

Product Specification

# SPECIFICATION FOR APPROVAL

- ( ● ) Preliminary Specification
- (   ) Final Specification

Title	52.0" F-HD TFT LCD
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BUYER	General
MODEL	-

SUPPLIER	LG.Philips LCD Co., Ltd.
*MODEL	LC520WU2
SUFFIX	SLA2

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

APPROVED BY	SIGNATURE DATE
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Please return 1 copy for your confirmation with your signature and comments.

**TV Product Development Dept.  
LG. Philips LCD Co., Ltd**

## Product Specification

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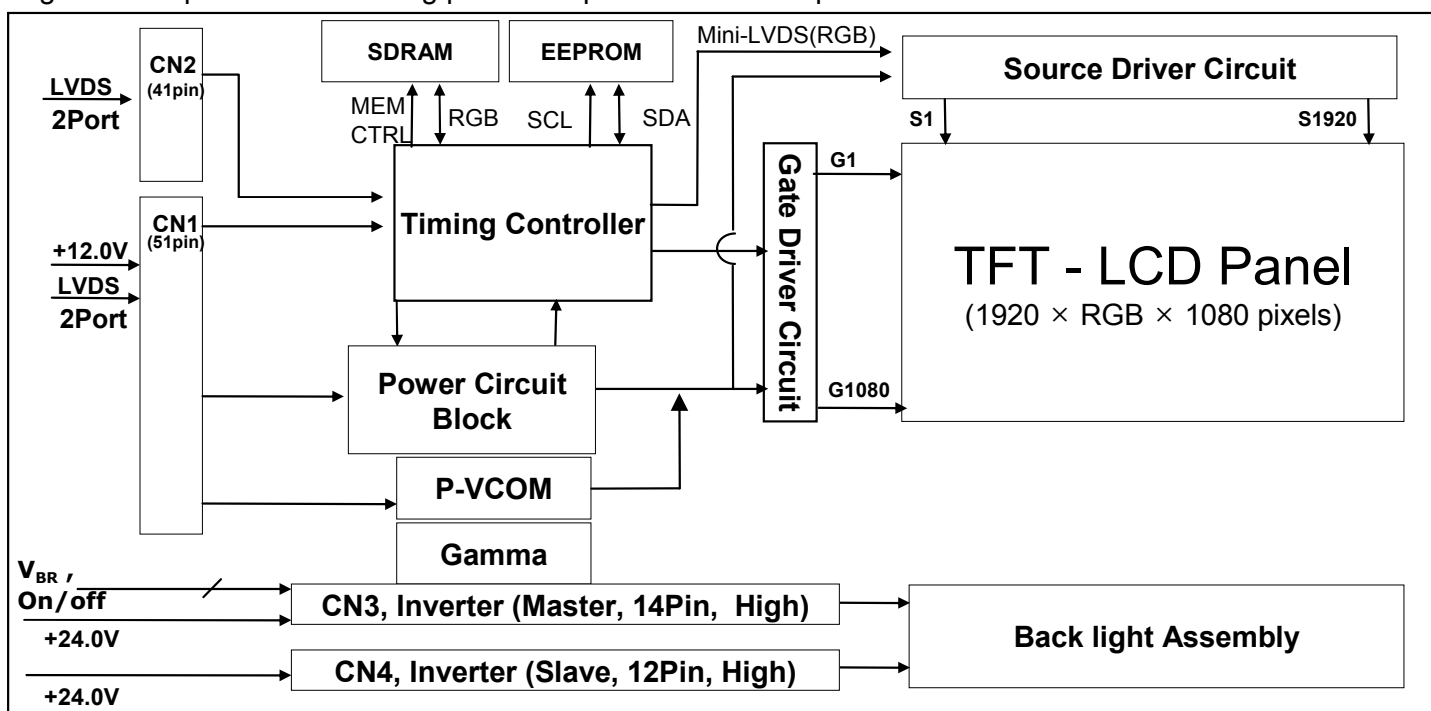
## Product Specification

## 1. General Description

LC520WU2 is a Color Active Matrix Liquid Crystal Display with an 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 black mode. It has a 52.04 inch diagonally measured active display area with WUXGA resolution (1080 vertical by 1920 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 luminance of the sub-pixel color is determined with a 10-bit gray scale signal for each dot, thus presenting a palette of more than 1.07Billion(10bit) of colors.

It has been designed to apply the 10-bit 4 port LVDS interface.

It is intended to support LCD TV, PCTV where high brightness, super wide viewing angle, high color gamut, high color depth and fast moving picture response time are important.



### General Features

Active Screen Size	52.04 inches(1321.816mm) diagonal
Outline Dimension	1236.0mm(H) x 719.2mm(V) x 61.5mm(D) (Typ.)
Pixel Pitch	0.600mm x 0.600mm
Pixel Format	1920 horiz. by 1080 vert. pixels RGB stripe arrangement
Color Depth	10-bit, 1.07Billion colors
Luminance, White	500 cd/m <sup>2</sup> (Center 1 point Typ.)
Viewing Angle (CR>10)	Viewing angle free ( R/L 178(Typ.), U/D 178(Typ.))
Power Consumption	Total 260.8 Watt (Typ.) (Logic= 10.0 W, Lamp= 250 W [Vbr_A=1.65V] )
Weight	23.0 Kg (Typ.)
Display Operating Mode	Transmissive mode, normally black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer

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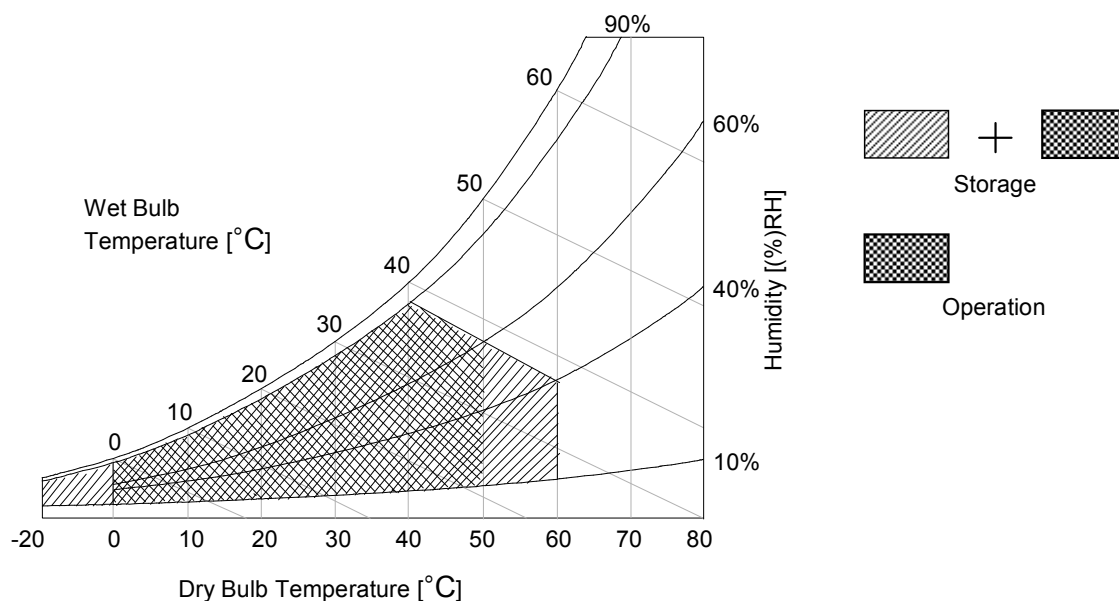
## 2. Absolute Maximum Ratings

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

**Table 1. ABSOLUTE MAXIMUM RATINGS**

Parameter		Symbol	Value		Unit	Remark
			Min	Max		
Power Input Voltage	LCD circuit	V <sub>LCD</sub>	-0.3	+14.0	V <sub>DC</sub>	at 25 ± 2 °C
	Inverter	V <sub>BL</sub>	-0.3	+27.0	V <sub>DC</sub>	
Inverter Control Voltage	ON/OFF	V <sub>OFF/VON</sub>	-0.3	+5.5	V <sub>DC</sub>	
	Brightness	V <sub>BR</sub>	0.0	+5.0	V <sub>DC</sub>	
Operating Temperature		T <sub>OP</sub>	0	+50	°C	Note 1,2
Storage Temperature		T <sub>ST</sub>	-20	+60	°C	
Operating Ambient Humidity		H <sub>OP</sub>	10	90	%RH	
Storage Humidity		H <sub>ST</sub>	10	90	%RH	

- Notes : 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.  
2. Gravity mura can be guaranteed under 40 °C condition.



## Product Specification

### 3. Electrical Specifications

#### 3-1. Electrical Characteristics

It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The other input power for the CCFL/Backlight is to power inverter.

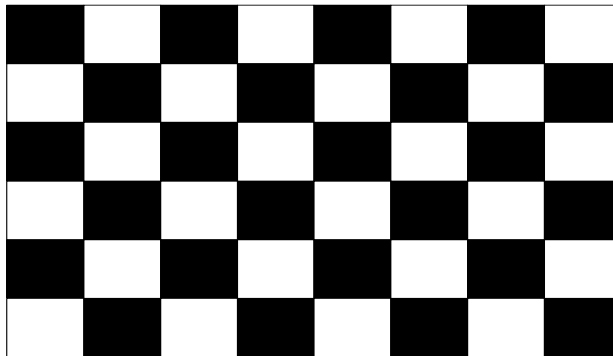
**Table 2-1. ELECTRICAL CHARACTERISTICS**

Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
MODULE :						
Power Input Voltage	V <sub>LCD</sub>	11.4	12.0	12.6	V <sub>DC</sub>	
Power Input Current	I <sub>LCD</sub>	-	0.83	1.08	A	1
		-	1.5	1.95	A	2
Power Consumption	P <sub>LCD</sub>	-	9.96	12.96	Watt	1
Rush current	I <sub>RUSH</sub>	-	-	5.0	A	3

Note :

1. The specified current and power consumption are under the  $V_{LCD}=12.0V$ ,  $25 \pm 2^{\circ}C$ ,  $f_V=120Hz$  condition whereas mosaic pattern(8 x 6) is displayed and  $f_V$  is the frame frequency.
2. The current is specified at the maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power Input is 1ms(min.).

White :1023Gray  
Black : 0Gray



Mosaic Pattern(8 x 6)

## Product Specification

Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter	Symbol	Values			Unit	Notes		
		Min	Typ	Max				
Inverter :								
Power Supply Input Voltage	VBL	22.8	24.0	25.2	Vdc	1		
Power Supply Input Voltage Ripple		-	-	0.5	Vp-p	1		
Power Supply Input Current	After Aging	IBL_A	-	10.4	11.4	A	$V_{BR-A} = 1.65V \dots 1$	
			-	11.2	12.2	A	$V_{BR-A} = 3.3V \dots 1$	
	Before Aging	IBL_B	-	13.5	14.5	A	$V_{BR-A} = 1.65V \dots 2$	
			-	13.5	14.5	A	$V_{BR-A} = 3.3V \dots 2$	
Power Supply Input Current (In-Rush)	Irush	-	-	14.5	A	$V_{BL} = 22.8V$ $V_{BR-B} = 3.3V$ $V_{BR-A} = 1.65V$		
Power Consumption	PBL	-	250	274	W	$V_{BR-A} = 1.65V \dots 1$		
Input Voltage for Control System Signals	Brightness Adjust		$V_{BR-A}$	0.0	1.65	3.3	Vdc	
	On/Off	On	V on	2.5	-	5.0	Vdc	
		Off	V off	-0.3	0.0	0.8	Vdc	
	Brightness Adjust		$V_{BR-B}$	0	-	3.3	V	3
Lamp:								
Life Time		30,000			Hrs	4		

## Notes :

- Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 120 minutes at  $25 \pm 2^\circ\text{C}$ . The specified current and power consumption are under the typical supply Input voltage 24V and  $V_{BR}$  ( $V_{BR-A} : 1.65V$  &  $V_{BR-B} : 3.3V$ ), it is total power consumption.  
The ripple voltage of the power supply input voltage is under 0.5 Vp-p. LPL recommend Input Voltage is  $24.0V \pm 5\%$ .
- Electrical characteristics are determined within 30 minutes at  $25 \pm 2^\circ\text{C}$ .  
The specified currents are under the typical supply Input voltage 24V.
- The brightness of the lamp after lighted for 5minutes is defined as 100%.  
TS is the time required for the brightness of the center of the lamp to be not less than 95% at typical current.  
The screen of LCD module may be partially dark by the time the brightness of lamp is stable after turn on.
- Specified Values are for a single lamp which is aligned horizontally.  
The life time is determined as the time which luminance of the lamp is 50% compared to that of initial value at the typical lamp current ( $V_{BR-A} : 1.65V$  &  $V_{BR-B} : 3.3V$ ), on condition of continuous operating at  $25 \pm 2^\circ\text{C}$
- The duration of rush current is about 10ms.

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## 3-2. Interface Connections

This LCD module employs two kinds of interface connection, 51-pin and 41-pin connectors are used for the module electronics and 14-pin connector & 12 pin connector are used for the integral backlight system.

### 3-2-1. LCD Module

- LCD Connector(CN1,CN2): FI-RE51S-HF or equivalent , Refer to below and next Page Table
- Mating Connector : FI-RE51HL

**Table 3-1. MODULE CONNECTOR(CN1) PIN CONFIGURATION**

No	Symbol	Description	No	Symbol	Description
1	GND	Ground	27	GND	Ground
2	NC	No connection	28	RA2N	SECOND CHANNEL A-
3	NC	No connection	29	RA2P	SECOND CHANNEL A+
4	NC	No connection	30	RB2N	SECOND CHANNEL B-
5	NC	No connection	31	RB2P	SECOND CHANNEL B+
6	NC	No connection	32	RC2N	SECOND CHANNEL C-
7	LVDS Select	logic: "L" : NS, "H" : JEIDA	33	RC2P	SECOND CHANNEL C+
8	NC	No connection	34	GND	Ground
9	NC	No connection	35	RCLK2N	SECOND CLOCK CHANNEL Clk-
10	NC	No connection	36	RCLK2P	SECOND CLOCK CHANNEL Clk+
11	GND	Ground	37	GND	Ground
12	RA1N	FIRST CHANNEL A-	38	RD2N	SECOND CHANNEL D-
13	RA1P	FIRST CHANNEL A+	39	RD2P	SECOND CHANNEL D+
14	RB1N	FIRST CHANNEL B-	40	RE2N	SECOND CHANNEL E-
15	RB1P	FIRST CHANNEL B+	41	RE2P	SECOND CHANNEL E+
16	RC1N	FIRST CHANNEL C-	42	GND	Ground
17	RC1P	FIRST CHANNEL C+	43	GND	Ground
18	GND	Ground	44	GND	Ground (NSB)
19	RCLK1N	FIRST CLOCK CHANNEL Clk-	45	GND	Ground
20	RCLK1P	FIRST CLOCK CHANNEL Clk+	46	GND	Ground
21	GND	Ground	47	NC	No connection
22	RD1N	FIRST CHANNEL D-	48	V <sub>LCD</sub>	Power Supply +12.0V
23	RD1P	FIRST CHANNEL D+	49	V <sub>LCD</sub>	Power Supply +12.0V
24	RE1N	FIRST CHANNEL E-	50	V <sub>LCD</sub>	Power Supply +12.0V
25	RE1P	FIRST CHANNEL E+	51	V <sub>LCD</sub>	Power Supply +12.0V
26	GND	Ground	-	-	-

- Note :
1. All GND(ground) pins should be connected together to the LCD module's metal frame.
  2. All V<sub>LCD</sub> (power input) pins should be connected together.
  3. All Input levels of LVDS signals are based on the IEA 664 Standard.
  4. Specific pins(pin No. #2~#6) are used for internal data process of the LCD module.  
If not used, these pins are no connection.
  5. Specific pin No. #44 is used for "No signal detection" of system signal interface.  
It should be GND for NSB(No Signal Black) during the system interface signal is not.  
If this pin is "H", LCD Module displays AGP(Auto Generation Pattern).



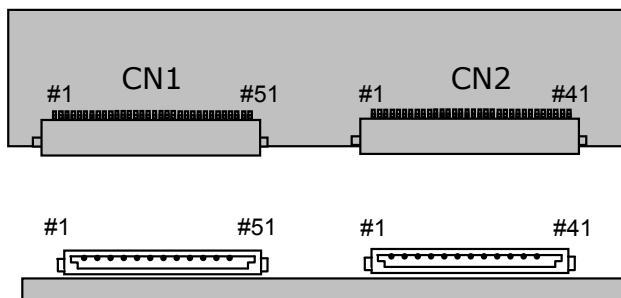
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- LCD Connector(CN2): FI-RE41S-HF or equivalent , Refer to below table
- Mating Connector : FI-RE41HL

**Table 3-2. MODULE CONNECTOR(CN2) PIN CONFIGURATION**

No	Symbol	Description	No	Symbol	Description
1	NC	No connection(Reserved)	22	RE3N	Third CHANNEL E-
2	NC	No connection	23	RE3P	Third CHANNEL E+
3	NC	No connection	24	GND	Ground
4	NC	No connection	25	GND	Ground
5	NC	No connection	26	RA4N	Fourth CHANNEL A-
6	NC	No connection	27	RA4P	Fourth CHANNEL A+
7	NC	No connection	28	RB4N	Fourth CHANNEL B-
8	NC	No connection	29	RB4P	Fourth CHANNEL B+
9	GND	Ground	30	RC4N	Fourth CHANNEL C-
10	RA3N	Third CHANNEL A-	31	RC4P	Fourth CHANNEL C+
11	RA3P	Third CHANNEL A+	32	GND	Ground
12	RB3N	Third CHANNEL B-	33	RCLK4N	Fourth CLOCK CHANNEL Clk-
13	RB3P	Third CHANNEL B+	34	RCLK4P	Fourth CLOCK CHANNEL Clk+
14	RC3N	Third CHANNEL C-	35	GND	Ground
15	RC3P	Third CHANNEL C+	36	RD4N	Fourth CHANNEL D-
16	GND	Ground	37	RD4P	Fourth CHANNEL D+
17	RCLK3N	Third CLOCK CHANNEL Clk-	38	RE4N	Fourth CHANNEL E-
18	RCLK3P	Third CLOCK CHANNEL Clk+	39	RE4P	Fourth CHANNEL E+
19	GND	Ground	40	GND	Ground
20	RD3N	Third CHANNEL D-	41	GND	Ground
21	RD3P	Third CHANNEL D+	-		

Note : 1. All GND(ground) pins should be connected together to the LCD module's metal frame.

**Rear view of LCM**

[CN1]

- Part/No. : FI-RE51S-HF(JAE) or Equivalent
- Mating connector : FI-RE51HL  
(Manufactured by JAE)

[CN2]

- Part/No. : FI-RE41S-HF(JAE) or Equivalent
- Mating connector : FI-RE41HL  
(Manufactured by JAE)

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**3-2-2. Backlight Inverter****Master**

- Inverter Connector : S14B-PH-SMC (JST)  
or Equivalent
- Mating Connector : PHR-14 or Equivalent

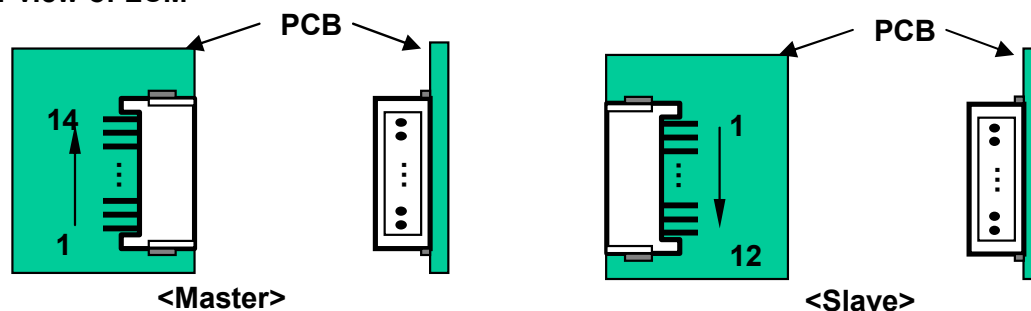
**Slave**

- Inverter Connector : S12B-PH-SMC (JST)  
or Equivalent
- Mating Connector : PHR-12 or Equivalent

**Table 7. INVERTER CONNECTOR PIN CONFIGURATION**

Pin No	Symbol	Description	Master	Slave	Note
1	VBL	Power Supply +24.0V	VBL	VBL	
2	VBL	Power Supply +24.0V	VBL	VBL	
3	VBL	Power Supply +24.0V	VBL	VBL	
4	VBL	Power Supply +24.0V	VBL	VBL	
5	VBL	Power Supply +24.0V	VBL	VBL	
6	GND	Backlight Ground	GND	GND	
7	GND	Backlight Ground	GND	GND	
8	GND	Backlight Ground	GND	GND	1
9	GND	Backlight Ground	GND	GND	
10	GND	Backlight Ground	GND	GND	
11	VBR-A	Analog dimming voltage DC 0.0V ~ 3.3V (Typ : 1.65V)	VBR-A	Don't care	2, 3
12	VON/OFF	0.0V ~ 5.0V	On/Off	Don't care	
13	VBR-B	Burst dimming voltage DC 0.0V ~ 3.3V	VBR-B	-	3
14	Status	Normal : Upper 3.0V Abnormal : Under 0.7V	Status	-	4

- Notes :
1. GND should be connected to the LCD module's metal frame.
  2. If Pin #11 is open, VBR-A = 1.65V. When apply over 1.65V (~ 3.3V) continuously, its luminance is increasing however lamp's life time is decreasing.  
It could be usable for boost up luminance when using DCR (=Dynamic contrast ratio) function only.
  3. Minimum Brightness : VBR-B = 0V Maximum Brightness : VBR-B = 3.3V
  4. Even though Pin #14 is open, there is no effect on inverter operating, The output terminal of inverter.
  5. Each impedance of pin #11, 12 and 13 is 100[kΩ], 100[kΩ], 150 [kΩ]

**◆ Rear view of LCM**

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### 3-3. Signal Timing Specifications

Table 6 shows the signal timing required at the input of the LVDS transmitter. All of the interface signal timing should be satisfied with the following specification for normal operation.

**Table 6. TIMING TABLE for NTSC/ATSC (DE Only Mode)**

ITEM		Symbol	Min	Typ	Max	Unit	Notes
Horizontal	Display Period	$t_{HV}$	-	480	-	$t_{CLK}$	1920/4
	Blank	$t_{HB}$	40	70	200	$t_{CLK}$	1
	Total	$t_{HP}$	520	550	680	$t_{CLK}$	
Vertical	Display Period	$t_{VV}$	-	1080	-	Lines	
	Blank	$t_{VB}$	10	45	86	Lines	1
	Total	$t_{VP}$	1090	1125	1166	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Notes
Frequency	DCLK	$f_{CLK}$	66.97	74.25	75.00	MHz	
	Horizontal	$f_H$	121.8	135	136.4	KHz	2
	Vertical	$f_V$	108.2	120	121.2	Hz	2

- Notes : 1. The Input of HSYNC & VSYNC signal does not have an effect on normal operation(DE Only Mode).  
If you use spread spectrum for EMI, add some additional clock to minimum value for clock margin.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate and the horizontal frequency.

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Table 7 shows the signal timing required at the input of the LVDS transmitter. All of the interface signal timing should be satisfied with the following specification for normal operation.

**Table7. TIMING TABLE for DVB/PAL (DE Only Mode)**

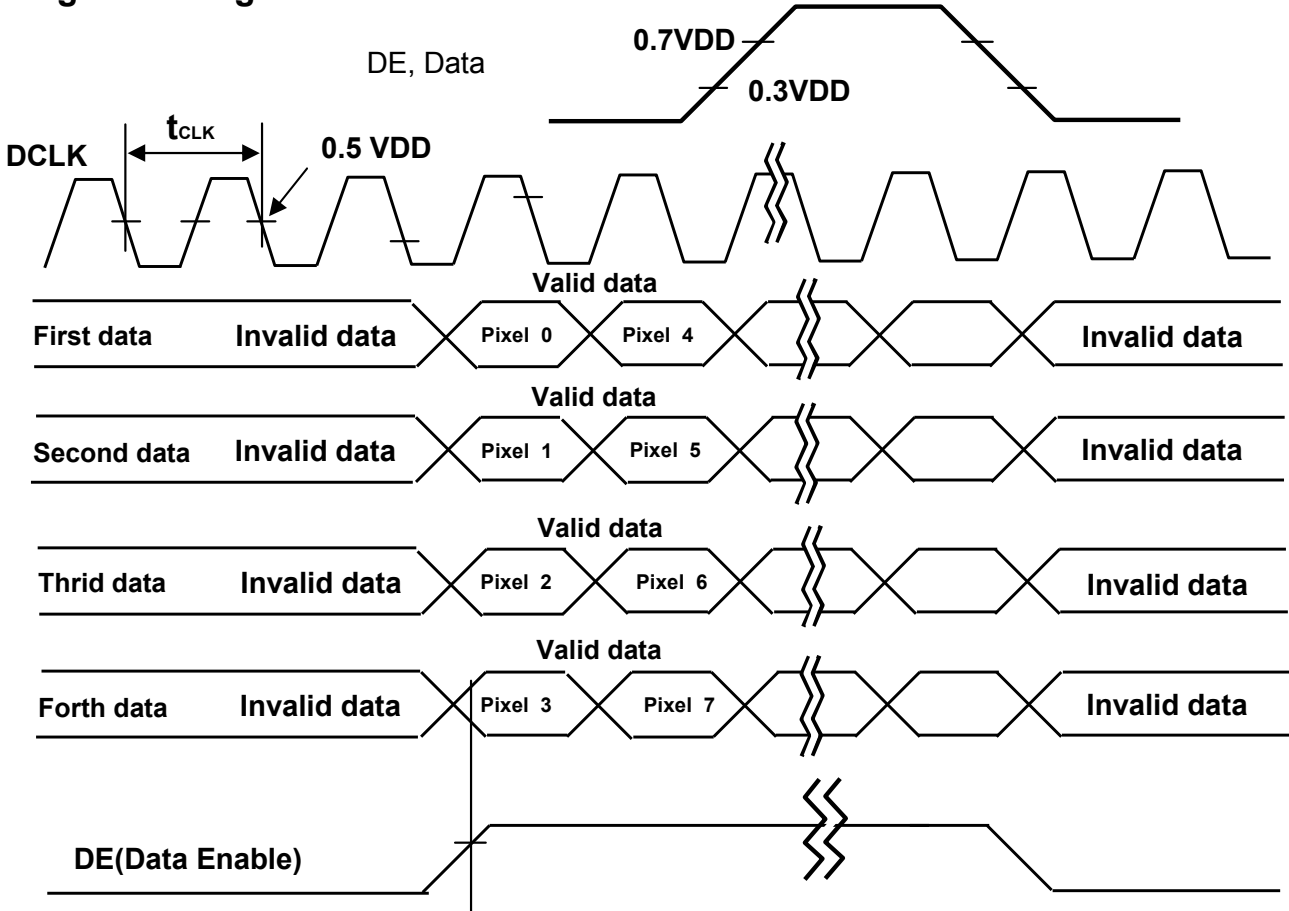
ITEM		Symbol	Min	Typ	Max	Unit	Notes
Horizontal	Display Period	$t_{HV}$	-	480	-	$t_{CLK}$	1920/4
	Blank	$t_{HB}$	40	70	200	$t_{CLK}$	1
	Total	$t_{HP}$	520	550	680	$t_{CLK}$	
Vertical	Display Period	$t_{VV}$	-	1080	-	Lines	
	Blank	$t_{VB}$	228	270	300	Lines	1
	Total	$t_{VP}$	1308	1350	1380	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Notes
Frequency	DCLK	$f_{CLK}$	66.97	74.25	75.00	MHz	
	Horizontal	$f_H$	121.8	135	140	KHz	2
	Vertical	$f_V$	90.2	100	103.7	Hz	2

- Notes : 1. The Input of HSYNC & VSYNC signal does not have an effect on normal operation(DE Only Mode).  
If you use spread spectrum for EMI, add some additional clock to minimum value for clock margin.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate and the horizontal frequency.

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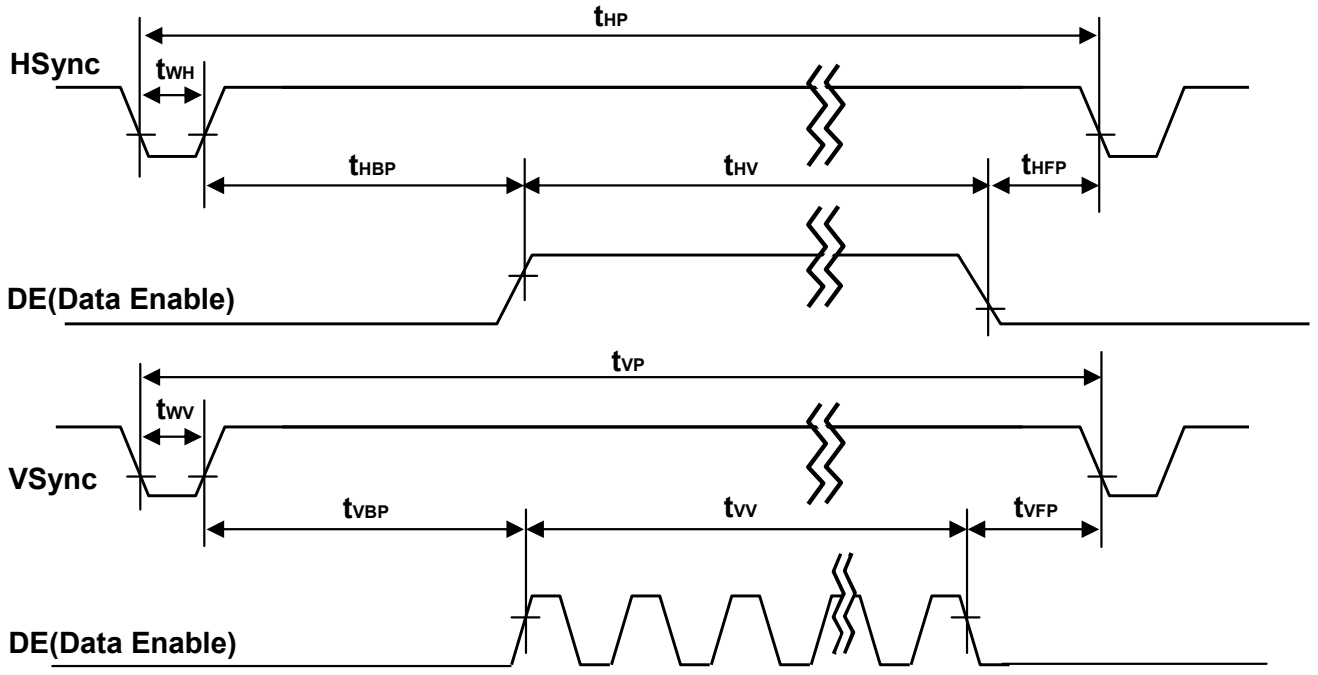
3-4. Signal Timing Waveforms



\* Reference : Sync. Relation

\*  $t_{HB} = t_{HFP} + t_{WH} + t_{HBP}$

\*  $t_{VB} = t_{VFP} + t_{VW} + t_{VBP}$



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### 3-5. Color Data Reference

The brightness of each primary color(red,green,blue) is based on the 10-bit gray scale data input for the color. The higher binary input, the brighter the color. Table 6 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				
		R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	B7	B6	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	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Blue (1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	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	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED (000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (001)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	...	...										...										...									
	RED (1022)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	...	...										...										...									
	GREEN (1022)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	GREEN (1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
BLUE	BLUE (000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	...	...										...										...									
	BLUE (1022)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
	BLUE (1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

## Product Specification

## 3-6. Power Sequence

## 3-6-1. LCD Driving circuit

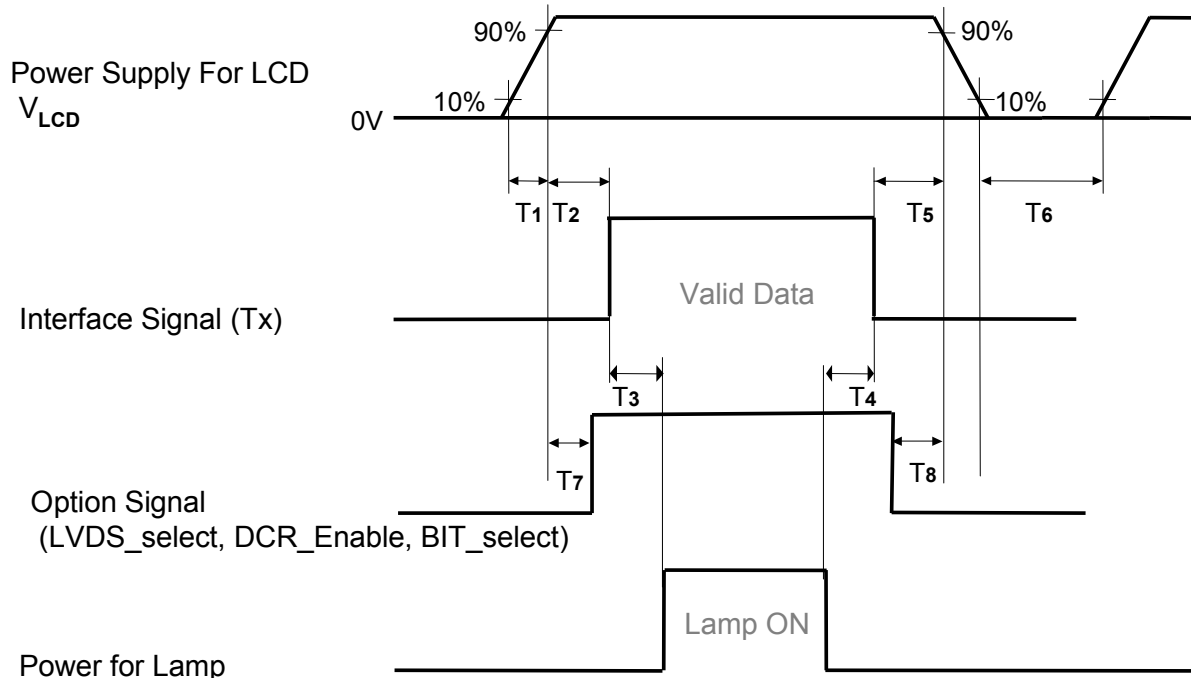


Table 7. POWER SEQUENCE

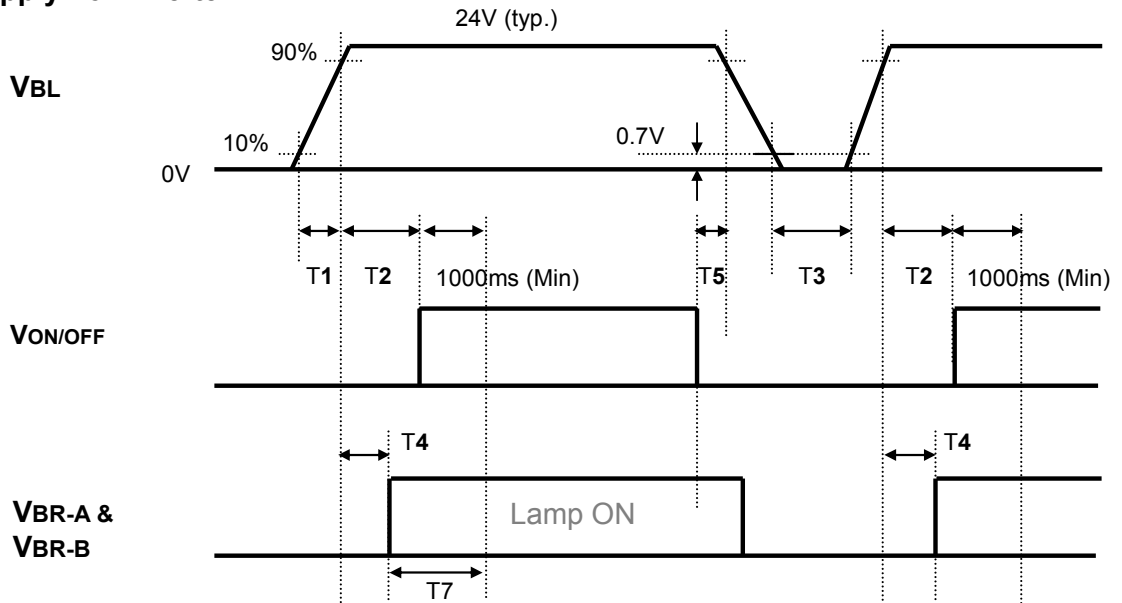
Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	0.5	-	20	ms	
T2	0.5	-	$3 \times (1/f_v)$	ms	3,5
T3	200	-	-	ms	4
T4	200	-	-	ms	4
T5	0	-	-	ms	3,5
T6	2.0	-	-	s	2,6
T7	0	-	T2	ms	5
T8	0	-	T5	ms	5

- 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  $V_{LCD}$  to 0V.
  3. The case when the T2/T5 exceed  $3 \times (1/f_v)$ , it operates protection pattern (Black pattern) till valid signal inputted. There is no reliability problem. (ex. 60Hz :  $3 \times (1/60\text{Hz}) = 50\text{ms}$ )
  4. The T3/T4 is recommended value, the case when failed to meet a minimum specification, abnormal display would be shown. There is no reliability problem.
  5. If the on time of signals (Interface signal and Option signals) precedes the on time of Power ( $V_{LCD}$ ), check the LCD logic Power ( $V_{cc}$ ) is under 0.8V, otherwise it will be happened abnormal display.
  6. T6 should be measured after the Module has been fully discharged between power off and on period.

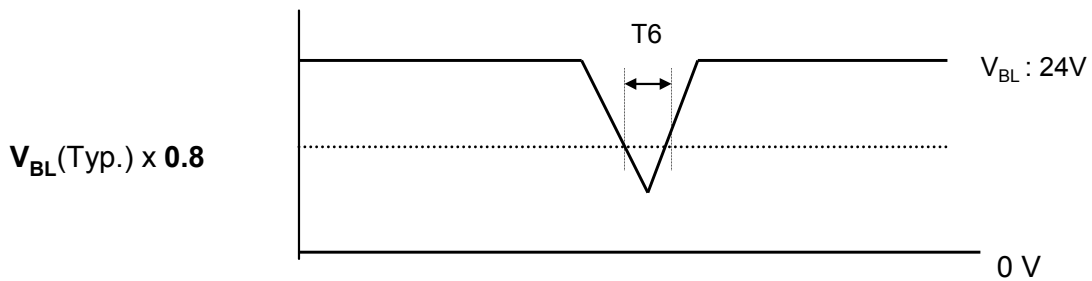
Product Specification

**3-6-2. Sequence for Inverter**

**Power Supply For Inverter**



**3-6-3. Deep condition for Inverter**



**Table 8. Power Sequence for Inverter**

Parameter	Values			Units	Remarks
	Min	Typ	Max		
T1	20	-	-	ms	1
T2	500	-	-	ms	
T3	200	-	-	ms	
T4	0	-	-	ms	2
T5	10	-	-	ms	
T6	-	-	10	ms	$V_{BL}(Typ) \times 0.8$
T7	1000	-	-	ms	3

- Notes :
1. T1 describes rising time of 0V to 24V and this parameter does not applied at restarting time.
  2. T4(max) is less than T2.
  3. In T7 section, VBR-B is recommended 3.3V.



## Product Specification

## 4. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' for 120min in a dark environment at  $25\pm 2^{\circ}\text{C}$ . The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of  $\Phi$  and  $\theta$  equal to  $0^{\circ}$ .

It is presented additional information concerning the measurement equipment and method in FIG. 1.

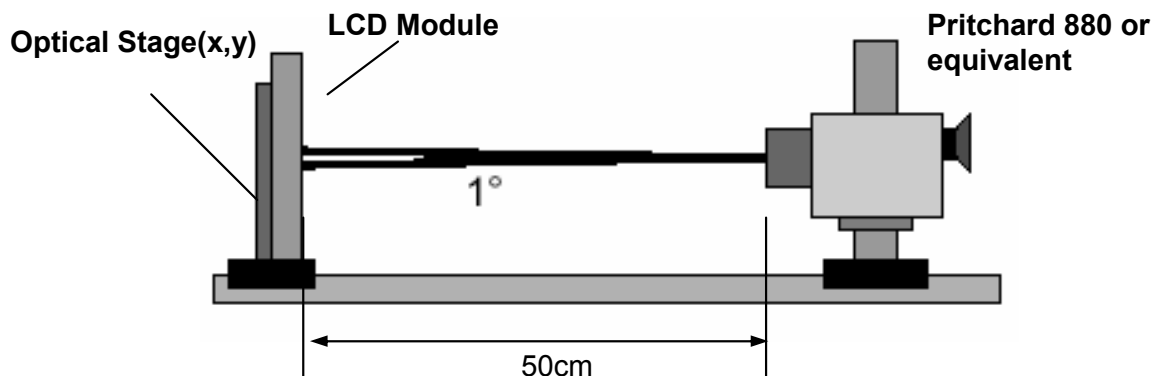


FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 9. OPTICAL CHARACTERISTICS

$T_a = 25\pm 2^{\circ}\text{C}$ ,  $V_{\text{LCD}} = 12.0\text{V}$ ,  $f_v = 120\text{Hz}$ ,  $D_{\text{clk}} = 74.25\text{MHz}$ ,  $V_{\text{BR-A}} = 1.65\text{V}$ ,  $V_{\text{BR-B}} = 3.3\text{V}$

Parameter		Symbol	Value			Unit	Note
			Min	Typ	Max		
Contrast Ratio		CR	700	1000			1
Surface Luminance, white		$L_{\text{WH}}$	400	500		$\text{cd}/\text{m}^2$	2
Luminance Variation		$\delta_{\text{WHITE}}$   5P			1.3		3
Response Time	MPRT	-	-	8	10	ms	4
Color Coordinates [CIE1931]	RED	Rx		0.665			
		Ry		0.321			
	GREEN	Gx		0.192			
		Gy	Typ	0.668	Typ		
	BLUE	Bx	-0.03	0.142	+0.03		
		By		0.080			
	WHITE	Wx		0.279			
	Wy		0.292				
Viewing Angle (CR>10)							
	x axis, right( $\phi=0^{\circ}$ )	$\theta_r$	89	-	-	Degree	5
	x axis, left ( $\phi=180^{\circ}$ )	$\theta_l$	89	-	-		
	y axis, up ( $\phi=90^{\circ}$ )	$\theta_u$	89	-	-		
	y axis, down ( $\phi=270^{\circ}$ )	$\theta_d$	89	-	-		
Gray Scale							6

## Product Specification

Note : 1. Contrast Ratio(CR) is defined mathematically as :

CR(Contrast Ratio) = Maximum CR<sub>n</sub> (n=1, 2, 3, 4, 5)

$$CR_n = \frac{\text{Surface Luminance at position n with all white pixels}}{\text{Surface Luminance at position n with all black pixels}}$$

n = the Position number(1, 2, 3, 4, 5). For more information, see FIG 2.

2. Surface luminance are determined after the unit has been 'ON' and 30min after lighting the backlight in a dark environment at  $25 \pm 2^\circ\text{C}$ . Surface luminance is the luminance value at center 1-point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see the FIG. 2.

3. The variation in surface luminance,  $\delta$  WHITE is defined as :

$$\delta \text{ WHITE}(5P) = \text{Maximum}(L_{on1}, L_{on2}, L_{on3}, L_{on4}, L_{on5}) / \text{Minimum}(L_{on1}, L_{on2}, L_{on3}, L_{on4}, L_{on5})$$

Where  $L_{on1}$  to  $L_{on5}$  are the luminance with all pixels displaying white at 5 locations .

For more information, see the FIG. 2.

4. MPRT is defined as the 10% to 90% blur-edge width  $B_{ij}$ (pixels) and scroll speed  $U$ (pixels/frame)at the moving picture. For more information, see FIG 4

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 module surface. For more information, see the FIG. 5.

6. Gray scale specification

Gamma Value is approximately 2.2. For more information, see the Table 10.

**Table 10. GRAY SCALE SPECIFICATION**

Gray Level	Luminance [%] (Typ.)
L0	0.10
L63	0.22
L127	1.02
L191	2.49
L255	4.71
L319	7.70
L383	11.5
L447	16.2
L511	21.7
L575	28.2
L639	35.5
L703	43.8
L767	53.1
L831	63.3
L895	74.5
L959	86.8
L1023	100

Product Specification

Measuring point for surface luminance & measuring point for luminance variation

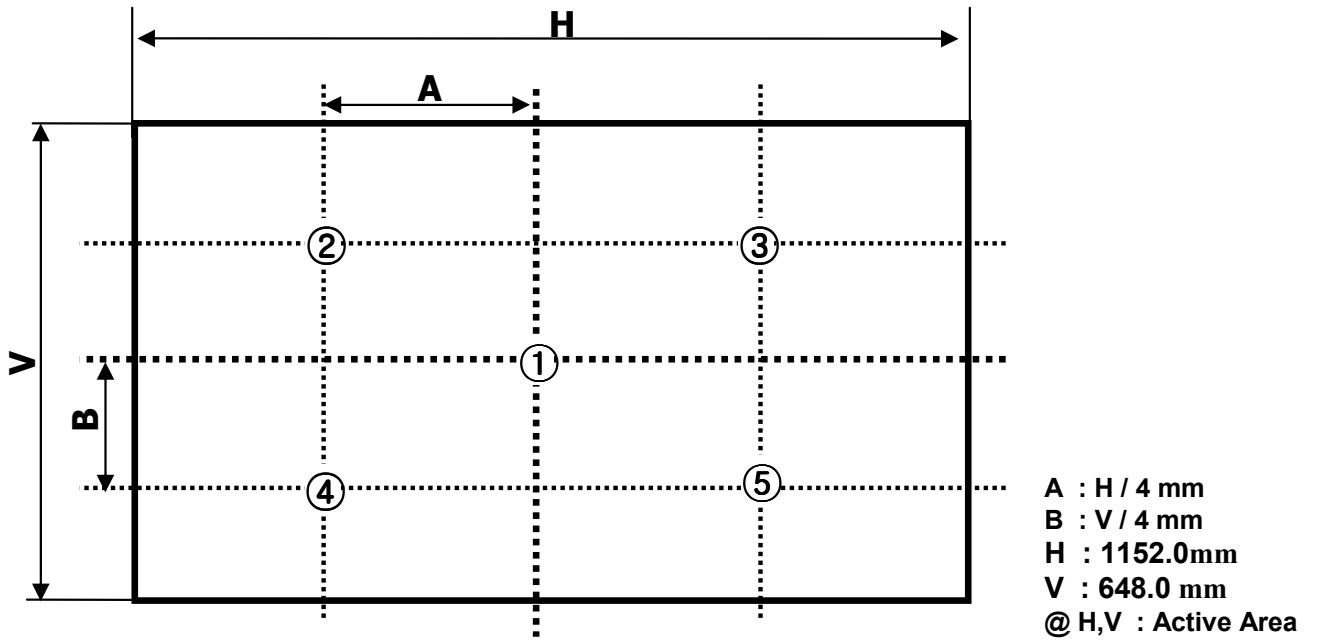
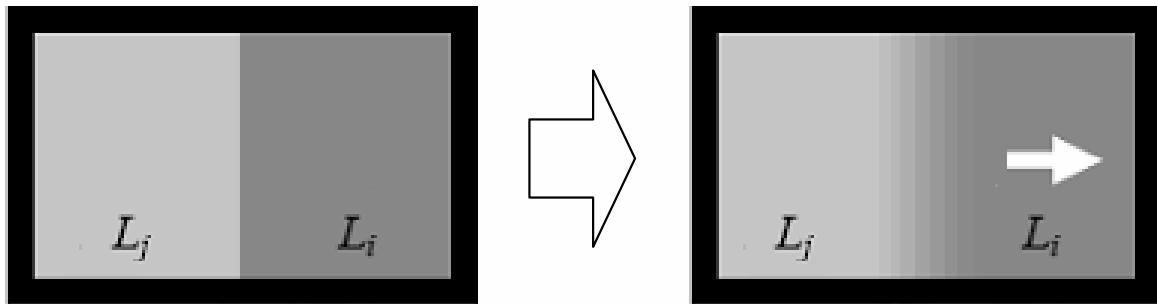


FIG. 2 Measure Point for Luminance

MPRT is defined as the 10% to 90% blur-edge with  $B_{ij}$ (pixels) and scroll speed  $U$ (pixels/frame)at the moving picture.



$$M = \frac{1}{U} B_{ij} \quad (i \neq j)$$

Example)  $B_{ij} = 12\text{pixels}$ ,  $U = 10\text{pixels} / 120\text{Hz}$   
 $M = 12\text{pixels} / (10\text{pixels} / 120\text{Hz})$   
 $= 12\text{pixels} / \{10\text{pixels} / (1/120)\text{s}\}$   
 $= 12 / 1,200 \text{ s}$   
 $= 10 \text{ ms}$

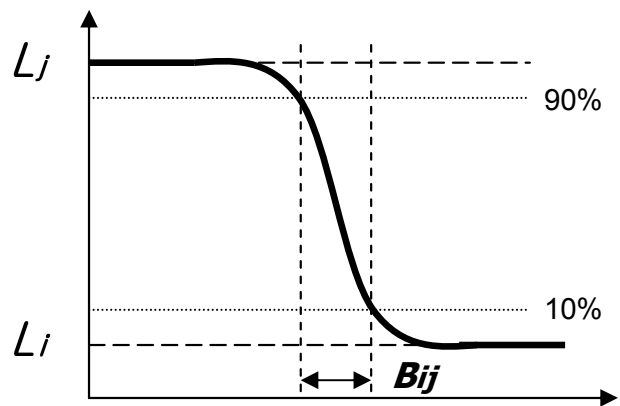


FIG. 3 MPRT

## Product Specification

Dimension of viewing angle range

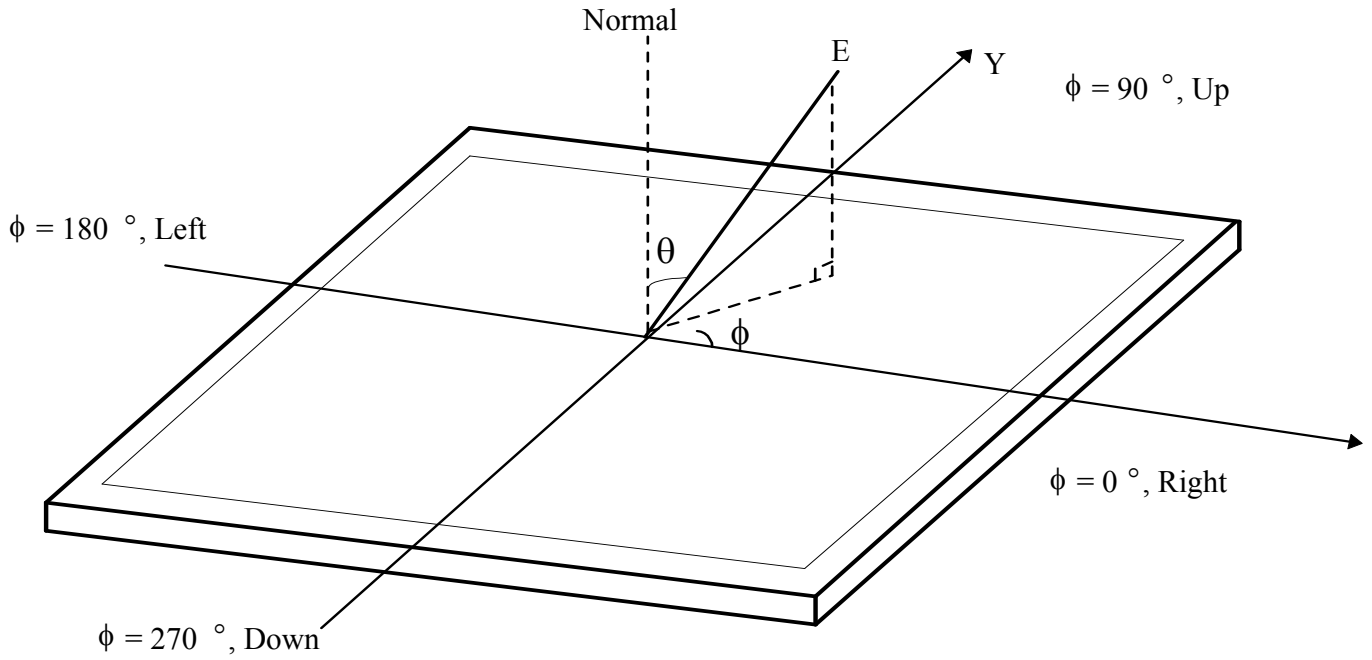


FIG. 4 Viewing angle

## Product Specification

**5. Mechanical Characteristics**

Table 11 provides general mechanical characteristics.

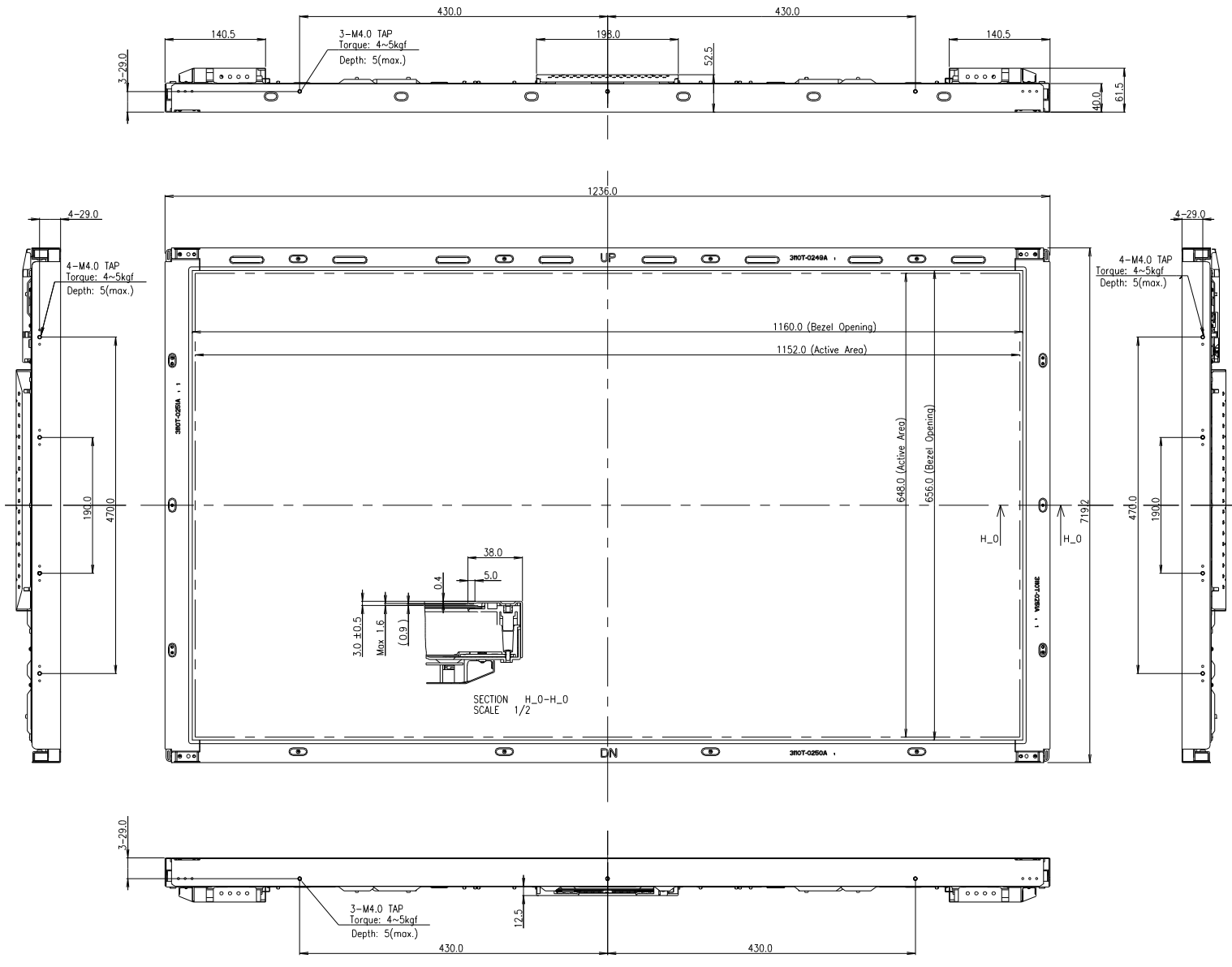
**Table 11. MECHANICAL CHARACTERISTICS**

Outline Dimension	Horizontal	1236.0 mm
	Vertical	719.2 mm
	Depth	61.5 mm
Bezel Area	Horizontal	1160.0mm
	Vertical	656.0mm
Active Display Area	Horizontal	1152.0mm
	Vertical	648.0mm
Weight	23.0 Kg (Typ.) /24.2Kg (Max)	

Note : Please refer to a mechanic drawing in terms of tolerance at the next page.

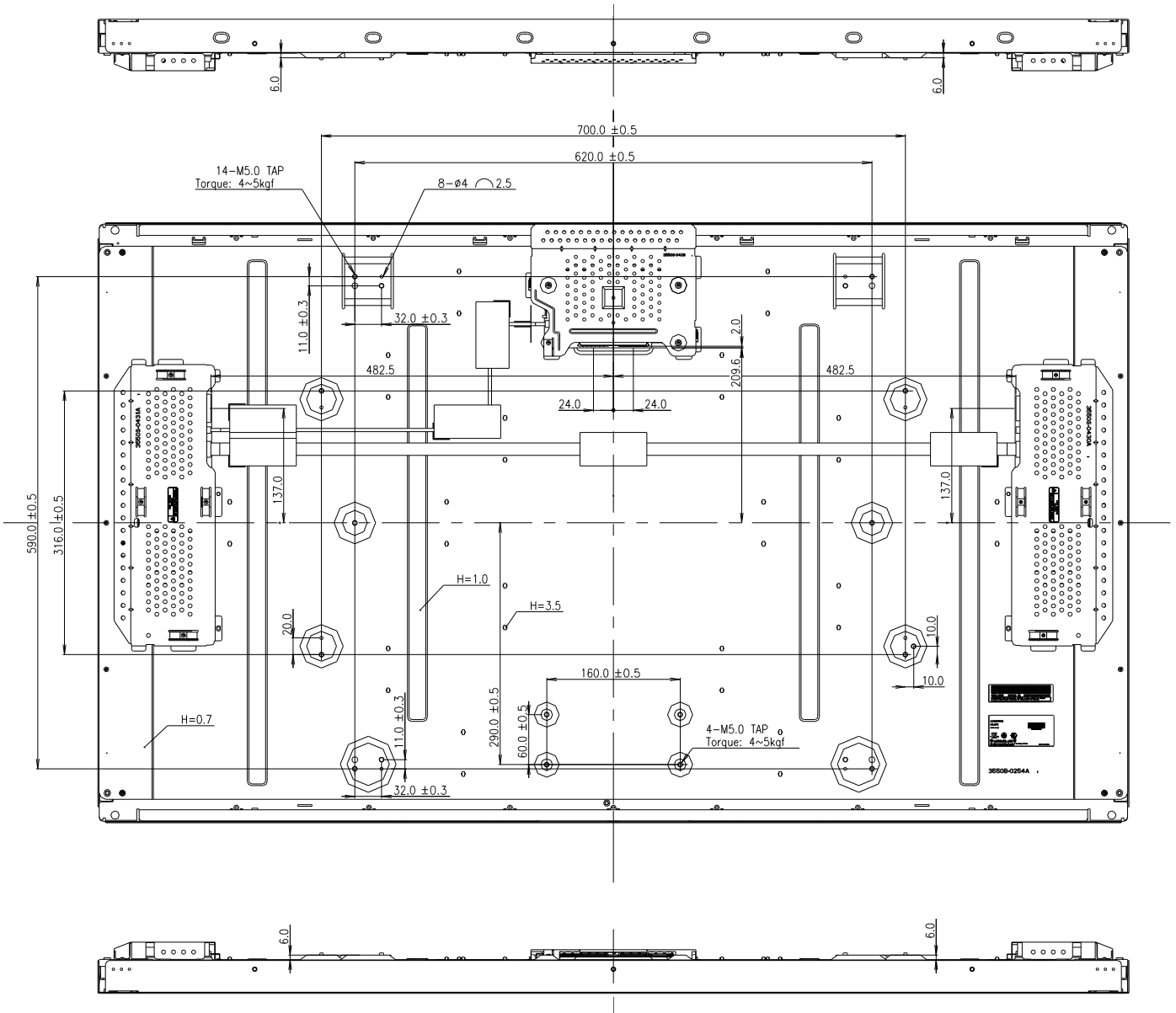
Product Specification

<FRONT VIEW>



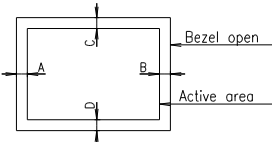
Product Specification

<REAR VIEW>



NOTES

1. Unspecified tolerances are to be  $\pm 1.0\text{mm}$ .
2. The length of mounting screw is MAX 5.5mm.
3. Tilt and partial disposition tolerance of display area are as following.
  - (1) X-Direction :  $IA-BI \leq 1.5\text{mm}$
  - (2) Y-Direction :  $IC-DI \leq 1.5\text{mm}$



4. Torque : 3.5 ~ 4.5Kgf.cm
5. This part should be contains Eco-hazardous substances (Pb, Cd, Hg, Cr6+, PBB, PBDE, etc.) within standard level of LG.Philips LCD, Details should be followed Green Procurement standard[B-8022]. Especially, Part should be followed and controlled the following specifications.
  - (1) Eco-hazardous substances test report should be submitted when Part certification test and First Mass Production.
  - (2) Don't flow Eco-hazardous substances into resin by using scrap.
  - (3) Don't flow Eco-hazardous substances into metal by using impurities or improper stuff.

## Product Specification

## 6. Reliability

**Table 12. ENVIRONMENT TEST CONDITION**

No.	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 40°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Vibration test (non-operating)	Wave form : random Vibration level : 1.0G RMS Bandwidth : 10-300Hz Duration : X,Y,Z, 30 min One time each direction
6	Shock test (non-operating)	Shock level : 35G Waveform : half sine wave, 11ms Direction : ±X, ±Y, ±Z One time each direction
7	Humidity condition Operation	Ta= 40 °C, 90%RH
8	Altitude operating storage / shipment	0 - 15,000 ft 0 - 40,000 ft

Note : Before and after Reliability test, LCM should be operated with normal function.



## 7. International Standards

### 7-1. Safety

- a) UL 60065, 7<sup>th</sup> Edition, dated June 30, 2003, Underwriters Laboratories, Inc., Standard for Audio, Video and Similar Electronic Apparatus.
- b) CAN/CSA C22.2, No. 60065:03, Canadian Standards Association, Standard for Audio, Video and Similar Electronic Apparatus.
- c) IEC60065:2001, 7<sup>th</sup> Edition CB-scheme and EN 60065:2002, Safety requirements for Audio, Video and Similar Electronic Apparatus..

### 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) CISPR13 "Limits and Methods of Measurement of Radio interference characteristics of Sound and Television broadcast receivers and associated equipment"  
CISPR22 "Limits and Methods of Measurement of Radio interference characteristics of Information Technology Equipment" International Special Committee on Radio Interference.
- c) EN55013 "Limits and Methods of Measurement of Radio interference characteristics of Sound and Television broadcast receivers and associated equipment"  
EN55022 "Limits and Methods of Measurement of Radio interference characteristics of Information Technology Equipment" European Committee for Electro Technical Standardization.(CENELEC), 1988(Including A1:2000)

## Product Specification

**8. Packing****8-1. Designation of Lot Mark**

a) Lot Mark

A	B	C	D	E	F	G	H	I	J	K	L	M
---	---	---	---	---	---	---	---	---	---	---	---	---

A,B,C : SIZE(INCH)

D : YEAR

F : PANEL CODE

H : ASSEMBLY CODE

E : MONTH

G : FACTORY CODE

I,J,K,L,M : SERIAL NO.

Note

## 1. YEAR

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Mark	1	2	3	4	5	6	7	8	9	0

## 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

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 Pallet : 10 pcs

b) Pallet Size : 1350mmx1150x950mm

## 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 benzine. 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.
- (7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
- (8) A screw which is fastened up the steels should be a machine screw.  
 (if not, it causes metallic foreign material and deal LCM a fatal blow)
- (9) Please do not set LCD on its edge.
- (10) It is recommended to avoid the signal cable and conductive material over the inverter transformer for it can cause the abnormal display and temperature rising.

### 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) The protection film is attached to the bezel with a small masking tape.  
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) 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 bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.