

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	LC104S1
SUFFIX	A1

\*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
I. H. Ahn / G.Leader	_____
<b>REVIEWED BY</b>	
H. J. Kim Research Engineer	_____
<b>PREPARED BY</b>	
C. S. SO Research Engineer	_____

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





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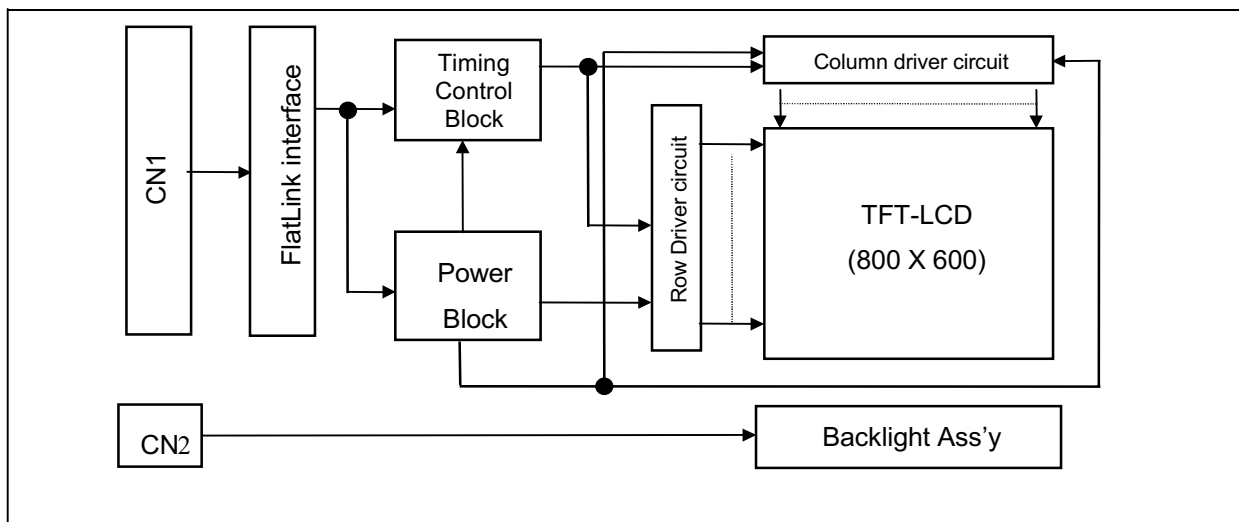
**1. General Description**

The LC104S1-A1 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 transflective type<sup>(1)</sup> 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 LC104S1-A1 has been designed to apply the interface method that enables low power. Flat Link must be used as a LVDS(Low Voltage Differential Signaling) chip.

The LC104S1-A1 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 LC104S1-A1 characteristics provide an excellent flat display for office automation products such as Tough PC.

(ref. No. 1 : Transflective type means that has a function of transmissive and reflective mode in display and display is visible indoor or outdoor under dark and sunlight at all.)



**General Features**

Active screen size	10.4 inches(26.4cm) diagonal
Outline Dimension	224.5(H) x 172.0(V) x 6.1(D) mm(Typ.) <a href="#">Pls refer to page 20 for details.</a>
Pixel Pitch	0.88 mm x RGB X 0.264mm
Pixel format	800 horiz. By 600 vert. Pixels (RGB stripes arrangement)
Color depth	6-bit, about 262,144 colors
Luminance, white	120 cd/m <sup>2</sup> (Typ.) (Transmissive only) , reflectance = 14%
Power Consumption	0.9W logic(typ.) / 3.0W CCFL(1) (TYP.)
Weight	310g(Typ.) 320g(Max.)
Display operating mode	Transflective mode, Normally White
Surface treatments	Hard coating(3H) of the front polarizer Anti-glare treatment of the rear polarizer

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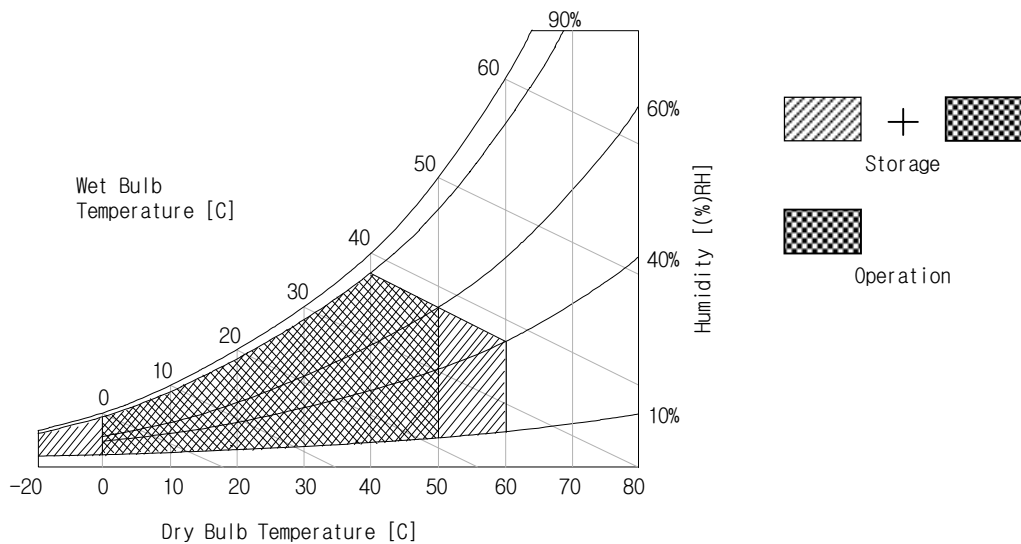
2. Absolute Maximum Ratings

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

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	symbol	Values		Units	Notes
		Min.	Max.		
Power Input Voltage	V <sub>CC</sub>	-0.3	4.0	Vdc	At 25 ± 5°C
Operating Temperature	T <sub>OP</sub>	0	50	°C	1
Storage Temperature	T <sub>ST</sub>	-20	60	°C	1
Operating Ambient Humidity	H <sub>OP</sub>	10	90	%RH	1
Storage Humidity	H <sub>ST</sub>	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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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 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.
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%.
7. The lamp power consumption shown above does not include loss of external inverter.  
The used lamp current is the lamp typical current.
8. 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  $25 \pm 2^\circ\text{C}$ .
9. 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**

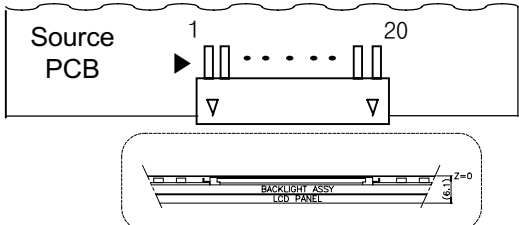
Interface chip must be used FlatLink, part No. THC63LVDM63A(Transmitter), THC63LVDF64A(Receiver) made by Thine Microsystems, Inc.

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)	<p>1. Interface chips</p> <p>1.1 LCD : LPZ4E102S6L including LVDS Receiver</p> <p>1.2 System : THC63LVDM63A or Equivalent</p> <p>*Pin to Pin compatible with TI LVDS</p> <p>2. Connector</p> <p>2.1 LCD : DF19K-20P-1H (HIROSE)</p> <p>2.2 Mating :</p> <p style="padding-left: 20px;">Discrete Wire type : DF19G-20S-1C (HIROSE)</p> <p style="padding-left: 20px;">FPC type : DF19G-20S-1F (HIROSE)</p> <p>2.3 Connector pin arrangement</p> <div style="text-align: center;">  <p>[LCD Module rear view]</p> </div> <p>* Refer to page 20 to get details</p>
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	No Connection	
18	GND	No Connection	
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 by JST 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	High voltage side using Pink color cable	1
2	LV	Low voltage side using Black color cable	1

Notes : 1. The high voltage side terminal is colored pink. The low voltage side terminal is white

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**Table 5. REQUIRED SIGNAL ASSIGNMENT FOR FlatLink Transmitter**

Pin#	Pin Name	Require Signals	Pin#	Pin Name	Require Signals
1	D4	R4	48	D3	R3
2	Vcc	Vcc	47	D2	R2
3	D5	R5	46	GND	GND
4	D6	G0	45	D1	R1
5	GND	GND	44	D0	R0
6	D7	G1	43	NC	NC
7	D8	G2	42	LVDS GND	LVDS GND
8	Vcc	Vcc	41	Y0M	A0M
9	D9	G3	40	Y0P	A0P
10	D10	G4	39	Y1M	A1M
11	GND	GND	38	Y1P	A1P
12	D11	G5	37	LVDS Vcc	LVDS Vcc
13	D12	B0	36	LVDS GND	LVDS GND
14	NC	NC	35	Y2M	A2M
15	D13	B1	34	Y2P	A2P
16	D14	B2	33	CLKOUTM	CLKM
17	GND	GND	32	CLKOUTP	CLKP
18	D15	B3	31	LVDS GND	LVDS GND
19	D16	B4	30	PLLGND	PLL GND
20	D17	B5	29	PLL Vcc	PLL Vcc
21	Vcc	Vcc	28	PLLGND	PLL GND
22	D18	HSYNC	27	$\overline{\text{SHDN}}$	$\overline{\text{SHDN}}$
23	D19	VSYNC	26	CLKIN	Dclk
24	GND	GND	25	D20	DE(Data Enable)

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

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### 3-3. Signal Timing Specifications

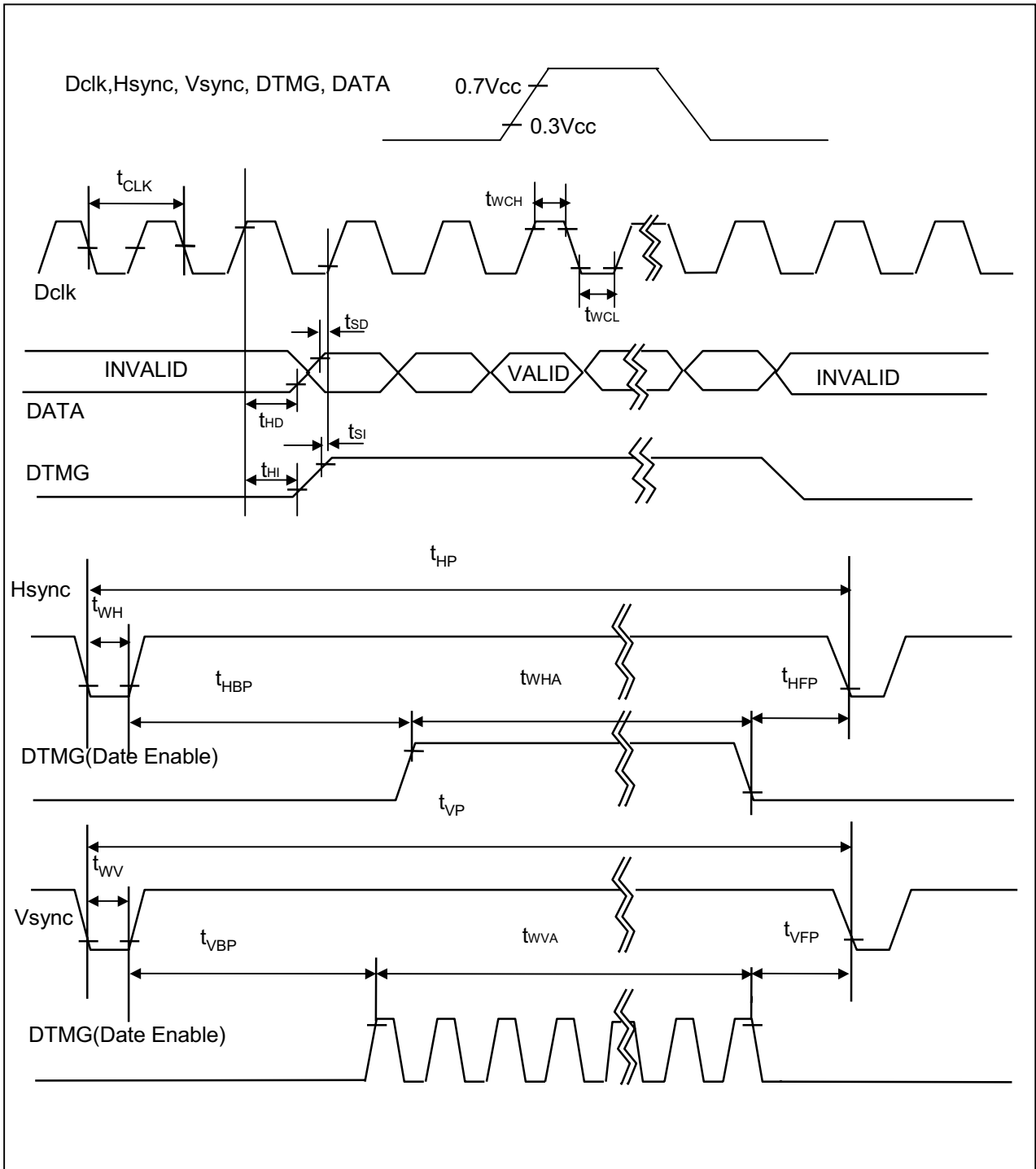
This is the signal timing required at the input of the LVDS Transmitter. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

**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	$t_{HP}$	
DE (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

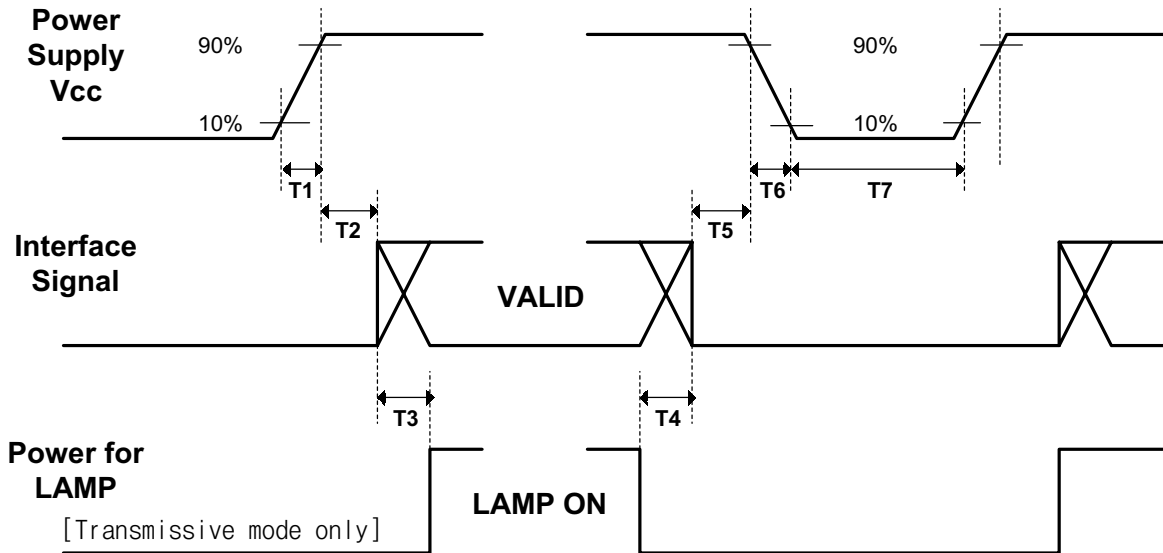
The brightness of each primary color(red,green and blue) is based on the 6-bit gray scale data input for the color ; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

**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
Basic Colors	Black	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
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
	Blue(63)	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
	Magenta	1	1	1	1	1	1	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
	White	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
	Red(01)	0	0	0	0	0	1	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(61)	1	1	1	1	0	1	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
	Red(63) Bright	1	1	1	1	1	1	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
	Green(01)	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	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
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	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
Blue	Blue(00) Dark	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	1
	Blue(02)	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	1	1	1	1	0	1
	Blue(62)	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	1	1	1	1	1	1

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3-6. Power Sequence



Parameter	Value			Units
	Min.	Typ.	Max.	
T <sub>1</sub>	-	-	10	(ms)
T <sub>2</sub>	0	-	50	(ms)
T <sub>3</sub>	200	-	-	(ms)
T <sub>4</sub>	200	-	-	(ms)
T <sub>5</sub>	0	-	50	(ms)
T <sub>6</sub>	0	-	10	(ms)
T <sub>7</sub>	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<sub>CC</sub> 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

4.1 Transmissive Mode

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 500mm from the LCD surface at a viewing angle of  $\Phi$  and  $\theta$  equal to 0 °.

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

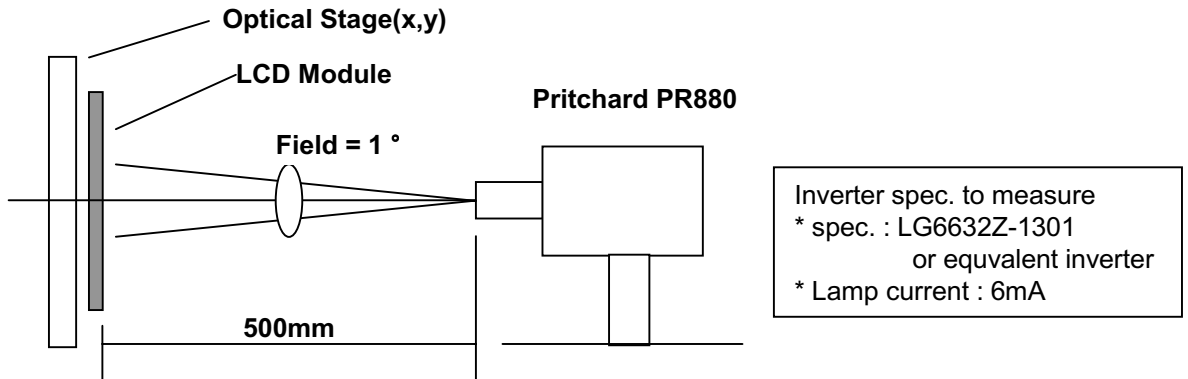


FIG. 1 Optical Characteristic Measurement method

Table 8. OPTICAL CHARACTERISTICS

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
Surface Luminance, white at center 1point	$L_{(WH)}$	102	120	-	cd/m <sup>2</sup>	2
Luminance Variation at 9points	$\delta_{WHITE}$	-	1.2	1.4	%	3
Contrast Ratio at center 1point	CR	28	40	-	-	1
Response Time	$Tr$					
Rise Time	$Tr_R$	-	10	15	ms	4
Decay Time	$Tr_D$	-	30	35	ms	
Viewing Angle at CR $\geq$ 5						
x axis, right( $\phi=0^\circ$ )	$\theta_r$	25	-	-	degree	5
x axis, left ( $\phi=180^\circ$ )	$\theta_l$	25	-	-	degree	
y axis, up ( $\phi=90^\circ$ )	$\theta_u$	25	-	-	degree	
y axis, down ( $\phi=270^\circ$ )	$\theta_d$	45	-	-	degree	
CIE Color Coordinates						
Red	$R_x$	0.393	0.423	0.453	-	$\sigma$ is $\pm 0.03$
	$R_y$	0.255	0.285	0.315	-	
Green	$G_x$	0.290	0.320	0.350	-	
	$G_y$	0.371	0.401	0.431	-	
Blue	$B_x$	0.180	0.210	0.240	-	
	$B_y$	0.226	0.256	0.286	-	
White	$W_x$	0.283	0.313	0.343	-	
	$W_y$	0.299	0.329	0.359	-	

The normal temperature : 25 $\pm$ 2°C , Vcc = 3.3volts

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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 500mm from the surface with all pixels displaying white. For more information see FIG 2.

When  $I_{BL}=6.0\text{mA}$ ,  $L_{WH}=102\text{cd/m}^2(\text{Min.})$   $120\text{cd/m}^2(\text{Typ.})$  under Transmissive mode only

3. The variation in surface luminance ,  $\delta \text{ WHITE}$  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 9 points luminance. For more information see FIG 2.

$$\delta \text{ WHITE} = \text{Maximum}(L_{ON1}, L_{ON2}, \dots, L_{ON9}) \div \text{Minimum}(L_{ON1}, L_{ON2}, \dots, L_{ON9})$$

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 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	1.3
L7	2.1
L15	5.3
L23	10.0
L31	17.7
L39	28.2
L47	43.6
L55	65.3
L63	100

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FIG. 2 Luminance

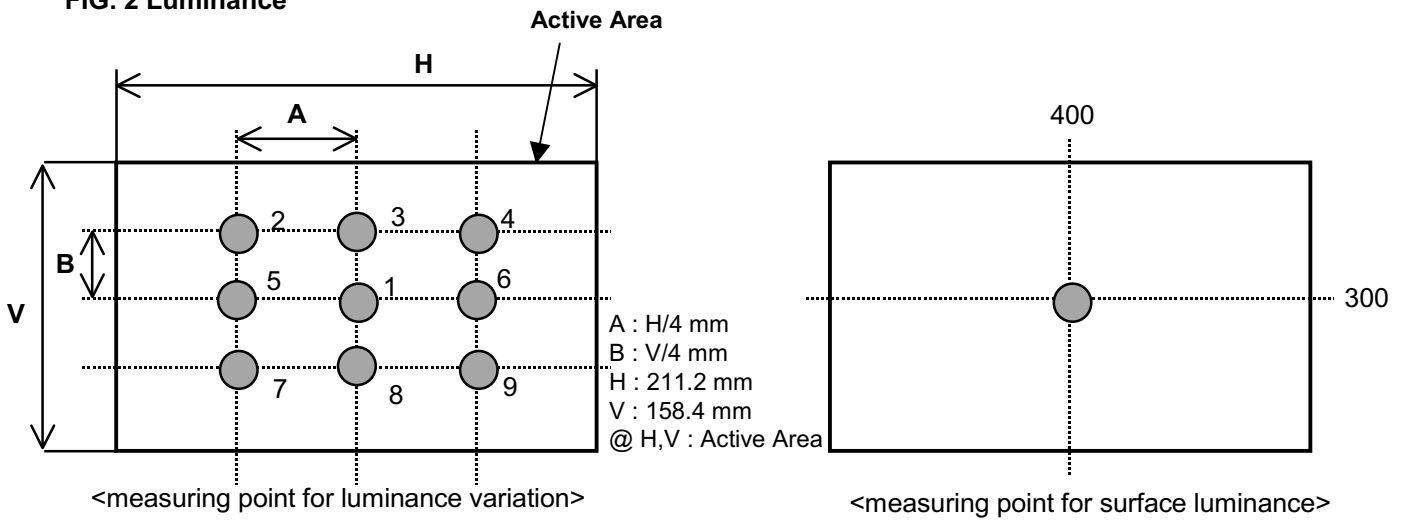


FIG. 3 Response Time

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

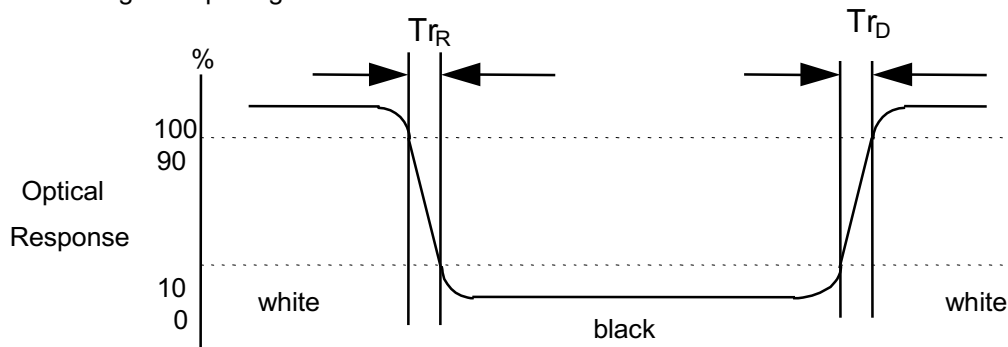
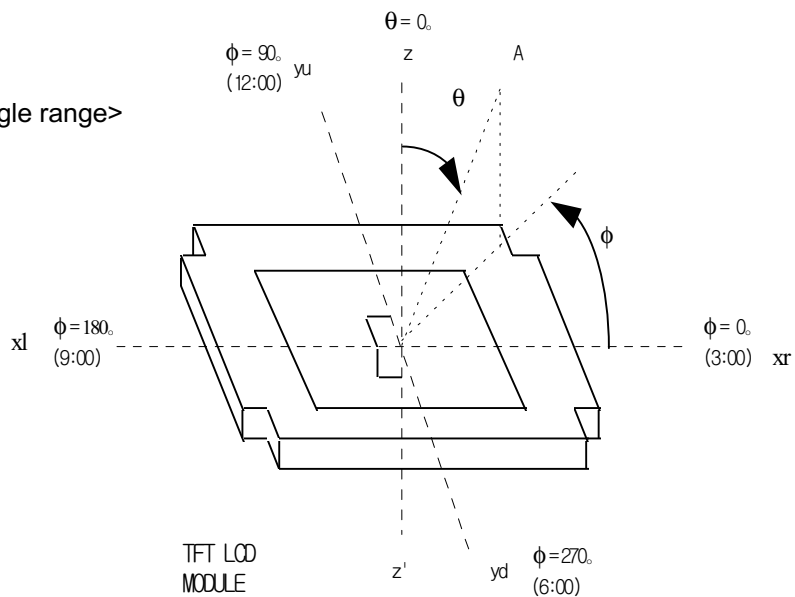


FIG. 4 Viewing angle

<dimension of viewing angle range>



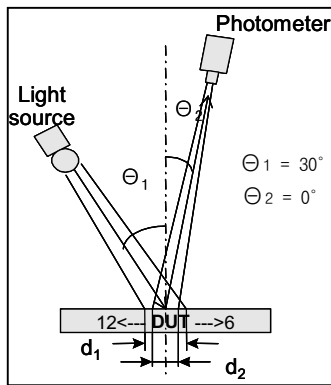
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4.2 Reflective Mode

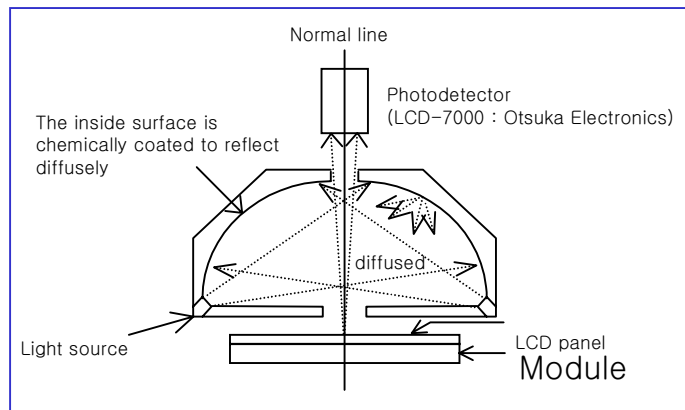
Optical characteristics are determined after the unit has been 'OFF' and stable for approximately 30 minutes in a dark environment at 25 °C.

The optical characteristics shall be measured with the method shown in Fig. 2 below.

And A use of this data is not to guarantee but to refer to a reflective mode.



< Method A >



< Method B >

FIG. 2 Optical Characteristic Measurement methods

Table 9. OPTICAL CHARACTERISTICS

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
Contrast at center 1point	CR	-	5	-	-	1 at 15pages
Response Time	Tr					
Rise Time	Tr <sub>R</sub>	-	10	15	ms	4 at 15pages
Decay Time	Tr <sub>D</sub>	-	30	35	ms	
Viewing Angle at CR ≥2						
x axis, right(φ=0°)	θ <sub>r</sub>	40	-	-	degree	5 at 15pages
x axis, left (φ=180°)	θ <sub>l</sub>	40	-	-	degree	
y axis, up (φ=90°)	θ <sub>u</sub>	40	-	-	degree	
y axis, down (φ=270°)	θ <sub>d</sub>	40	-	-	degree	
CIE Color Coordinates						
White	W <sub>x</sub>	-	0.410	-	-	7
Using C65 light source	W <sub>y</sub>	-	0.439	-	-	
Reflectance	RF	-	14	-	%	8

Notes : 7. It is assumed that chromaticity of the light source is(x=0.308, y=315)

The measuring system is CM-2002(with the unit reflecting diffusely) made by MINOLTA co. Ltd.

\*It is measured by Method B in Fig 2.

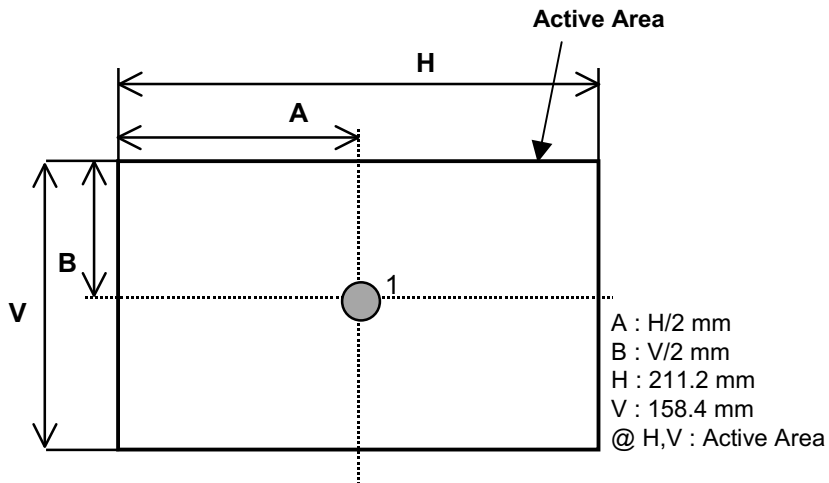
8. Reflectance is defined as follows:

$$\text{Reflectance} = \frac{\text{Light detected level of the reflection by the LCD module}}{\text{Light detected level of the reflection by BaSO}_4} \times 100$$

\*It is measured by Method A in Fig 2.

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FIG. 5 definition of measuring location



5. Mechanical Characteristics

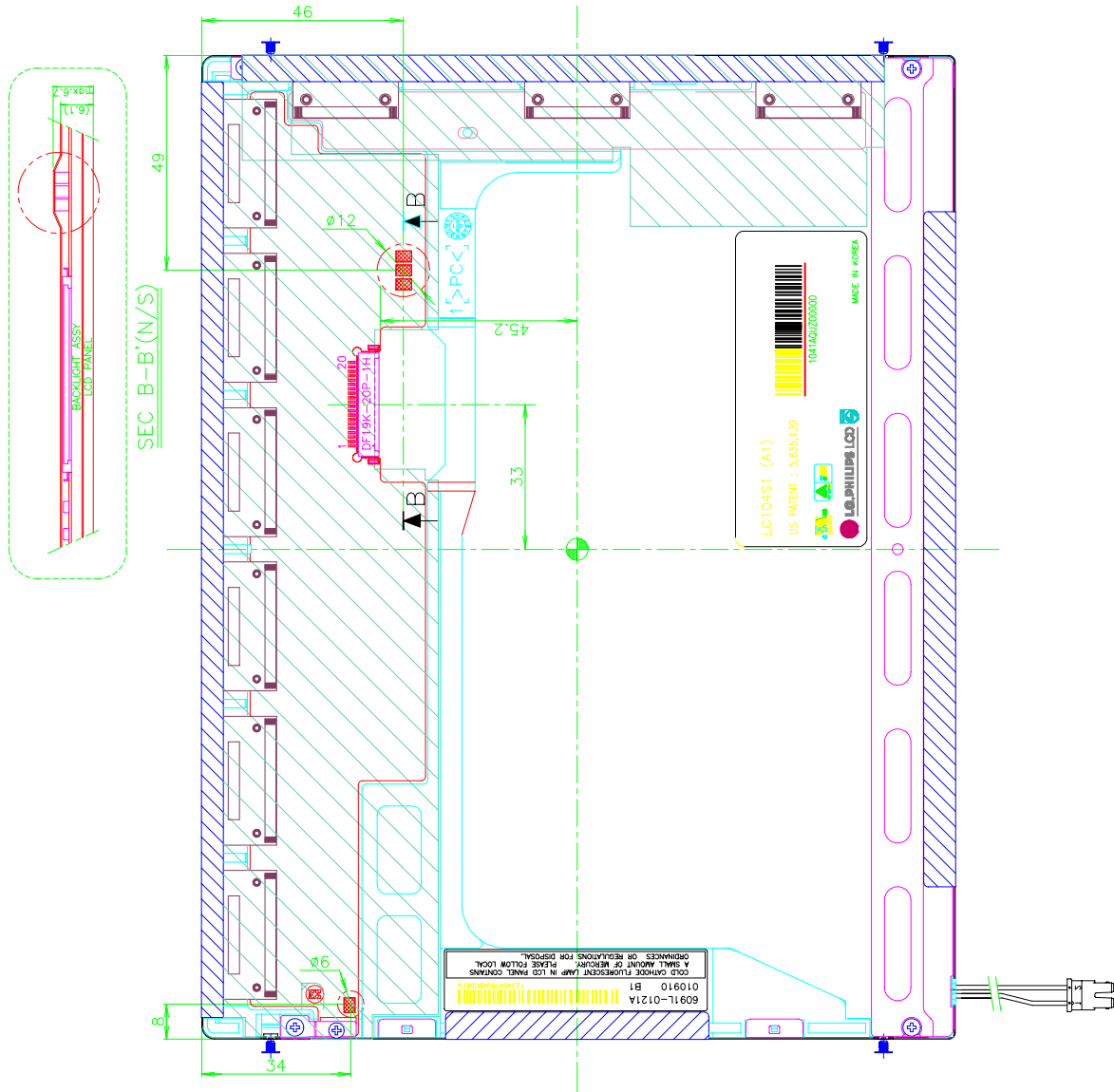
The contents provide general mechanical characteristics for the model LC104S1-A1. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outside dimensions	Horizontal	224.5 ± 0.5mm
	Vertical	172.0 ± 0.5mm
	Depth	6.1 ± 0.3mm(Pls refer to page20 for details)
Bezel area	Horizontal	214.2 ± 0.5mm
	Vertical	161.8 ± 0.5mm
Active display area	Horizontal	211.2mm
	Vertical	158.4mm
Weight(approximate)	310g(Typ.), 320g(Max.)	
Surface Treatment	Hard coating(3H) of the front polarizer Anti-glare treatment of the rear polarizer	



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<REAR VIEW>

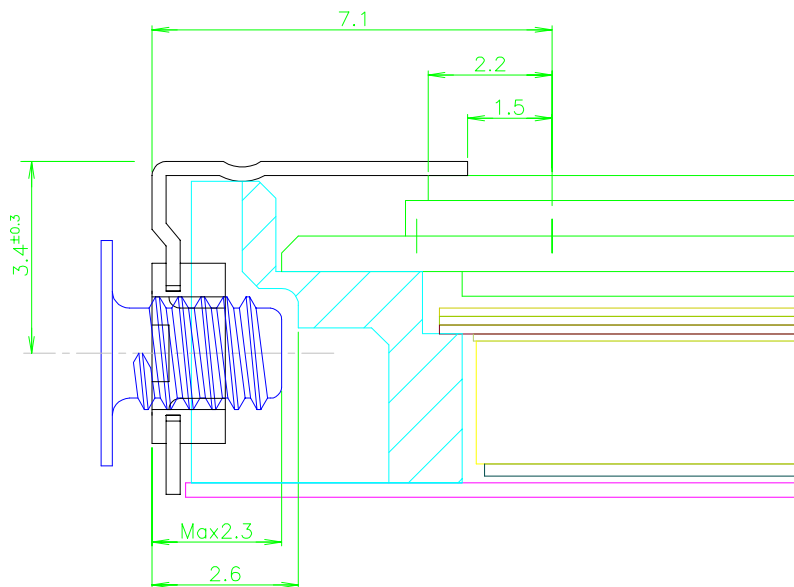


- Notes 1. Unspecified dimensional tolerance is  $\pm 0.5\text{mm}$
- 2. The max thickness including components height( Phantom circled Area) is 6.7mm

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<DETAIL DESCRIPTION OF SIDE MOUNTING SCREW>

SEC A-A(S=10/1)



- \*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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## 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 Electrotechnical Standardization (CENELEC), 1998



## 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 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.

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## 10. IIS (Incoming Inspection Standard)

### 10.1. Inspection Method

#### 10.1.1. Ambient conditions

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

#### 10.1.2. Viewing distance

The distance between the LCM and the inspector's eyes shall be at least 35Cm.

#### 10.1.3. Viewing Angle

The inspection shall be conducted within normal viewing angle range.  
※ Refer to 14pages for viewing angle.

#### 10.1.4. Measurement mode

Inspection method is based on transmissive mode only.

### 10.2 Inspection Criteria

#### 10.2. Dot Defect

##### 10.2.1. Bright Dot

Dots(sub-pixels) which appeared brightly in the screen when the LCM displayed with dark pattern.

- R,G or B 1 dot ----- 10 Max
- Adjacent 2 dots ----- 2 Max(Horizontal only)
- Total amount of Bright dots ----- 10 Max
- Minimum Distance between bright dots ----- 20 mm, Max 2

##### 10.2.2. Dark Dot

Dots(sub-pixels) which appeared darkly in the screen when the LCM displayed with bright pattern.

- 1 dot ----- 10 Max
- Adjacent 2 dots ----- 2 Max(Horizontal only)
- Total amount of Dark dot ----- 10 Max
- Minimum Distance between dark dots ----- 20 mm, Max 2

##### 10.2.3. Total amount of Dot Defects ----- 15 Max(Combination)

- Note) a. Every dot herein means Sub-Pixel(Each Red,Green, or Blue Color)  
 b. Bright & Dark dots are larger than half sub-pixel.  
 (Dots smaller than half sub-pixel are not counted as a defect dots.)

Product Specification

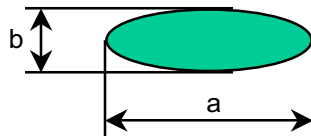
10.3. Polarizer Defects

Items		Criteria
Scratches	Linear	$0.01 \leq W \leq 0.1, 0.3 \leq L \leq 3.5, n \leq 4$
Dent	Circular	$0.2 \leq D \leq 0.5, n \leq 4, 0.5 \leq D \leq 1.0, n \leq 1$

Note)

a. Average Diameter

$$D = \frac{a+b}{2}$$



W : Width  
L : Length  
D : Average diameter  
n : Number of Defects

b. Linear :  $a > 2b$ , Circular :  $a \leq 2b$

c. Extraneous substances which can be wiped out, like Finger Print, Particles, are not considered as a defect.

d. Defects which is on the Black Matrix(outside of Active Area) are not considered as a defect.

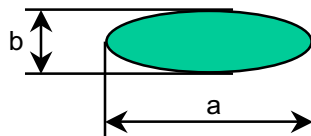
10.4 Foreign Material

Items		Criteria
Foreign Material	Linear	$0.01 \leq W \leq 0.1, 0.3 \leq L \leq 3.5, N \leq 7, n \leq 4$
	Circular	(Bright) $0.1 \leq D \leq 0.4, n \leq 4$ (Gray) $0.1 \leq D \leq 0.8, n \leq 4$

Note)

a. Average Diameter

$$D = \frac{a+b}{2}$$



W : Width  
L : Length  
D : Average diameter  
n : Number of Foreign Material  
N : Number of Pixels on which Foreign Material resides

b. Linear :  $a > 2b$ , Circular :  $a \leq 2b$

c. In case of Linear Foreign Material, both length(L) and number of pixels(N) are used as criteria for the sake of inspection convenience.

10.5. Line Defect

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

10.6. Bezel Appearance

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

10.7. Others

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