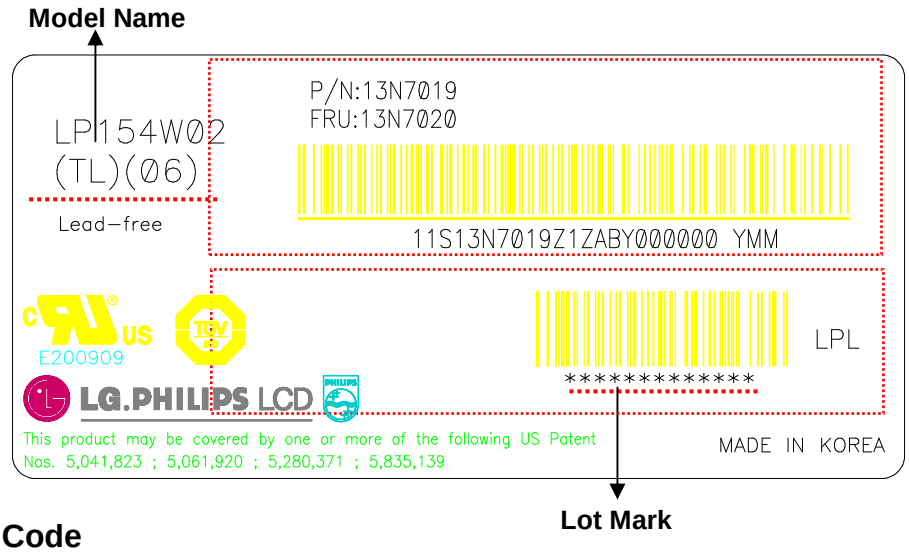
Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing Form

a) Package quantity in one box : 10 pcs

b) Box Size : 441mm ×373mm × 348mm

8-3. Label Description



LPL Code

(1) Model Name : **L P 1 5 4 W 0 2 - T L 0 6**

- Revision Code
- Product Type
- Display Mode
- Basic Model Serial No.
- Resolution : WSXGA+
- Size (inch) : 15.4”
- Application : NBPC
- LGPL Brand Initial: L

(2) Lot Mark : **1 5 4 4 8 K Z 3 0 0 0 0 1**

- SERIAL NO.
- ASSEMBLY CODE
- FACTORY CODE
- MONTH
- YEAR
- SIZE

LENOVO Code

1) LENOVO P/N : 13N7019

2) FRU P/N : 13N7020

9. PRECAUTIONS

Please pay attention to the following 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 a 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 describe 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 determined 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

			LG LP154W02-TL06					
Byte# (decimal)	Byte# (HEX)	Field Name and Comments	Value (HEX)		Value (binary)	Data		
0	00	Header	0	0	0000 0000			Header
1	01	Header	F	F	1111 1111			
2	02	Header	F	F	1111 1111			
3	03	Header	F	F	1111 1111			
4	04	Header	F	F	1111 1111			
5	05	Header	F	F	1111 1111			
6	06	Header	F	F	1111 1111			
7	07	Header	0	0	0000 0000			
8	08	ID system Manufacturer Name	2	4	0010 0100	IBM		Vender/ Product ID
9	09	Compressed ASCII	4	D	0100 1101			
10	0A	ID Product Code	8	7	1000 0111	#WSXGA+		
11	0B	ID Product Code	2	8	0010 1000			
12	0C	LCD Module Serial No. = 0 (If not used)	0	0	0000 0000			
13	0D	LCD Module Serial No. = 0 (If not used)	0	0	0000 0000			
14	0E	LCD Module Serial No. = 0 (If not used)	0	0	0000 0000			
15	0F	LCD Module Serial No. = 0 (If not used)	0	0	0000 0000			
16	10	Week of Manufacture	0	0	0000 0000	00		
17	11	Year of Manufacture	0	F	0000 1111	2005		
18	12	EDID Structure version	0	1	0000 0001	1		EDID Version/ Revision
19	13	EDID Revision	0	3	0000 0011	3		
20	14	Video Input Definition = Digital I/P,non TMDS CRGB	8	0	1000 0000			Display Parameter
21	15	Max H image size(cm) = 33.12cm	2	1	0010 0001	33		
22	16	Max V image size(cm) = 20.70cm	1	5	0001 0101	21		
23	17	Display gamma	7	8	0111 1000	2.2		
24	18	Feature support(DPMS) = Active off, RGB Color	0	A	0000 1010			
25	19	Red/Green low Bits	B	C	1011 1100			Color Characteristic
26	1A	Blue/White Low Bits	A	5	1010 0101			
27	1B	Red X	9	8	1001 1000	0.595		
28	1C	Red Y	5	8	0101 1000	0.345		
29	1D	Green X	5	5	0101 0101	0.332		
30	1E	Green Y	8	B	1000 1011	0.544		
31	1F	Blue X	2	8	0010 1000	0.157		
32	20	Blue Y	2	4	0010 0100	0.141		
33	21	White X	5	0	0101 0000	0.313		
34	22	White Y	5	4	0101 0100	0.329		
35	23	Established Timing I = 00h(If not used)	0	0	0000 0000			Established Timings
36	24	Established Timing II = 00h(If not used)	0	0	0000 0000			
37	25	Manufacturer's Timings = 00h(If not used)	0	0	0000 0000			
38	26	Standard Timing Identification 1 was not used	0	1	0000 0001			Standard Timing ID
39	27	Standard Timing Identification 1 was not used	0	1	0000 0001			
40	28	Standard Timing Identification 2 was not used	0	1	0000 0001			
41	29	Standard Timing Identification 2 was not used	0	1	0000 0001			
42	2A	Standard Timing Identification 3 was not used	0	1	0000 0001			
43	2B	Standard Timing Identification 3 was not used	0	1	0000 0001			
44	2C	Standard Timing Identification 4 was not used	0	1	0000 0001			
45	2D	Standard Timing Identification 4 was not used	0	1	0000 0001			
46	2E	Standard Timing Identification 5 was not used	0	1	0000 0001			
47	2F	Standard Timing Identification 5 was not used	0	1	0000 0001			
48	30	Standard Timing Identification 6 was not used	0	1	0000 0001			
49	31	Standard Timing Identification 6 was not used	0	1	0000 0001			
50	32	Standard Timing Identification 7 was not used	0	1	0000 0001			
51	33	Standard Timing Identification 7 was not used	0	1	0000 0001			
52	34	Standard Timing Identification 8 was not used	0	1	0000 0001			
53	35	Standard Timing Identification 8 was not used	0	1	0000 0001			

APPENDIX A. Enhanced Extended Display Identification Data (EEDID™) 2/3

54	36	Pixel Clock/10,000 (LSB)	A	8	1010 1000	122MHz		Timing Descriptor #1
55	37	Pixel Clock/10,000 (MSB) /	2	F	0010 1111			
56	38	Horizontal Active	9	0	1001 0000	1680 pixels		
57	39	Horizontal Blanking	E	0	1110 0000	224 pixels		
58	3A	Horizontal Active : Horizontal Blanking	6	0	0110 0000			
59	3B	Vertical Avtive	1	A	0001 1010	1050 lines		
60	3C	Vertical Blanking	1	0	0001 0000	16 lines		
61	3D	Vertical Active : Vertical Blanking	4	0	0100 0000			
62	3E	Horizontal Sync. Offset	2	0	0010 0000	32 pixels		
63	3F	Horizontal Sync Pulse Width	4	0	0100 0000	64 pixels		
64	40	Vertical Sync Offset : Sync Width	1	3	0001 0011	1/3 lines		
65	41	Horizontal Vertical Sync Offset/Width upper 2bits = 0	0	0	0000 0000	0		
66	42	Horizontal Image Size = 331.2 mm	4	B	0010 0001	331		
67	43	Vertical Image Size = 207.0mm	C	F	0001 0101	207		
68	44	Horizontal & Vertical Image Size	1	0	0001 0000			
69	45	Horizontal Border = 0	0	0	0000 0000			
70	46	Vertical Border = 0	0	0	0000 0000			
71	47	Non-interlaced,Normal display,no stereo,Digital separate sync,H/V pol negatives	1	9	0001 1001			
72	48	Pixel Clock/10,000 (LSB) 50Hz	**B**	**7**	**1011 0111**	**101.67MHz**		Timing Description #2
73	49	Pixel Clock/10,000 (MSB) / 50Hz	**2**	**7**	**0010 0111**			
74	4A	Horizontal Active	9	0	1001 0000	1680 pixels		
75	4B	Horizontal Blanking	E	0	1110 0000	224 pixels		
76	4C	Horizontal Active : Horizontal Blanking	6	0	0110 0000			
77	4D	Vertical Avtive	1	A	0001 1010	1050 lines		
78	4E	Vertical Blanking	1	0	0001 0000	16 lines		
79	4F	Vertical Active : Vertical Blanking	4	0	0100 0000			
80	50	Horizontal Sync. Offset	2	0	0010 0000	32 pixels		
81	51	Horizontal Sync Pulse Width	4	0	0100 0000	64 pixels		
82	52	Vertical Sync Offset : Sync Width	1	3	0001 0011	1/3 lines		
83	53	Horizontal Vertical Sync Offset/Width upper 2bits = 0	0	0	0000 0000	0		
84	54	Horizontal Image Size = 331.2 mm	4	B	0010 0001	331		
85	55	Vertical Image Size = 207.0mm	C	F	0001 0101	207		
86	56	Horizontal & Vertical Image Size	1	0	0001 0000			
87	57	Horizontal Border = 0	0	0	0000 0000			
88	58	Vertical Border = 0	0	0	0000 0000			
89	59	Non-interlaced,Normal display,no stereo,Digital separate sync,H/V pol negatives	1	9	0001 1001			
90	5A	Detailed Timing Descriptor #3	0	0	0000 0000	0		Timing Description #3
91	5B		0	0	0000 0000	0		
92	5C		0	0	0000 0000	0		
93	5D		0	F	0000 1111	15		
94	5E		0	0	0000 0000	0		
95	5F	(Horizontal active pixel /8)-31	B	3	1011 0011	179		
96	60	Image Aspect Ratio(16:10)	0	A	0000 1010	16 : 10		
97	61	Low Refresh Rate #1(50Hz)	3	2	0011 0010	50		
98	62	(Horizontal active pixel /8)-31	B	3	1011 0011	179		
99	63	Image Aspect Ratio(16:10)	0	A	0000 1010	16 : 10		
100	64	Low Refresh Rate #2(40Hz)	2	8	0010 1000	40		
101	65	Brightness(1/10nit)	1	4	0001 0100	20		
102	66	Feature flag(TN mode)	0	1	0000 0001	1		
103	67	Reserved 00h	0	0	0000 0000	0		
104	68	EISA manufacturer code(3 Character ID)	3	2	0011 0010	LPL		
105	69	Compressed ASCII	0	C	0000 1100			
106	6A	Panel Supplier Reserved - Product code	0	0	0000 0000			
107	6B	(Hex, LSB first)	0	0	0000 0000			

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

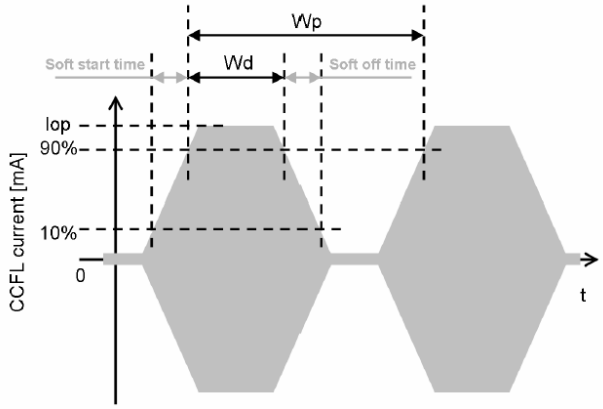
108	6C	Detailed Timing Descriptor #4	0	0	0000 0000			Timing Description #4
109	6D		0	0	0000 0000			
110	6E		0	0	0000 0000			
111	6F		F	E	1111 1110			
112	70		0	0	0000 0000			
113	71	(Supplier S/N)	4	C	0100 1100	L		
114	72	(Supplier S/N)	5	0	0101 0000	P		
115	73	(Supplier S/N)	3	1	0011 0001	1		
116	74	(Supplier S/N)	3	5	0011 0101	5		
117	75	(Supplier S/N)	3	4	0011 0100	4		
118	76	(Supplier S/N)	5	7	0101 0111	W		
119	77	(Supplier S/N)	3	0	0011 0000	0		
120	78	(Supplier S/N)	3	2	0011 0010	2		
121	79	(Supplier S/N)	2	D	0010 1101	-		
122	7A	(Supplier S/N)	5	4	0101 0100	T		
123	7B	(Supplier S/N)	4	C	0100 1100	L		
124	7C	(Supplier S/N)	3	0	0011 0000	0		
125	7D	(Supplier S/N)	3	6	0011 0110	6		
126	7E	Extension flag = 00	0	0	0000 0000			Extension Flag
127	7F	Checksum	7	F	0111 1111			Checksum

APPENDIX B. Special Statements for LP154W02 of Lenovo's Notebook

1.Maximum Leakage Current of CCFL
The lamp leakage current is measured by the current difference between input and output current, whereas the output current is set at 6.0 mA.

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
Maximum Leakage Current	I_L		1.2	1.7	mA	

2.Minimum CCFL Current
In case of inverter using PWM (Pulse Width Modulation) dimming control method, the duty ratio will be varied from 100%(maximum brightness) to 15%(minimum brightness). CCFL will work form 15% to 100% duty ratio without any problems including specified CCFL reliability when any requirements for CCFL are observed at the whole specified range of duty ratio. The duty ratio is defined as follows,



15% ≤Duty ratio≤100%
Duty ratio[%] = Wd [msec] /Wp [msec] x 100
Duty ration does not include soft start time / soft off time.
Where:
Wd : Duty time [msec]
Wp : Width of PWM frequency [msec]
Iop : Peak current at maximum brightniess [mA]

3.Refresh Rate for Power Saving Mode
In this documentation, all reliabilities are specified for timing specification based on refresh rate of 60Hz. However, LP154W02 has a good actual performance even at lower refresh rate(eg. 40Hz or 50Hz) for power saving mode, whereas LP154W02 is secured only for function under lower refresh rate.
60Hz at Normal mode, 50Hz ,40 Hz at Power save mode. Don't care Flicker level (power save mode).

4. Power Sequence for T4 and T7
In this documentation, power sequence is specified differently compared with LPL's standard power sequence. LP154W02 is believed that there is no problem for current power sequence specification. However, LG.Philips LCD always recommends standard power sequence for more stable operation, specially, Min. 200[msec] for T4 and Min. 400[msec] for T7.

5. White Color Shift
White Color shift at 12,000 hours lifetime should be within +0.04 for both x and y from the initial value.