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SPECIFICATION FOR APPROVAL

- (●) Preliminary Specification
() Final Specification

Title	7.0" WVGA (800 x RGB x 480) TFT LCD
--------------	--

BUYER	
MODEL	

SUPPLIER	LG.Philips LCD Co., Ltd.
*MODEL	LB070WV1
Suffix	TD07

SIGNATURE	DATE
/	_____
/	_____
/	_____

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

SIGNATURE	DATE
C.S. KYEONG / G.Manager	_____
REVIEWED BY	
S.D. JUNG / Manager	_____
/ Manager	_____
PREPARED BY	
O. J. KWON / Engineer	_____
/ Engineer	_____

Products Engineering Dept
LG. Philips LCD Co., Ltd

Product Specification

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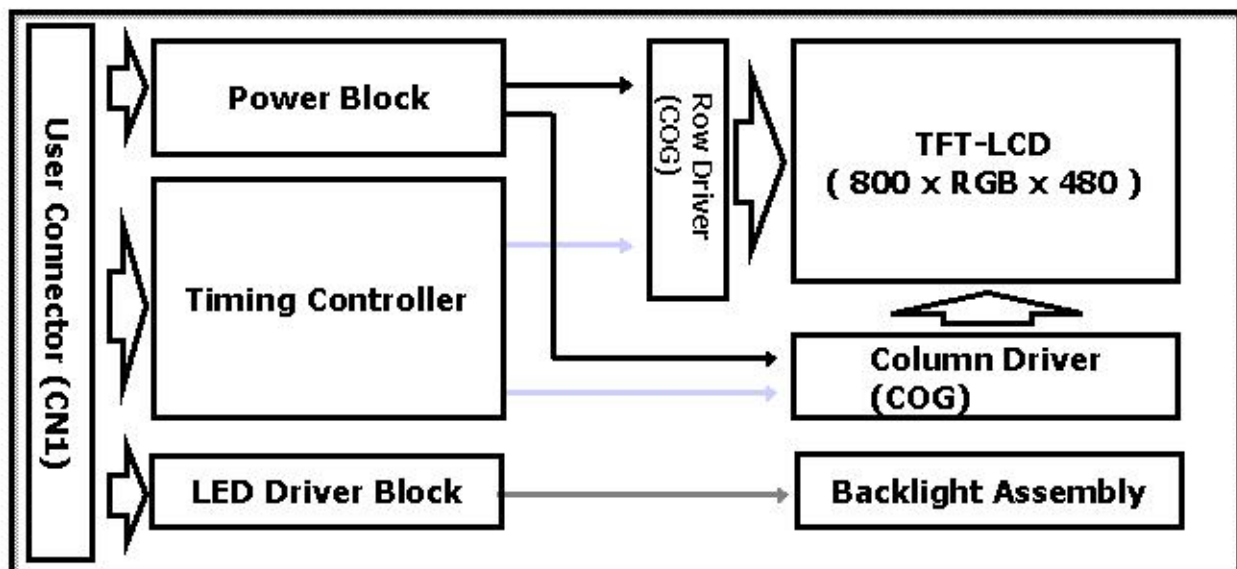
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1. General Description

The LB070WV1 is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode(LED) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. This TFT-LCD has 7.0 inches diagonally measured active display area with WVGA resolution(800 horizontal by 480 vertical pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 6-bit gray scale signal for each dot, thus, presenting a palette of more than 262,144 colors.

The LB070WV1 has been designed to apply the interface method that enables low power, high speed, low EMI.

The LB070WV1 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 LB070WV1 characteristics provide an excellent flat display.



General Features

Active Screen Size	7.0 inches diagonal
Outline Dimension	165x104.6x5mm
Pixel Pitch	0.1905 mm × 0.1905 mm
Pixel Format	800 horiz. by 480 vert. Pixels RGB strip arrangement
Color Depth	6-bit, 262,144 colors
Luminance, White	250 cd/m ² (Typ.)
Power Consumption	TBD
Weight	TBD
Display Operating Mode	Transmissive mode, normally white
Surface Treatment	Anti-glare treatment of the front polarizer

2. Absolute Maximum Ratings

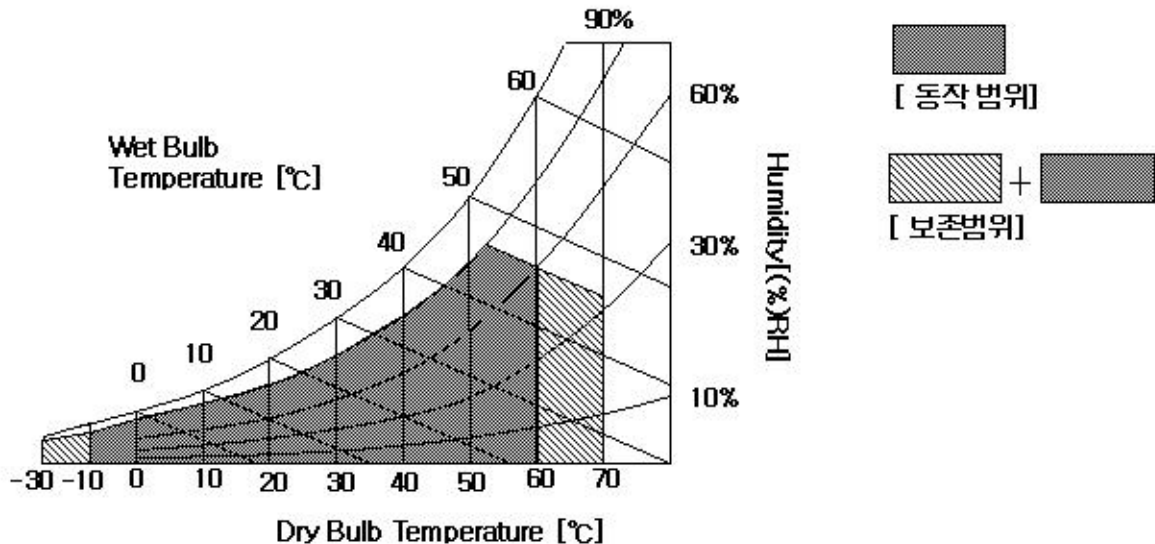
The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Values		Units	Notes	
		Min	Max			
Power Input Voltage	VCC	0.0	3.6	Vdc	at 25 ± 5°C	
Storage Temperature	Hst	-20	70	°C	1	
Operating Temperature	Surface Of Panel	T _p	-10	60	°C	1,2
	Ambient	T _a	-	-	°C	1,2,3

Notes :

1. Maximum wet-bulb temperature is 52°C. Condensation of dew must be avoided, because it may cause electrical current leakage, and deterioration of performance and quality.
2. The operating temperature means that LCD Module guarantees operation of the circuit.
All the contents of Electro-optical specifications are guaranteed under the room temperature condition.
3. This temperature is ambient temperature with regard to the heat which is generated under operation of circuit and backlight on.(reference value)



3. Electrical Specifications

3-1. Electrical Characteristics

The LB070WV1 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input which powers the **LED**, is typically generated by an LED Driver. The LED Driver is an internal unit to the LCD.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
LCD :						
Power Supply Input Voltage	V _{CC}	3.0	3.3	3.6	V _{DC}	
Power Supply Input Current	I _{CC}	-	TBD	TBD	mA	1
Power Consumption	P _C	-	TBD	TBD	Watt	1
LED :						
Power Supply Input Voltage	V _{LED}	TBD	5	TBD	V	-
Power Supply Input Current	I _{BL}	TBD	TBD	TBD	mA	-
LED Brightness Control Input (PWM Signal Input)	BRT _{FREQ}	TBD	200	TBD	Hz	
	BRT _{LOW}	0	-	0.2	V	
	BRT _{HIGH1}	1.4	-	5	V	V _{LED} > 5V
	BRT _{HIGH2}	1.4	-	V _{LED}	V	V _{LED} < 5V
Life Time		TBD	-	-	Hrs	-

Note)

1. The specified current and power consumption are under the V_{CC} = 3.3V , 25°C, f_v = 60Hz condition whereas "Full Black Pattern" is displayed and f_v is the frame frequency.

3-2. Interface Connections

This LCD employs one interface connection, a 40 pin connector is used for the module electronics interface. The electronics interface connector is a model FH19SC-40S-0.5SH(05), manufactured by HIROSE.

Table 3. MODULE CONNECTOR PIN CONFIGURATION (CN1)

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	GND	Ground	21	GND	Ground
2	GND	Ground	22	B0	Blue Data Signal 0 (LSB)
3	CLK	Clock	23	B1	Blue Data Signal 1
4	GND	Ground	24	B2	Blue Data Signal 2
5	GND	Ground	25	GND	Ground
6	R0	Red Data Signal 0 (LSB)	26	B3	Blue Data Signal 3
7	R1	Red Data Signal 1	27	B4	Blue Data Signal 4
8	R2	Red Data Signal 2	28	B5	Blue Data Signal 5 (MSB)
9	GND	Ground	29	GND	Ground
10	R3	Red Data Signal 3	30	GND	Ground
11	R4	Red Data Signal 4	31	GND	Ground
12	R5	Red Data Signal 5 (MSB)	32	DE	Data Enable
13	GND	Ground	33	VCC	+3.3V(Power Supply)
14	G0	Green Data Signal 0 (LSB)	34	VCC	+3.3V(Power Supply)
15	G1	Green Data Signal 1	35	VLED	Power Supply for LED Driver circuit
16	G2	Green Data Signal 2	36	VLED	Power Supply for LED Driver circuit
17	GND	Ground	37	VLED	Power Supply for LED Driver circuit
18	G3	Green Data Signal 3	38	BRT	Brightness control for LED BL
19	G4	Green Data Signal 4	39	GND	Ground
20	G5	Green Data Signal 5 (MSB)	40	GND	Ground

3-3. Signal Timing Specifications

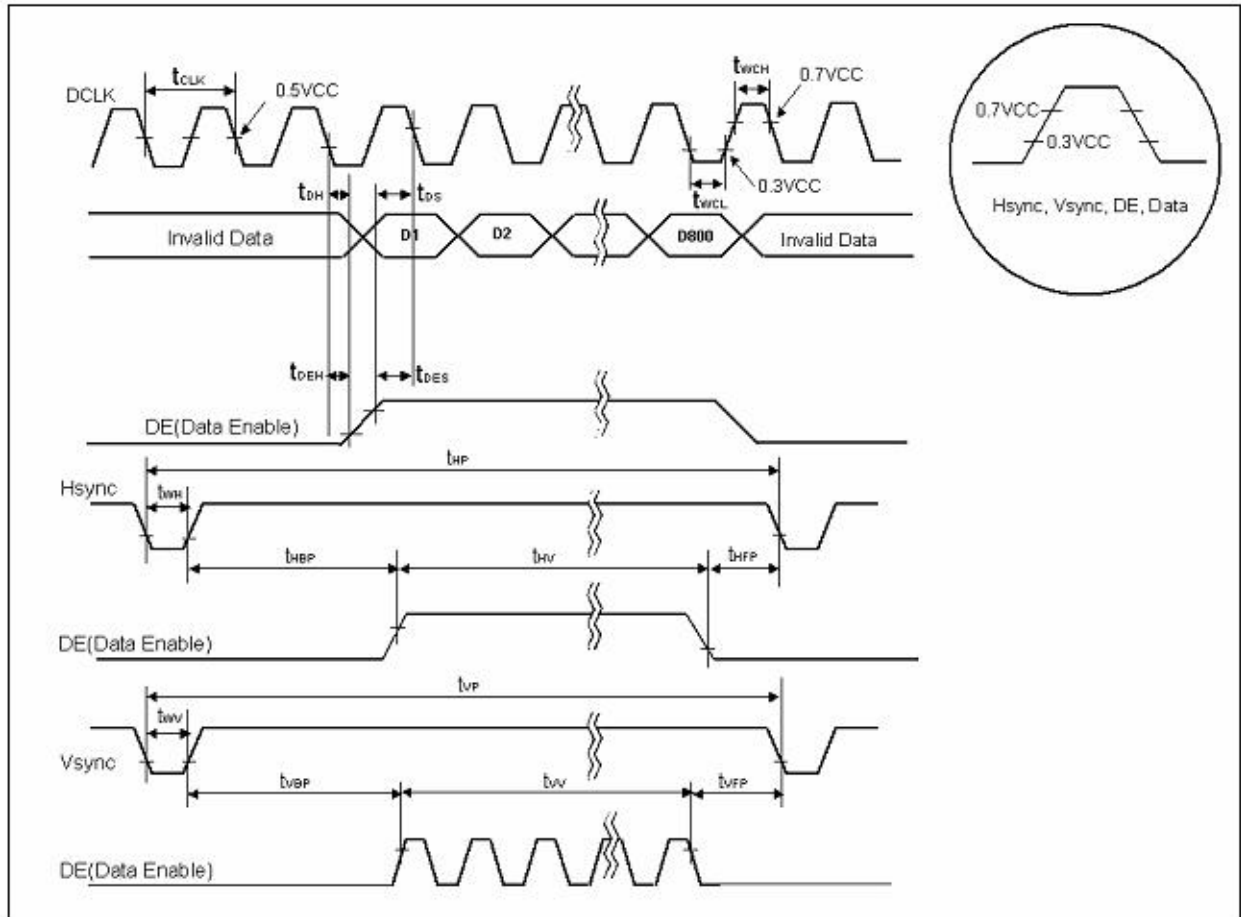
This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications for its proper operation.

Table 5. TIMING TABLE

*** 60Hz Framerate ***

	Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
DCLK	Frequency	f_{CLK}	31.95	33.26	34.60	MHz	
	Period	t_{CLK}	28.90	30.06	31.30	ns	
	High Level Width	t_{WCH}	6	-	-	ns	
	Low Level Width	t_{WCL}	6	-	-	ns	
DATA	Setup Time	t_{DS}	4	-	-	ns	
	Hold Time	t_{DH}	4	-	-	ns	
DE	Setup Time	t_{DES}	5	-	-	ns	
	Hold Time	t_{DEH}	5	-	-	ns	

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 6. COLOR DATA REFERENCE

Color		Input Color Data																	
		RED						GREEN						BLUE					
		MSB			LSB			MSB			LSB			MSB			LSB		
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (01)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
					
	RED (62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (01)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
					
	GREEN (62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN (63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
BLUE	BLUE (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE (01)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
					
	BLUE (62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

3-6. Power Sequence

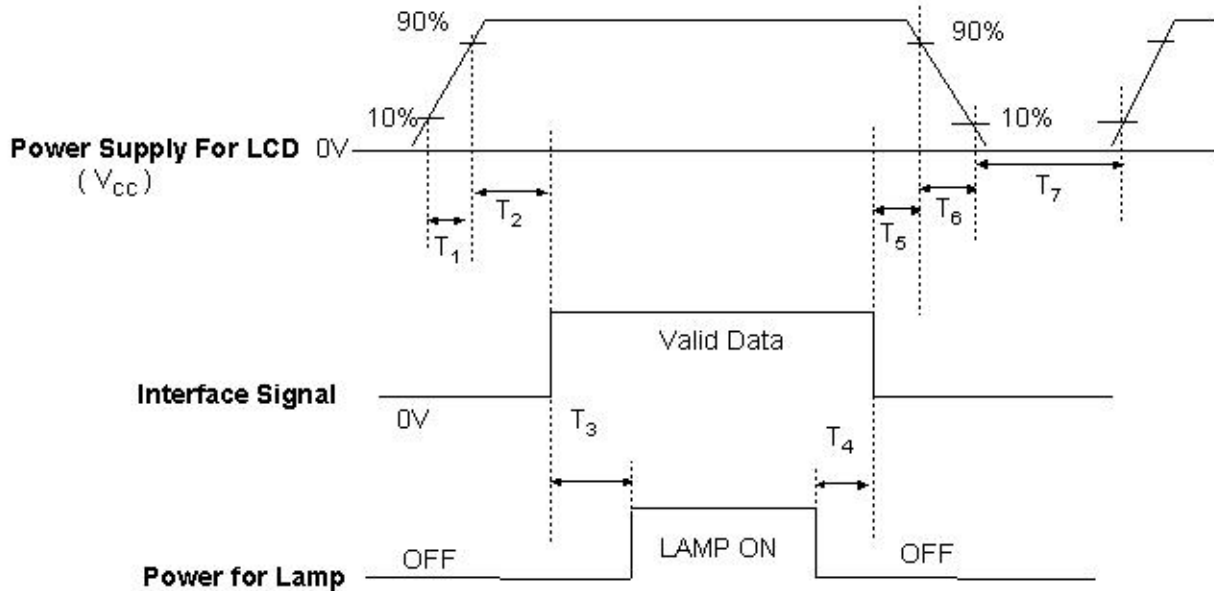


Table 7. POWER SEQUENCE TABLE

Parameter	Value			Units
	Min.	Typ.	Max.	
T ₁	TBD	-	TBD	(ms)
T ₂	TBD	-	TBD	(ms)
T ₃	TBD	-	-	(ms)
T ₄	TBD	-	-	(ms)
T ₅	TBD	-	TBD	(ms)
T ₆	TBD	-	TBD	(ms)
T ₇	TBD	-	-	(ms)

Note)

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 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°.

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

FIG. 1 Optical Characteristic Measurement Equipment and Method

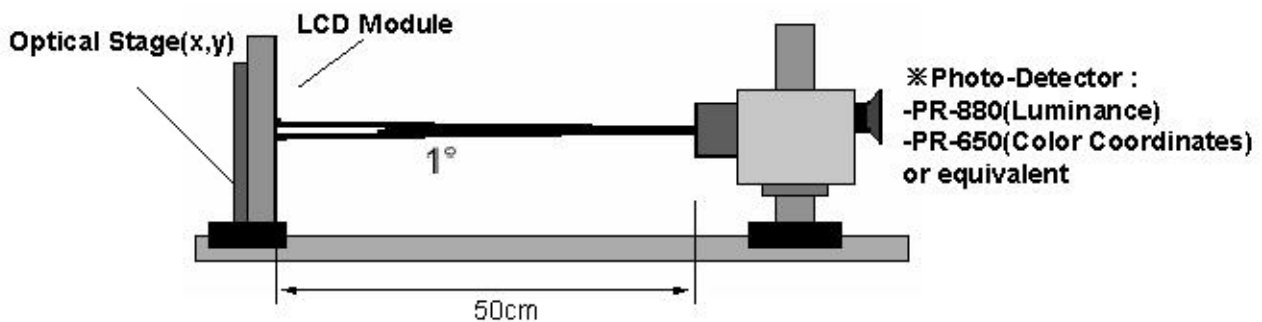


Table 9. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, f=60Hz, f_{CLK}= 33.26MHz, I_{BL} = 6.0mA_{RMS}

Parameter	Symbol	Values			Units	Notes
		Min	Typ	Max		
Contrast Ratio	CR	-	400	-		1
Surface Luminance, white	L _{WH}	-	250	-	cd/m ²	2
Luminance Variation	δ _{WHITE}	-	1.4	1.6		3
Response Time						4
: Rise Time	Tr _R	-	10	20	ms	
: Decay Time	Tr _D	-	15	30	ms	
Color Coordinates						2
: RED	RX	TBD	TBD	TBD		
: GREEN	GX	TBD	TBD	TBD		
: BLUE	BX	TBD	TBD	TBD		
: WHITE	WX	TBD	TBD	TBD		
: Y-axis	WY	TBD	TBD	TBD		
Viewing Angle						5
: x axis, right (Φ=0°)	Θr	TBD	TBD	-	degree	
: x axis, left (Φ=180°)	Θl	TBD	TBD	-	degree	
: y axis, up (Φ=90°)	Θu	TBD	TBD	-	degree	
: y axis, down (Φ=270°)	Θd	TBD	TBD	-	degree	
Gray Scale						6

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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 measured at the center point(L₁) of the LCD with all pixels displaying white at the distance of 50cm by PR-880. Color Coordinates are measured at the center point(L₁) of the LCD with all pixels displaying red, green, blue and white at the distance of 50cm by PR-650. For more information, refer to the FIG 1 and FIG 2.

3. Luminance % uniformity is measured for 9 point For more information see FIG 2.

$$\delta \text{ WHITE} = \text{Maximum}(L_1, L_2, \dots, L_9) \div \text{Minimum}(L_1, L_2, \dots, L_9)$$

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

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>

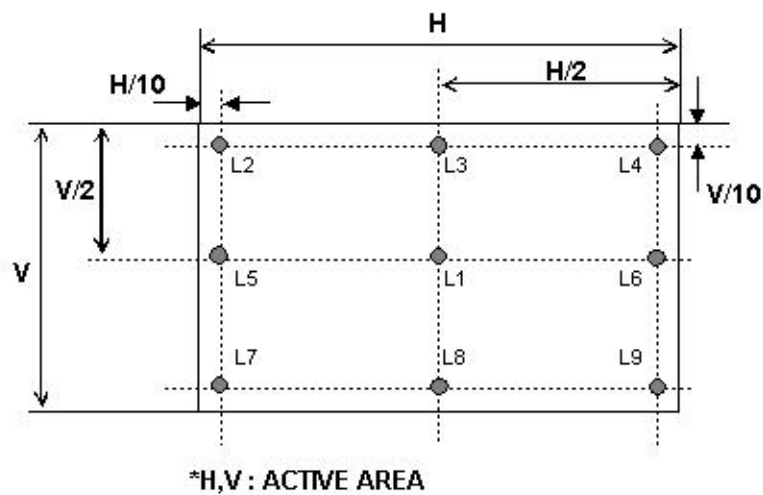


FIG. 3 Response Time

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

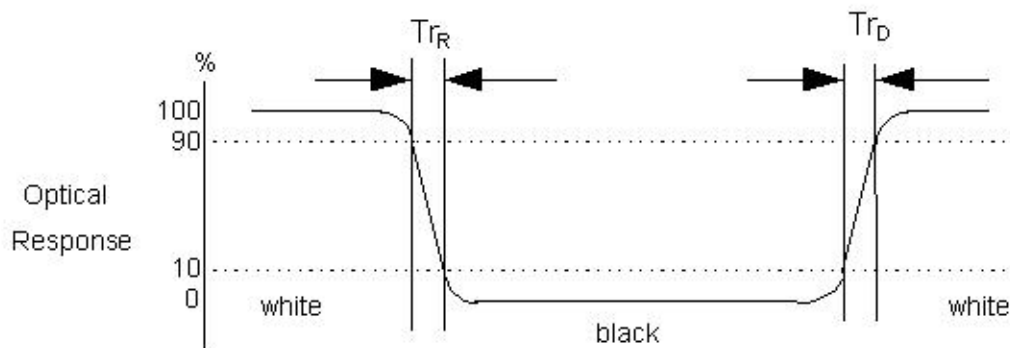
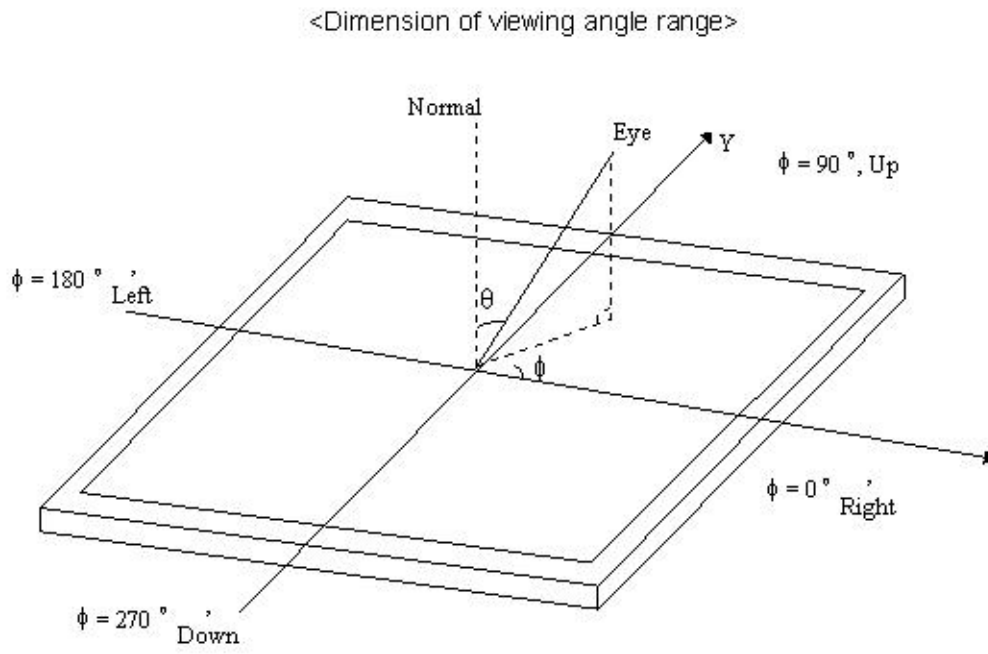


FIG. 4 Viewing angle



5. Mechanical Characteristics

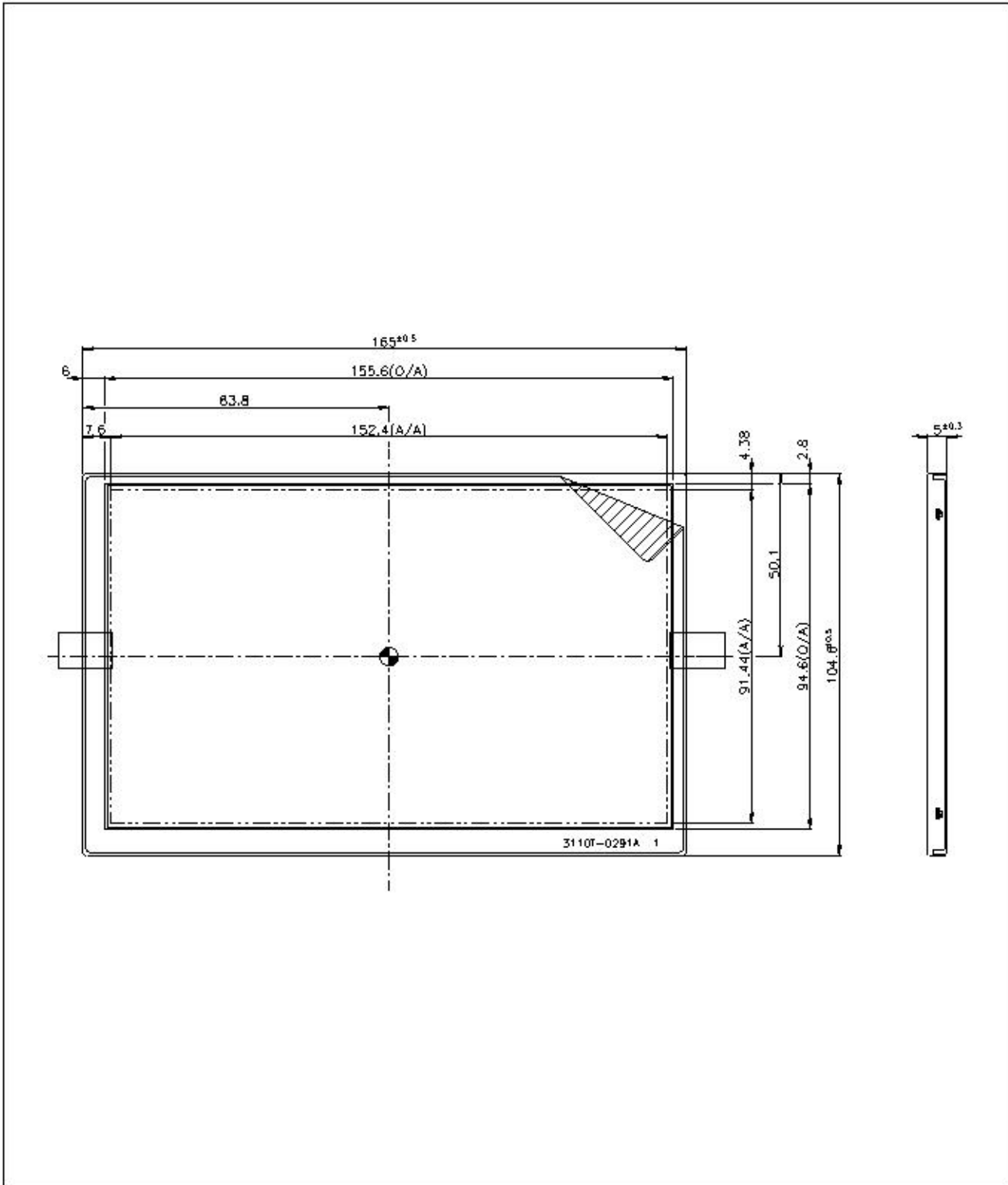
The contents provide general mechanical characteristics for the model LB070WV1. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal	165 mm(Typ)
	Vertical	104.6 mm(Typ)
	Depth	5.0 mm (Typ.)
Bezel Area	Horizontal	155.6 mm (Typ.)
	Vertical	94.6 mm (Typ.)
Active Display Area	Horizontal	152.40 mm (Typ.)
	Vertical	91.44 mm (Typ.)
Weight	TBD g(Typ.) / TBD g (Max.)	
Surface Treatment	Anti-glare treatment of the front polarizer	

Product Specification

<FRONT VIEW>

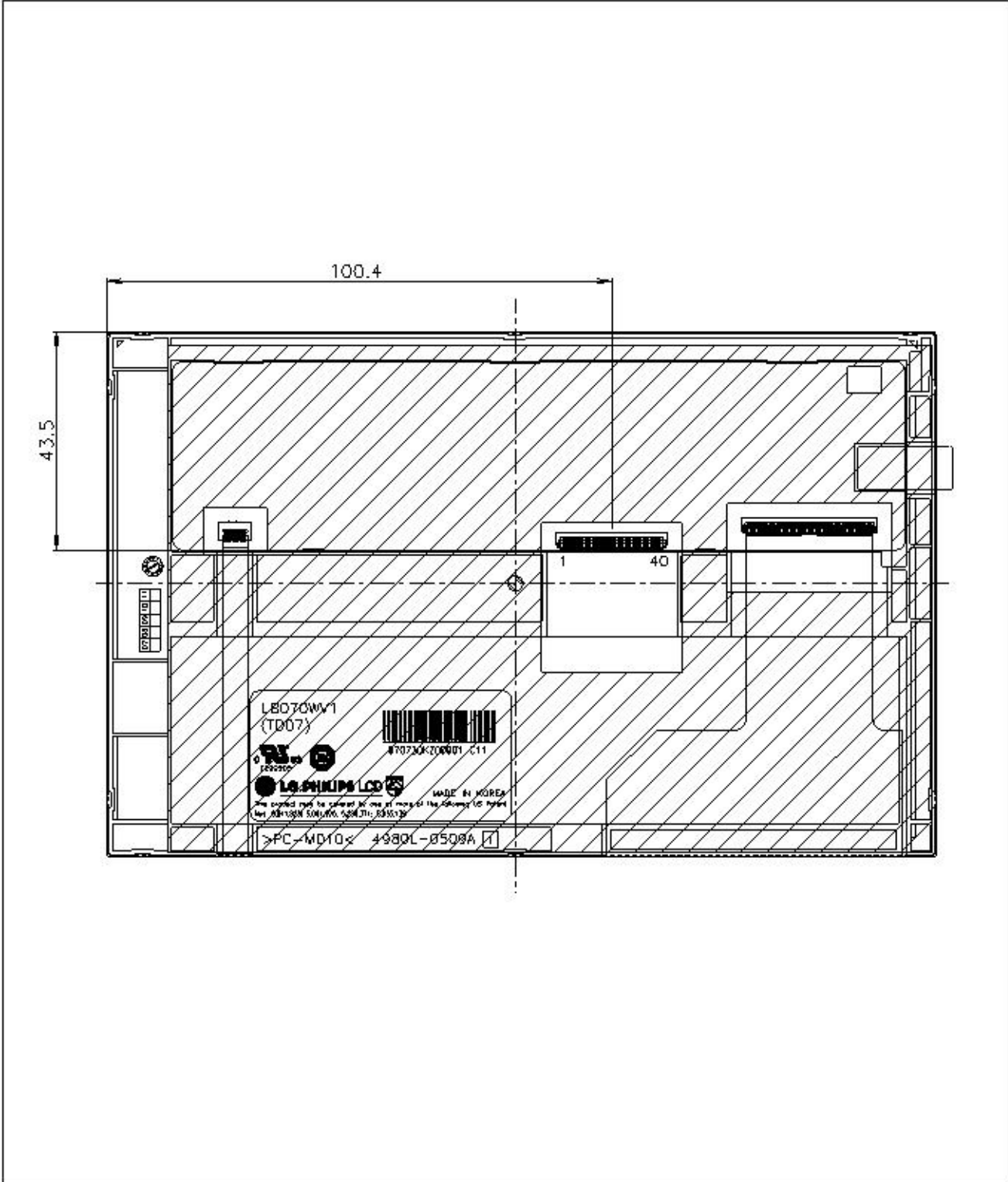
Note) Unit:[mm], General tolerance: ± 0.3 mm



Product Specification

<REAR VIEW>

Note) Unit: [mm], General tolerance: $\pm 0.3\text{mm}$



6. Reliability

Environment test condition

No.	Test Item	Conditions
1	High Temperature Storage Test	TBD
2	Low Temperature Storage Test	TBD
3	High Temperature Operation Test	TBD
4	Low Temperature Operation Test	TBD
5	High Temperature and High Humidity Operation Test	TBD
6	High Temperature and High Humidity Storage Test	TBD
7	Vibration test (non-operating)	TBD
8	Shock test (non-operating)	TBD
9	Thermal Shock Test (non-operating)	TBD

※ Ta= Ambient Temperature, Tp= Panel Temperature

{ 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)

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)

E : MONTH

G : ASSEMBLY CODE

D : YEAR

F : FACTORY CODE

H ~ 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. 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 : TBD

b) Box Size : TBD

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 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.

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 charmois soaked with normal-hexane.