SPECIFICATION
FOR
APPROVAL

(◆) **Preliminary Specification**

(   ) **Final Specification**

Title	15.0" SXGA+ TFT LCD

BUYER	IBM
MODEL	

SUPPLIER	LG.Philips LCD Co., Ltd.
*MODEL	LP150E07
Suffix	TL02

*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   **Signaure**

J. H. Lee / S.Manager

REVIEWED BY

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N.J. Seong / Engineer

**Product Engineering Dept.
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Contents

RECORD OF REVISIONS

| Revision No	Revision Date	Page	Description	Note
0.0	Oct 30..2004	-	First Draft	

1. General Description

 The LP150E07 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 15.0 inches diagonally measured active display area with SXGA+ resolution(1050 vertical by 1400 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 LP150E07 has been designed to apply the interface method that enables low power, high speed, low EMI.

 The LP150E07 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 LP150E07 characteristics provide an excellent flat display for office automation products such as Notebook PC.
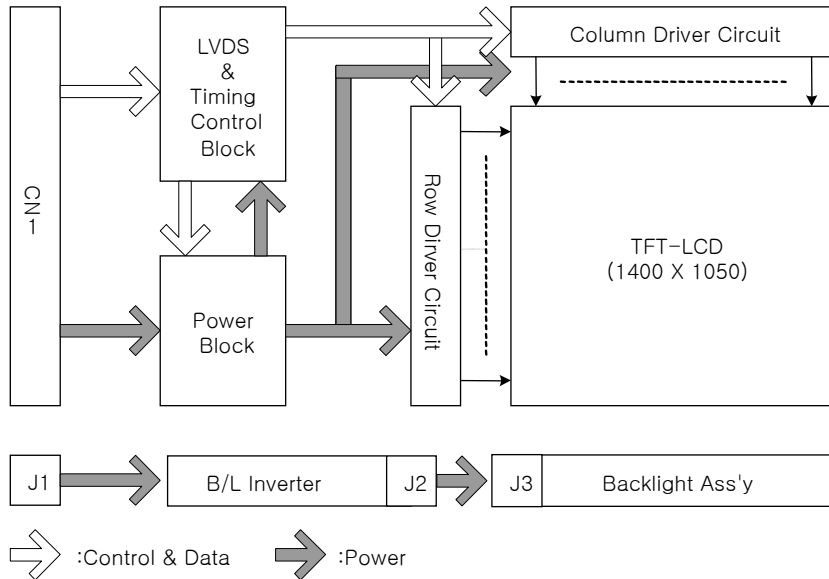
General Features

| Active Screen Size	15.0 inches(38. 1cm) diagonal
Outline Dimension	317.2(H) × 241.4(V) × 6.0(D) mm (Max.)
Pixel Pitch	0.2175 mm × 0.2175 mm
Pixel Format	1400 horiz. By 1050 vert. Pixels RGB strip arrangement
Color Depth	6-bit, 262,144 colors
Luminance, White	200cd/m^2(Tpy.), 170 cd/m^2(Min.), 1p
Power Consumption	Total 5.4 W (Typ.)　　(1.4W Logic / 4.0W Backlight)
Weight	535g (Max.)
Display Operating Mode	Transmissive mode, normally white
Surface Treatment	Hard coating(3H) Maker:Nitto Denco ARC150T

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	TST	-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.

Dry Bulb Temperature [℃]
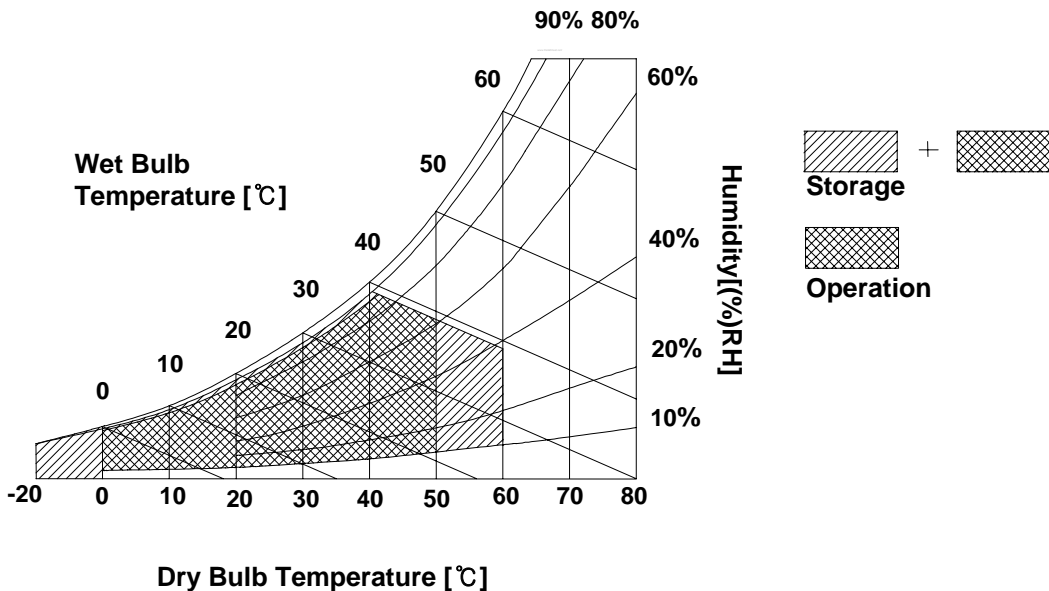
3. Electrical Specifications

3-1. Electrical Characteristics

The LP150E07 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			Unit	Notes
		Min	Typ	Max		
MODULE :						
Power Supply Input Voltage	VCC	3.0	3.3	3.6	Vdc	
Power Supply Input Current	I_{CC}	-	420	483	mA	1
Power Consumption	Pc	-	1.40	1.74	Watt	1
Differential Impedance	Zm	90	100	110	ohm	2
LAMP :						
Operating Voltage	V_{BL}	860	665	630	V_{RMS}	3
Operating Current	I_{BL}	3.0	6.0	6.5	mA_{RMS}	
Established Starting Voltage	Vs					4
at 25 °C		-	-	1165	V_{RMS}	
at 0 °C		-	-	1400	V_{RMS}	
Operating Frequency	f_{BL}	50	65	80	kHz	5
Discharge Stabilization Time	Ts	-	-	3	Min	6
Power Consumption	P_{BL}	-	4.0	4.4	Watt	7
Life Time		10,000	-	-	Hrs	8

Note : The design of the inverter must have specifications 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 current and power consumption are under the VCC=3.3V, 25°C, f_V=60Hz condition whereas Mosaic 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 $\pm$ 10%.
4. FOS, and reliability test condition is at 6.0mA
5. 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. The used lamp current is the lamp typical current.

6. The output of the inverter must have symmetrical(negative and positive) voltage waveform and symmetrical current waveform.(Unsymmetrical ratio is less than 10%) Please do not use the inverter which has unsymmetrical voltage and unsymmetrical 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.

7. Let's define 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%.

8. The lamp power consumption shown above does not include loss of external inverter.
The used lamp current is the lamp typical current.

9. The life is determined as the time at which brightness of the lamp is 50% compared to that of initial value at the maximum lamp current(6.0mA_{RMS}) on condition of continuous operating at $25 \pm 2°C$

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 $\sqrt{2} \pm 10\%$.
    * Inverter output waveform had better be more similar to ideal sine wave.
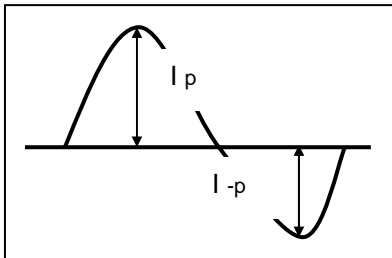
* Asymmetry rate:

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

* Distortion rate

$$I_p (\text{or } I_{-p}) / I_{rms}$$

※ 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.
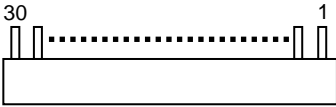
3-2. Interface Connections

The interface connections are compatible with ISP (Industry Standard Panels) 15.0" Mounting and Top
Level Interface Requirements (Version2, June,2000) defined by SPWG (Standard Panels Working Group).
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 GT101-30S-HR11 manufactured by LG Cable. The pin
configuration for the connector is shown in the table below.

Table 3. MODULE CONNECTOR PIN CONFIGURATION (CN1)

Pin	Symbol	Description	Notes
1	VSS	Ground	
2	VCC	Power Supply, 3.3V Typ.	
3	VCC	Power Supply, 3.3V Typ.	
4	V_{EDID}	DDC 3.3V power	
5	NC	No Connection	
6	NC	No Connection	1, Interface chips
7	NC	No Connection	1.1 LCD : KZ4E053G11(LCD Controller)
8	Odd_R_{IN}0-	-LVDS differential data (odd pixels R0-R5, G0)	including LVDS Receiver
9	Odd_R_{IN}0+	+LVDS differential data (odd pixels R0-R5, G0)	1.2 System : THC63LVDF823A or equivalent
10	VSS	Ground	* Pin to Pin compatible with TI LVDS
11	Odd_R_{IN}1-	-LVDS differential data (odd pixels G1-G5, B0-B1)	
12	Odd_R_{IN}1+	+LVDS differential data (odd pixels G1-G5, B0-B1)	2. Connector
13	VSS	Ground	2.1 LCD : FI-XB30SRL-HF11, JAE or
14	Odd_R_{IN}2-	-LVDS differential data (odd pixels B2-B5, HS, VS, DE)	MDF76LARW-30S-1H, Hirose
15	Odd_R_{IN}2+	+LVDS differential data (odd pixels B2-B5, HS, VS, DE)	equivalent. Locking design
16	VSS	Ground	2.2 Mating : FI-X30M or equivalent.
17	Odd_Clk_{IN}-	-LVDS differential clock (odd pixels)	2.3 Connector pin arrangement
18	Odd_Clk_{IN}+	+LVDS differential clock(odd pixels)	
19	VSS	Ground	
20	Even_R_{IN}0-	-LVDS differential data (even pixels R0-R5, G0)	
21	Even_R_{IN}0+	+LVDS differential data (even pixels R0-R5, G0)	
22	VSS	Ground	
23	Even_R_{IN}1-	-LVDS differential data (even pixels G1-G5, B0-B1)	
24	Even_R_{IN}1+	+LVDS differential data (even pixels G1-G5, B0-B1)	
25	VSS	Ground	
26	Even_R_{IN}2-	-LVDS differential data (even pixels B2-B5, HS, VS, DE)	
27	Even_R_{IN}2+	+LVDS differential data (even pixels B2-B5, HS, VS, DE)	
28	VSS	Ground	
29	Even_Clk_{IN}-	-LVDS differential clock (even pixels)	
30	Even_Clk_{IN}+	+LVDS differential clock (even pixels)	

Note: All GND(ground) pins should be connected together and to GND which should also be connected to
the LCD's metal frame. All VCC (power input) pins should be connected together.

The backlight interface connector is a model BHSR-02VS-1, manufactured by JST or Compatible.
The mating connector part number is SM02B-BHSS-1 or equivalent.

Table 4. BACKLIGHT CONNECTOR PIN CONFIGURATION (J1)

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 pink and the low voltage side terminal is Green.
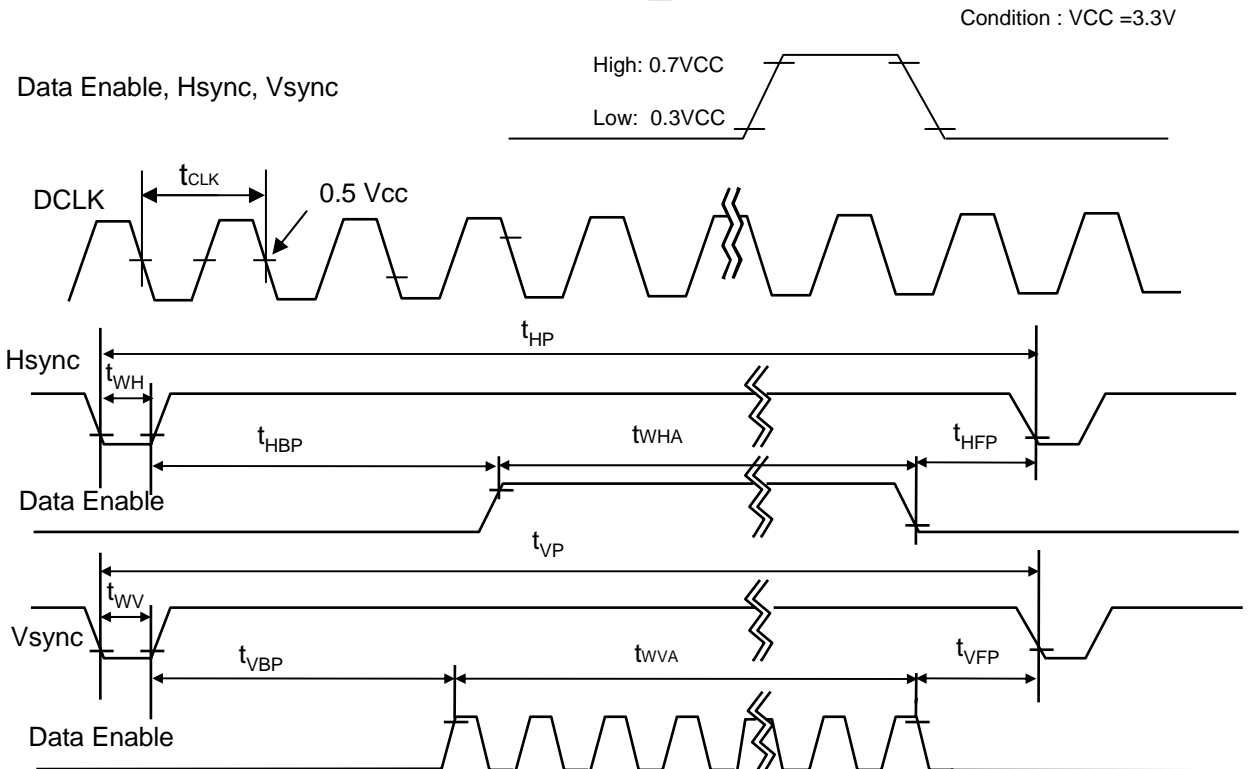
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3-3. Signal Timing Specifications

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 it's proper operation.

Table 6. TIMING TABLE

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Frequency	fCLK	53.5	54	54.5	MHz	15.4ns
Hsync	Period	tHP	800	840	880	tCLK	
	Width	tWH	8	-	-		
Vsync	Period	tVP	1060	1071	1100	tHP	
	Width	tWV	2	-	-		
Data Enable	Horizontal back porch	tHBP	8	-	-	tCLK	
	Horizontal front porch	tHFP	8	-	-		
	Vertical back porch	tVBP	3	-	-	tHP	
	Vertical front porch	tVFP	2	-	-		

3-4. Signal Timing Waveforms

Condition : VCC =3.3V

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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	
		R 5	R 4	R 3	R 2	R 1	R 0	G 5	G 4	G 3	G 2	G 1	G 0	B 5	B 4	B 3	B 2	B 1	B 0
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

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3-6. Power Sequence
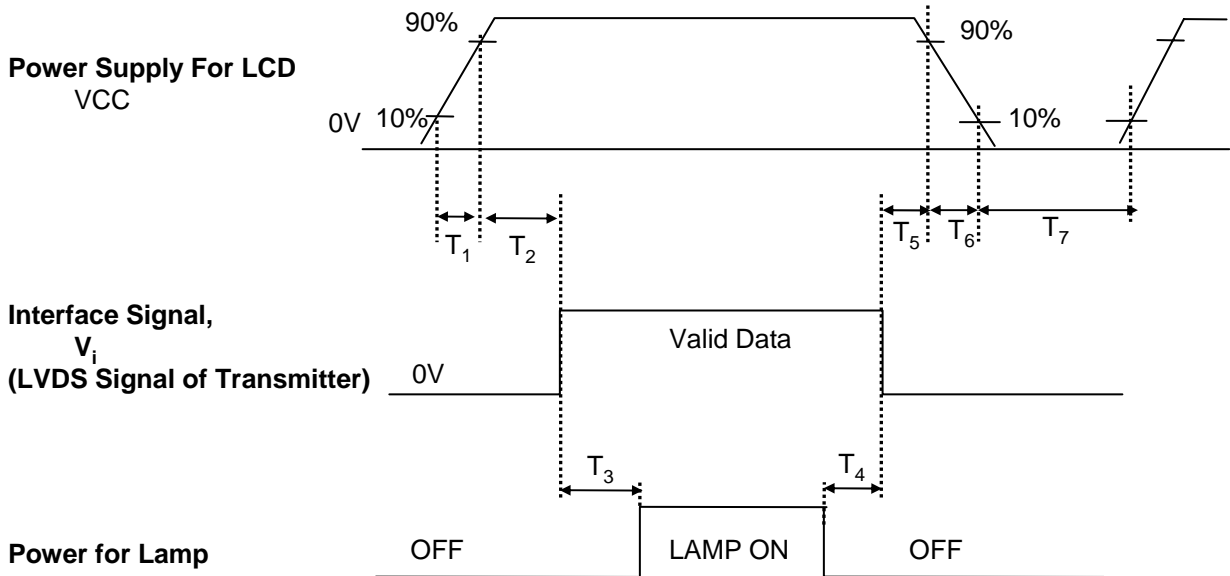
Table 7. POWER SEQUENCE TABLE

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	-	100	(ms)
T_7	400	-	-	(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 VCC 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.

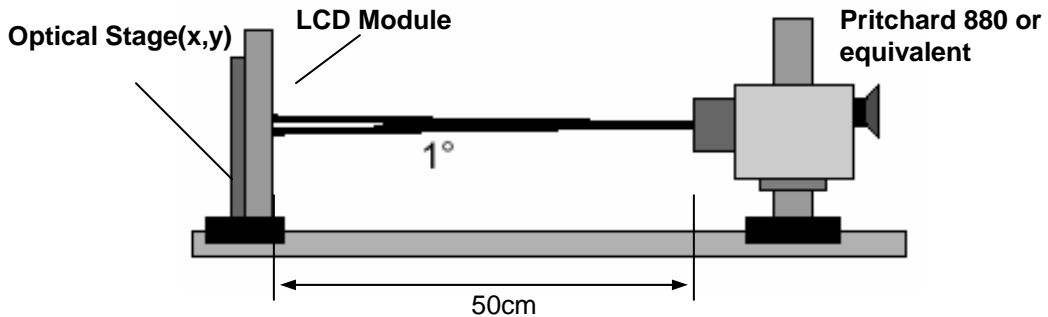### FIG. 1 Optical Characteristic Measurement Equipment and Method

Optical Stage(x,y)　**LCD Module**　**Pritchard 880 or equivalent**

1°

50cm

Table 9. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, f$_V$=60Hz, f$_{CLK}$= 65MHz, Iout = 6.0mA

Parameter	Symbol	Values			Units	Notes
		Min	Typ	MAx		
Contrast Ratio	CR	350	-	-		1
Surface Luminance, white	L$_{WH}$ (at 6.0mA)	170	200	-	cd/m^2	2
Luminance Variation	δ_{WHITE}	-	-	50	%	3
Response Time	Tr(Tr$_{R+}$ Tr$_D$)	-	30	45	ms	4
Color Coordinates						
RED	RX	TBD	TBD	TBD		
	RY	TBD	TBD	TBD		
GREEN	GX	TBD	TBD	TBD		
	GY	TBD	TBD	TBD		
BLUE	BX	TBD	TBD	TBD		
	BY	TBD	TBD	TBD		
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	45	-	degree	
x axis, left (Φ=180°)	Θl	40	45	-	degree	
y axis, up (Φ=90°)	Θu	10	15	-	degree	
y axis, down (Φ=270°)	Θd	30	35	-	degree	

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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 1 point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 1.

$$L_{WH} = L_1$$

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

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

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

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

6. Gray scale specification   * f_V = 60Hz

Gray Level	Luminance [%] (Typ)
L0	TBD
L7	TBD
L15	TBD
L23	TBD
L31	TBD
L39	TBD
L47	TBD
L55	TBD
L63	TBD

FIG. 2 Luminance

<measuring point for surface luminance & measuring point for luminance variation>

H,V : ACTIVE AREA
A : H/4 mm
B : V/4 mm
C : 10 mm
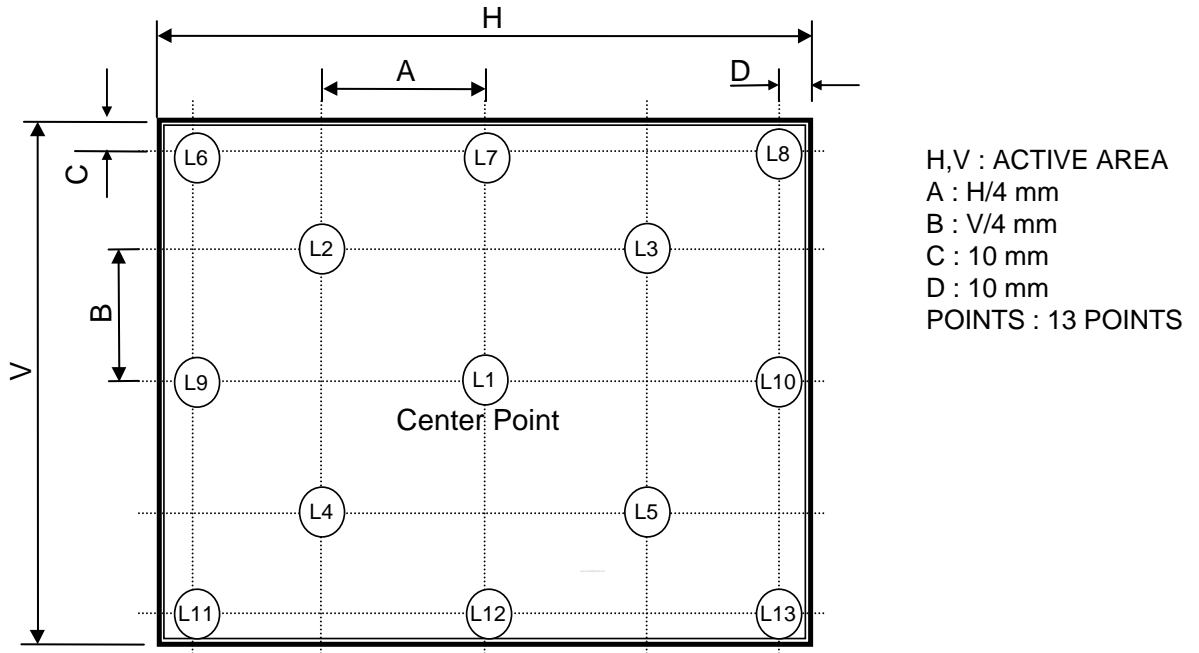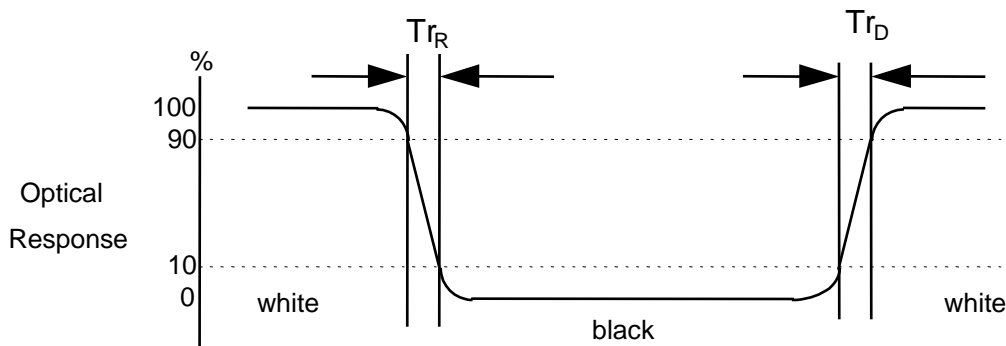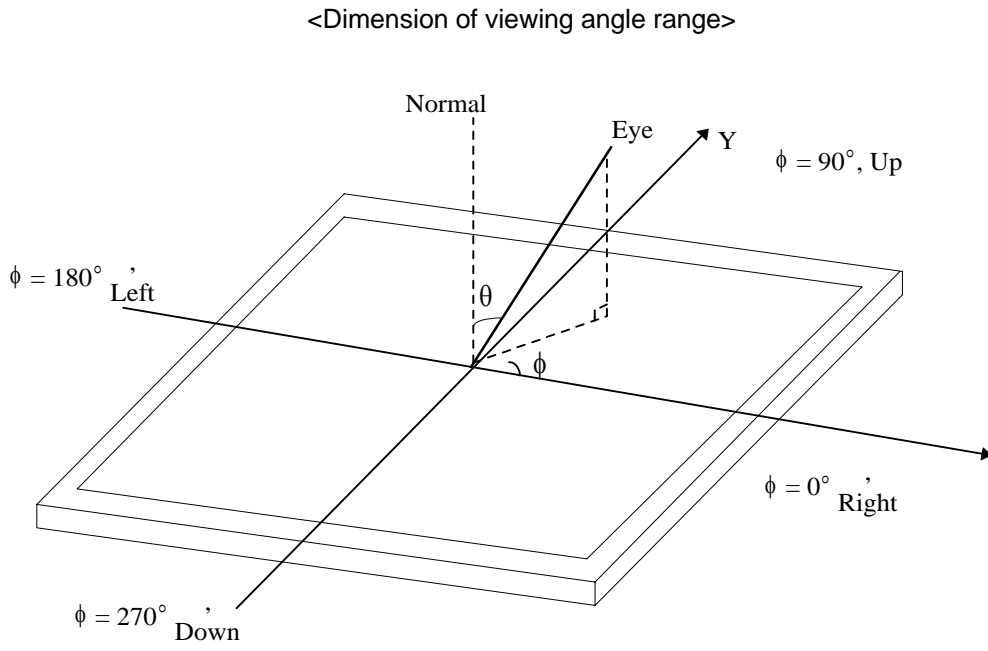D : 10 mm
POINTS : 13 POINTS

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>

Product Specification

5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LP150E07. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal	317.2 ± 0.5mm
	Vertical	241.4 ± 0.5mm
	Depth	6.0mm(Max.)
Bezel Area	Horizontal	307.5 ± 0.5mm
	Vertical	231.4 ± 0.5mm
Active Display Area	Horizontal	304.5 mm
	Vertical	228.375 mm
Weight	535g (Max.)	
Surface Treatment	Hard coating(3H) Maker:Nitto Denco ARC150T	

LG.PHILIPS LCD
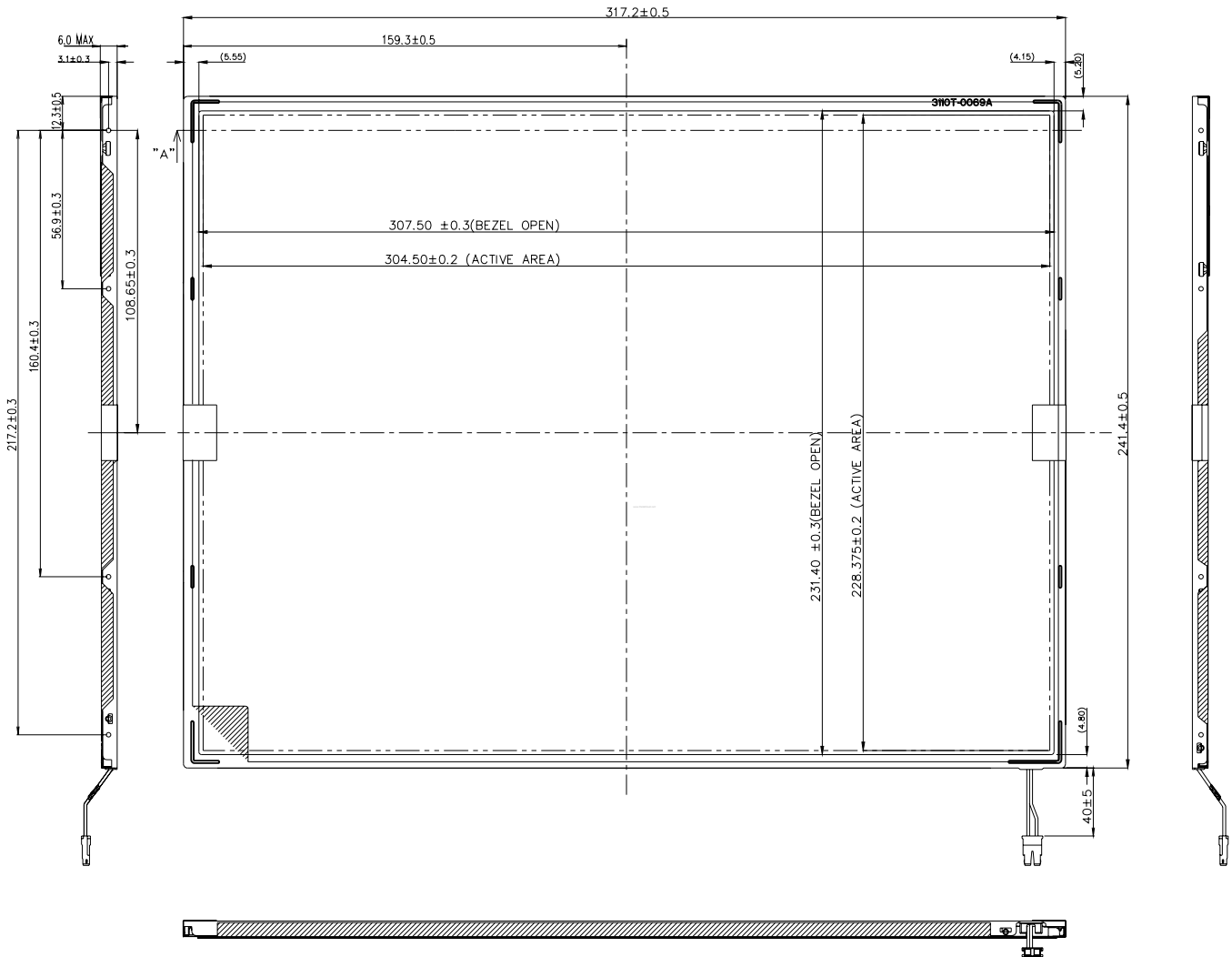
Product Specification
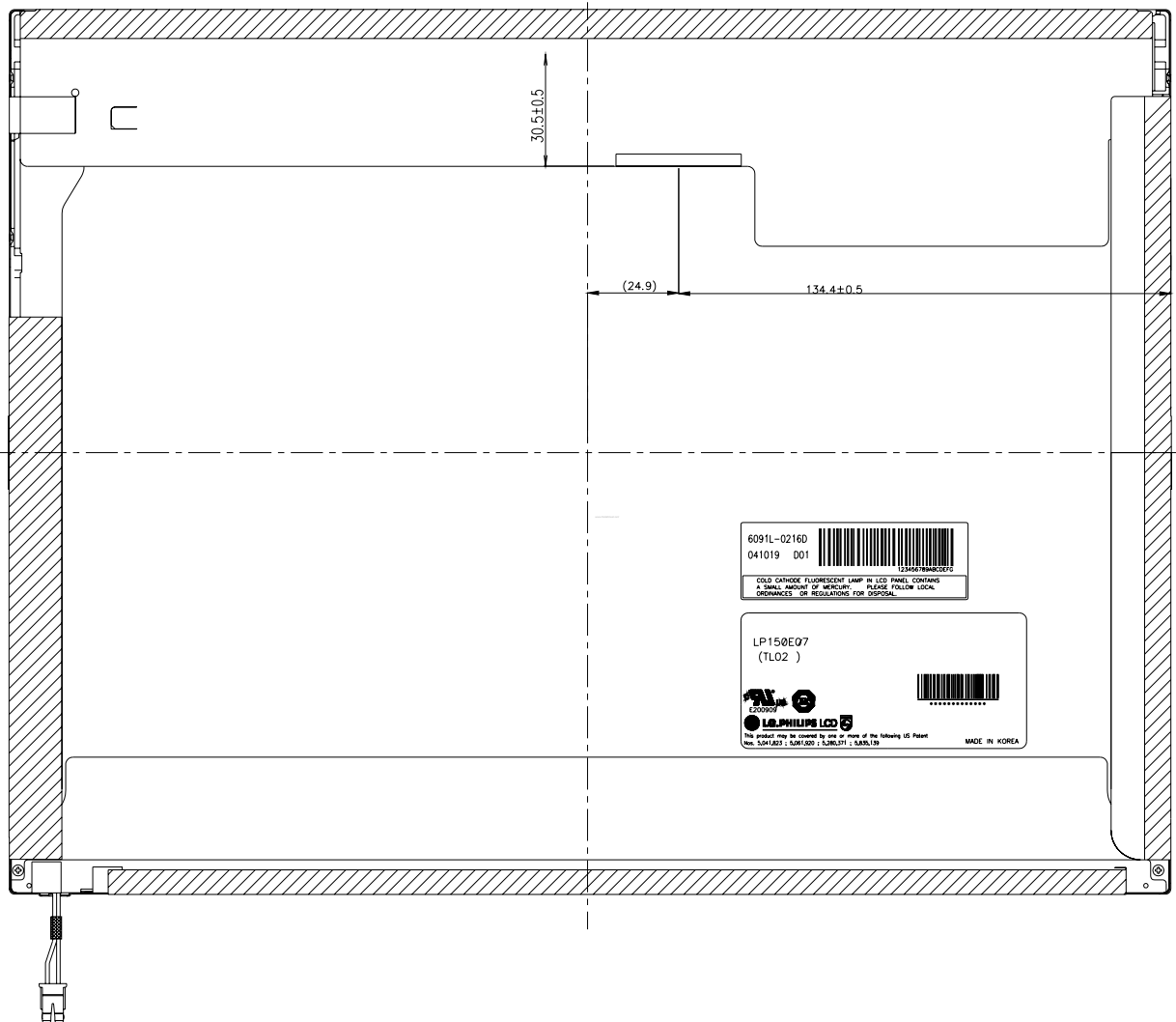
<FRONT VIEW>   Note) Unit:[mm], General tolerance: ± 0.5mm

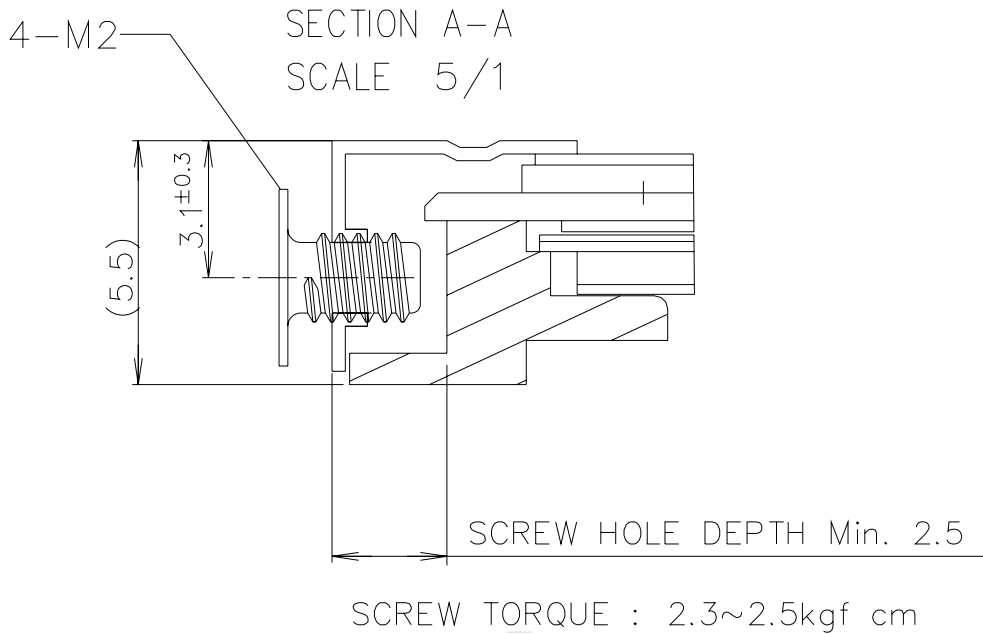## Product Specification

<REAR VIEW>   Note) Unit:[mm], General tolerance: ± 0.5mm

30.5±0.5

(24.9)   134.4±0.5

6091L-0216D
041019   D01
1234567894BCDEFG

COLD CATHODE FLUORESCENT LAMP IN LCD PANEL CONTAINS
A SMALL AMOUNT OF MERCURY.   PLEASE FOLLOW LOCAL
ORDINANCES   OR REGULATIONS FOR DISPOSAL.

LP150EQ7
(TLO2)

E200909

LG.PHILIPS LCD

This product may be covered by one or more of the following US Patent
Nos. 5,041,823 ; 6,061,920 ; 5,280,371 ; 5,835,139   MADE IN KOREA

Product Specification

[DETAIL DESCRIPTION OF SIDE MOUNTING SCREW]

4-M2

SECTION A-A
SCALE 5/1

3.1±0.3

(5.5)

SCREW HOLE DEPTH Min. 2.5

SCREW TORQUE : 2.3~2.5kgf cm

6. Reliability

Environment test condition

No.	Test Item	Conditions
1	High temperature storage test	Ta= 60°C, 240h
2	Low temperature storage test	Ta= -20°C, 240h
3	High temperature operation test	Ta= 50°C, 50%RH, 240h
4	Low temperature operation test	Ta= 0°C, 240h
5	Vibration test (non-operating)	Sine wave, 10 ~ 500 ~ 10Hz, 1.5G, 0.37oct/min 3 axis, 1hour/axis
6	Shock test (non-operating)	Half sine wave, 180G, 2ms one shock of each six faces(I.e. run 180G 2ms for all six faces)
7	Altitude operating storage / shipment	0 ~ 10,000 feet (3,048m) 24Hr 0 ~ 40,000 feet (12,192m) 24Hr

{ Result Evaluation Criteria }
 There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

7. International Standards

7-1. Safety

a) UL 60950, Third Edition, Underwriters Laboratories, Inc., Dated Dec. 11, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
b) CAN/CSA C22.2, No. 60950, Third Edition, Canadian Standards Association, Dec. 1, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
c) EN 60950 : 2000, Third Edition
IEC 60950 : 1999, Third Edition
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
 (Including A1: 2000)

Product Specification

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 : Inch
D : Year
E : Month
F : Panel Code
G : Factory Code
H : Assembly Code
I,J,K,L,M : Serial No

Note

1. Year

Year	97	98	99	2000	2001	2002	2003	2004	2005	2006	2007
Mark	7	8	9	0	1	2	3	4	5	6	7

2. Month

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	4	4	5	6	7	8	9	A	B	C

3. Panel Code

Panel Code	P1 Factory	P2 Factory	P3 Factory	P4 Factory	P5 Factory	Hydis Panel
Mark	1	2	3	4	5	H

4. Factory Code

Factory Code	LPL Gumi	LPL Nanjing
Mark	K	C

5. Serial No

Serial No.	1 ~ 99,999	100,000 ~
Mark	00001 ~ 99999	A0001 ~ A9999, - - - - , Z9999

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 : 12 pcs
b) Box Size : 372mm × 317mm × 308mm

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) The protection film is attached to the bezel with a small masking tape.
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) 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 bezel after the protection film is peeled off.
(3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.