

SPECIFICATION FOR APPROVAL

- (●) Preliminary Specification
 () Final Specification

Title	47.0" WUXGA TFT LCD
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BUYER	General
MODEL	-

SUPPLIER	LG.Philips LCD Co., Ltd.
*MODEL	LC470WU2
SUFFIX	SLA1 (RoHS Verified)

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

APPROVED BY	SIGNATURE DATE
/	_____
/	_____
/	_____

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

APPROVED BY	SIGNATURE DATE
J.H. Yoon / Senior Manager	_____
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PREPARED BY	
S.S. Lee / Engineer	_____

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

Product Specification

Contents

Number	ITEM	Page
	COVER	1
	CONTENTS	2
	RECORD OF REVISIONS	3
1	GENERAL DESCRIPTION	4
2	ABSOLUTE MAXIMUM RATINGS	5
3	ELECTRICAL SPECIFICATIONS	6
3-1	ELECTRICAL CHARACTERISTICS	6
3-2	INTERFACE CONNECTIONS	8
3-3	SIGNAL TIMING SPECIFICATIONS	11
3-4	SIGNAL TIMING WAVEFORMS	13
3-5	COLOR DATA REFERENCE	14
3-6	POWER SEQUENCE	15
4	OPTICAL SPECIFICATIONS	17
5	MECHANICAL CHARACTERISTICS	21
6	RELIABILITY	24
7	INTERNATIONAL STANDARDS	25
7-1	SAFETY	25
7-2	EMC	25
8	PACKING	26
8-1	DESIGNATION OF LOT MARK	26
8-2	PACKING FORM	26
9	PRECAUTIONS	27
9-1	MOUNTING PRECAUTIONS	27
9-2	OPERATING PRECAUTIONS	27
9-3	ELECTROSTATIC DISCHARGE CONTROL	28
9-4	PRECAUTIONS FOR STRONG LIGHT EXPOSURE	28
9-5	STORAGE	28
9-6	HANDLING PRECAUTIONS FOR PROTECTION FILM	28

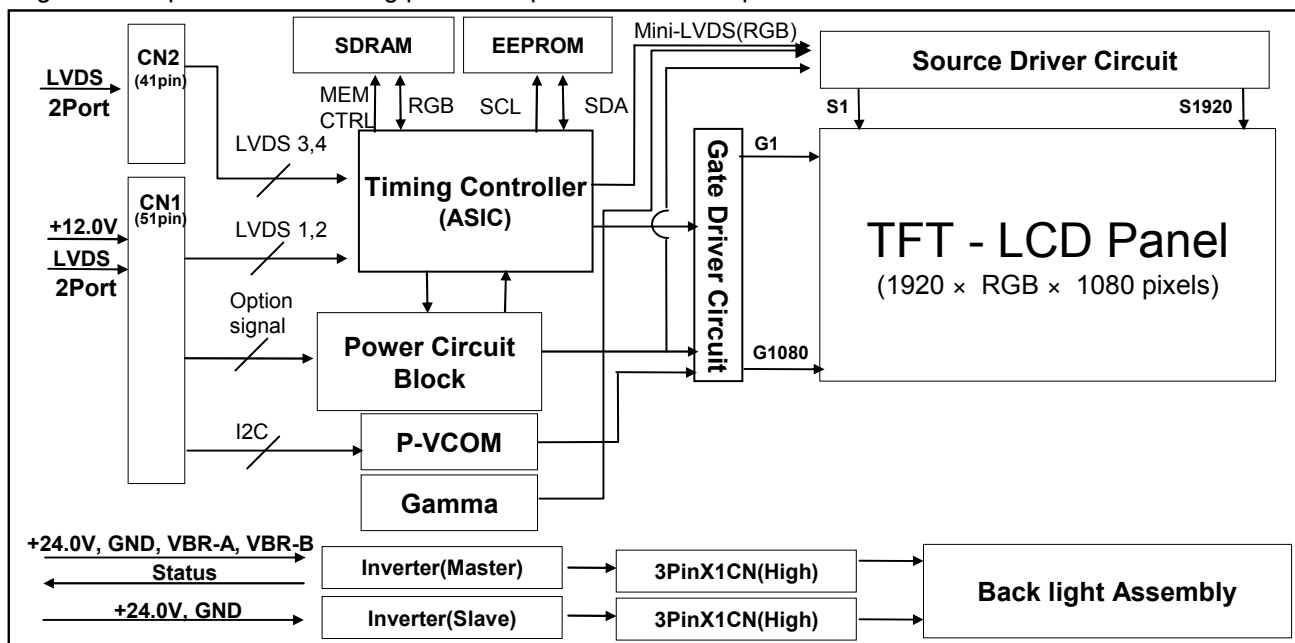
Product Specification

1. General Description

LC470WU2 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 47 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 8bit or 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	46.96 inches(1192.78mm) diagonal
Outline Dimension	1096.0 mm(H) x 640.0 mm(V) x 55.0 mm(D) (Typ.)
Pixel Pitch	541.5 μ m x 541.5 μ m x RGB
Pixel Format	1920 horiz. by 1080 vert. pixels RGB stripe arrangement
Color Depth	10-bit, 1.07Billion colors
Luminance, White	500 cd/m ² (Center 1 point Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178(Typ.), U/D 178(Typ.))
Power Consumption	Total 250.2 Watt (Typ.) (Logic= 10.2W, Inverter=240W[VBR-A = 1.65V])
Weight	16.5 Kg (Typ.)
Display Operating Mode	Transmissive mode, normally black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer

Product Specification

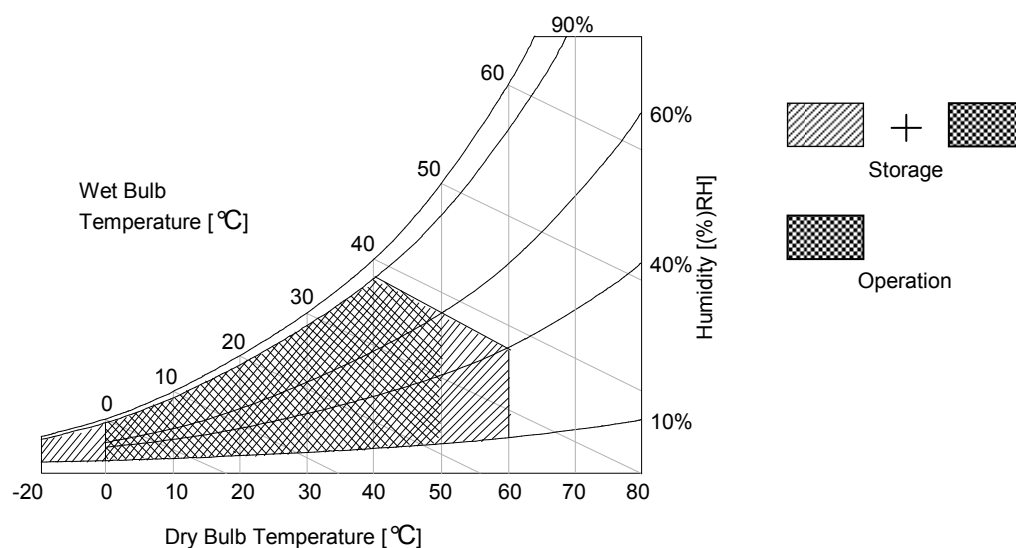
2. Absolute Maximum Ratings

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

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Value		Unit	Remark
			Min	Max		
Power Input Voltage	LCM	V_{LCD}	+8.0	14.0	V_{DC}	at $25 \pm 2 \text{ }^\circ\text{C}$
	Backlight inverter	V_{BL}	21.6	27.0	V_{DC}	When operating
Option input voltage(select)		V_I	-0.3	3.6	V_{DC}	#7 Pin
ON/OFF Control Voltage		$V_{ON/OFF}$	-0.3	+5.5	V_{DC}	
Brightness Control Voltage		V_{BR-A}/V_{BR-B}	0.0	+5.0	V_{DC}	
Operating Temperature		T_{OP}	0	+50	$^\circ\text{C}$	Note 1,2
Storage Temperature		T_{ST}	-20	+60	$^\circ\text{C}$	
Operating Ambient Humidity		H_{OP}	10	90	%RH	
Storage Humidity		H_{ST}	10	90	%RH	

- Notes : 1. Temperature and relative humidity range are shown in the figure below.
 Wet bulb temperature should be $39 \text{ }^\circ\text{C}$ Max. and no condensation of water.
 2. Gravity mura can be guaranteed under $40 \text{ }^\circ\text{C}$ 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.

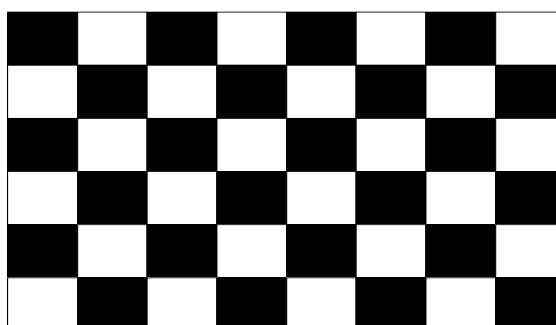
Table 2-1. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
MODULE :						
Power Input Voltage	V _{LCD}	11.4	12.0	12.6	V _{DC}	
Power Input Current	I _{LCD}	-	850	1105	mA	1
		-	1205	1567	mA	2
Power Consumption	P _{LCD}	-	10.2	13.26	Watt	1
Rush current	I _{RUSH}	-	-	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 2~3ms and rising time of power Input is 1ms(min.).

White : 255Gray(1023Gray)
Black : 0Gray



Mosaic Pattern(8 x 6)

Product Specification

Table 2-2. ELECTRICAL CHARACTERISTICS

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	11	A	$V_{BR-A} = 1.65V \dots 1$	
			-	11	12	A	$V_{BR-A} = 3.3V \dots 1$	
	Before Aging	IBL_B	-	11	12	A	$V_{BR-A} = 1.65V \dots 2$	
			-	12	13	A	$V_{BR-A} = 3.3V \dots 2$	
Power Supply Input Current (In-Rush)	Irush	-	-	14	A	$V_{BL} = 22.8V$ $V_{BR-B} = 3.3V$ $V_{BR-A} = 1.65V$		
Power Consumption	PBL	-	240	264	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:								
Discharge Stabilization Time	Ts			3	min	4		
Life Time		30,000			Hrs	5		

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.
- Brightness Control.
This V_{BR-B} Voltage control brightness.

V_{BR-B} Voltage	Function	V_{BR-B} Voltage	Function
0V	Minimum Duty (20%)	3.3V	Maximum Duty (100%)

- The brightness of the lamp after lighted for 5minutes is defined as 100%.
 T_S 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.

Product Specification

3-2. Interface Connections

This LCD module employs two kinds of interface connection, 51pin(CN1) and 41pin(CN2) connectors are used for the module electronics and 14-pin connector and 12 pin connector are used for the integral backlight system.

3-2-1. LCD Module

- LCD Connector(CN1): FI-RE51S-HF, Refer to below 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(Reserved)
2	NC	Reserved	28	RA2N	SECOND CHANNEL A-
3	NC	Reserved	29	RA2P	SECOND CHANNEL A+
4	NC	Reserved	30	RB2N	SECOND CHANNEL B-
5	NC	Reserved	31	RB2P	SECOND CHANNEL B+
6	NC	Reserved	32	RC2N	SECOND CHANNEL C-
7	LVDS Select	'H' = JEIDA , 'L' = VESA	33	RC2P	SECOND CHANNEL C+
8	NC	Reserved	34	GND	Ground
9	NC	Reserved	35	RCLK2N	SECOND CLOCK CHANNEL Clk-
10	NC	Reserved	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 _{LCD}	Power Supply +12.0V
23	RD1P	FIRST CHANNEL D+	49	V _{LCD}	Power Supply +12.0V
24	RE1N	FIRST CHANNEL E-	50	V _{LCD}	Power Supply +12.0V
25	RE1P	FIRST CHANNEL E+	51	V _{LCD}	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_{LCD} (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 pins(pin No. #8~#9) are used for Inverter test of the LCD module.
If not used, these pins are no connection.
 6. 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).

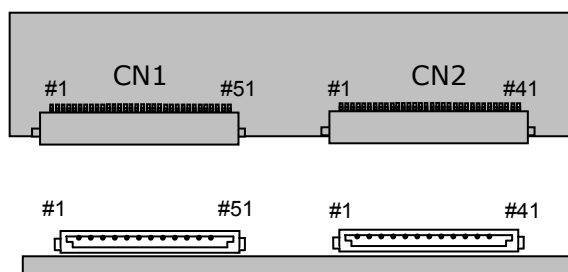
Product Specification

- LCD Connector(CN2): FI-RE41S-HF, 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)
 - Mating connector : FI-RE51HL
 (Manufactured by JAE)
- [CN2]
 - Part/No. : FI-RE41S-HF(JAE)
 - Mating connector : FI-RE41HL
 (Manufactured by JAE)

Product Specification

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 5. 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.

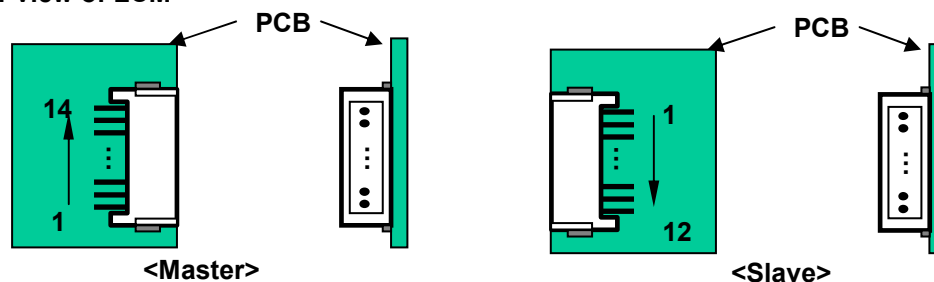
It could be usable for boost up luminance when using DCR (=Dynamic contrast ratio) function only.

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 127[k Ω], 84.7[k Ω], 208.8[k Ω]

◆ Rear view of LCM



Product Specification

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	Note
Horizontal	Display Period	t_{HV}	480	480	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	1080	1080	Lines	
	Blank	t_{VB}	10	45	86	Lines	1
	Total	t_{VP}	1090	1125	1166	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Note
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

- Note : 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.

Product Specification

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)

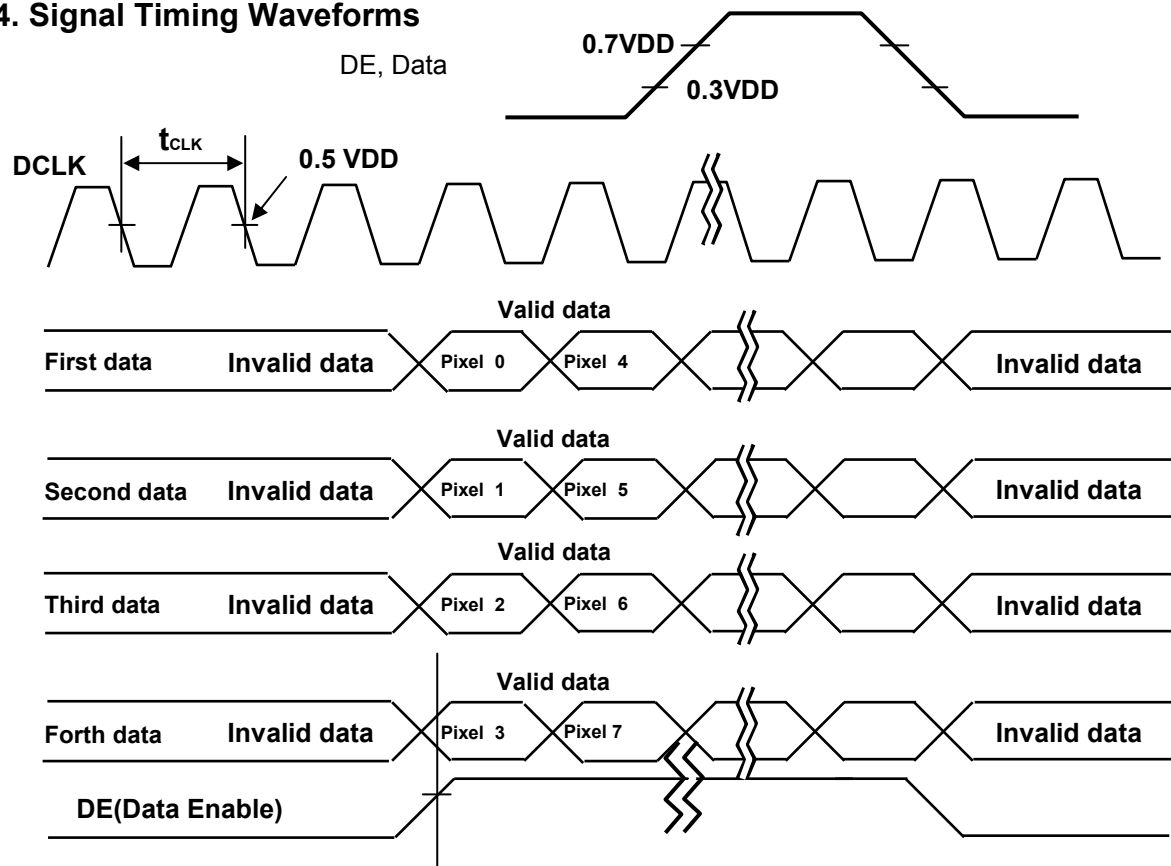
ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	t_{HV}	480	480	480	t_{CLK}	1920/4
	Blank	t_{HB}	40	70	200	t_{CLK}	1
	Total	t_{HP}	520	550	680	t_{CLK}	
Vertical	Display Period	t_{VV}	1080	1080	1080	Lines	
	Blank	t_{VB}	228	270	300	Lines	1
	Total	t_{VP}	1308	1350	1380	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Note
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

- Note : 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.

Product Specification

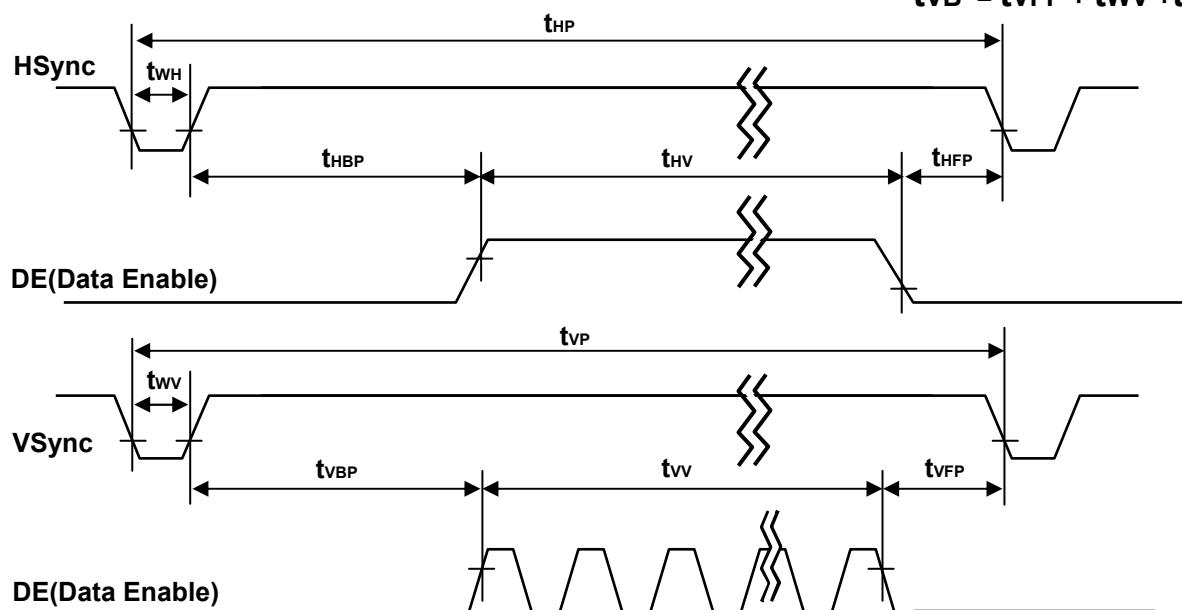
3-4. Signal Timing Waveforms



* Reference : Sync. Relation

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

* $t_{VB} = t_{VFP} + t_{WV} + t_{VBP}$



Product Specification

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 8 provides a reference for color versus data input.

Table 8. 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	
	RED (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	
		
	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	
	RED (1023)	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	
	GREEN (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	
		
	GREEN (1022)	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	
	GREEN (1023)	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	
	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	
		
	BLUE (1022)	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	1	1	1	1	1	1	1	1	1	1	

Product Specification

3-6. Power Sequence

3-6-1. Sequence for LCM

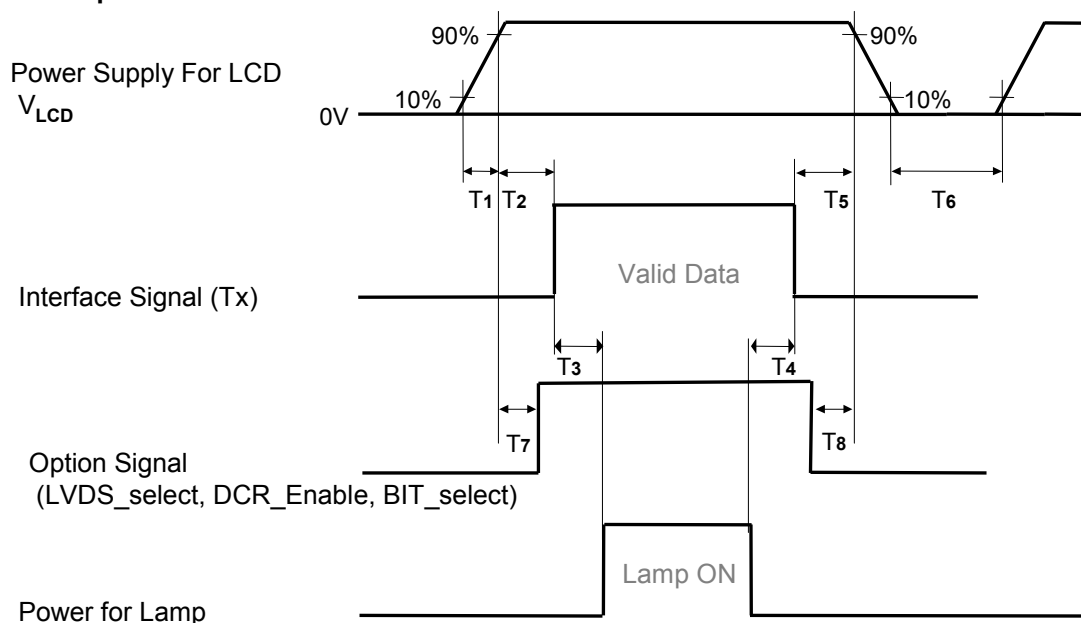


Table 9. POWER SEQUENCE

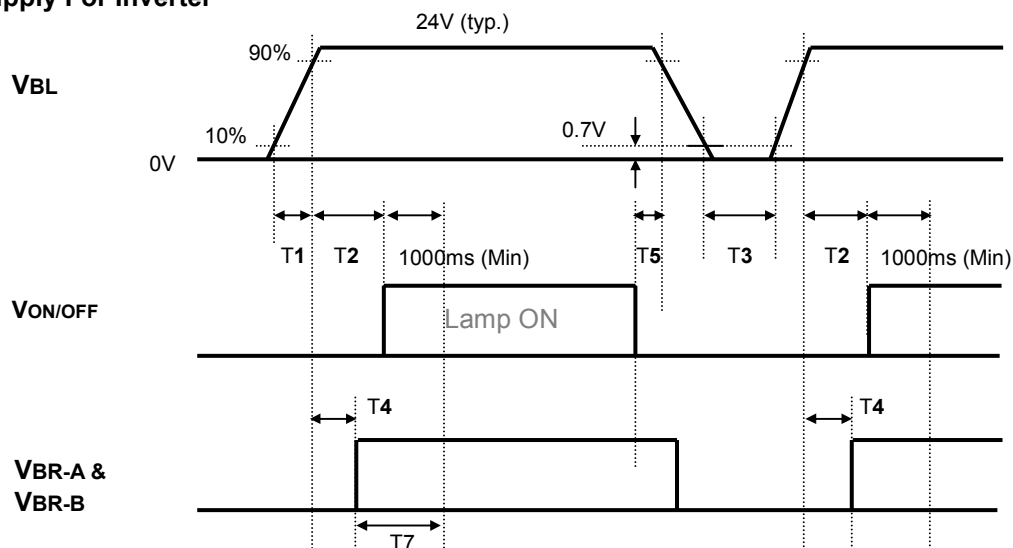
Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	0.5	-	20	ms	
T2	0.5	-	$3 \times (1/f_V)$	ms	3,5
T3	200	-	-	ms	4
T4	200	-	-	ms	4
T5	0	-	-	ms	3,5
T6	2.0	-	-	s	2,6
T7	0	-	T2	ms	5
T8	0	-	-	ms	5

- 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 maximum specification, it operates protection pattern(Black pattern) till valid signal inputted. There is no reliability problem.
 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 option signal(DISM or DCR_Enable) 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

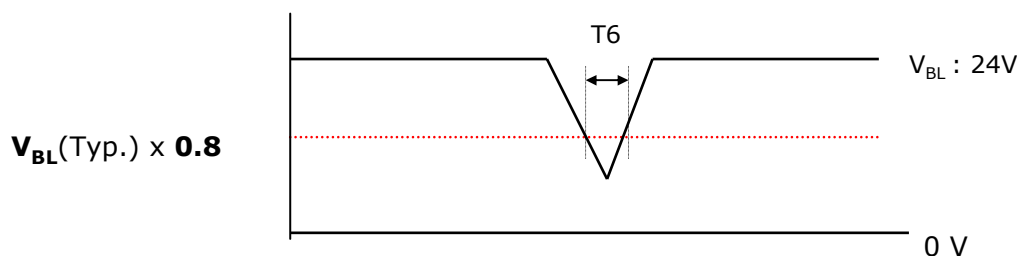


Table 10. Power Sequence for Inverter

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 Specification

Optical characteristics are determined after the unit has been 'ON' and Stable 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 Φ and θ equal to 0° .

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

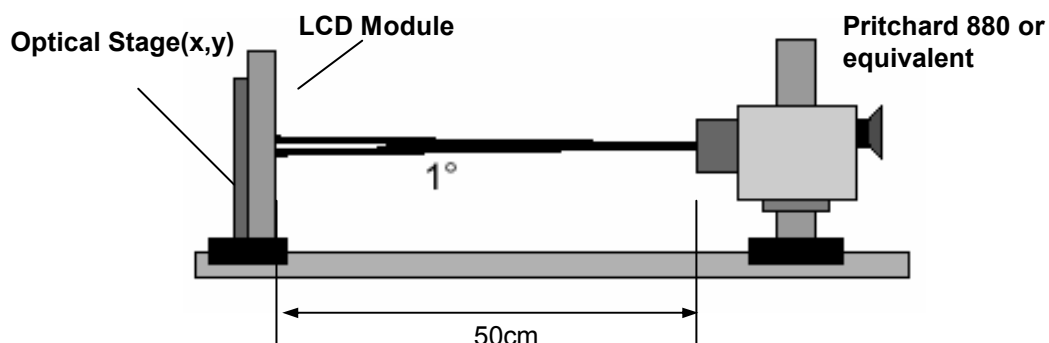


FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 11. OPTICAL CHARACTERISTICS

$T_a = 25 \pm 2^\circ\text{C}$, $V_{\text{LCD}} = 12.0\text{V}$, $f_v = 120\text{Hz}$, $D_{\text{clk}} = 297\text{MHz}$, $V_{\text{BR-A}} = 1.65\text{V}$, $V_{\text{BR-B}} = 3.3\text{V}$

Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
Contrast Ratio	CR	700	1000			1
Surface Luminance, white	L_{WH}	400	500		cd/m^2	2
Luminance Variation	δ_{WHITE} 5P			1.3		3
Response Time	MPRT	-	8	10	ms	4
Color Coordinates [CIE1931]	RED	R_x	0.663			
		R_y	0.324			
	GREEN	G_x	0.199			
		G_y	0.659			
	BLUE	B_x	0.141			
		B_y	0.082			
	WHITE	W_x	0.279			
		W_y	0.292			
Viewing Angle (CR>10)						
	x axis, right ($\phi=0^\circ$)	θ_r	89	-	-	degree
	x axis, left ($\phi=180^\circ$)	θ_l	89	-	-	
	y axis, up ($\phi=90^\circ$)	θ_u	89	-	-	
	y axis, down ($\phi=270^\circ$)	θ_d	89	-	-	
Gray Scale						6

Product Specification

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

CR (Contrast Ratio) = Maximum CR_n (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± 2°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 , δ WHITE is defined as :

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

Where L_{on1} to L_{on5} are the luminance with all pixels displaying white at 5 locations .
For more information, see FIG 2.

4. MPRT is defined as the 10% to 90% blur-edge width Bij(pixels) and scroll speed U(pixels/frame)at the moving picture. For more 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

Gamma Value is approximately 2.2.

For more information, see Table 12.

Table 12. GRAY SCALE SPECIFICATION

Gray Level	Luminance [%] (Typ) [Normal]
10bit	
L0	0.10
L63	0.29
L127	1.06
L191	2.50
L255	4.69
L319	7.66
L383	11.5
L447	16.1
L511	21.6
L575	28.1
L639	35.4
L703	43.7
L767	53.0
L831	63.2
L895	74.5
L959	86.7
L1023	100

Product Specification

Measuring point for surface luminance & measuring point for luminance variation

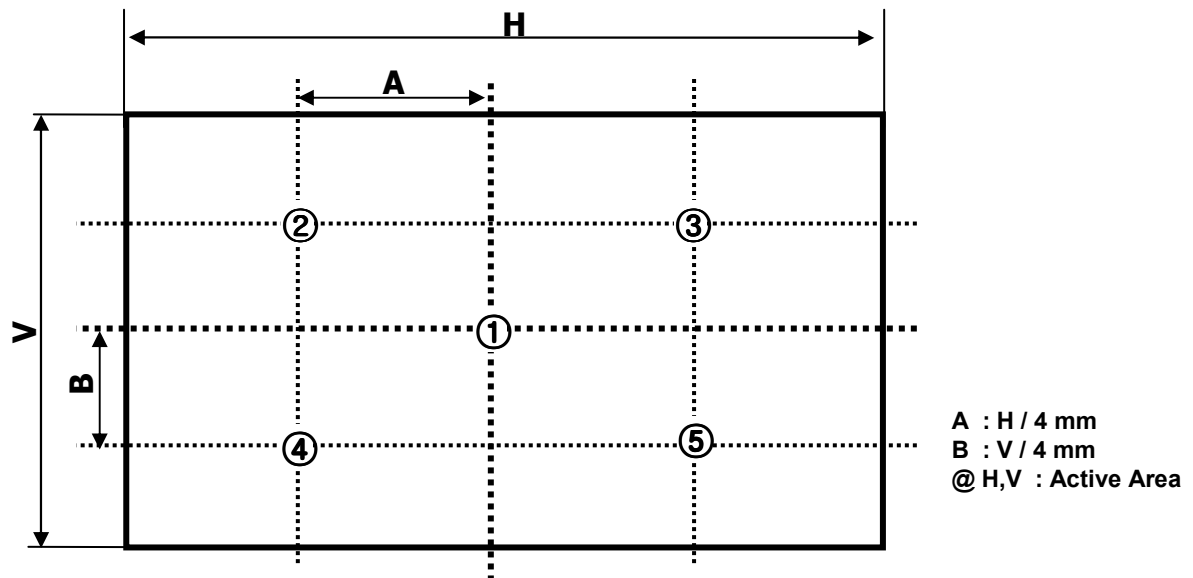
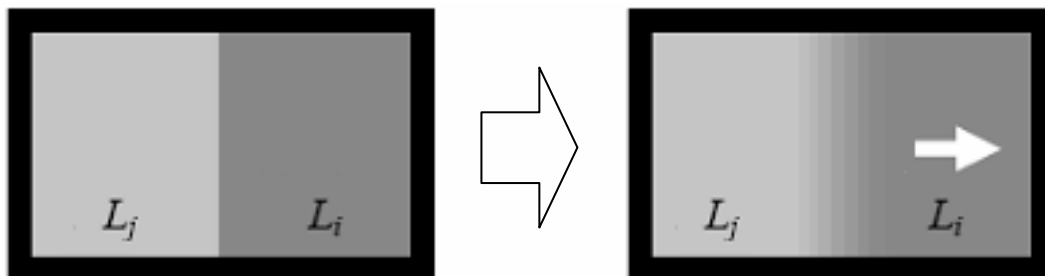


FIG. 2 Measure Point for Luminance

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) $B_{ij} = 12\text{pixels}$, $U = 10\text{pixels} / 120\text{Hz}$

$$\begin{aligned} M &= 12\text{pixels} / (10\text{pixels} / 120\text{Hz}) \\ &= 12\text{pixels} / \{10\text{pixels} / (1/120)\text{s}\} \\ &= 12 / 1,200 \text{ s} \\ &= 10 \text{ ms} \end{aligned}$$

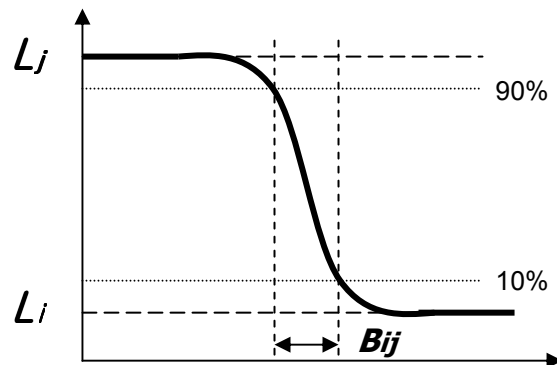


FIG. 3 MPRT

Product Specification

Dimension of viewing angle range

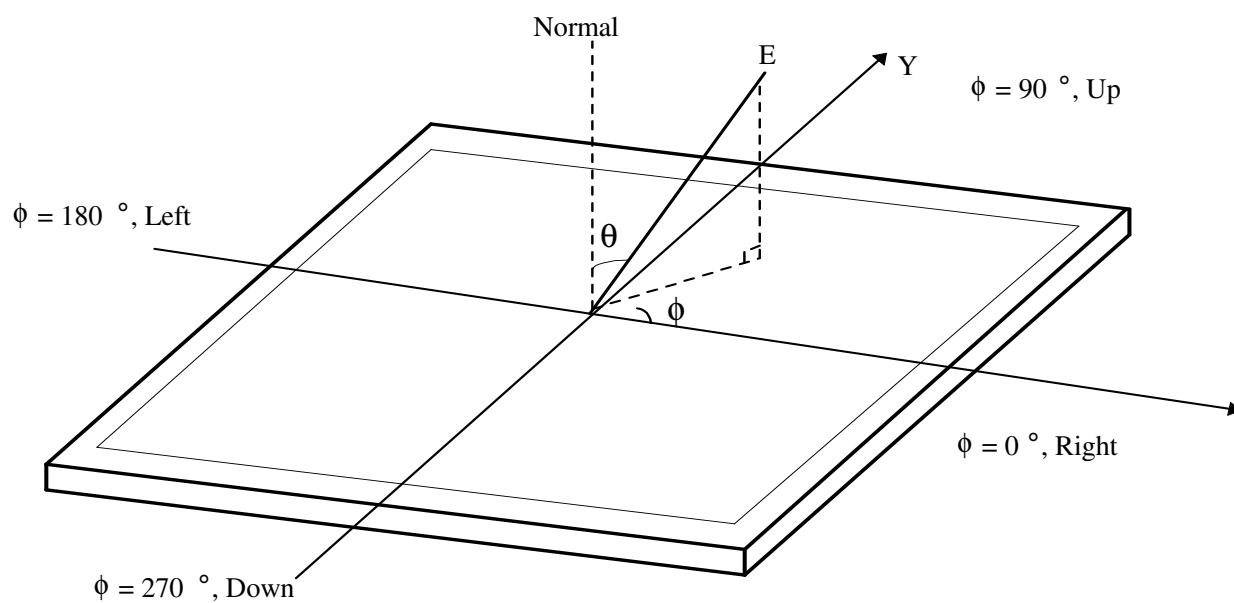


FIG. 4 Viewing angle

Product Specification

5. Mechanical Characteristics

The following items provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD module.

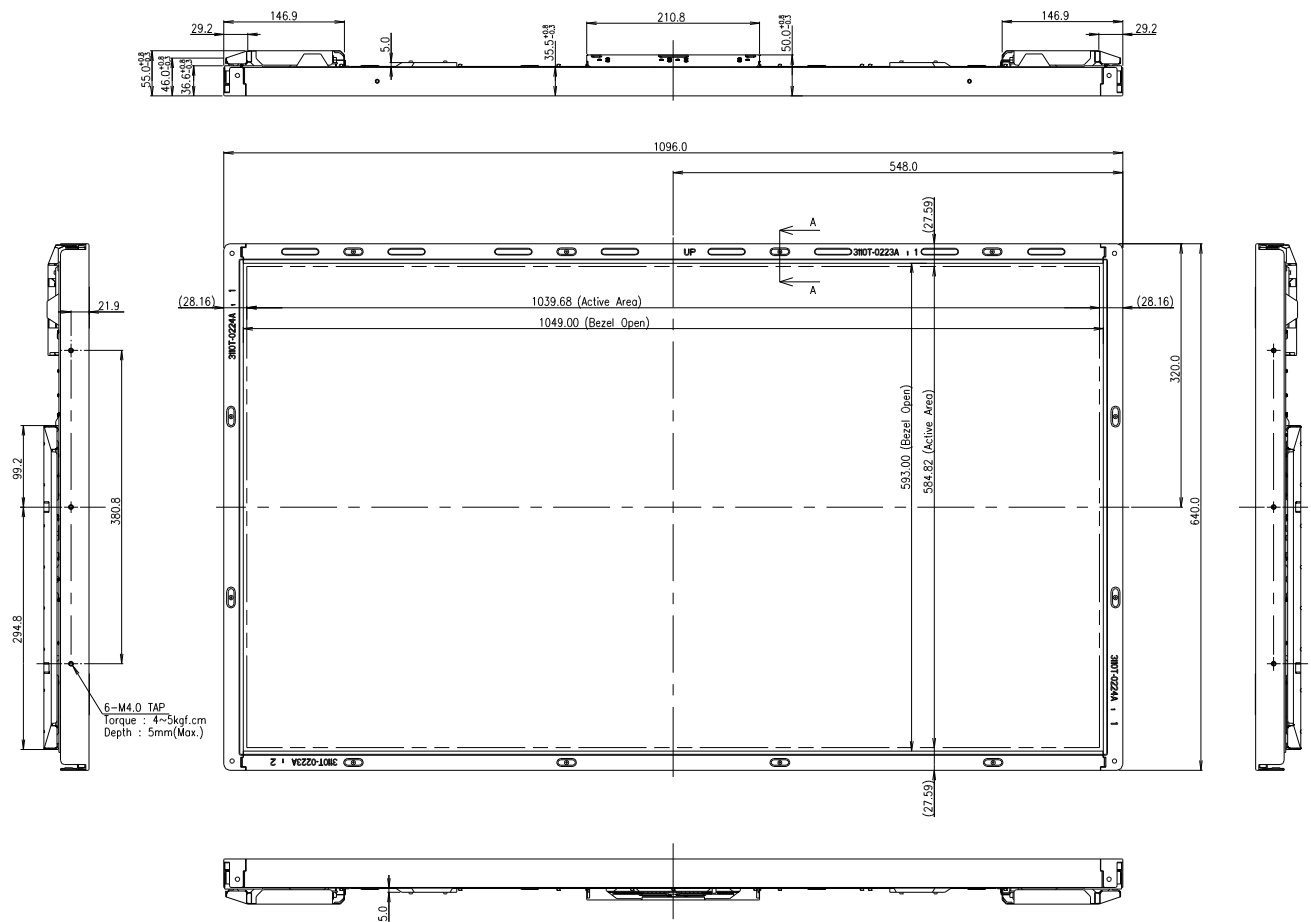
Table 13. MECHANICAL CHARACTERISTICS

Outline Dimension	Horizontal	1096.0 mm
	Vertical	640.0 mm
	Depth	55.0 mm
Bezel Area	Horizontal	1049.0mm
	Vertical	593.0mm
Active Display Area	Horizontal	1039.68mm
	Vertical	584.82mm
Weight	16.5Kg (Typ.) , 17.5Kg(max)	
Surface Treatment	Hard coating(3H) Anti-glare treatment of the front polarizer	

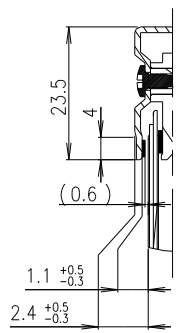
Note : Please refer to a mechanic drawing in terms of tolerance at the next page.

Product Specification

<FRONT VIEW>



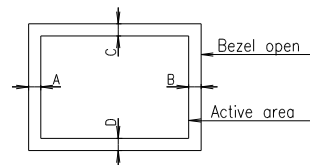
6-M4.0 TAP
Torque : 4~5kgf.cm
Depth : 5mm(Max.)



SECTION A-A

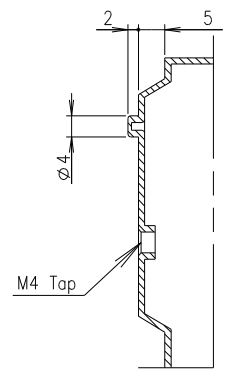
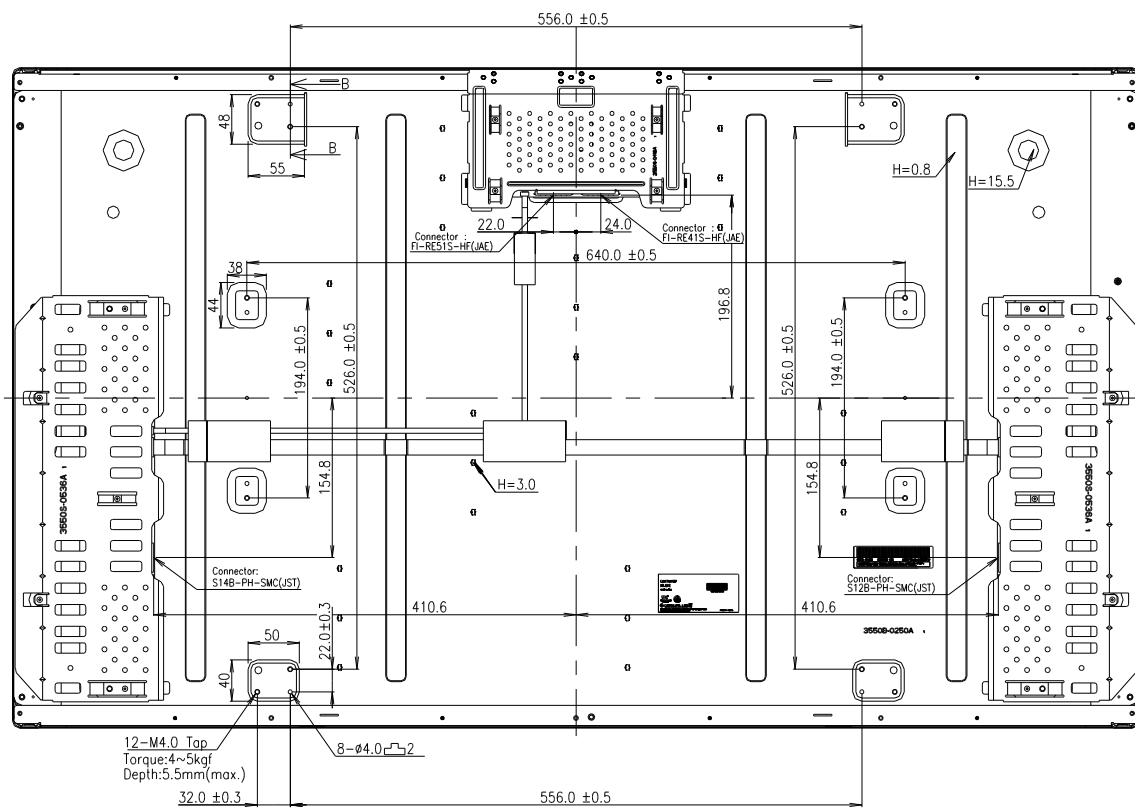
NOTES

1. Unspecified tolerances are to be $\pm 1.0\text{mm}$.
2. 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 $\leq 1.5\text{mm}$



Product Specification

<REAR VIEW>



SECTION B-B
SCALE 1/1

Product Specification

6. Reliability**Table 14. 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= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Vibration test (non-operating)	Wave form : random Vibration level : 1.0Grms Bandwidth : 10-300Hz Duration : X,Y,Z, 30 min One time each direction
6	Shock test (non-operating)	Shock level :50G(X,Y axis) , 35G(Z axis) Waveform : half sine wave, 11ms Direction : ±X, ±Y, ±Z One time each direction
7	Humidity condition Operation	Ta= 40 °C, 90%RH, 240h
8	Altitude operating storage / shipment	0 - 14,000 feet(4267.2m) 0 - 40,000 feet(12192m)

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

7. International Standards

7-1. Safety

- a) UL 60065, 7th 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, 7th 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)

E : MONTH

D : YEAR

F ~ 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	3	4	5	6	7	8	9	A	B	C

b) Location of Lot Mark

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

8-2. Packing Form

a) Package quantity in one pallet : 12 pcs

b) Pallet Size : 1220mm X 1140mm X 860mm

Product Specification

9. Precautions

Please pay attention to the followings when you use this TFT LCD module.

9-1. Mounting Precautions

- (1) You must mount a module using specified mounting holes (Details refer to the drawings).
- (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 a mounting 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.

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.

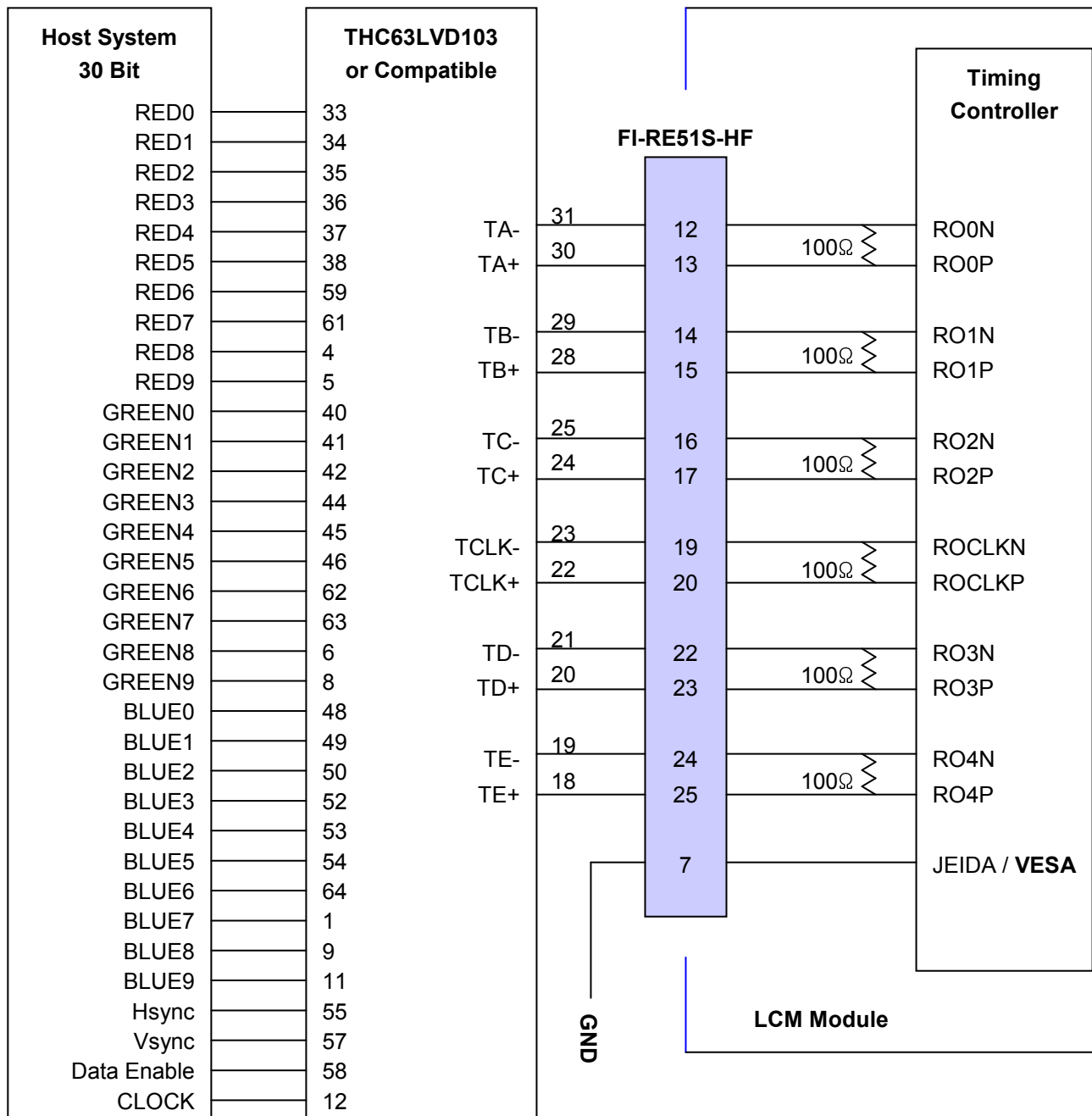
- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they 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.

APPENDIX-I-1

■ REQUIRED SIGNAL ASSIGNMENT FOR LVDS TRANSMITTER (Pin7="L or NC")



Note : 1. The LCD module uses a 100 Ohm[Ω] resistor between positive and negative lines of each receiver input.

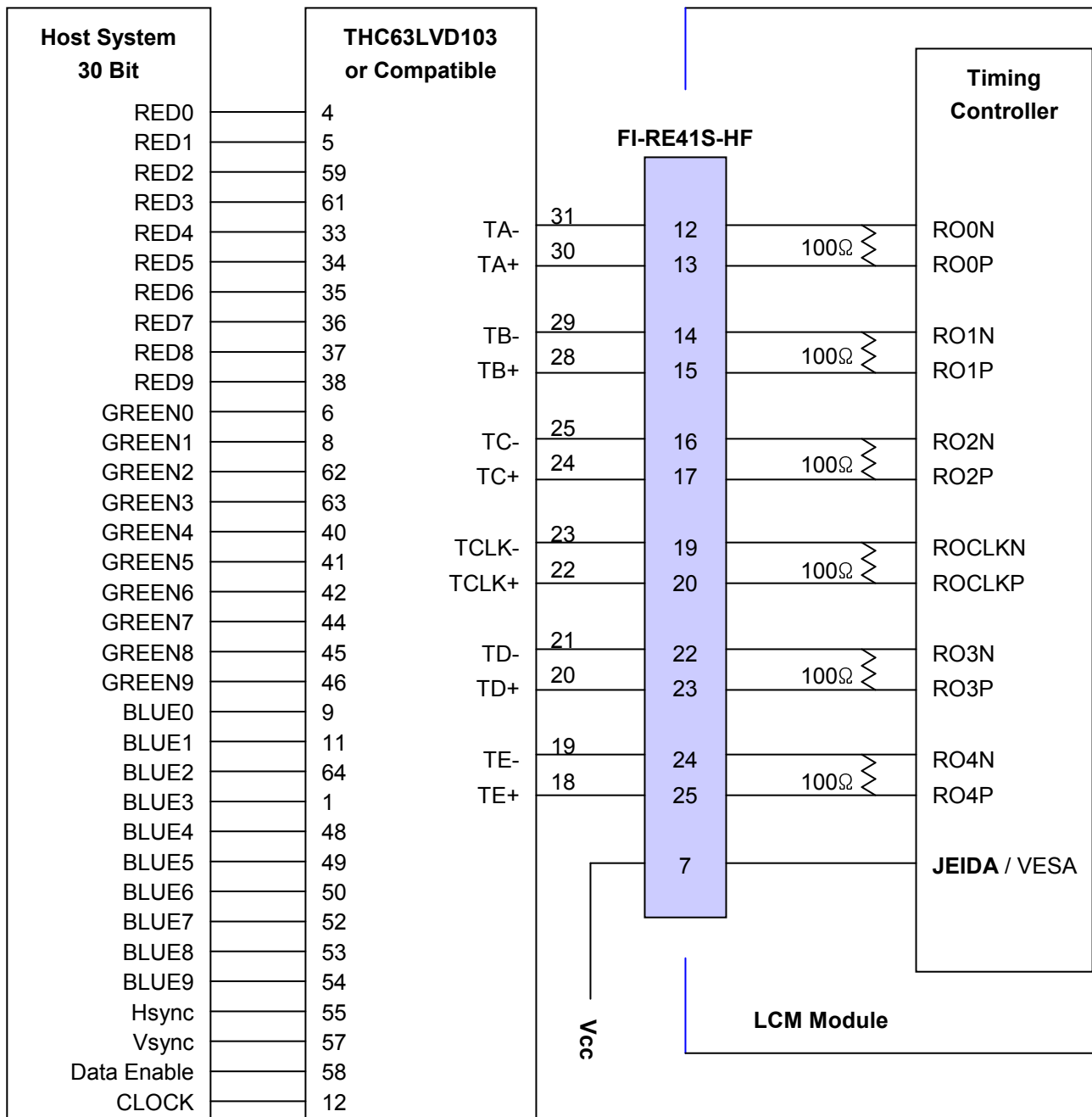
2. Refer to LVDS Transmitter Data Sheet for detail descriptions. (THC63LVD103 or Compatible)

3. '9' means MSB and '0' means LSB at R,G,B pixel data.

Product Specification

APPENDIX-I-2

■ REQUIRED SIGNAL ASSIGNMENT FOR LVDS TRANSMITTER (Pin7="H")

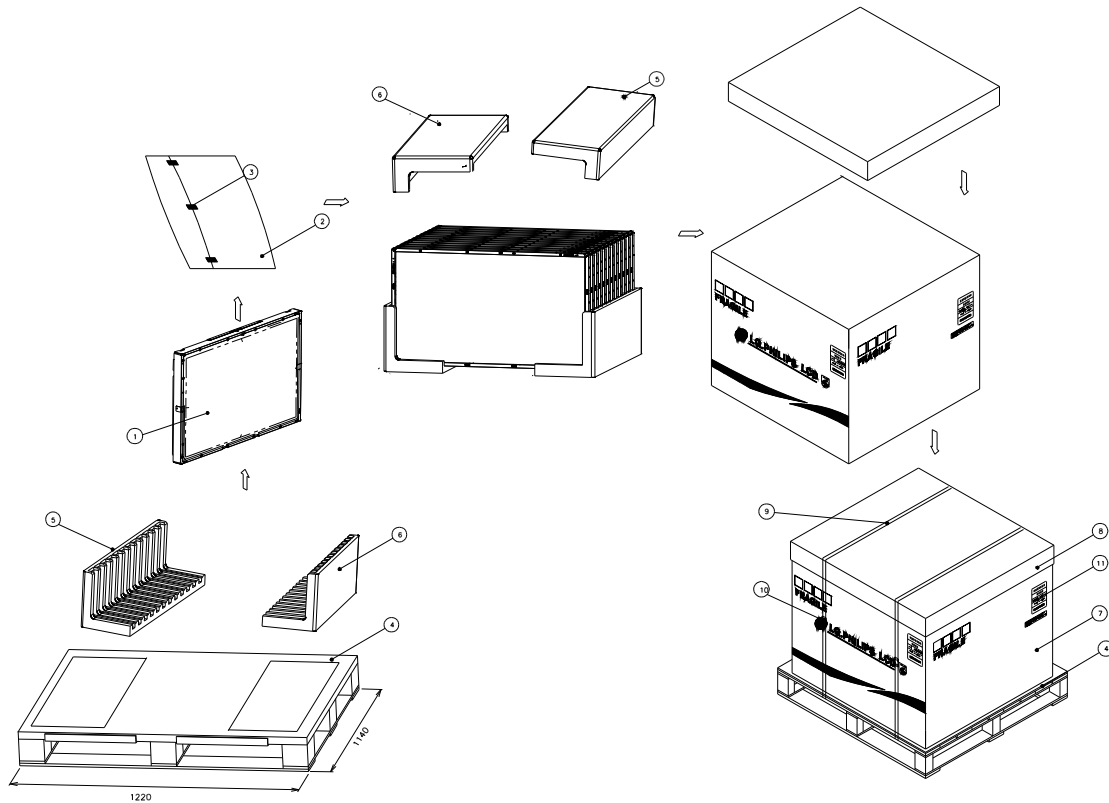


- Note :
1. The LCD module uses a 100 Ohm[Ω] resistor between positive and negative lines of each receiver input.
 2. Refer to LVDS Transmitter Data Sheet for detail descriptions. (THC63LVD103 or Compatible)
 3. '9' means MSB and '0' means LSB at R,G,B pixel data.

Product Specification

APPENDIX- II

■ Pallet Ass'y

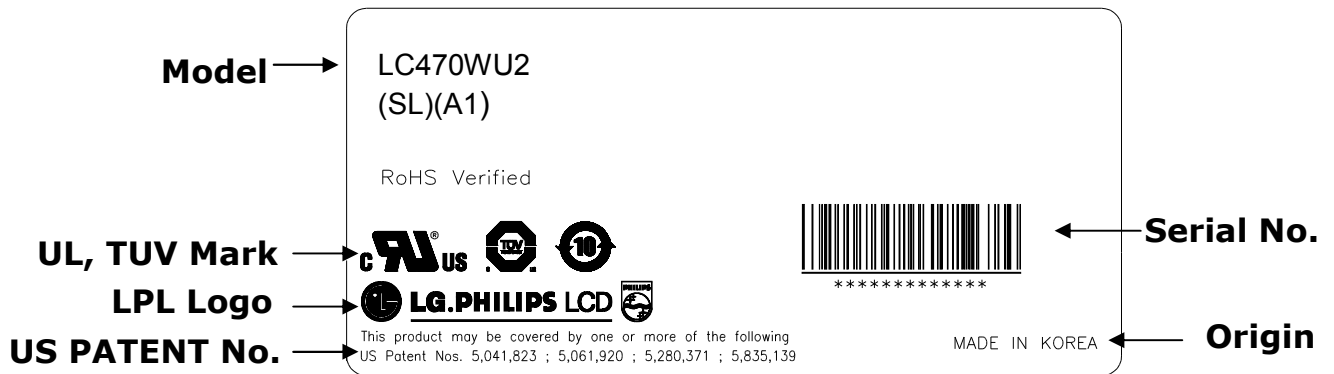


NO.	DESCRIPTION	MATERIAL
1	LCD Module	
2	BAG	47INCH
3	TAPE	MASKING 20MM X 50M
4	PALLET	PAPER 1220X1140X138MM
5	PACKING	EPS
6	PACKING	EPS
7	ANGLE PACKING	PAPER
8	ANGLE COVER	PAPER
9	BAND,CLIP	STEEL
10	BAND	PP
11	LABEL	YUPO PAPER 80G 100X100

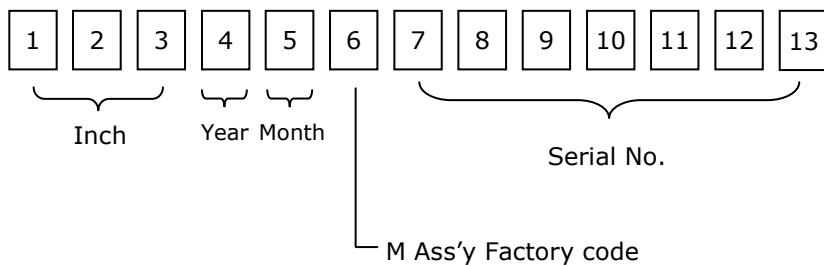
Product Specification

APPENDIX- III

■ LCM Label




■ Serial No. (See CAS 26page for more information)



APPENDIX- IV

■ Pallet Label

LC470WU2	
SLA1	
12 PCS	001/01-01
REMARK	
MADE IN KOREA	RoHS Verified
 ***** **	