

Product Specification

SPECIFICATION FOR APPROVAL

(◆) Preliminary Specification
() Final Specification

Title	15.0" XGA TFT LCD
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BUYER	IBM
MODEL	

SUPPLIER	LG.Philips LCD CO., Ltd.
*MODEL	LP150X09
SUFFIX	A3

*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
S. H. Kang / S.Manager	
REVIEWED BY	
J. H. Lee / Manager	
PREPARED BY	
Engineer	

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

Product Specification

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Records of revision

Revision No	Revision Date	Page	DESCRIPTION
0.0	July, 17, 2003	-	First Draft.Preliminary Specifications

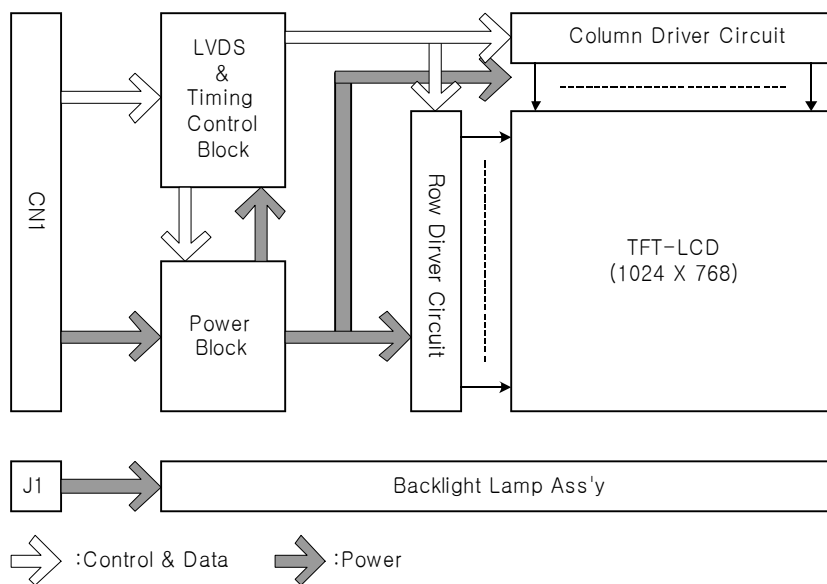
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1. General Description

The LP150X09 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 a 15.0 inch diagonally measured active display area with XGA resolution(768 vertical by 1024 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 LP150X09 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 LP150X09 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 LP150X09 characteristics provide an excellent flat display for office automation products such as Notebook PC.



General Features

Active screen size	15.0 inch(38.1cm) diagonal
Outline Dimension	317.3(H) x 241.5(V) x 5.7(D) mm(Typ)
Pixel Pitch	0.297(H) x 0.297(V) mm
Pixel format	1024 horiz. By 768 vert. Pixels RGB stripes arrangement
Color depth	6-bit, 262,144 colors
Luminance, white	230 cd/m ² (Typ.) Center 1Point
Power Consumption	5.01W (Windows Typ)
Weight	540g(Typ.)
Display operating mode	Transmissive mode, normally white
Surface treatments	Anti-glare & hard coating 3H, Anti-Reflection

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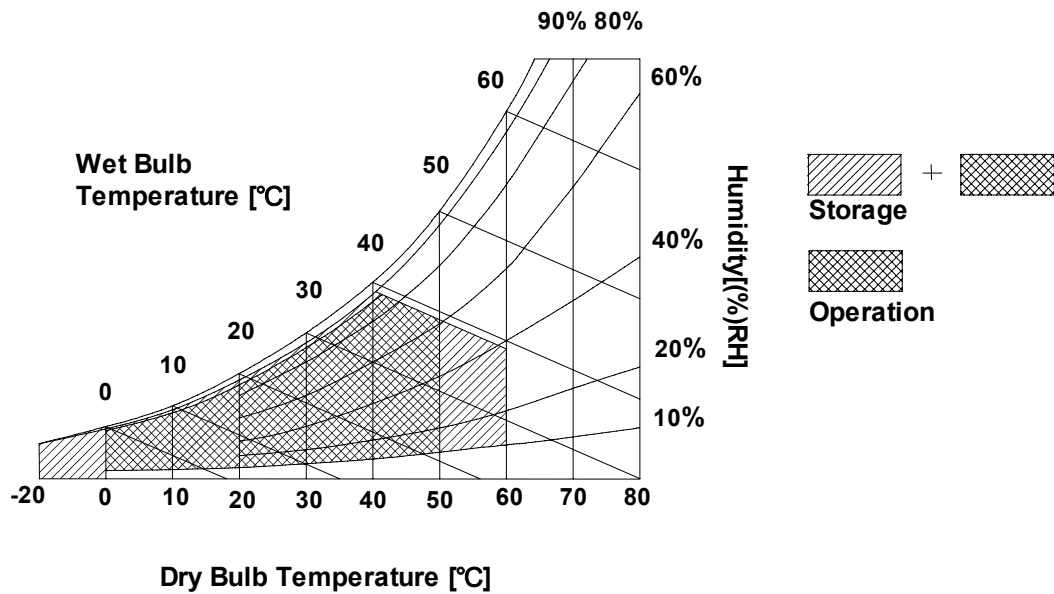
2. Absolute Maximum Ratings

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	V_{CC}	-0.3	4.0	Vdc	At $25 \pm 5^{\circ}\text{C}$
Operating Temperature	T_{OP}	0	50	$^{\circ}\text{C}$	1
Storage Temperature	T_{ST}	-20	60	$^{\circ}\text{C}$	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.



Product Specification
3. Electrical Specifications
3-1. Electrical Characteristics

The LP150X09 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.

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	Window	I _{CC}	-	305	350	mA	1
	Full Black		-	345	400		
	2 by 2 sub pixel		-	365	420		
Power Consumption	Window	Pc	-	1.01	1.16	Watt	1
Differential Impedance	Zm	90	100	110	ohm	2	
LAMP :							
Operating Voltage	V _{BL}	660(6.5mA)	680(6.0mA)	830(3.0mA)	V _{RMS}	3	
Operating Current	I _{BL}	3.0	6.0	6.5	mA _{RMS}	4	
Established Starting Voltage	V _s					5	
	at 25°C	-	-	1230	V _{RMS}		
	at 0°C	-	-	1500	V _{RMS}		
Operating Frequency	f _{BL}	40	60	80	kHz	6	
Discharge Stabilization Time	T _s	-	-	3	Min	7	
Power Consumption	P _{BL}	-	4.1	4.5	Watt	8	
Life Time		10,000	-	-	Hrs	9	

Notes : **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.

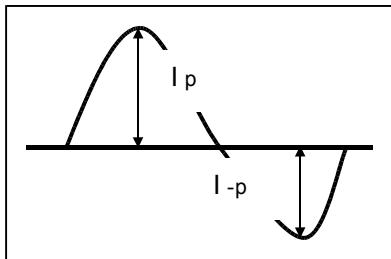
When you design or order the inverter, please make sure unwanted lighting caused by the mismatch of the lamp and the inverter(no lighting, flicker, etc) never occurs. When you confirm it, the LCD Assembly should be operated in the same condition as installed in your instrument.

1. The specified current and power consumption are under the VCC=3.3V, 25°C, f_v=60Hz condition whereas Window 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. The used lamp current is the lamp typical current.

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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 interference 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 **typical lamp current (6.0mA_{RMS})**.
9. The life time 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 $25 \pm 2^\circ\text{C}$.

- * 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:

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

* 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.

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3-2. Interface Connections

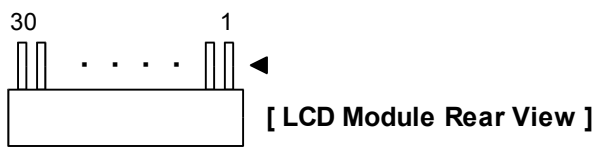
Interface chip must be used FlatLink, part No. SN75LVDS84(Transmitter made by Texas Instrument Inc or equivalence.

This LCD employs two interface connections, a 30 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 FI-XB30SR-HF11 manufactured by JAE

The pin configuration for the connector is shown in the table 3.

Table 3. MODULE CONNECTOR PIN CONFIGURATION(LVDS)

Pin	Symbol	Description	Notes
1	GND	Ground	<p>1. LVDS Interfacing</p> <p>1.1 System : SN75LVDS84(TI) or equivalent *Pin to Pin compatible with Thine LVDS</p> <p>1.2 LCD : THC63LVD64A(THINE)</p> <p>2. Connector</p> <p>2.1 LCD : JAE FI-XB30SR-HF11</p> <p>2.2 Mating : JAE FI-X30M or equivalent</p> <p>2.3 Connector pin arrangement</p>  <p>[LCD Module Rear View]</p>
2	Vcc	Power(3.3V)	
3	Vcc	Power(3.3V)	
4	V_EDID	No Connection	
5	NC	Test Pin for supplier	
6	CLK_EDID	No Connection	
7	DATA_EDID	No Connection	
8	A1M	Differential Signal	
9	A1P	Differential Signal	
10	GND	Ground	
11	A2M	Differential Signal	
12	A2P	Differential Signal	
13	GND	Ground	
14	A3M	Differential Signal	
15	A3P	Differential Signal	
16	GND	Ground	
17	CLKM	Differential Signal	
18	CLKP	Differential Signal	
19	GND	Ground	
20	NC	No Connection	
21	NC	No Connection	
22	GND	Ground	
23	NC	No Connection	
24	NC	No Connection	
25	GND	Ground	
26	NC	No Connection	
27	NC	No Connection	
28	GND	Ground	
29	NC	No Connection	
30	NC	No Connection	

The backlight interface connector is a model BHSR-02VS-1, manufactured by JST. The mating connector part number is SM02B-BHS-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 pink. The low voltage side terminal is white.

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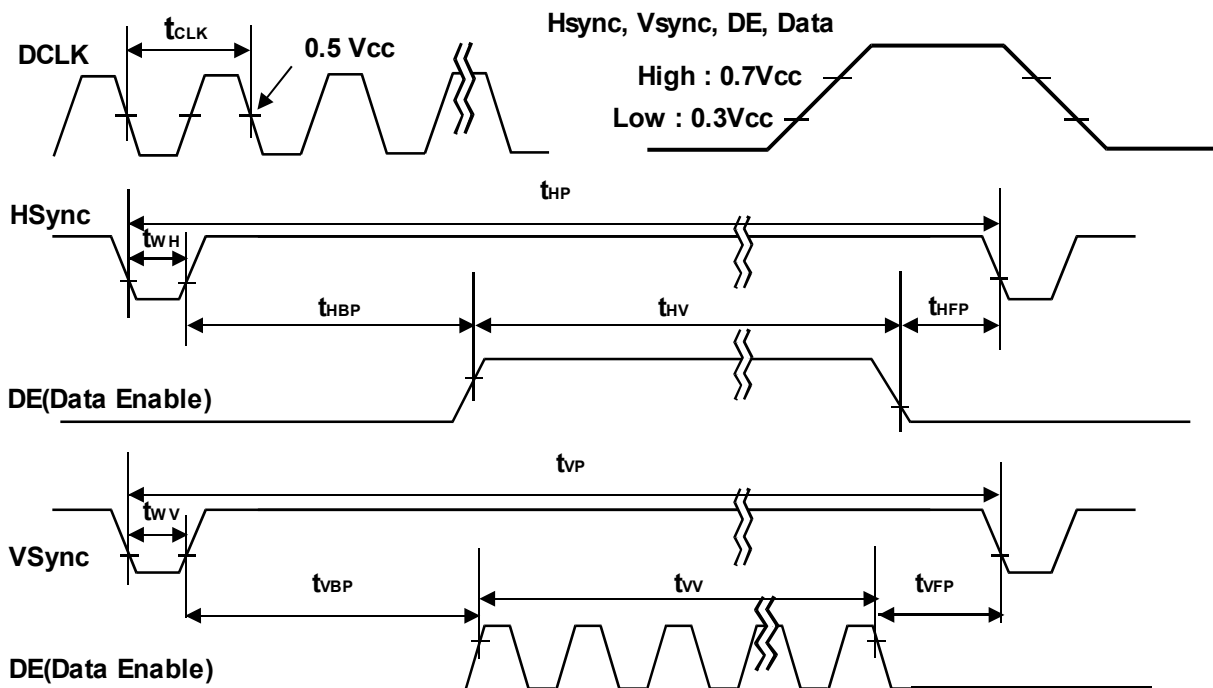
3-3. Signal Timing Specifications

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 5. Timing Table

	ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTES
Dclk	Frequency	-	40	65	68	MHz	
Hsync	Period	t_{HP}	1206	1344	1364	t_{CLK}	
	Width	t_{WH}	8	136	-		
Vsync	Period	t_{VP}	780	806	830	t_{HP}	
	Frequency	f_V	40	60	60	Hz	Don't care Flicker level
	Width	t_{WV}	1	6	-	t_{HP}	
DE (Data Enable)	Horizontal Valid	t_{HV}	1024	1024	1024	t_{CLK}	
	Horizontal Back Porch	t_{HBP}	10	160	-		
	Horizontal Front Porch	t_{HFP}	10	24	-		
	Vertical Valid	t_{VV}	768	768	768	t_{HP}	
	Vertical Back Porch	t_{VBP}	7	29	-		
	Vertical Front Porch	t_{VFP}	1	3	-		

3-4. Signal Timing Waveforms



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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 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 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	1	0	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

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3-6. Power Sequence

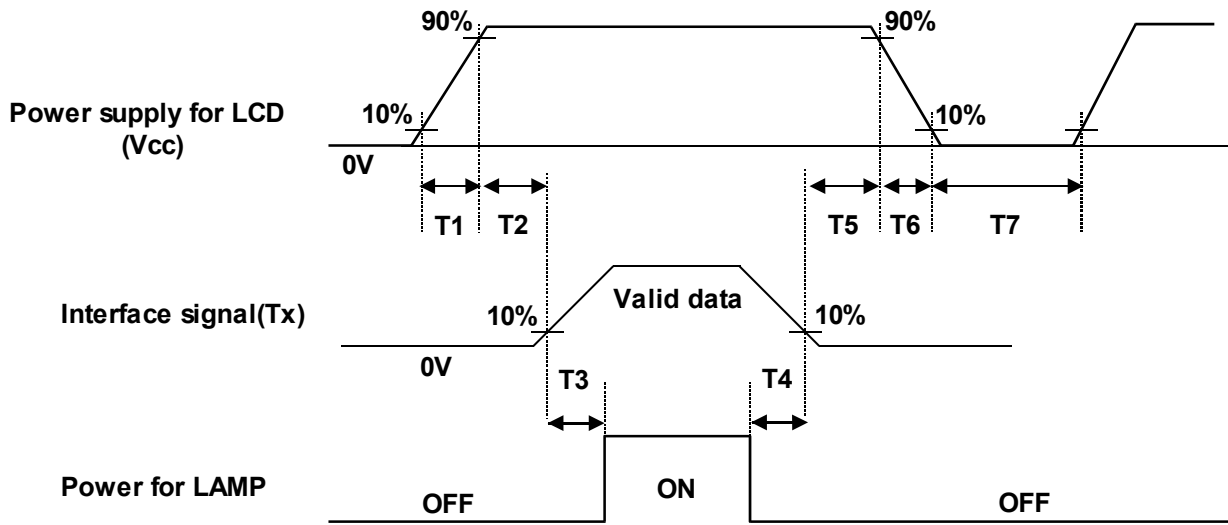


Table 7. POWER SEQUENCE TABLE

Parameter	Values			Units
	Min.	Typ.	Max.	
T 1	0	—	10	(ms)
T 2	0	—	50	(ms)
T 3	200	—	—	(ms)
T 4	0	—	—	(ms)
T 5	0	—	50	(ms)
T 6	0	—	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 signals are valid.

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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

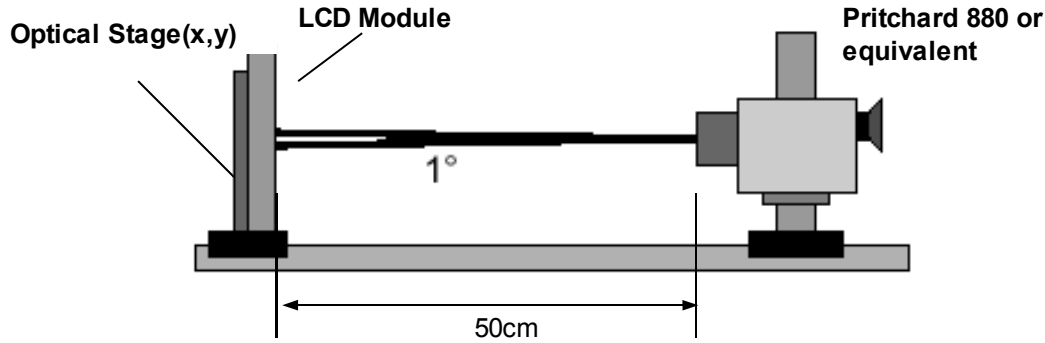


Table 8. OPTICAL CHARACTERISTICS (Ta=25 °C, V_{CC}=3.3V, f_v=60Hz Dclk=65MHz, I_{BL}=6.0mAms)

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
Contrast Ratio	CR	150	200	-		1
Surface Luminance, white	L _{WH}	185	230	-	cd/m ²	2
Luminance Variation	δ_{WHITE}	60	-	-		3
Response Time						4
Rise Time	Tr _R	-	10	20	ms	
Decay Time	Tr _D	-	20	30	ms	
CIE Color Coordinates						
Red	XR	0.562	0.587	0.612		
Green	YR	0.318	0.343	0.368		
Blue	XG	0.296	0.321	0.346		
White	YG	0.505	0.530	0.555		
	XB	0.134	0.159	0.184		
	YB	0.115	0.140	0.165		
	XW	0.288	0.313	0.338		
	YW	0.309	0.329	0.349		
Viewing Angle						5
x axis, right ($\phi=0^\circ$)	θ_r	40	45	-	degree	
x axis, left ($\phi=180^\circ$)	θ_l	40	45	-	degree	
y axis, up ($\phi=90^\circ$)	θ_u	10	15	-	degree	
y axis, down ($\phi=270^\circ$)	θ_d	30	35	-	degree	
Gray Scale	-	-	-	-		6

* Measured Inverter : 6632Z-1301A(LG Electronics)

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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 under the condition of $I_{BL}=6.0\text{mA}$. For more information see FIG 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 dividing the maximum L_N of 13 points luminance by minimum L_N of 13 points luminance. For more information see FIG 2.

$$\delta_{\text{WHITE}} = \text{Minimum}(L_{N1}, L_{N2}, \dots, L_{N13}) \div \text{Maximum}(L_{N1}, L_{N2}, \dots, L_{N13})$$

4. Response time is the time required for the display to transition from white to black(Rise Time, T_{R}) and from black to white(Decay Time, T_{D}). For additional information see FIG 3.

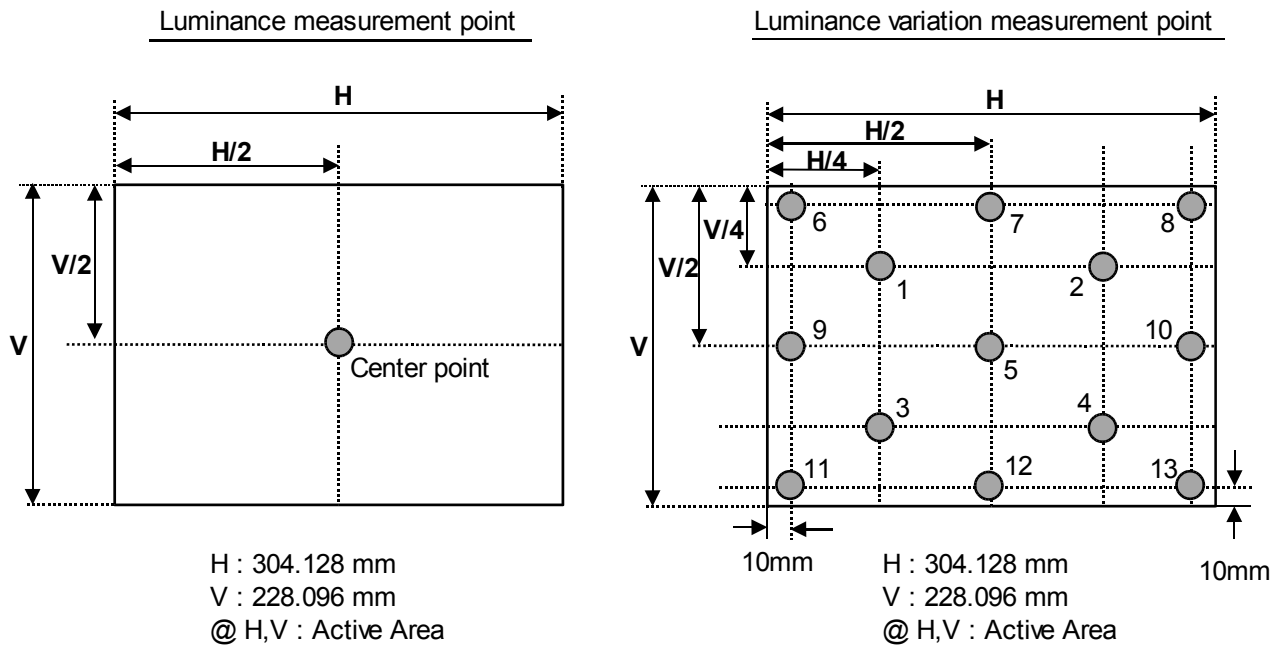
5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.

6. Gray scale specification * $f_V=60\text{Hz}$

Gray Level	Luminance(%) (Typ.)
L0	0.39
L7	1.20
L15	4.50
L23	11.3
L31	22.0
L39	38.0
L47	57.5
L55	80.0
L63	100

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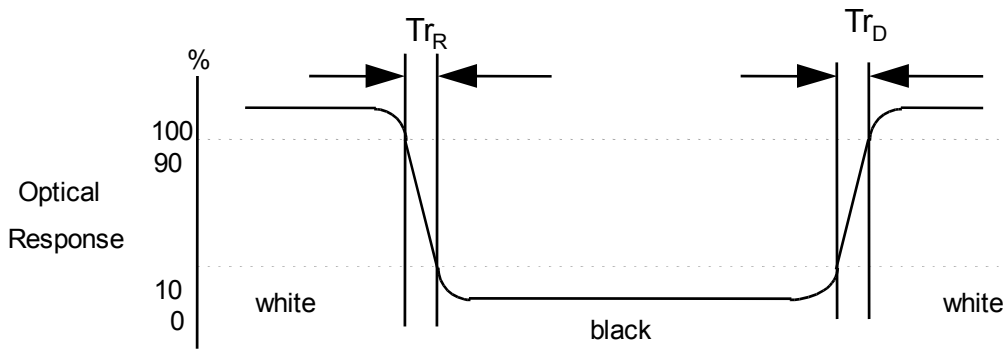
FIG. 2 Luminance & Luminance variation



Notes) The Adjacent point must be opposite horizontally or vertically.

FIG. 3 Response Time

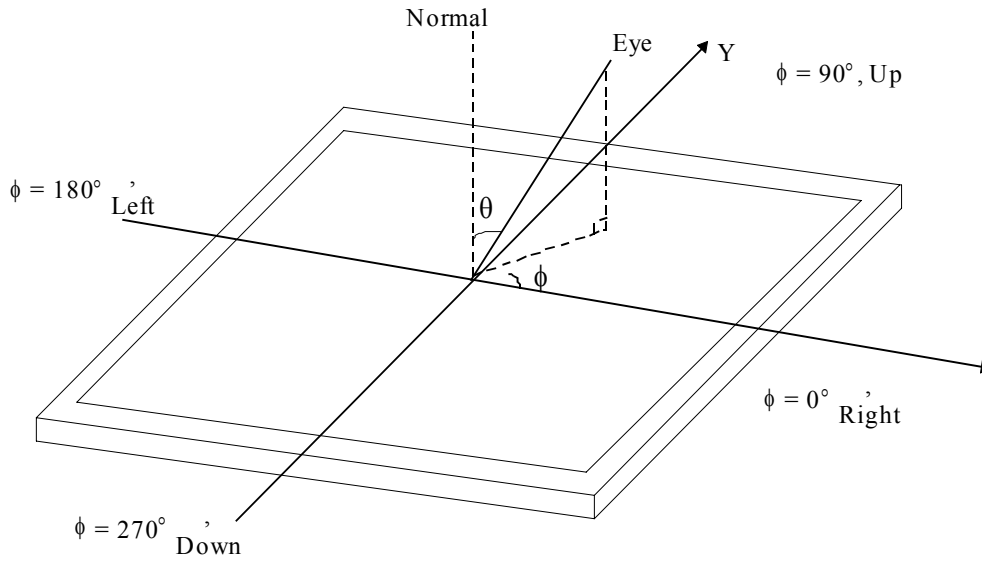
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



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FIG. 4 Viewing angle

<dimension of viewing angle range>



Product Specification

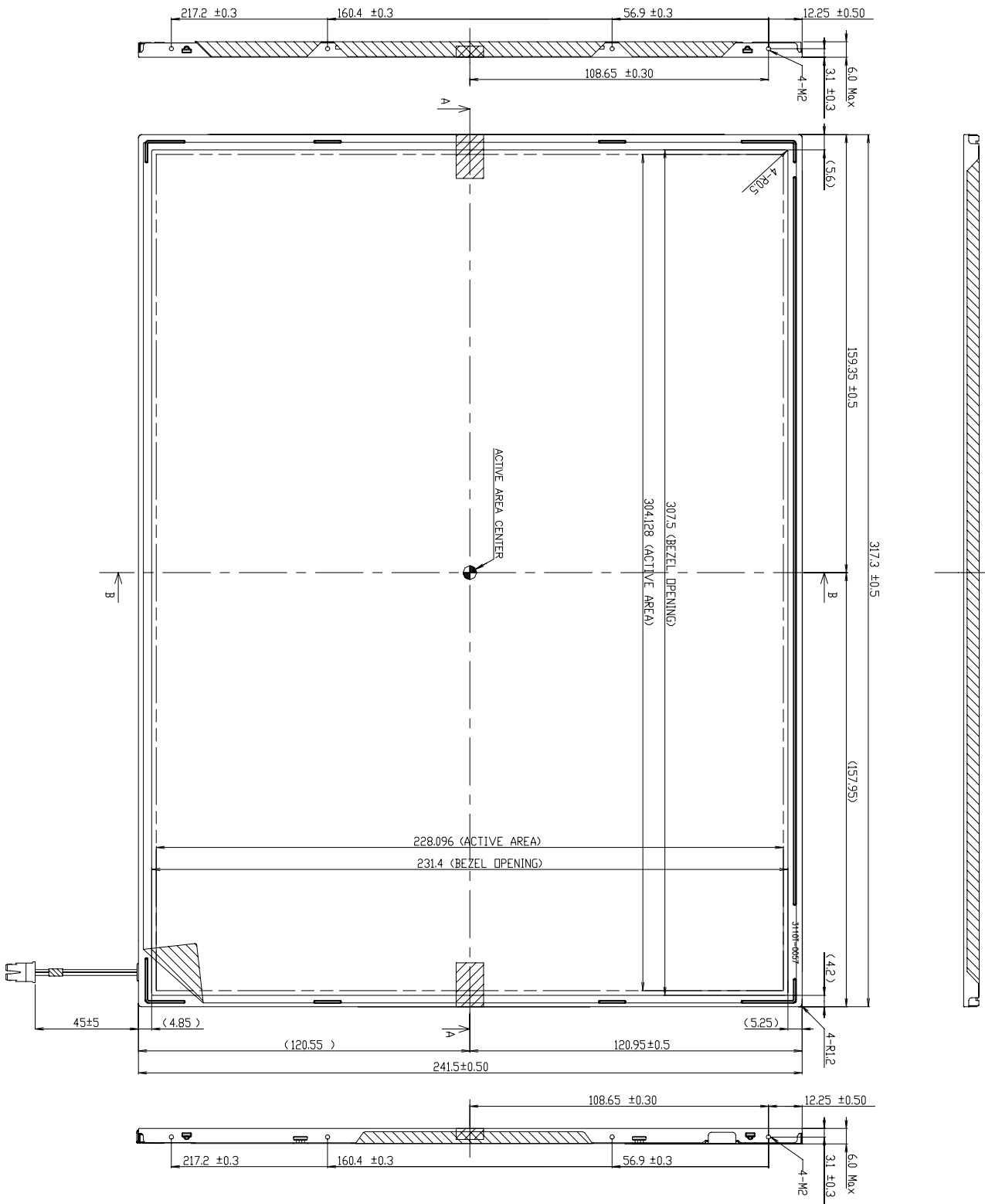
5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LP150X09. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outside dimensions	Horizontal	317.3 ± 0.5mm
	Vertical	241.5 ± 0.5mm
	Depth	5.7 ± 0.3mm
Bezel area	Horizontal	307.5 ± 0.5mm
	Vertical	231.4 ± 0.5mm
Active display area	Horizontal	304.128mm
	Vertical	228.096mm
Weight(approximate)	540g(Typ.) 555g(Max)	
Surface Treatment	Anti-glare & hard coating 3H, Anti-Reflection	

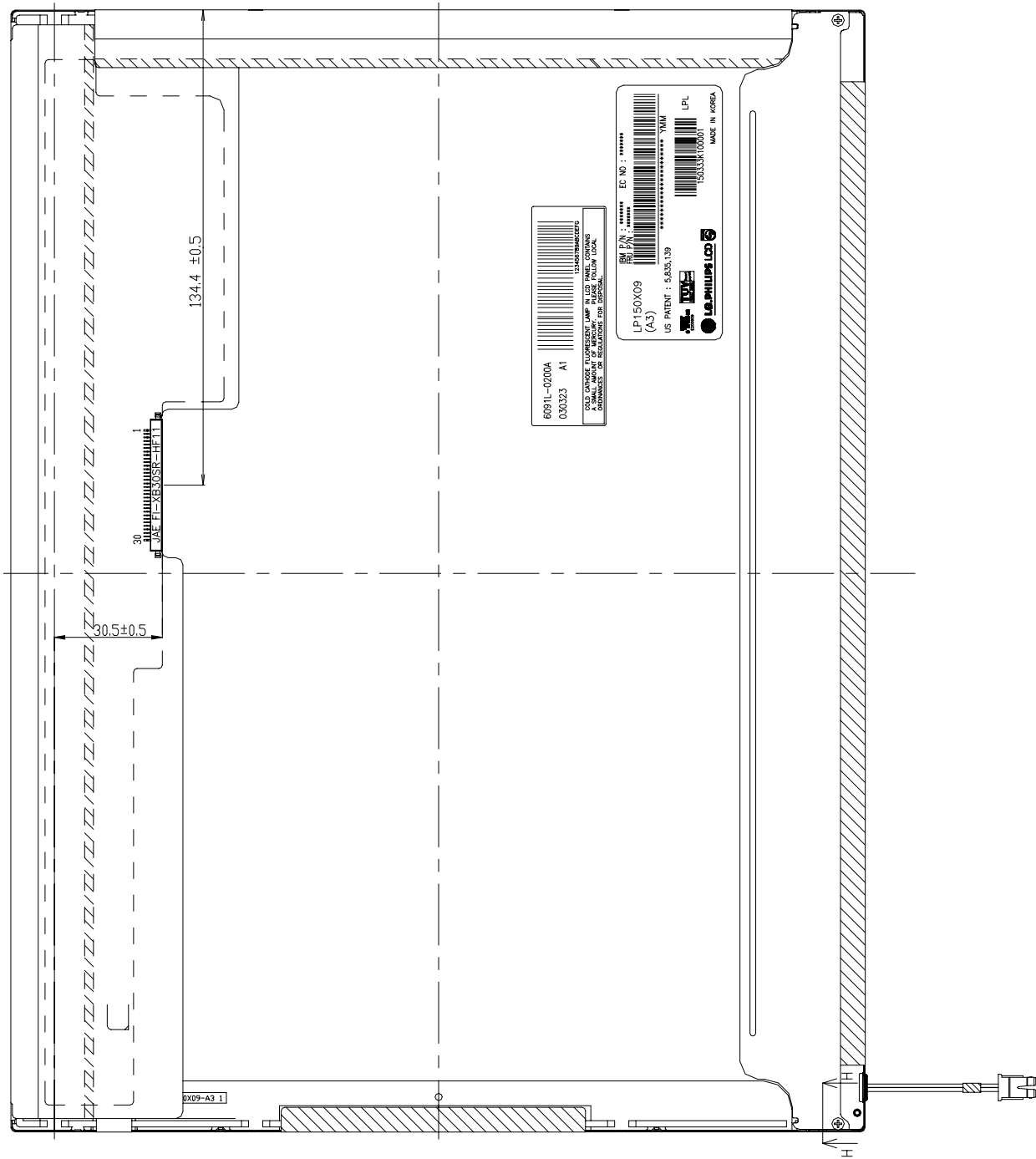
Product Specification

<FRONT VIEW>



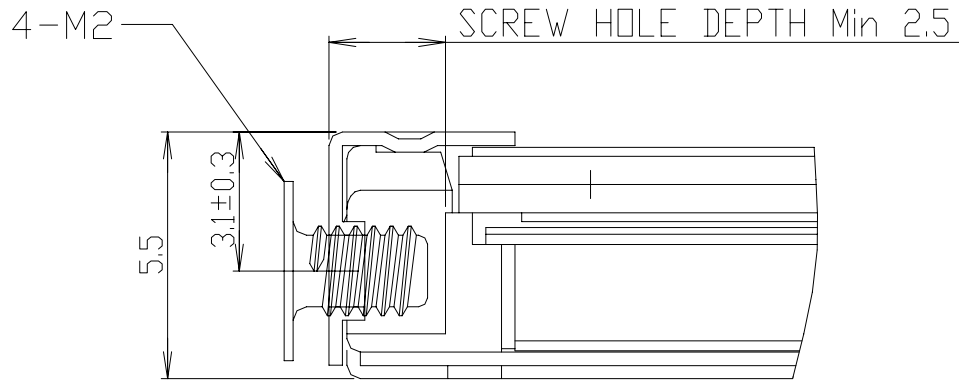
Product Specification

<REAR VIEW>



Product Specification

<DETAIL DESCRIPTION OF SIDE MOUNTING SCREW>



SCREW TORQUE : 2.3~2.5kgf.cm

SECTION H-H
SCALE 5/1

Notes : 1. Screw plated through the method of non-electrolytic nickel plating is preferred to reduce possibility that results in vertical and/or horizontal line defect due to the conductive particles from screw surface.

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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, 100G, 6ms one shock of each six faces(l.e. run 100G 6ms 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.

- ON/OFF Cycle

: The display module will be capable of being operated over 24,000 ON/OFF cycles (Lamp power & Vcc ON/OFF)

- Mean time Between Failure

: The LCD Panel and interface board assembly (excluding the CCFL) have a mean time between failures of 30,000 hours with a confidence level 90%.

Product Specification**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 : TBD pcs
- b) Box Size : TBDmm × TBDmm × TBDmm

Product Specification

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.
- (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 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 :
 $V=\pm 200\text{mV}$ (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.

Product Specification

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.

Product Specification

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Product Specification
Revision Status

Rev. No.	Chapter	Contents	Date	Issued & amended by
1.0	All	Originated IIS	08/Aug/03	Albert Nam

Product Specification

1.0 Introduction

1.1. Scope

This Incoming Inspection Standard shall be applied to TFT-LCD modules (hereafter called the "LCMs") supplied by LG.Philips LCD (hereafter called the "Supplier") to its Customer.

1.2. Incoming inspection Right

The Customer shall have the right to conduct at its own cost and expense, an incoming inspection of the LCMs at the destination specified in the relevant B/L (Bills of Lading) in accordance with the LCM's specifications separately agreed upon and the inspection criteria set forth in this article.

The Customer shall notify the Supplier in writing of the inspection results (acceptance or rejectance) in accordance with the said Incoming Inspection Standard within 40 days from the date of the B/L.

Should the Customer fail to notify the results to Supplier within 40 days period, the right to reject the LCMs shall then lapse, and the said LCMs shall be deemed to have been accepted by the Customer.

1.3. Handling Precautions

- LCM Devices are made of fragile material such as Glass and plastic and may be broken or cracked if dropped it, so **PLEASE** handle them with care.
 - **DO NOT** press the area covered with PET or such materials. These are weak point of LCMs since of TCPs(Driver ICs) and PWBs.
 - **PLEASE** support the Bezel with your finger when connecting the interface cable.
 - Please **DO NOT** touch the surface of the Glass(Polarizer).
 - **PLEASE** wear the Wrist Strap when handling.
- Semiconductive devices are included in the LCMs and they should be handled with care to prevent any electrostatic discharge(ESD).
- **PLEASE** keep the LCMs in the specified, original packing boxes when storage.
 - **DO NOT** stack the LCMs too high without wrapping material such as AIR CAP.
 - Before use the LCMs, **PLEASE** check the Engineering specification.
 - LCMs contain a small amount of Liquid Crystal and Mercury. **PLEASE** follow local ordinances or regulations for disposal.

Product Specification

2.0 Generals

2.1. Sampling Method

Unless otherwise agreed upon in writing, the sampling inspection shall be applied to the Customer's incoming inspection.

- 2.1.1. Lot size : Quantity per shipment lot (minimum lot size : 100 pieces)
- 2.1.2. Sampling type : Normal inspection, Single sampling
- 2.1.3. Inspection level : II
- 2.1.4. Sampling table : MIL-STD-105D

2.2. Acceptable Quality Level(AQL)

The AQL for major and minor defects shall be respectively set forth below.

- 2.2.1. Major = 0.65 %
- 2.2.2. Minor = 1.5 %

2.3. Classification of defects

Defects are classified as either a major defect or a minor defect based on the degree of defect defined herein.

2.2.1. Major defect

The major defect is a defect that is likely to result in product failure, or reduction in the product's intended usage.

2.2.2. Minor defect

The minor defect is a defect that has little bearing on the effective use or operation of the product.

Specific criteria of judgment of major and/or minor defects or other related issues shall be in accordance with the Appendix A, "Classification of Defects".

2.4. Determination of acceptability and subsequent disposal

If the number of defects found in the LCM sampling lot is equal to or less than the AQL(Acceptable Quality Level), the lot shall be accepted.

If the number of defects found in the LCM sampling lot is greater than the AQL, the lot shall be rejected. The Customer shall inform the Supplier of the results of such inspection detailly within the time period stipulated in chapter 1.2. "Incoming inspection Right".

Product Specification

2.4.1. Accepted lot

An acceptance under the above incoming inspection shall constitute an acceptance by the Customer of such lot of the LCMs in terms of the landed quality thereof.

2.4.2. Rejected lot

If a shipment lot of products is rejected under the above incoming inspection due to any defects of which the Supplier is responsible and such a fact is clearly confirmed by the Supplier through a separate inspection or as otherwise decided, the Supplier shall choose one of the following three options which must be determined by mutual consent.

The Supplier shall advise the Customer of its choice not later than 10 working days (Monday through Friday) of receipt of the "Customer's notification of rejected lot":

- a. The Customer shall return the rejected lot to the place to be designated by the Supplier and the Supplier shall screen all of the products in the lot and repair or replace the defective LCMs.
- b. The Supplier shall screen all of the LCMs in the lot and repair or replace the defective LCMs within a reasonable time period at the Customer's facility.
- c. The Customer shall screen the entire lot of LCMs at the expense of Supplier's, and the expense must be agreed by the Supplier. The rejected LCMs shall be returned to the place designated by the Supplier.

2.5. Inspection Method

2.5.1. Ambient conditions

- a. Temperature : **25±5 °C**
- b. Humidity : **65 ±10 % RH**
- c. Illumination : **Single 20W fluorescent lamp non-directive (300 to 700 Lux)**

2.5.2. Viewing distance

The distance between the LCM and the inspector's eyes shall be at least 30-50cm.

2.5.3. Viewing Angle

The inspection shall be conducted within normal viewing angle range.

※ Refer to the CAS for viewing angle.

3.0 Inspection Criteria **Product Specification**

3.1. Dot Defect

Bright (Lit) Dot

- R,G or B 1 dot ----- 7 Max
- Adjacent 2 dots ----- 1 Max (Except Vertical Green 2 adjacent)
- Total amount of Bright dots ----- 7 Max
- Minimum Distance between bright dots ---- 15 mm

Bright (Lit)Dot Portion

- Zero Lit ----- Over 90%
- Others ----- Below 10%
- 2adjacent ----- Below 1.5%

Dark Dot

- 1 dot ----- 7 Max
- Adjacent 2 dots ----- 2 Max
- Total amount of Dark dot ----- 7 Max
- Minimum Distance between dark dots ----- 15 mm

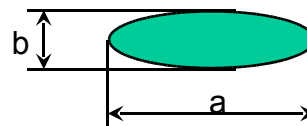
Total amount of Dot Defects ----- 8 Max (Combination)

Note) a. Every dot herein means Sub-Pixel(Each Red,Green, or Blue Color)
 b. Damaged less than half size of sub-pixel is not counted as defect
 c. Dots darker than half brightness of sub-pixel are not defined as bright dot defect and dots brighter than half brightness of sub-pixel is not defined as dark dot defect.

3.2. Polarizer Defects

Items		Criteria
Scratches	Linear	$0.05 \leq W < 0.10, 0.3 \leq L \leq 3.0, N \leq 4$
Dent	Circular	$0.2 \leq D \leq 0.4, N \leq 5$
Bubble		$0.2 \leq D \leq 0.4, N \leq 5$

Where, W :Width
 L : Length
 D : Average diameter $= (a+b)/2$



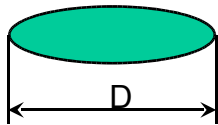
Product Specification

Note) continued

- c. Extraneous substances which can be wiped out, like Finger Print, Particles, are not considered as a defect.
- b. Defects which is on the Black Matrix(outside of Active Area) are not considered as a defect.

3.3 Foreign Material

Items	Criteria
Linear	$0.05 \leq W \leq 0.08, 0.3 \leq L \leq 2.0, N \leq 4$
Circular	$0.2 \leq D \leq 0.5, N \leq 5$



D : the line of apsides

3.4. Line Defect

All kinds of line defects such as vertical, horizontal or cross are not allowed.

3.5. Bezel Appearance

Scratches, minor bents, stains, particles on the Bezel frame are not considered as a defect.

3.6. Others

Issues which is not defined in this criteria shall be discussed with both parties, Customer and Supplier, for better solution.

Product Specification**4.0 RMAs****4.1. Verification**

The Supplier can verify the defective LCMs to segregate the responsibilities at Customer's facility or can request the Customer to ship the defective LCMs to assigned place for verification

This verification result shall be agreed mutually by the Customer and Supplier. This result can be corrected/changed after detail failure analysis at Supplier's facilities.

4.2. Supplier Induced Defects

All of the Supplier induced defective LCMs shall be returned to the Supplier for repair or replacement.

Before return the defective LCMs, the Customer needs Supplier's confirmation with RMA Number.

All of the returned LCMs shall be returned to the Customer within agreed time period.

4.3. Customer Induced Defects

The Customer can return the customer induced defective LCMs to the Supplier for repair.

The repair cost for Customer induced defective LCMs shall be agreed with both parties, Customer and Supplier.

Product Specification**5.0 Warranty****5.1. Warranty Period**

In-warranty period is **Eighteen(18)** Months from manufacturing month of LCM.

Note)

- a. Eighteen months are composed of twelfth months in-warranty period and sixth months distribution period.
- b. The manufacturing Month is on the LCMs as Supplier's serial No.
- c. If customer want to extend warranty, customer should pay 0.5% of a unit cost per 6months.

5.2. Repair Warranty

Repair warranty is **Twelve(12)** Months from repaired month for repaired LCMs.

Note) The Label for repair will be added after repairing.

5.3. Warranty avoidance

The warranty will be avoided in cases of below,

- a. When the warranty period is expired
- b. The Customer induced defective LCMs
- c. When the LCMs were repaired by 3rd party without Supplier's approval.
- d. When the LCMs were treated like Disassemble and Rework by the Customer and/or Customer's representatives without Supplier's approval.

6. Others

If any problems arise with the LCMs supplied by supplier, the Customer and Supplier will cooperate and make efforts to solve it with mutual confidence and respect.

Product Specification

Appendix A. Classification of Defects

Defect Mode	Criterion for Defect	Class
Operating Frequency	Specified range in the CAS	Major
Power Consumption	Specified range in the CAS	Major
Contrast Ratio	Specified range in the CAS	Major
Line Defect	Not allowed any Vertical,Horizontal,and Cross line	Major
Polarizer Defects	Shall be accordance with the item 3.0 "Inspection Criteria" in this standard	Minor
Extraneous Substance	Shall be accordance with the item 3.0 "Inspection Criteria" in this standard	Minor
Dot Defect	Shall be accordance with the item 3.0 "Inspection Criteria" in this standard	Minor
Bezel Claw Forming	The bezel claw is not formed sufficiently	Minor