

Product Specification

SPECIFICATION FOR APPROVAL

- (◆) Preliminary Specification
- () Final Specification

Title	10.4" SVGA TFT LCD
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BUYER	
MODEL	

SUPPLIER	LG.Philips LCD Co., Ltd.
Model	LP104S5
SUFFIX	A2VT

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

SIGNATURE	DATE
/	_____
/	_____
/	_____

APPROVED BY	DATE
S. H. Kang / G.Manager	_____
REVIEWED BY J. H. Lee / Manager H.S. Yoon / Manager	_____
PREPARED BY S.Y. Lee / Engineer J.H. Hwang / Engineer	_____

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

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

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Product Specification**RECORDS OF REVISIONS**

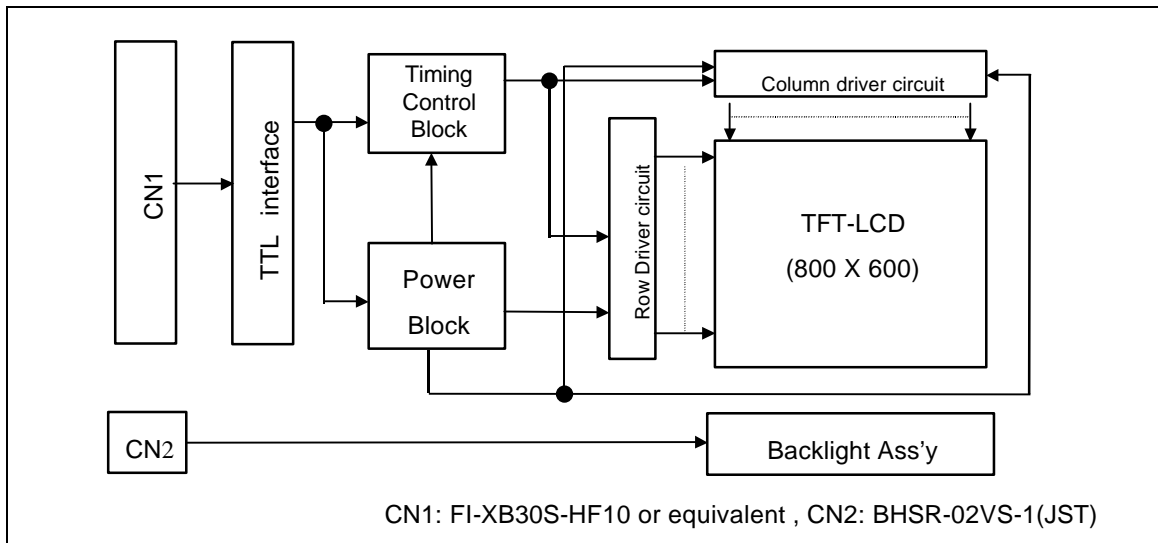
Version No	Date	Page	DESCRIPTION
0.0	Oct 06, 2000	-	First draft

Product Specification

1. General Description

The LP104S5-A2VT 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 10.4 inches diagonally measured active display area with SVGA resolution(600 vertical by 800 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 LP104S5-A2VT is intended to support applications where thin thickness is critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LP104S5-A2VT characteristics provide an excellent flat panel display for office automation products such as Notebook PC.



General Features

Active screen size	10.4 inches(264.16mm) diagonal
Outline dimensions	224.5(H) X 172.0(V) X 5.7(D) mm (Typ.)
Pixel pitch	0.264 mm X 0.264 mm
Pixel format	800 horiz. by 600 vert. pixels
	RGB stripe arrangement
Color depth	6-bit, 262,144 colors
Luminance,White	170 cd/m ² (Typ.)
Power Consumption	Total 3.9 Watt(Typ.)
Weight	310g (Typ.)
Display operating mode	Transmissive mode, normally white
Surface treatments	Hard coating (3H),

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3. Electrical Specifications

3-1. Electrical Characteristics

The LP104S5-A2VT 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}	-	290	360	A	1
Power Consumption	P _c	-	0.96	1.2	W	1
Rush Current	I _{RUSH}	-	1.0	1.5	A	3
Lamp						
Operating Voltage	V _{BL}	475(7mA)	500(6mA)	640(3mA)	V _{RMS}	4
Operating Current	I _{BL}	3.0	6.0	7	mA	
Established Starting Voltage at 25°C 0°C		-	-	845	V _{RMS}	5
		-	-	1015	V _{RMS}	5
Discharge Stabilization Time	T _s			3	min	7
Operating Frequency	f _{BL}	45	60	80	kHz	6
Power Consumption	P _{BL}	-	3.0	3.3	Watts	8
Life Time		20,000		-	Hours	9

Notes: **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 your instrument.

1. The specified current and power consumption are under the V_{cc} = 3.3V, 25°C, f_v = 60Hz condition

whereas mosaic pattern is displayed.

2. The duration of rush current is about 20ms.

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. (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 as possible from the horizontal synchronous frequency

and from its harmonics in order to prevent interference.

6. 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%.

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7. The lamp power consumption shown above does not include loss of external inverter.
8. The life time is determined as the time at which brightness of lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at $25 \pm 2^{\circ}\text{C}$.

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3-2. Interface Connections

This LCD employs interface connection, a 30 pin connector is used for the module electronics and a two pin connector is used for the backlight system.

The electronic interface connector is a FI-XB30S-HF10, 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	Vcc	Power (3.3V)	1. Connector 1.1 LCD: FI-XB30S-HF10 or equivalent 1.2 Mating: FI-30M (FPC Type) FI-X30H (Cable Type) 1.3 Connector pin arrangement 
2	Vcc	Power (3.3V)	
3	GND	Ground	
4	DTMG	Data Enable	
5	VSYNC	Vertical sync	
6	HSYNC	Horizontal sync	
7	GND	Ground	
8	DCLK	Data Clock	
9	GND	Ground	
10	R5	Red data (MSB)	
11	R4	Red data	
12	R3	Red data	
13	R2	Red data	
14	R1	Red data	
15	R0	Red data (LSB)	
16	GND	Ground	
17	G5	Green data(MSB)	
18	G4	Green data	
19	G3	Green data	
20	G2	Green data	
21	G1	Green data	
22	G0	Green data(LSB)	
23	GND	Ground	
24	B5	Blue data (MSB)	
25	B4	Blue data	
26	B3	Blue data	
27	B2	Blue data	
28	B1	Blue data	
29	B0	Blue data (LSB)	
30	GND	Ground	

[LCD Module Rear View]

The backlight interface connector is a model BHSR-02VS-1, manufactured by JST. 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 pink. The low voltage side terminal is black

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3-3. Signal Timing Specifications

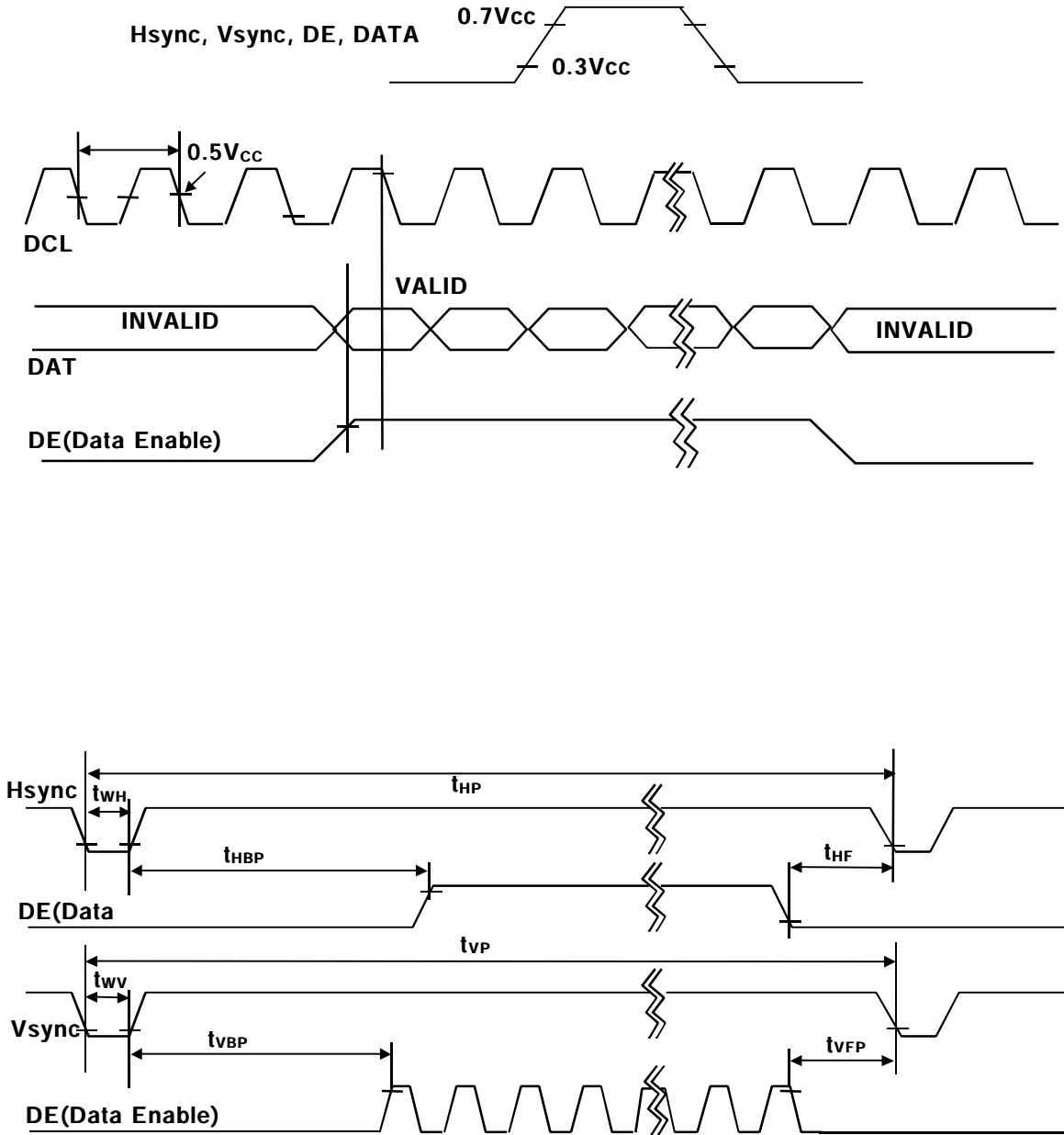
All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

Table 6 Timing Table

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Dclk	Period	t _{CLK}	25	26	27	ns	TYP. 38.5MHz
Hsync	Period	t _{HP}	990	1024	1100	t _{CLK}	
	Width-Active	t _{WH}	12	-	120		
Vsync	Period	t _{VP}	604	625	730	t _{HP}	
	Frequency	f _V	-	60	-	Hz	
	Width-Active	t _{WV}	1	-	24	t _{HP}	
DE (Data Enable)	H-Back Porch	t _{HBP}	30	-	-	t _{CLK}	
	H-Front Porch	t _{HFP}	30	-	-		
	V-Back Porch	t _{VBP}	0	-	-	t _{HP}	
	V-Front Porch	t _{VFP}	3	-	-		

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3-4. Signal Timing Waveforms



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3-5. Color Input Data Reference

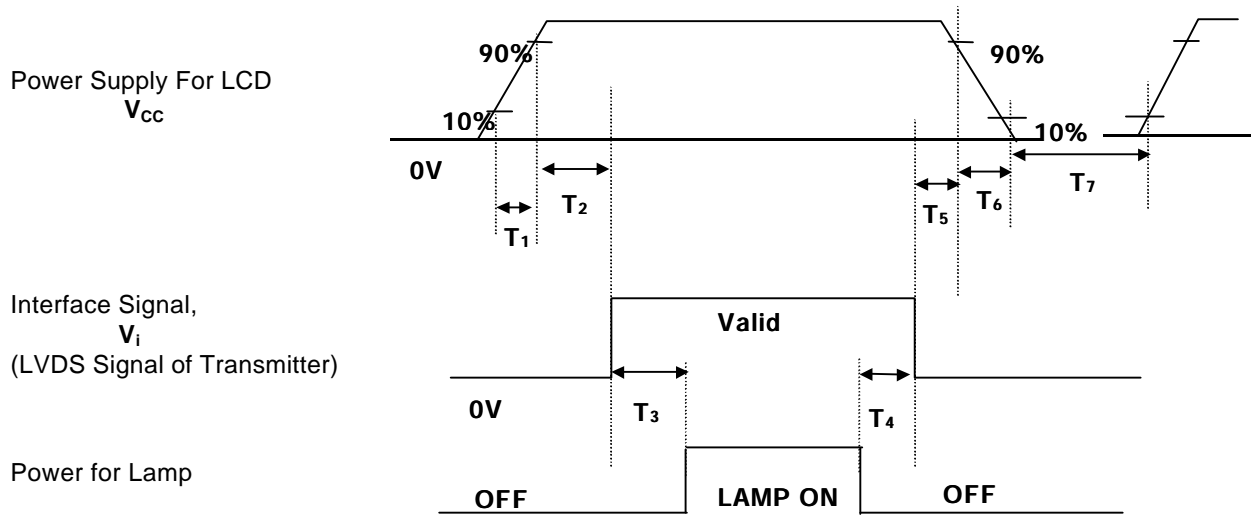
The brightness of each primary color(red, green and blue) is based on the 6-bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

Table 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

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3-6. Power Sequence



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

- 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.

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4. Optical Specifications

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°C.

FIG 1. presents additional information concerning the measurement equipment and method.

FIG. 1 Optical Characteristic Measurement Equipment and Method

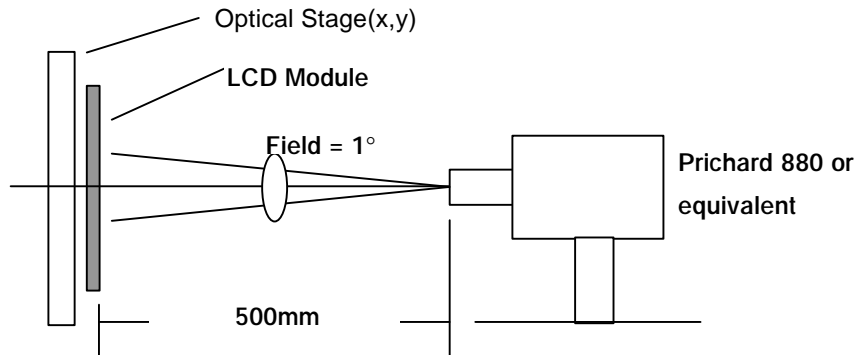


Table 8 OPTICAL CHARACTERISTICS ($T_a=25^\circ\text{C}$, $V_{cc}=3.3\text{V}$, $f_v =60\text{Hz}$, $D_{clk}=38.5\text{MHz}$, $I_{BL}= 6\text{mA}$)

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
Contrast Ratio	CR	-	200	-		1
Surface Luminance, white	L_{WH}	150	170	-	cd/m ²	2
Luminance Variation	δ_{WHITE}	-	1.35	1.45		3
Response Time	T_r					
Rise Time	T_{rR}	-	30	50	ms	4
Decay Time	T_{rD}	-	30	50		
CIE Color Coordinates						
Red	x_R		TBD			
	y_R		TBD			
Green	x_G		TBD			
	y_G		TBD			
Blue	x_B		TBD			
	y_B		TBD			
White	x_W	0.283	0.313	0.343		
	y_W	0.299	0.329	0.359		
Viewing Angle						
x axis, right ($\Phi=0^\circ$)	θ_r	40	-	-	degree	5
x axis, left($\Phi=180^\circ$)	θ_l	40	-	-		
y axis, up($\Phi=90^\circ$)	θ_u	10	-	-		
y axis, down ($\Phi=270^\circ$)	θ_d	30	-	-		
Gray Scale		-	-	-		6

Notes:

- Contrast Ratio (CR) is defined mathematically as :

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$
- Surface luminance is the center point across the LCD surface 50cm from the surface with all

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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'.

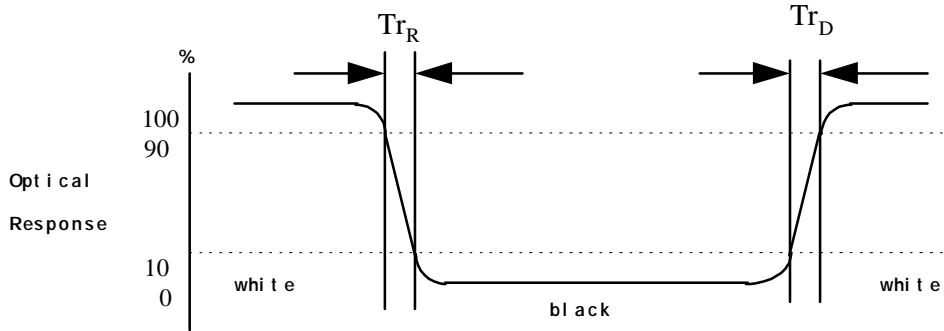
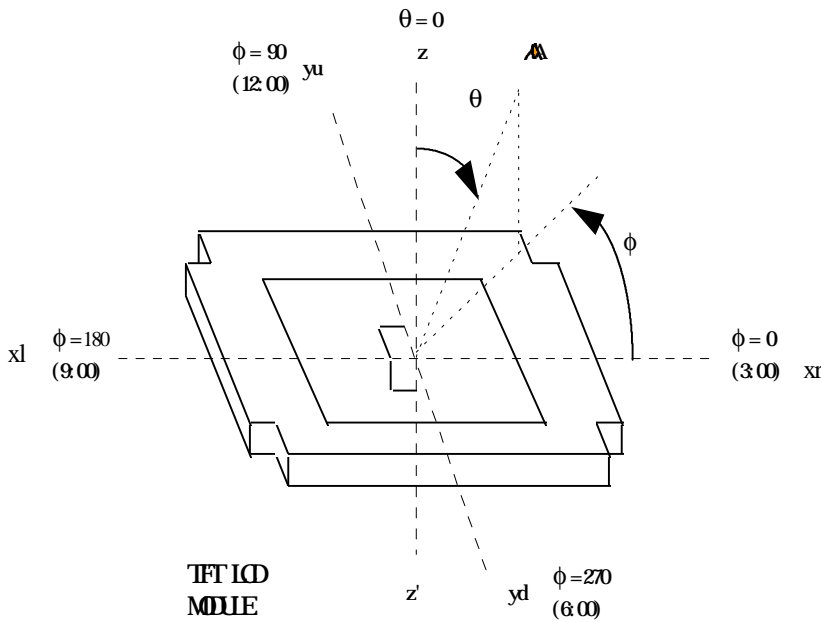


FIG. 4 Viewing angle

<Definition of viewing angle range>



A: E

Product Specification**5. Mechanical Characteristics**

The contents provide general mechanical characteristics for the model LP104S5-B2AP LCD. In addition, the figures in the next page are detailed mechanical drawings of the LCD.

Outside dimensions :

Horizontal	224.5 ± 0.5 mm
Vertical	172.0 ± 0.5 mm
Depth	5.7 ± 0.3 mm

Bezel area :

Horizontal	214.2 ± 0.5 mm
Vertical	161.8 ± 0.5 mm

Active Display area :

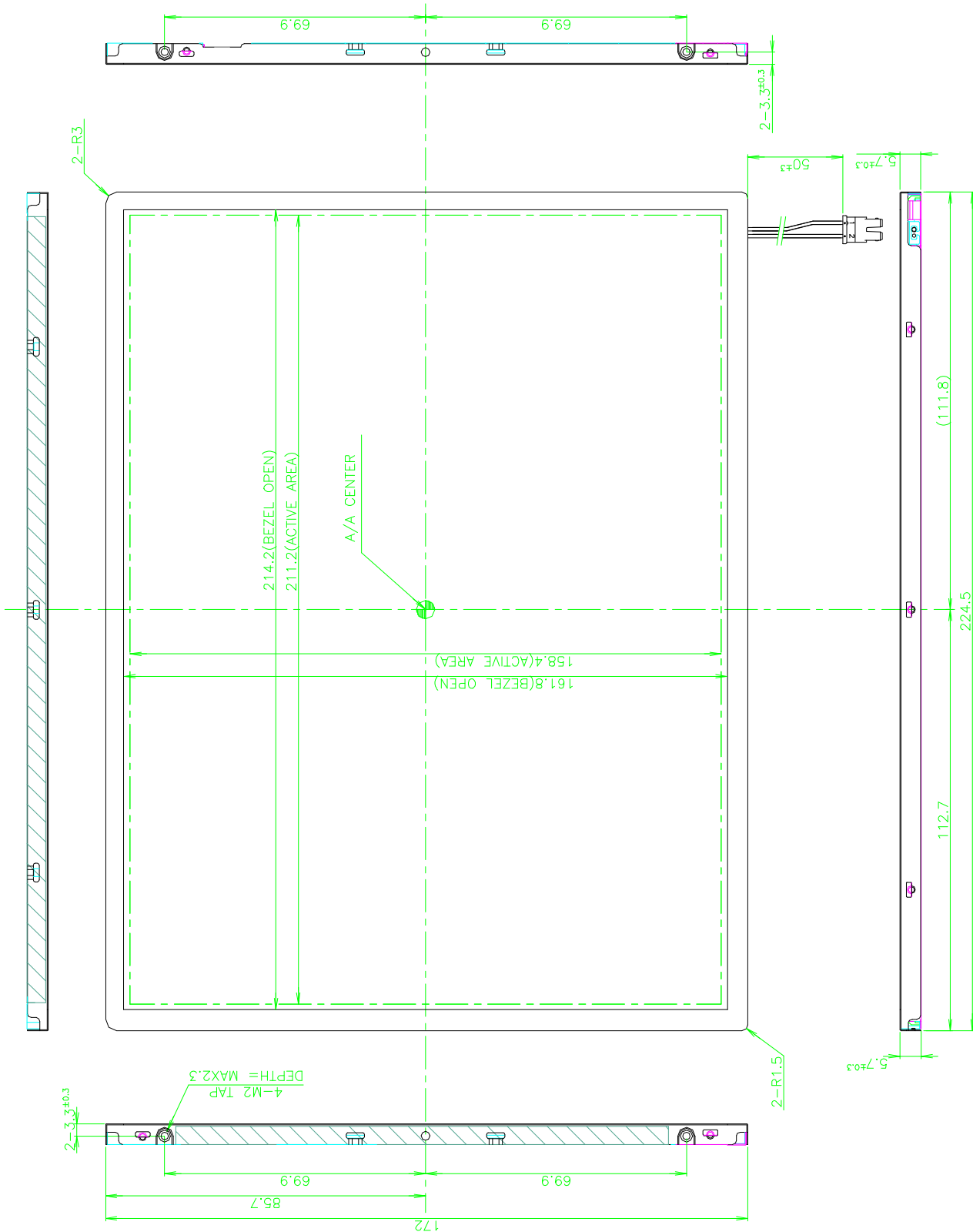
Horizontal	211.2 mm
Vertical	158.4 mm

Weight (approximate) : 310g (Typ.), 320g(Max.)

Surface Treatment : Hard coating (3H)
Anti-glare treatment of the front polarizer

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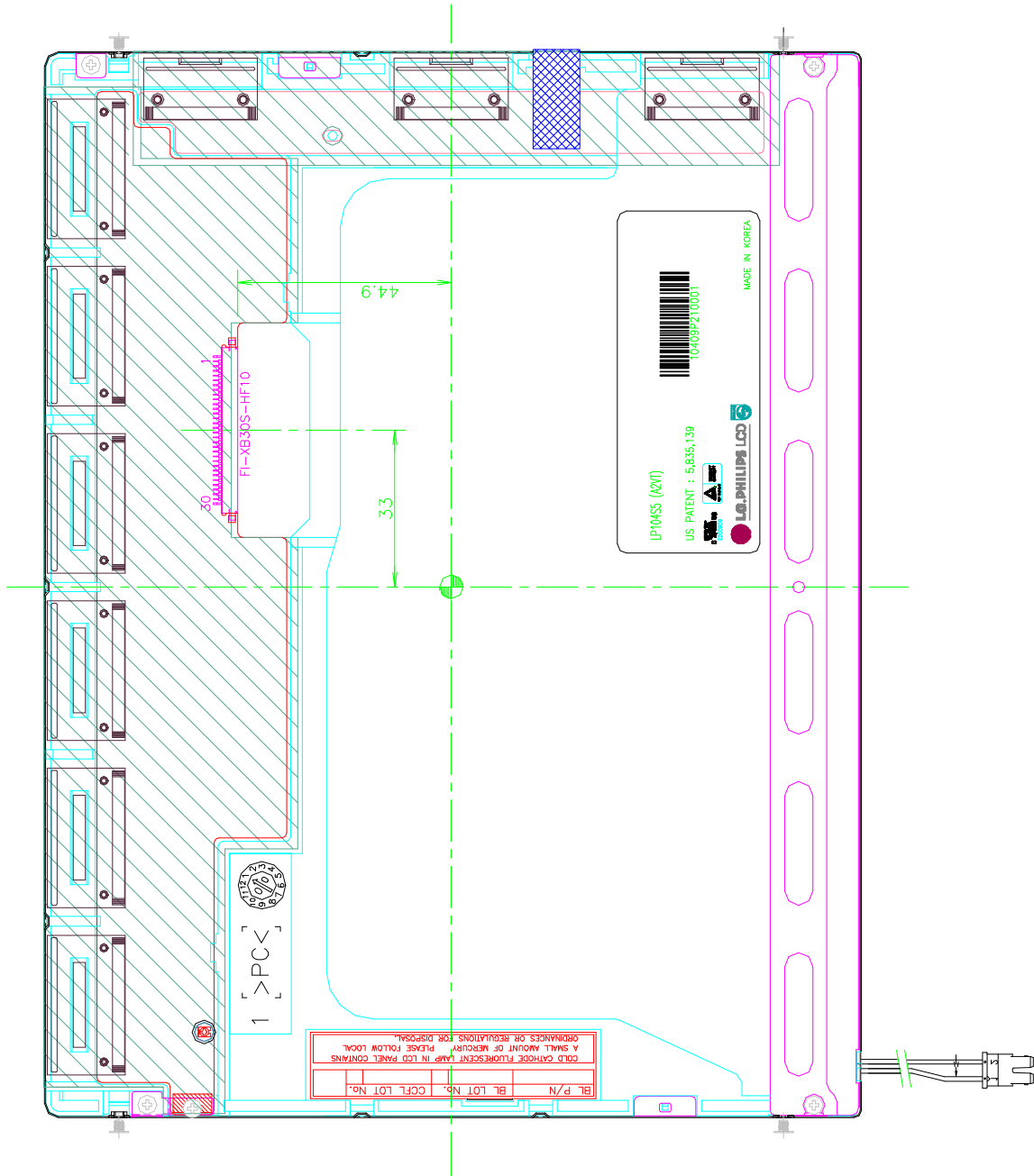
< FRONT VIEW >



1. UNSPECIFIED DIMENSIONAL TOLERANCES ARE ±0.5mm.

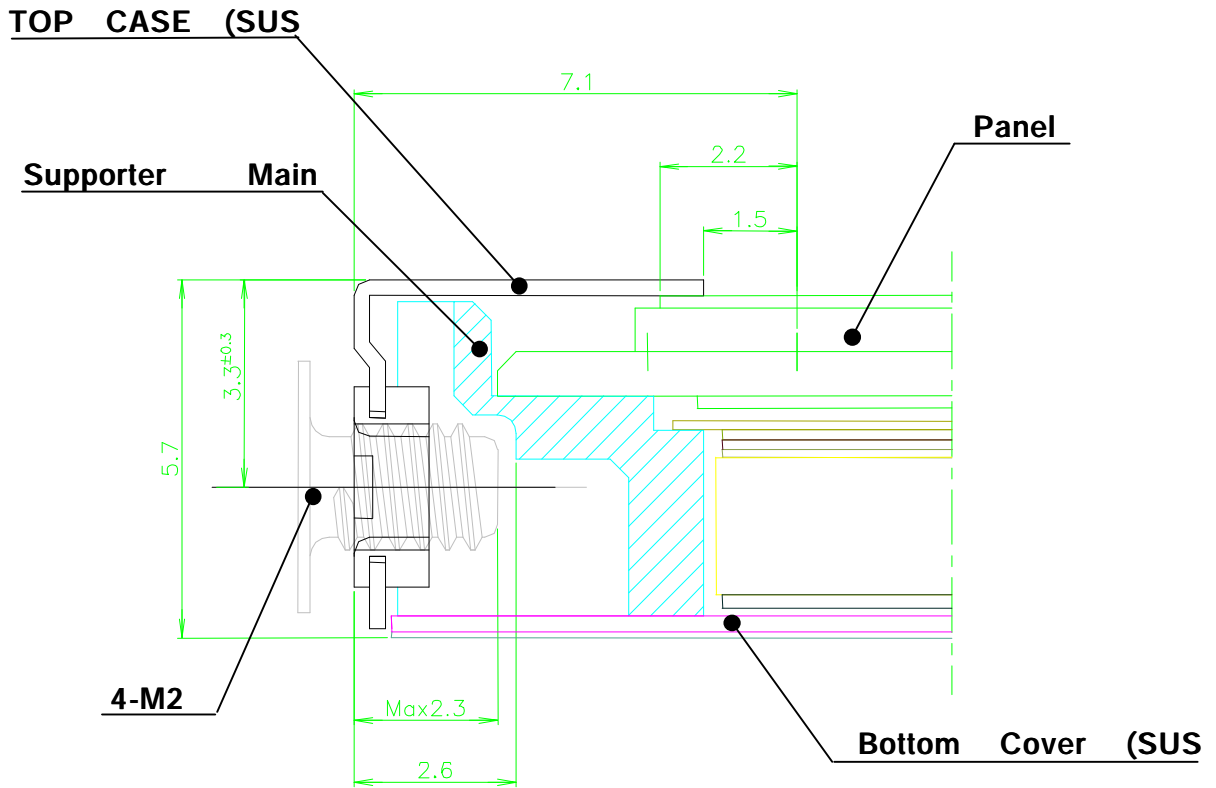
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<REAR VIEW >



<DETAIL DESCRIPTION OF SIDE MOUNTING SCREW>

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*Mounting screw depth : Max 2.3mm

*Screw(4ea) Torque : Max 2kgf/cm

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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, 1 hour/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 (3048m) 0 - 40,000 feet (12192m)

{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.

Product Specification**7. International Standards****7-1. Safety**

- a) UL 1950 Third Edition, Underwriters Laboratories, Inc. Jan. 28, 1995.
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.
- b) CAN/CSA C22.2 No. 950-95 Third Edition, Canadian Standards Association, Jan. 28, 1995.
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.
- c) EN 60950 : 1992 + A1 : 1993 + A2 : 1993 + A3 : 1995 + A4 : 1997 + A11 : 1997
IEC 950 : 1991 + A1 : 1992 + A2 : 1993 + A3 : 1995 + A4 : 1996
European Committee for Electrotechnical Standardization (CENELEC)
EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical Business Equipment.

7-2. EMC

- a) ANSI C63.4 'Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic 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 Interference Characteristics of Information Technology Equipment.' International Special Committee on Radio Interference
- c) EN 55022 'Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment.' European Committee for Electrotechnical Standardization (CENELEC),1988

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8. Packing

8-1. Designation of Lot Mark

a) Lot Mark



A, B, C : INCH CODE
 D : YEAR
 E : MONTH
 F, G : PANEL 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	3	4	5	6	7	8	9	A	B	C

b) Location of Lot Mark

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

8-2. Packing Form

a) Package quantity in one box : 10 pcs

b) Box Size : 371mm X 239mm X 300mm

Product Specification**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 a 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 soaked 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 minimize 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.