

Product Specification

SPECIFICATION FOR APPROVAL

- () Preliminary Specification
(●) Final Specification

Title	10.4" SVGA TFT LCD
-------	--------------------

BUYER	
MODEL	

SUPPLIER	LG.Philips LCD CO., Ltd.
*MODEL	LP104S5
SUFFIX	B2AP

*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. W. Lee /G.Manager	_____
REVIEWED BY J.H.Lee / Manager	_____
PREPARED BY J. S. Park / Engineer J. H. Hwang / Engineer	_____

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

Product Specification

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RECORDS OF REVISIONS

Revision No	Revision No	Page	DESCRIPTION
0.0	MAR 28, 2001	-	First Draft
1.0	APR 19. 2001	14	Final, Update (Changed Optical Specification - Luminance)

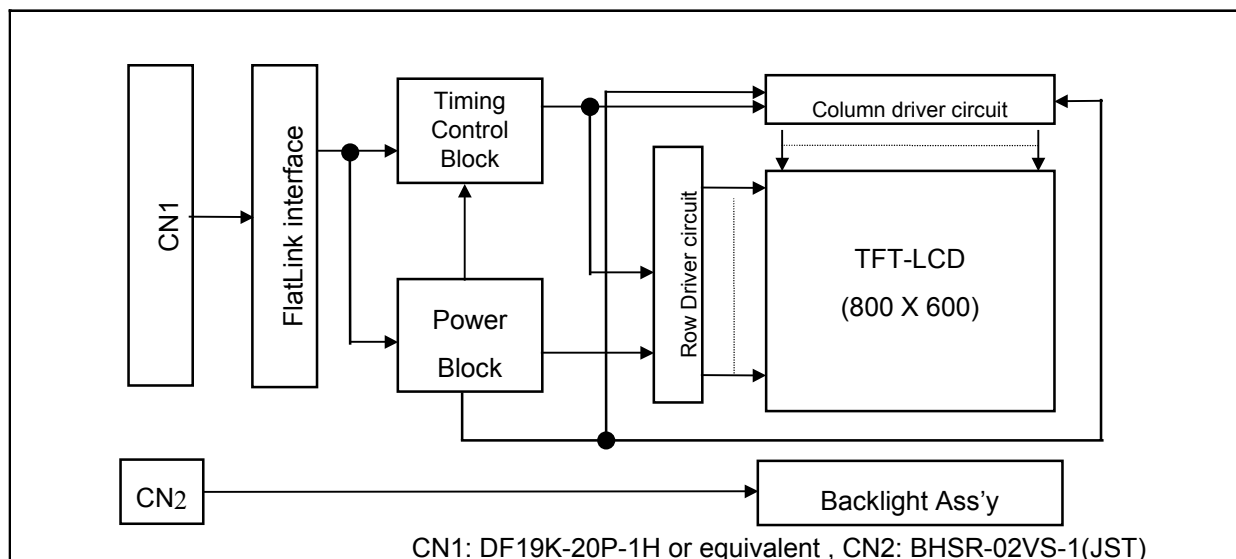
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1. General Description

The LP104S5-B2AP 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 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-B2AP 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 LP104S5-B2AP is intended to support applications where thin thickness, low power are critical factors and graphic display are important. In combination with the vertical arrangement of the sub-pixels, the LP104S5-B2AP characteristics provide an excellent flat display for office automation products such as Notebook PC.



General Features

Active screen size	10.4 inches (264.16mm) diagonal
Outline Dimension	224.5(H) x 172.0(V) x 5.7(D) mm(Typ.)
Pixel Pitch	0.264 mm x 0.264mm
Pixel format	800 horiz. By 600 vert. Pixels RGB stripes arrangement
Color depth	6-bit, 262,144 colors
Luminance, white	200 cd/m ² (Typ.)
Power Consumption	Total 4 Watt(Typ.)
Weight	300g(Typ.)
Display operating mode	Transmissive mode, normally white
Surface treatments	Hard coating(3H) Anti-glare treatment of the front polarizer, HAZE(13%)

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2. Absolute Maximum Ratings

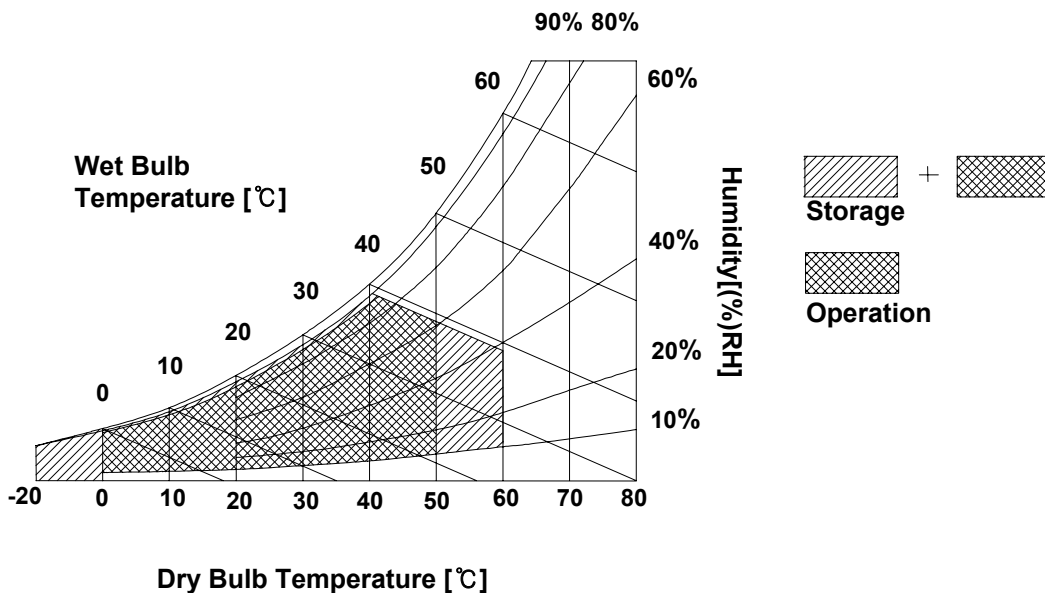
The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

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.



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3. Electrical Specifications

3-1. Electrical Characteristics

The LP104S5-B2AP 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}	-	0.29	0.32	A	1
Differential Impedance	Z _m	90	100	110	ohm	2
Power Consumption	P _C	-	0.95	1.06	Watts	1
Rush Current	I _{RUSH}		1.2	1.8	A	3
LAMP :						
Operating Voltage	V _{BL}	485	500	600	V _{RMS}	4
Operating Current	I _{BL}	3.0	6.0	6.5	mA	
Established Starting Voltage	V _S					5
at 25 °C		-	-	845	V _{RMS}	
at 0 °C		-	-	1015	V _{RMS}	
Operating Frequency	f _{BL}	45	60	80	kHz	6
Discharge Stabilization Time	T _s			3	Minutes	7
Power Consumption	P _{BL}	-	3.0	3.3	Watts	8
Life Time		20,000	-	-	Hrs	9

Note : The design of the inverter must have specification for the lamp in LCD Assembly.

The performance of the Lamp in LCM, for example life time or brightness, is extremely influenced by the characteristics of the DC-AC inverter. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

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

1. The specified current and power consumption are under the $V_{CC}=3.3V$, 25°C, $f_v=60Hz$ condition whereas vertical stripe 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 duration of rush current is about 20ms in two vertical stripe pattern.
4. The variance of the voltage is $\pm 10\%$.
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.

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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 typical lamp current on condition of continuous operating at $25 \pm 2^\circ\text{C}$.
- ※ 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. THC63LVDM63A(Transmitter), THC63LVDF64A(Receiver) made by Thine Microsystems, Inc.

This LCD employs two interface connections, a 20 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 DF19K-20P-1H manufactured by HIROSE. 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. Interface chips 1.1 LCD : LPZ4E102S6L(LCD Controller) including LVDS Receiver 1.2 System : THC63LVDM63A or equivalent * Pin to Pin compatible with TI LVDS 2. Connector 2.1 LCD: DF19K-20P-1H,HIROSE or equivalent 2.2 Mating: DF19G-20S-1C (Discrete wire Type) DF19G-20S-1F (FPC Type) DF19G-20S-1SD (Thin Co-Axial Cable Type) 2.3 Connector pin arrangement <div style="text-align: center;">  </div> [LCD Module Rear View]
2	Vcc	Power(3.3V)	
3	GND	Ground	
4	GND	Ground	
5	A1M	Differential Signal	
6	A1P	Differential Signal	
7	GND	Ground	
8	A2M	Differential Signal	
9	A2P	Differential Signal	
10	GND	Ground	
11	A3M	Differential Signal	
12	A3P	Differential Signal	
13	GND	Ground	
14	CLKM	Differential Signal	
15	CLKP	Differential Signal	
16	GND	Ground	
17	GND	Ground	
18	GND	Ground	
19	GND	Ground	
20	GND	Ground	

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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Table 5. REQUIRED SIGNAL ASSIGNMENT FOR FlatLink Transmitter

Pin #	Pin Name	Require Signals	Pin #	Pin Name	Require Signals
1	TA4	R4	48	TA3	R3
2	VCC	Vcc	47	TA2	R2
3	TA5	R5	46	GND	GND
4	TA6	G0	45	TA1	R1
5	GND	GND	44	TA0	R0
6	TB0	G1	43	NC	NC
7	TB1	G2	42	LVDS GND	LVDS GND
8	Vcc	Vcc	41	TA-	A0M
9	TB2	G3	40	TA+	A0P
10	TB3	G4	39	TB-	A1M
11	GND	GND	38	TB+	A1P
12	TB4	G5	37	LVDS Vcc	LVDS Vcc
13	TB5	B0	36	LVDS GND	LVDS GND
14	NC	NC	35	TC-	A2M
15	TB6	B1	34	TC+	A2P
16	TC0	B2	33	RCLK-	CLKM
17	GND	GND	32	RCLK+	CLKP
18	TC1	B3	31	LVDS GND	LVDS GND
19	TC2	B4	30	PLL GND	PLL GND
20	TC3	B5	29	PLL Vcc	PLL Vcc
21	Vcc	Vcc	28	PLL GND	PLL GND
22	TC4	HSYNC	27	PDWN	SHDN
23	TC5	VSYNC	26	CLKIN	Dclk
24	GND	GND	25	TC6	DE(Data Enable)

Notes : Refer to LVDS Transmitter Data Sheet for detail descriptions.

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3-3. Signal Timing Specifications

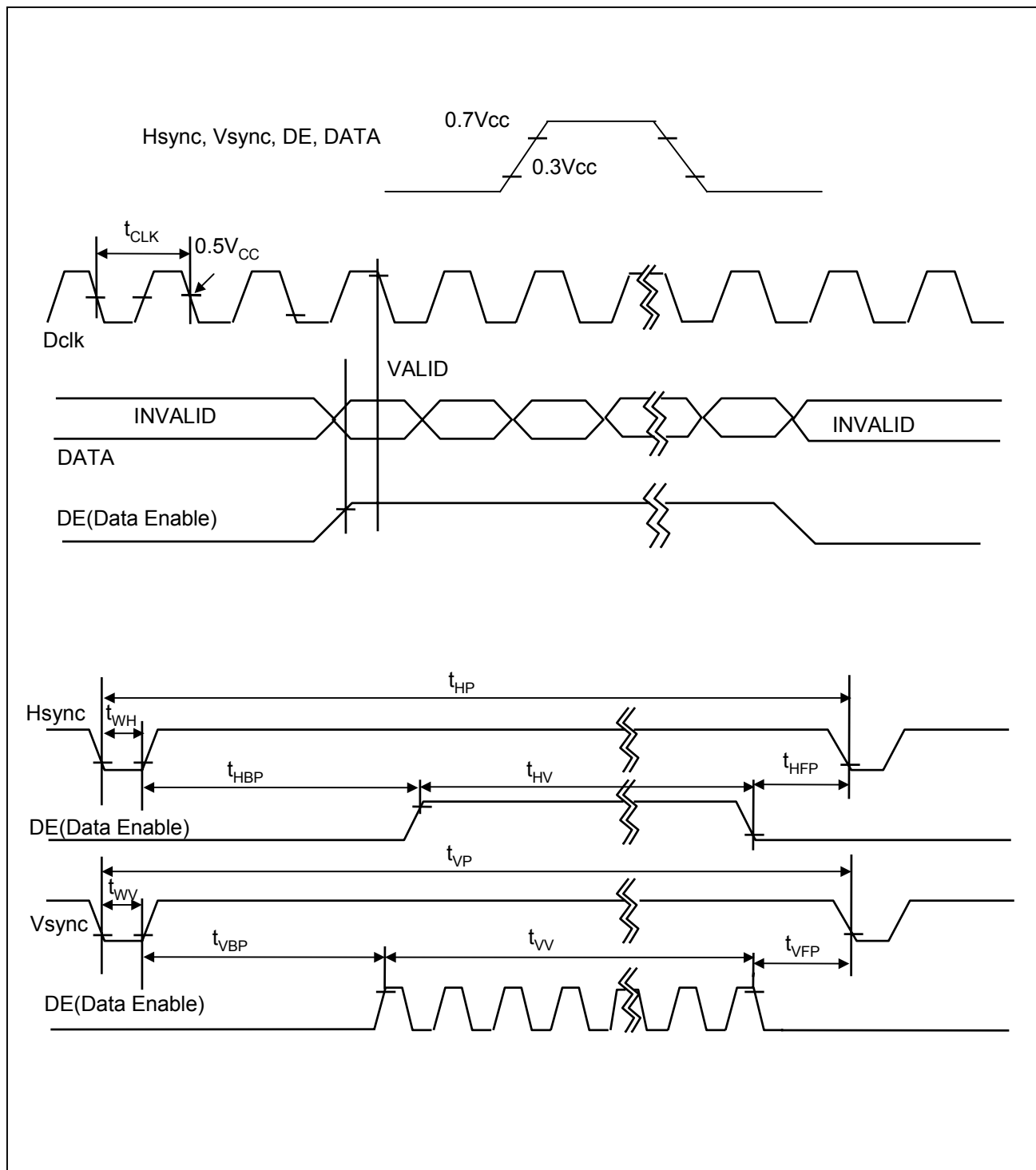
This is the signal timing required at the input of the LVDS Transmitter. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

Table 6. Timing Table

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTES
Dclk	Period	t_{CLK}	25	26	27	ns	38.5MHz
Hsync	Period	t_{HP}	990	1024	1100	t_{CLK}	
	Width	t_{WH}	12	-	120		
Vsync	Period	t_{VP}	606	625	730	t_{HP}	
	Frequency	f_V	60	60	60	Hz	
	Width	t_{WV}	1	-	24	t_{HP}	
(Data Enable)	Horizontal Valid	t_{HV}	800	800	800	t_{CLK}	
	Horizontal Back Porch	t_{HBP}	30	-	-		
	Horizontal Front Porch	t_{HFP}	30	-	-		
	Horizontal Blank	-	72	~	$t_{HP} - t_{HV}$		$t_{WH} + t_{HBP} + t_{HFP}$
	Vertical Valid	t_{VV}	600	600	600	t_{HP}	
	Vertical Back Porch	t_{VBP}	2	-	-		
	Vertical Front Porch	t_{VFP}	3	-	-		
	Vertical Blank	-	6	~	$t_{VP} - t_{VV}$		$t_{WV} + t_{VBP} + t_{VFP}$

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3-4. Signal Timing Waveforms



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3-5. Color Input Data Reference

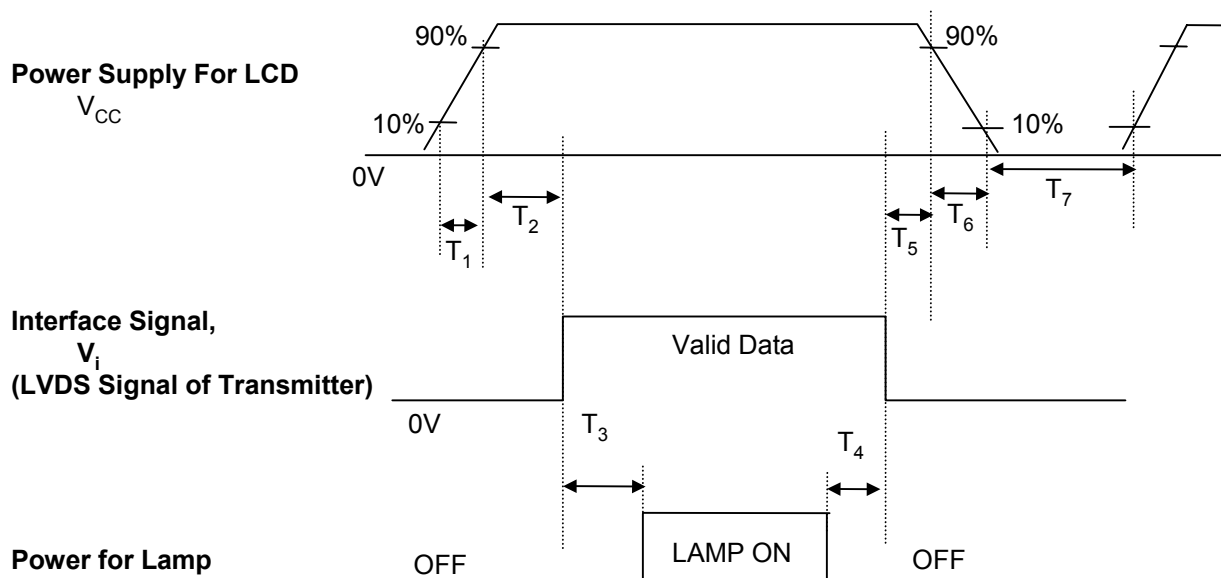
The brightness of each primary color(red,green and blue) is based on the 6-bit gray scale data input for the color ; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

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	0	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	ms
T ₃	200	-	-	ms
T ₄	200	-	-	ms
T ₅	0	-	50	ms
T ₆	-	-	10	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 V_{CC} to 0V.
 3. Lamp power must be turn on after power supply for LCD and interface signal are valid.

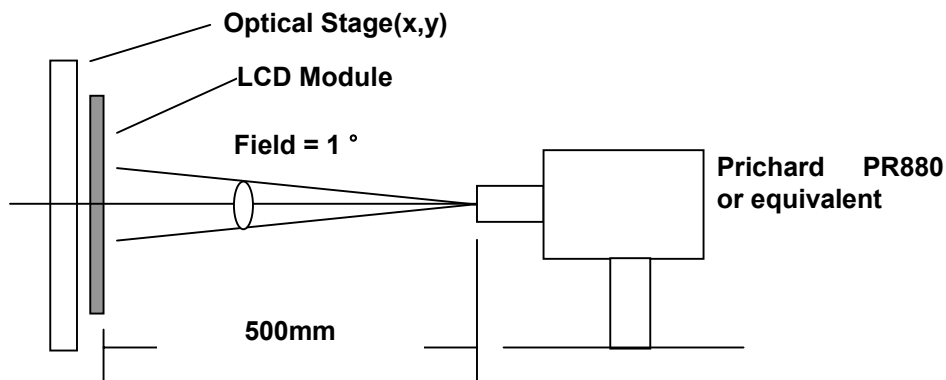
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4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25 °C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.

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

FIG. 1 Optical Characteristic Measurement Equipment and Method



(Ta=25 °C, V_{CC}=3.3V, f_V=60Hz
Dclk=38.5MHz, I_{BL}=6mA)

Table 8. OPTICAL CHARACTERISTICS

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
Contrast Ratio	CR	200	250	-		1
Surface Luminance, white	L _{WH}	160	200	-	cd/m ²	2
Luminance Variation	δ_{WHITE}	-	-	1.45		3
Response Time	Tr				ms	4
Rise Time	Tr _R	-	15	30		
Decay Time	Tr _D	-	30	50		
CIE Color Coordinates						
Red	XR	0.534	0.564	0.594		
	YR	0.304	0.334	0.364		
Green	XG	0.279	0.309	0.339		
	YG	0.515	0.545	0.575		
Blue	XB	0.124	0.154	0.184		
	YB	0.101	0.131	0.161		
White	XW	0.283	0.313	0.343		
	YW	0.299	0.329	0.359		
Viewing Angle						
x axis, right($\phi=0^\circ$)	θ_r	45	-	-	degree	5
x axis, left ($\phi=180^\circ$)	θ_l	45	-	-		
y axis, up ($\phi=90^\circ$)	θ_u	10	-	-		
y axis, down ($\phi=270^\circ$)	θ_d	30	-	-		
Gray Sclae	-	-	-	-		6

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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. For more information see FIG 2.

When $I_{BL}=6\text{mA}$, $L_{WH}=160\text{cd/m}^2(\text{Min.})$ $200\text{cd/m}^2(\text{Typ.})$

3. The variation in surface luminance, δ WHITE is determined by measuring L_{ON} at each test position 1 through 5, and then dividing the maximum L_{ON} of 5 points luminance by minimum L_{ON} of 5 points luminance. For more information see FIG 2.

$$\delta \text{ WHITE} = \text{Maximum}(L_{ON1}, L_{ON2}, \dots, L_{ON5}) \div \text{Minimum}(L_{ON1}, L_{ON2}, \dots, L_{ON5})$$

4. Response time is the time required for the display to transition from 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 5. 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	0.28
L7	0.64
L15	2.99
L23	8.7
L31	20.9
L39	34.2
L47	50.9
L55	70.8
L63	100

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FIG. 2 Luminance

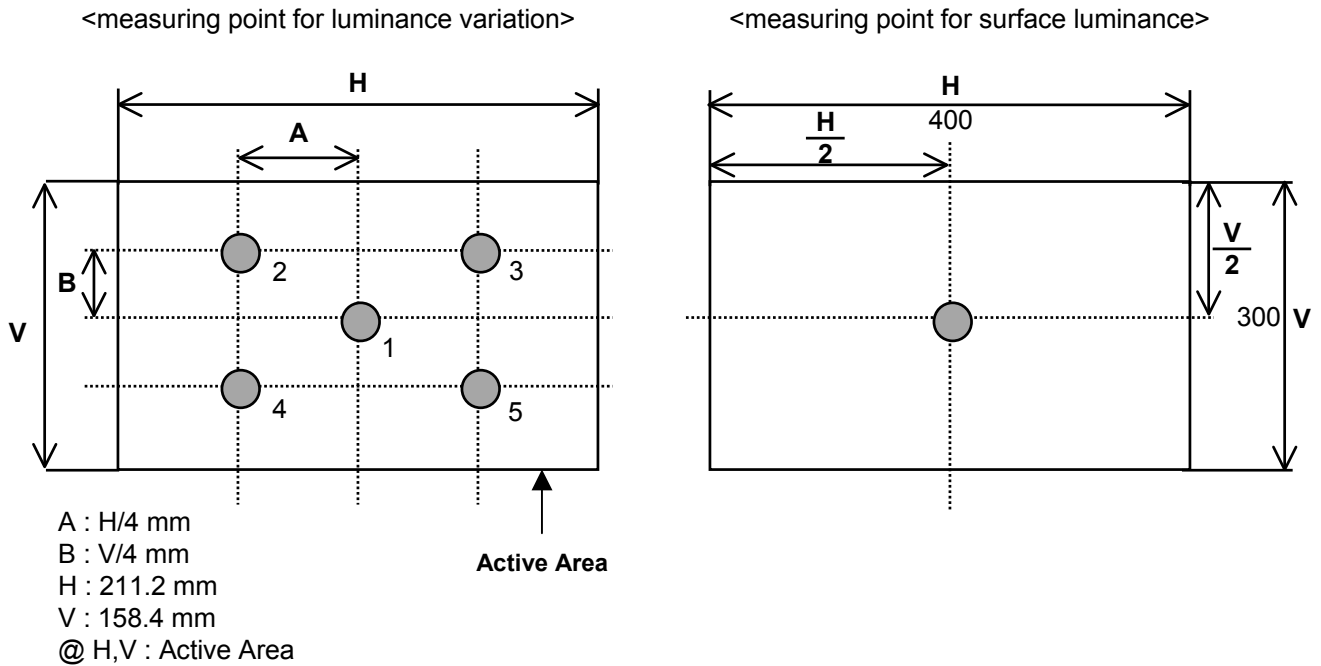
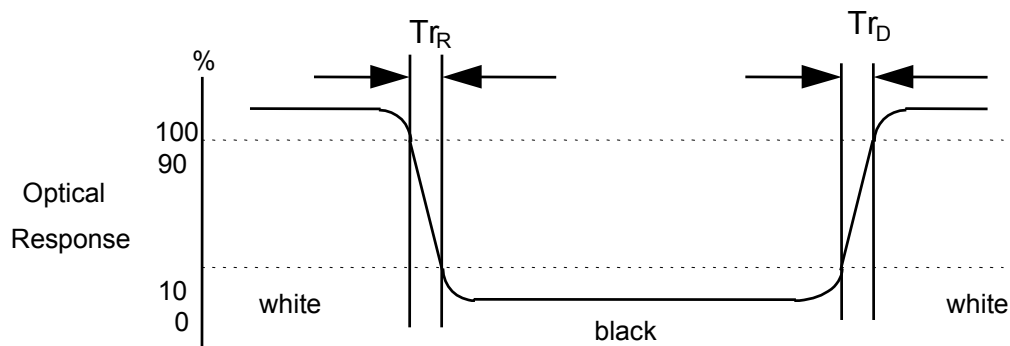


FIG. 3 Response Time

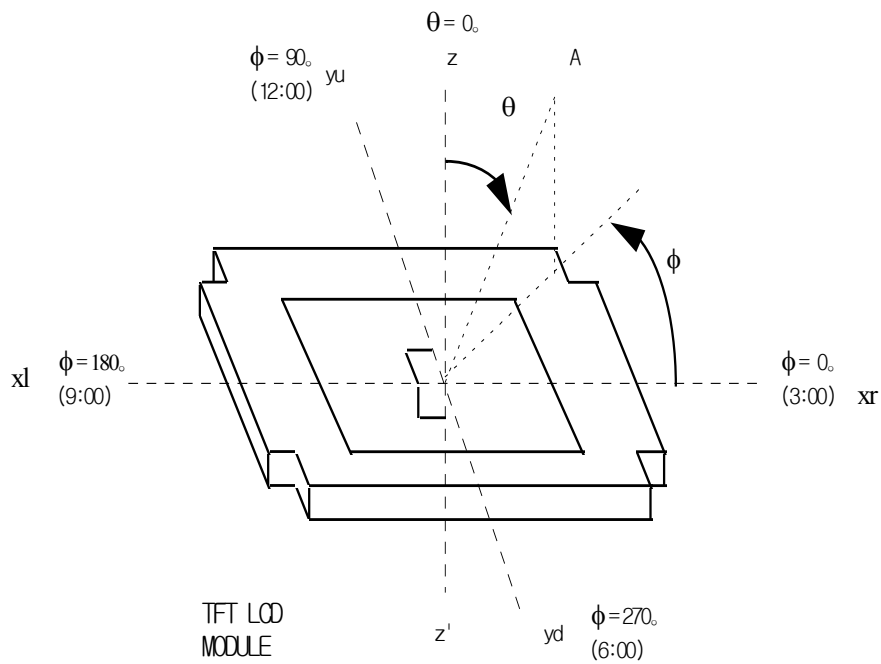
The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white”.



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FIG. 4 Viewing angle

<dimension of viewing angle range>



Product Specification

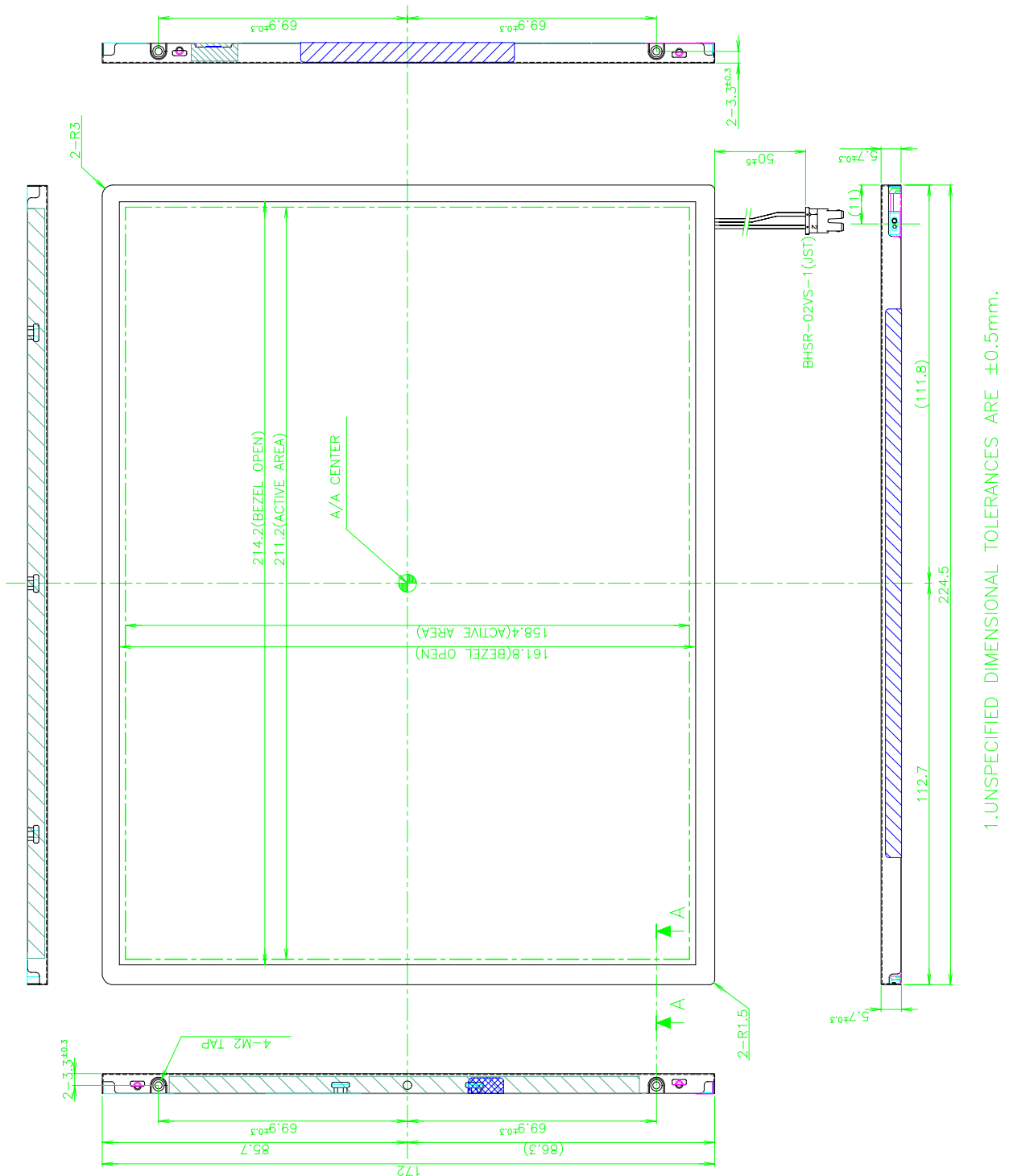
5. Mechanical Characteristics

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

Outside dimensions	Horizontal	$224.5 \pm 0.5\text{mm}$
	Vertical	$172.0 \pm 0.5\text{mm}$
	Depth	$5.7 \pm 0.3\text{mm}$
Bezel area	Horizontal	$214.2 \pm 0.5\text{mm}$
	Vertical	$161.8 \pm 0.5\text{mm}$
Active display area	Horizontal	211.2mm
	Vertical	158.4mm
Weight(approximate)	300g(Typ.), 310g(Max.)	
Surface Treatment	Hard coating(3H) Anti-glare treatment of the front polarizer Haze(13%)	

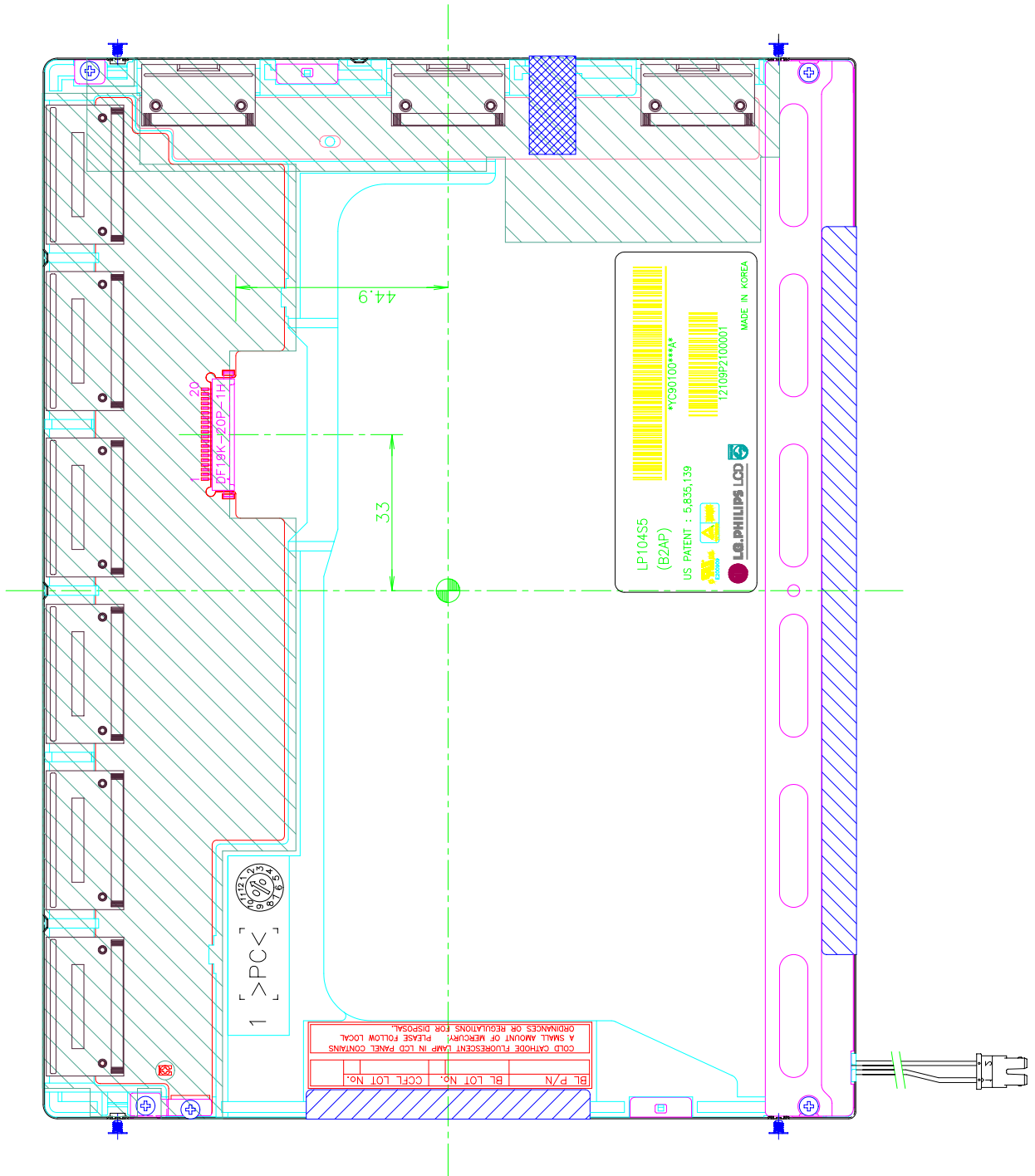
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<FRONT VIEW>



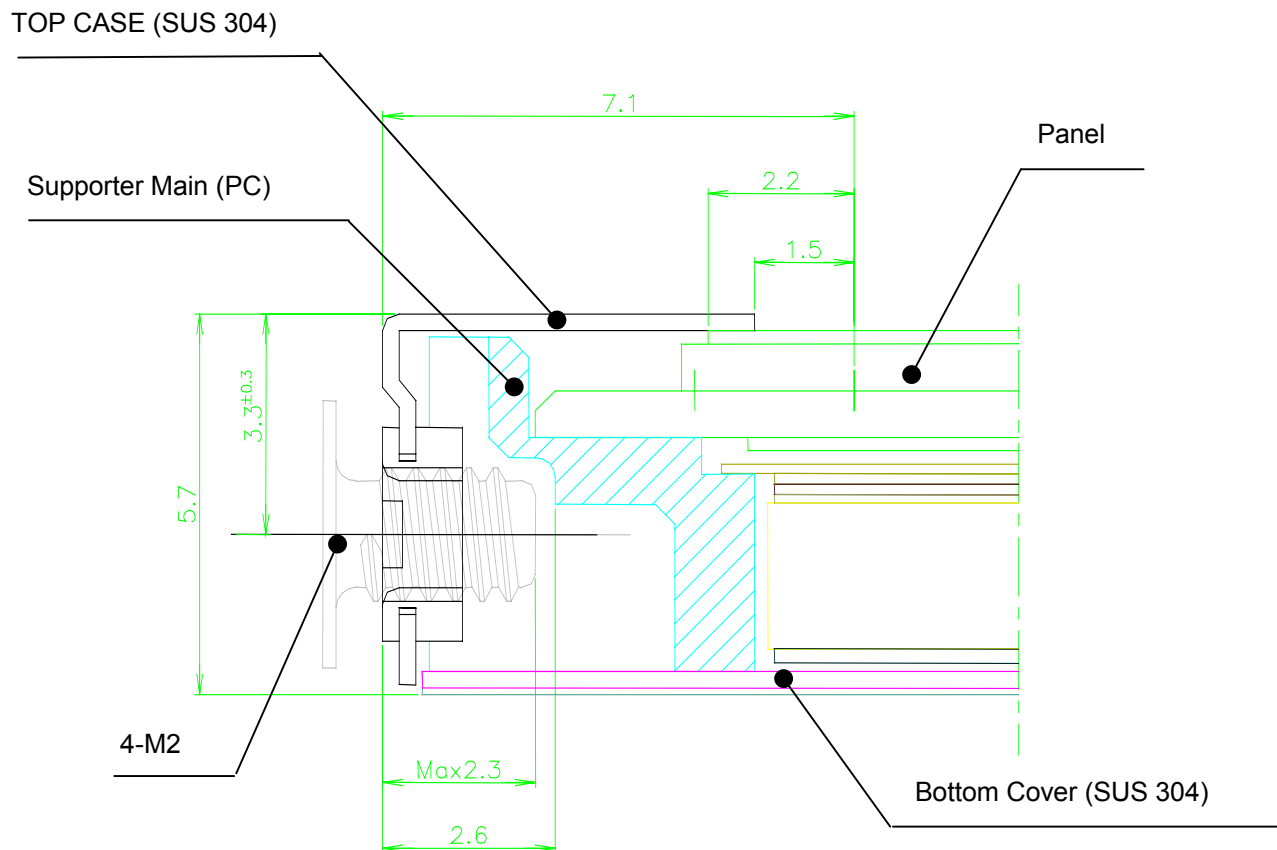
Product Specification

<REAR VIEW>



Product Specification

<DETAIL DESCRIPTION OF SIDE MOUNTING SCREW>



*Mounting screw depth : Max 2.3mm

*Screw(4ea) Torque : Max 2kgf•cm

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, 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(12,192m)

{ 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.

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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 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 Electro-technical Standardization (CENELEC), 1998

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
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A,B,C : SIZE

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

3. Serial No.

Serial No.	1 ~ 99999	100000 ~
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 : 10 pcs

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

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 or four sides.
- (2) You should consider the mounting structure so that uneven force(ex. Twisted stress) is not applied to the module.
And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach a transparent protective plate to the surface in order to protect the polarizer.
Transparent protective plate should have sufficient strength in order to the resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not describe because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are determined to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

9-2. OPERATING PRECAUTIONS

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
 $V = \pm 200\text{mV}$ (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.