LG.PHILIPS LCD

LC470WUD

Product Specification

SPECIFICATION
FOR
APPROVAL

(●)   **Preliminary Specification**

(   )   **Final Specification**

Title	47.0" WUXGA TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG.Philips LCD Co., Ltd.
*MODEL	LC470WUD
SUFFIX	SAC1

*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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S.S. LEE / Engineer	

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

Ver. 0.2

Product Specification

CONTENTS

Product Specification

RECORD OF REVISIONS

| Revision No.	Revision Date	Page	Description
0.1	Oct. 11, 2007	-	Preliminary Specification(First Draft)

Product Specification

1. General Description

LC470WUD 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 46.96 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(FRC) 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.
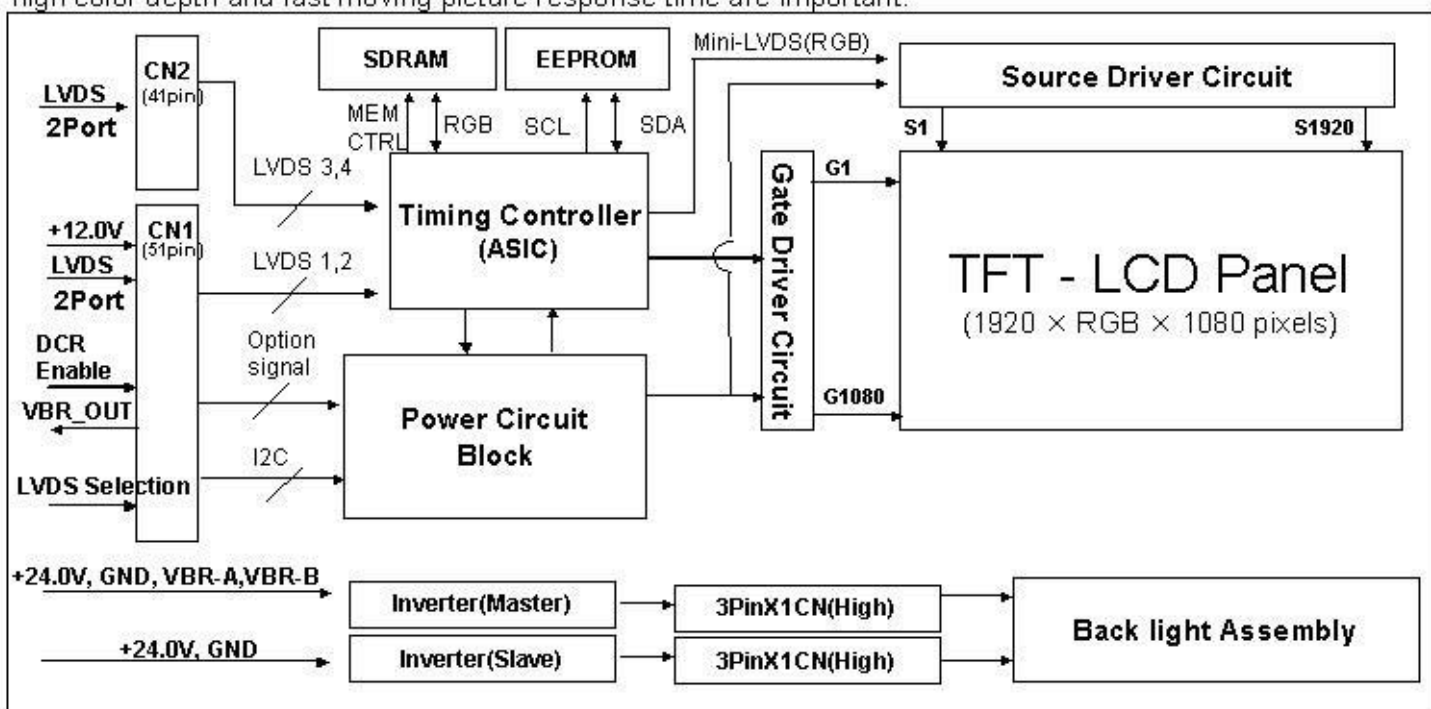
General Features

Active Screen Size	46.96 inch (1192.87mm) diagonal
Outline Dimension	1096.0(H) × 640.0 (V) × 51.0 mm(D) (Typ.)
Pixel Pitch	0.5415 mm × 0.5415 mm × RGB
Pixel Format	1920 horiz. by 1080 vert. Pixels, RGB stripe arrangement
Color Depth	10Bit(D) , 1.07 Billion colors
Luminance, White	500 cd/m^2 (Center 1point ,Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Min.), U/D 178 (Min.))
Power Consumption	Total 232.5 W (Typ.) [Logic=9.25W, Backlight=223W (V_{BR-A}=1.65V)]
Weight	14.5 Kg (Typ.)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer (Haze 13%)

Product Specification

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	LCM	VLCD	-0.3	+14.0	VDC	at 25 ± 2 ℃
	Backlight inverter	VBL	-0.3	+27.0	VDC	
ON/OFF Control Voltage		VON/OFF	-0.3	+5.5	VDC	
Brightness Control Voltage		VBR	0	+5.0	VDC	
Operating Temperature		TOP	0	+50	℃	
Storage Temperature		TST	-20	+60	℃	Note 1,2
Operating Ambient Humidity		HOP	10	90	%RH	
Storage Humidity		HST	10	90	%RH	

Note : 1. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39 ℃ Max. and no condensation of water.
2. Gravity mura can be guaranteed under 40℃ condition.
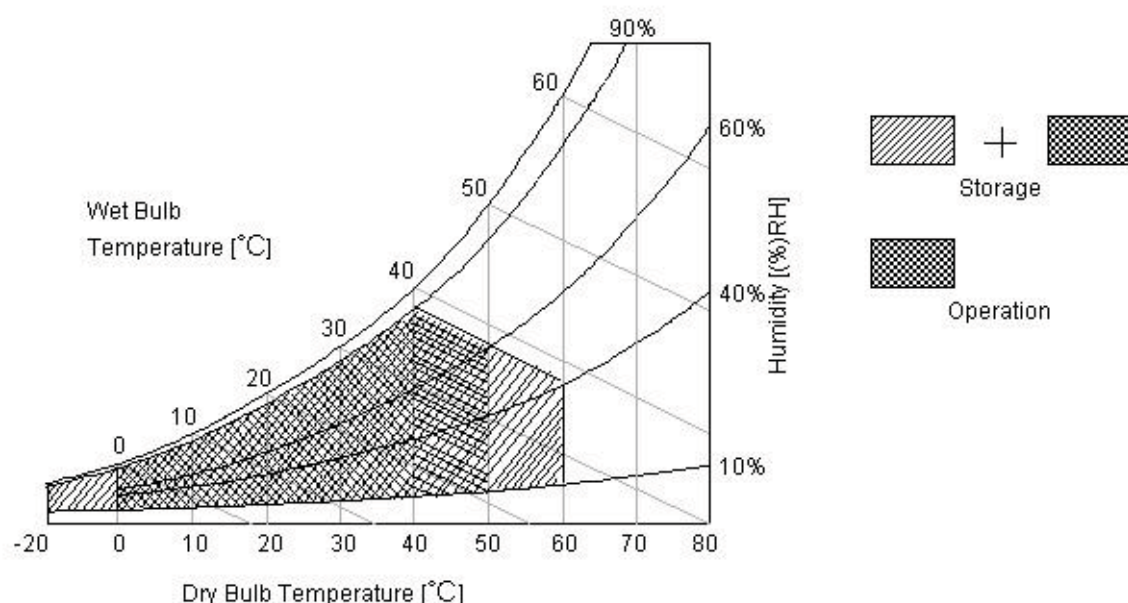
LC470WUD

Product Specification

3. Electrical Specifications

3-1. Electrical Characteristics

It requires two power inputs. One is employed to power for the LCD circuit.

The other Is used for the CCFL backlight circuit.

Table 2. ELECTRICAL CHARACTERISTICS (TBD)

Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
Circuit :						
Power Input Voltage	V_{LCD}	11.4	12.0	12.6	V_{DC}	
Power Input Current	I_{LCD}	539	771	1003	mA	1
		793	1134	1474	mA	2
Power Consumption	P_{LCD}	-	9.25	12.03	Watt	1
Rush current	I_{RUSH}	-	-	5	A	3

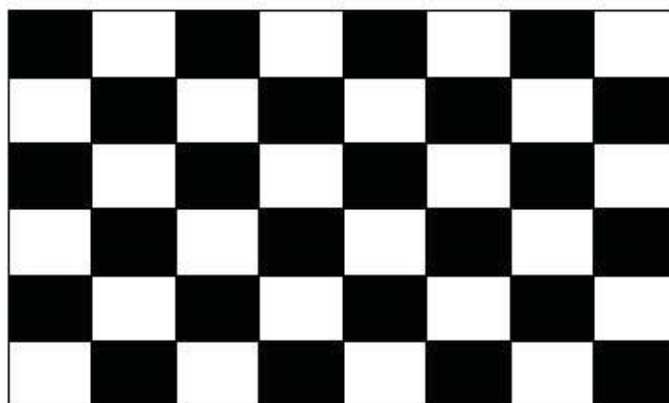Notes: 1. The specified current and power consumption are under the V_{LCD}=12.0V, 25 ± 2°C, f_V=120Hz condition whereas mosaic pattern(8 × 6) is displayed and f_V is the frame frequency.
2. The current is specified at maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power input is 1ms (min.).

White : 1023 Gray
Black : 0 Gray

Mosaic Pattern(8 × 6)

LC470WUD

Product Specification

Table 3. ELECTRICAL CHARACTERISTICS for IPB& Lamp (TBD)

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	-	9.3	10.3	A	VBR-A = 1.65V … 1
			-	10.0	11.0	A	VBR-A = 3.3V … 1
	Before Aging	IBL_B	-	11.0	12.0	A	VBR-A = 1.65V … 2
			-	12.0	13.0	A	VBR-A = 3.3V … 2
Power Supply Input Current (In-Rush)		Irush	-	-	14.0	A	VBL = 22.8V VBR-B = 3.3V VBR-A = 1.65V
Power Consumption		PBL	-	223	248	W	VBR-A = 1.65V … 1
Input Voltage for Control System Signals	Brightness Adjust	VBR-A	0.0	1.65	3.3	Vdc	
	On/Off — On	V on	2.5	-	5.0	Vdc	
	On/Off — Off	V off	-0.3	0.0	0.8	Vdc	
	Brightness Adjust	VBR-B	0	-	3.3	V	
Lamp:		Ts			3	min	3
Life Time			50,000			Hrs	4

Notes :
1. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 120 minutes at 25±2°C. The specified current and power consumption are under the typical supply Input voltage 24Vand VBR (VBR-A : 1.65V & VBR-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 ± 5%.
2. Electrical characteristics are determined within 30 minutes at 25±2°C.
   The specified currents are under the typical supply Input voltage 24V.
3. 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.
4. 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 (VBR-A : 1.65V & VBR-B :3.3V), on condition of continuous operating at 25 ± 2°C
5. The duration of rush current is about 10ms.

LC470WUD

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 two 3-pin Balance PCB connectors are used for the integral backlight system.

3-2-1. LCD Module

- LCD Connector(CN1): FI-RE51S-HF or Equivalent, Refer to below table.
- Mating Connector : FI-RE51HL

Table 4-1. MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	GND	Ground	27	GND	NC
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	VBR_EXT	External VBR	34	GND	Ground
9	VBR_OUT	VBR output	35	RCLK2N	SECOND CLOCK CHANNEL Clk-
10	DCR_Enable	'H' = Enable , 'L' = Disable	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	VLCD	Power Supply +12.0V
23	RD1P	FIRST CHANNEL D+	49	VLCD	Power Supply +12.0V
24	RE1N	FIRST CHANNEL E-	50	VLCD	Power Supply +12.0V
25	RE1P	FIRST CHANNEL E+	51	VLCD	Power Supply +12.0V
26	GND	Ground	-	-	-

Notes :　1. All GND(ground) pins should be connected together to the LCD module's metal frame .
　　　　　2. All VLCD (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).
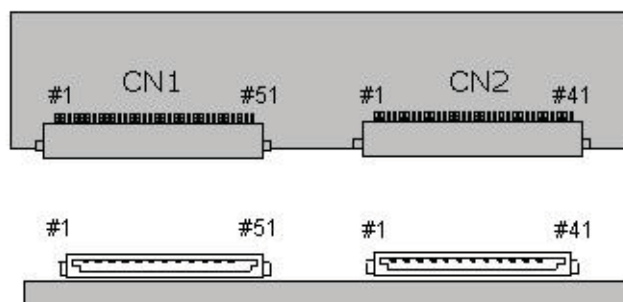
LC470WUD

Product Specification

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

Table 4-2. 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)

LC470WUD

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 CONFIGULATION

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	GND	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.
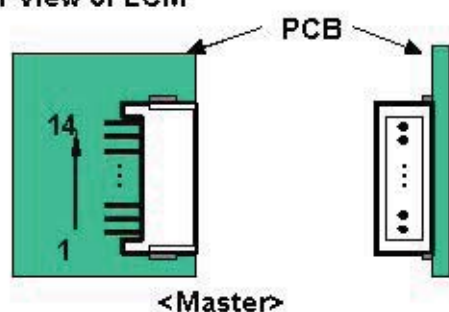   It could be usable for boost up luminance when using DCR (=Dynamic contrast ratio) function only.
      3. Minimum Brightness : VBR-B =0V   Maximum Brightness : VBR-B = 3.3V
      4. Even though Pin #14 is open, there is no effect on inverter operating, The output terminal of inverter.
      5. Each impedance of pin #11,12 and 13 is 143[KΩ], 42[KΩ],152[KΩ]

◆ **Rear view of LCM**

<Master>   <Slave>
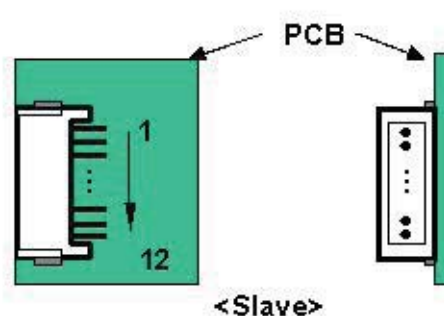
LC470WUD

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	Notes
Horizontal	Display Period	tHV	-	480	-	tclk	1920/4
	Blank	tHB	40	70	200	tclk	
	Total	tHP	520	550	680	tclk	
Vertical	Display Period	tVV	-	1080	-	Lines	
	Blank	tVB	10	45	86	Lines	
	Total	tVP	1090	1125	1166	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Notes
Frequency	DCLK	fCLK	66.97	74.25	75.00	MHz	
	Horizontal	fH	121.8	135	136.4	KHz	
	Vertical	fV	108.2	120	121.2	Hz	

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	tHV	-	480	-	tclk	1920/4
	Blank	tHB	40	70	200	tclk	
	Total	tHP	520	550	680	tclk	
Vertical	Display Period	tVV	-	1080	-	Lines	
	Blank	tVB	228	270	300	Lines	
	Total	tVP	1308	1350	1380	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Notes
Frequency	DCLK	fCLK	66.97	74.25	75.00	MHz	
	Horizontal	fH	121.8	135	140	KHz	
	Vertical	fV	90.2	100	103.7	Hz	

Note : The Input of HSYNC & VSYNC signal does not have an effect on normal operation(DE Only Mode).
The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate.
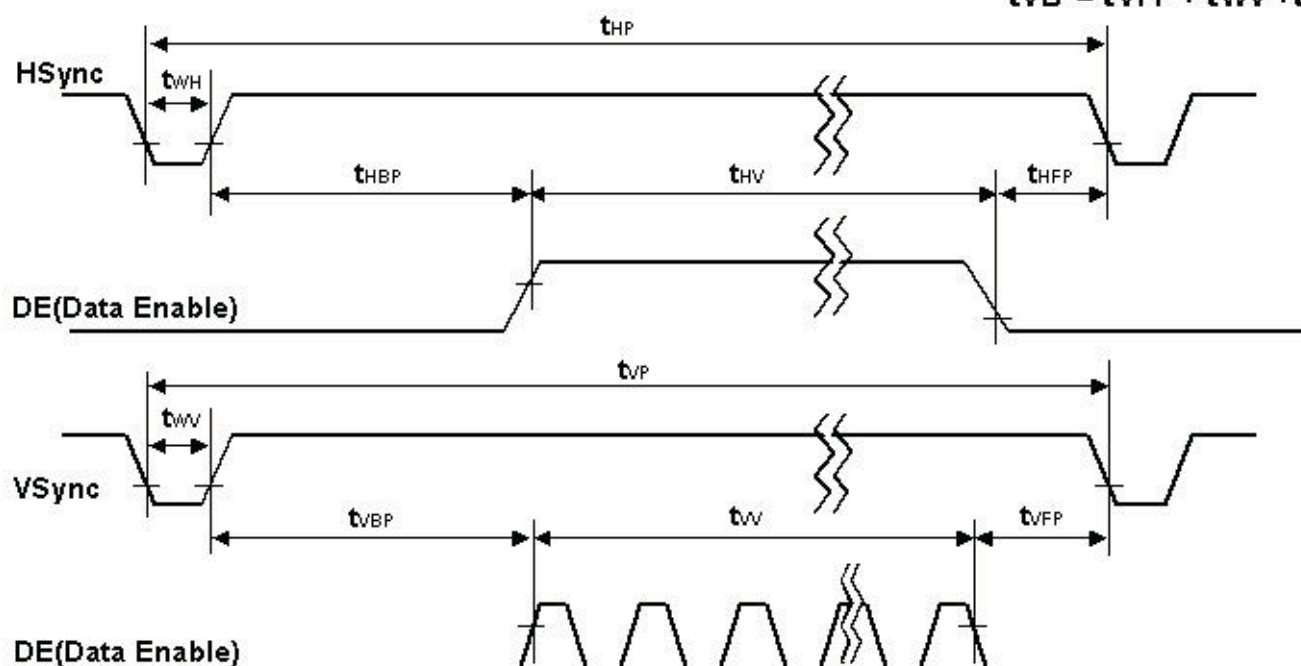
LC470WUD

Product Specification

3-4. Signal Timing Waveforms
DE, Data
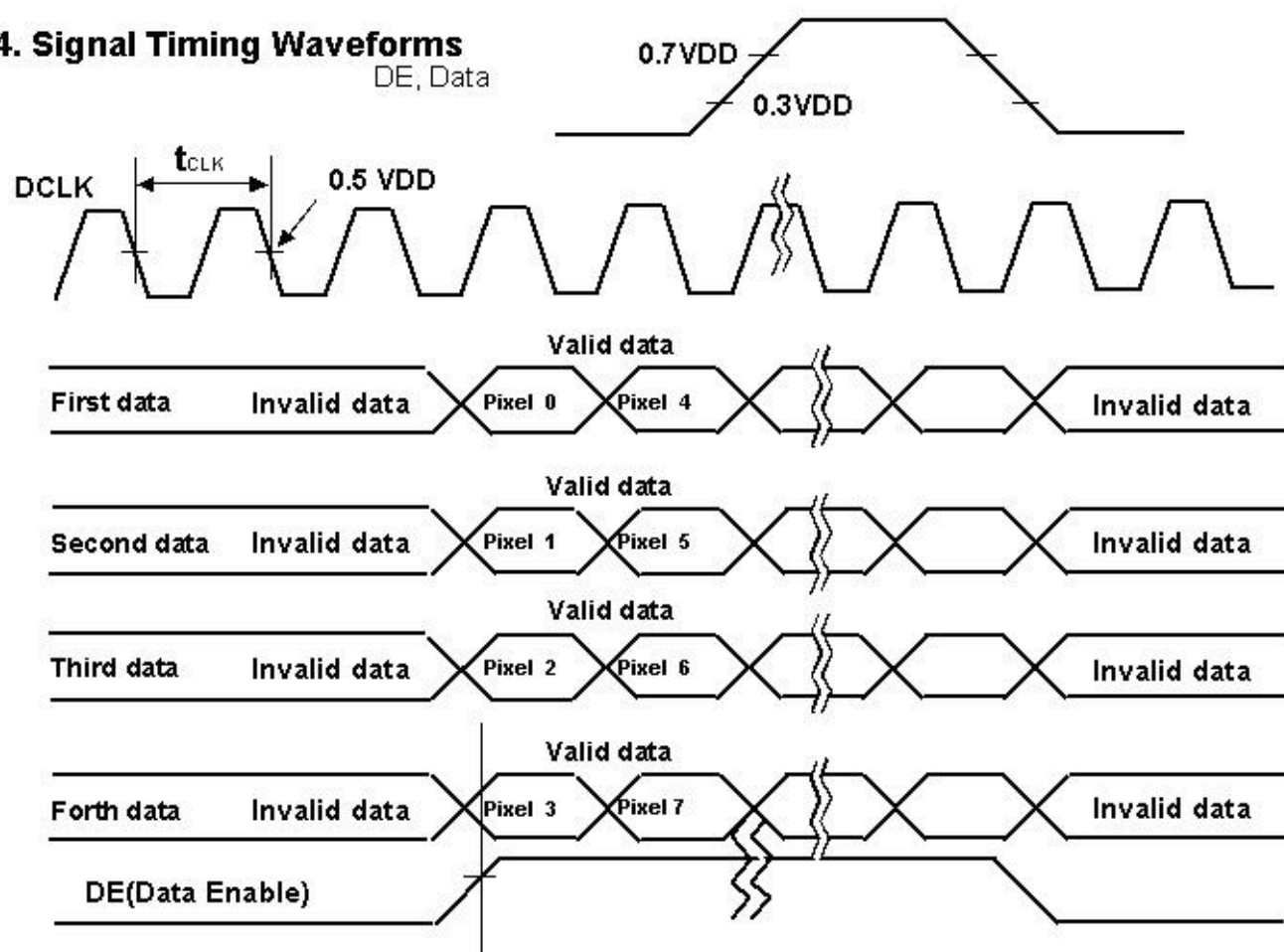
* Reference : Sync. Relation

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

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

LC470WUD

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 7 provides a reference for color versus data input.

Table 8. COLOR DATA REFERENCE

Color		Input Color Data																														
		RED MSB → LSB										GREEN MSB → LSB										BLUE 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

3-6. Power Sequence

3-6-1. LCD Driving circuit
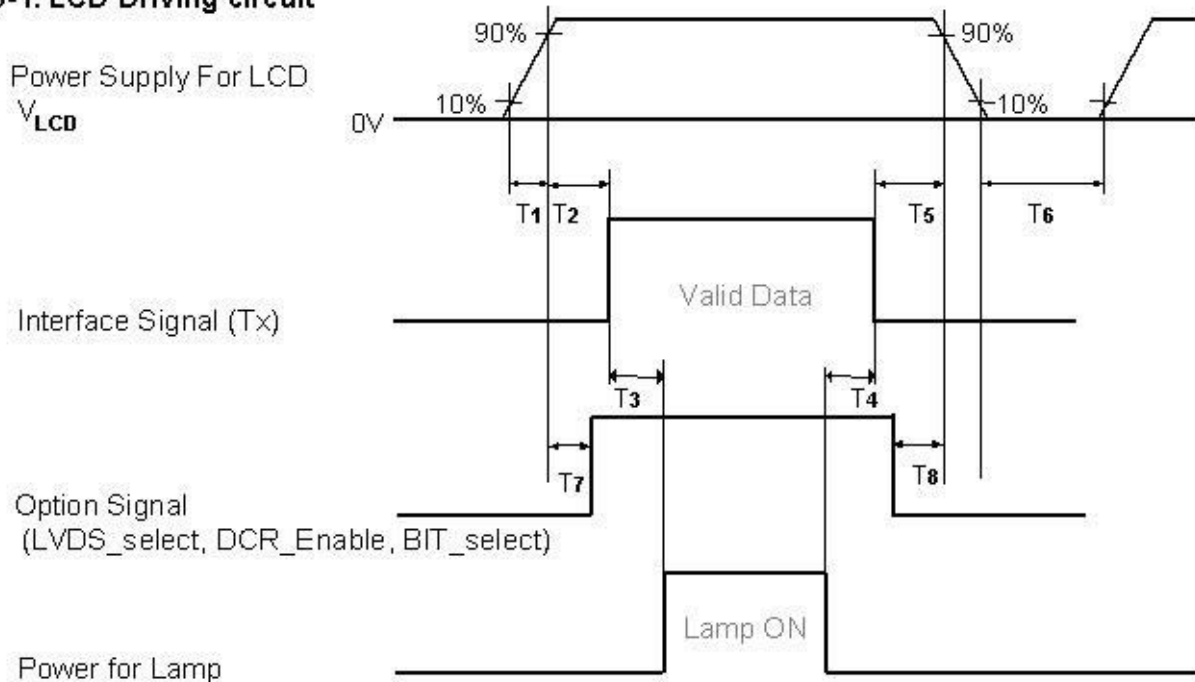
Table 9. POWER SEQUENCE

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 3x(1/fv), it operates protection pattern (Black pattern) till valid signal inputted. There is no reliability problem. (ex. 120Hz : 3x(1/120Hz) = 25ms)
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(Vcc) 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
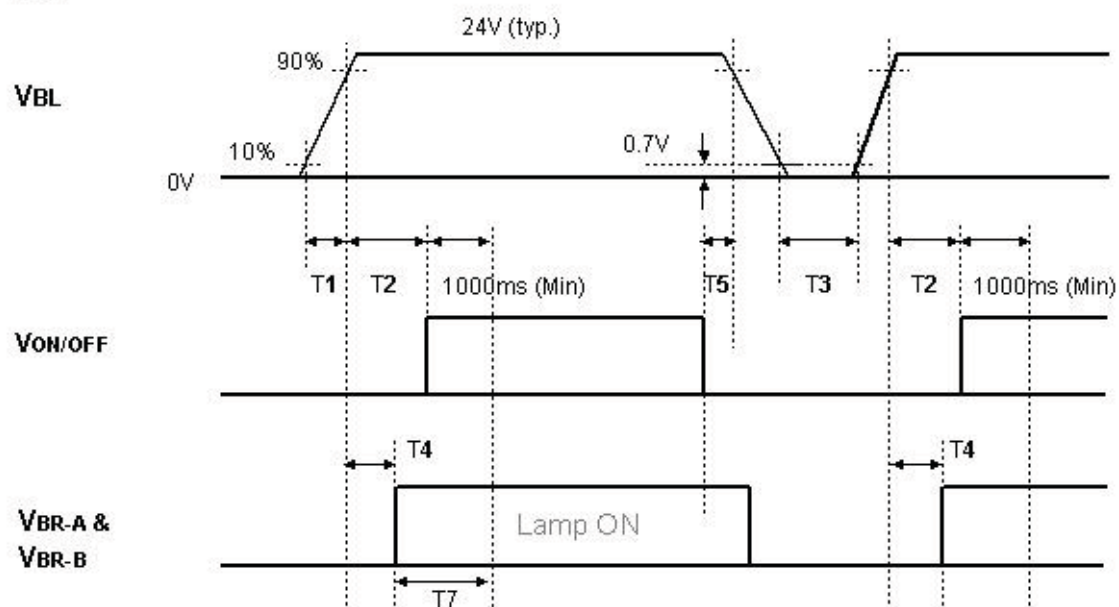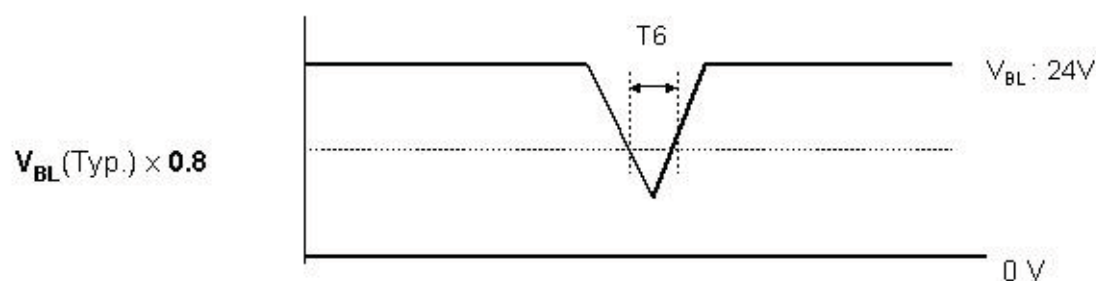

3-6-3. Deep condition for Inverter

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) x 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, V_{BR-B} is recommended 3.3V.

LC470WUD

Product Specification

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at 25±2°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.
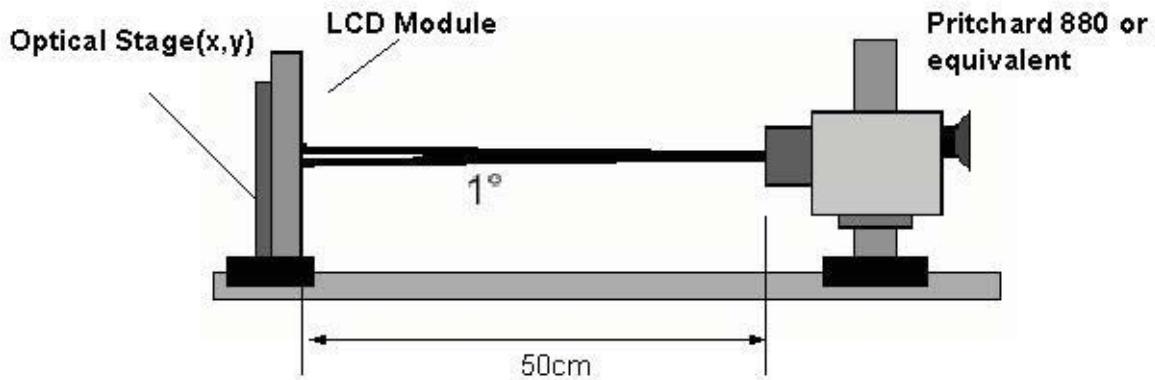FIG. 1 shows additional information concerning the measurement equipment and method.

FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 11. OPTICAL CHARACTERISTICS

Ta= 25±2°C, V_{LCD}=12.0V, fV=120Hz, Dclk=297MHz, V_{BR-A}=1.65V, V_{BR-B}=3.3V

Parameter		Symbol		Value			Unit	Note
				Min	Typ	Max		
Contrast Ratio		CR		TBD	1300	-		1
Surface Luminance, white		L_{WH}		400	500		cd/m²	2
Luminance Variation		δ_{WHITE}	5P			1.3		3
Response Time	MPRT	.		-	8	10	ms	4,5
	G to G	.		-	5	8	ms	
Color Coordinates [CIE1931]	RED	Rx			TBD			
		Ry			TBD			
	GREEN	Gx			TBD			
		Gy		Typ -0.03	TBD		Typ +0.03	
	BLUE	Bx			TBD			
		By			TBD			
	WHITE	Wx			0.279			
		Wy			0.292			
Viewing Angle (CR>10)								
	x axis, right(φ=0°)	θr		89	-	-	degree	6
	x axis, left (φ=180°)	θl		89	-	-		
	y axis, up (φ=90°)	θu		89	-	-		
	y axis, down (φ=270°)	θd		89	-	-		
Gray Scale					2.2			7

Ver. 0.2

LC470WUD

Product Specification

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

CR(Contrast Ratio) = Maximum CRn (n=1, 2, 3, 4, 5)

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

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

※ DCR Application : Refer to Appendix-III

2. Surface luminance are determined after the unit has been 'ON' and 30min after lighting the backlight in a dark environment at 25±2℃. 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 :

δ WHITE(5P) = Maximum(L_{on1}, L_{on2}, L_{on3}, L_{on4}, L_{on5}) / 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. Response time is the time required for the display to transition from G(N) to G(M) (Rise Time, Tr_R) and from G(M) to G(N) (Decay Time, Tr_D). For additional information see the FIG. 3. (N<M)

※ G to G Spec is average of measured time (N, M = 0 (Black) ~ 1023(White), 128 gray step).

5. 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 4

6. 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 .

7. Gray scale specification

Gamma Value is approximately 2.2. For more information, see the Table 12.

Table 12. GRAY SCALE SPECIFICATION

Gray Level	Luminance [%] (Typ.)
L0	(0.08)
L63	(0.22)
L127	(1.03)
L191	(2.52)
L255	(4.74)
L319	(7.74)
L383	(11.56)
L447	(16.22)
L511	(21.76)
L575	(28.20)
L639	(35.56)
L703	(43.85)
L767	(53.10)
L831	(63.33)
L895	(74.54)
L959	(86.76)
L1023	100

LC470WUD

Product Specification

Measuring point for surface luminance & measuring point for luminance variation

A : H / 4 mm
B : V / 4 mm
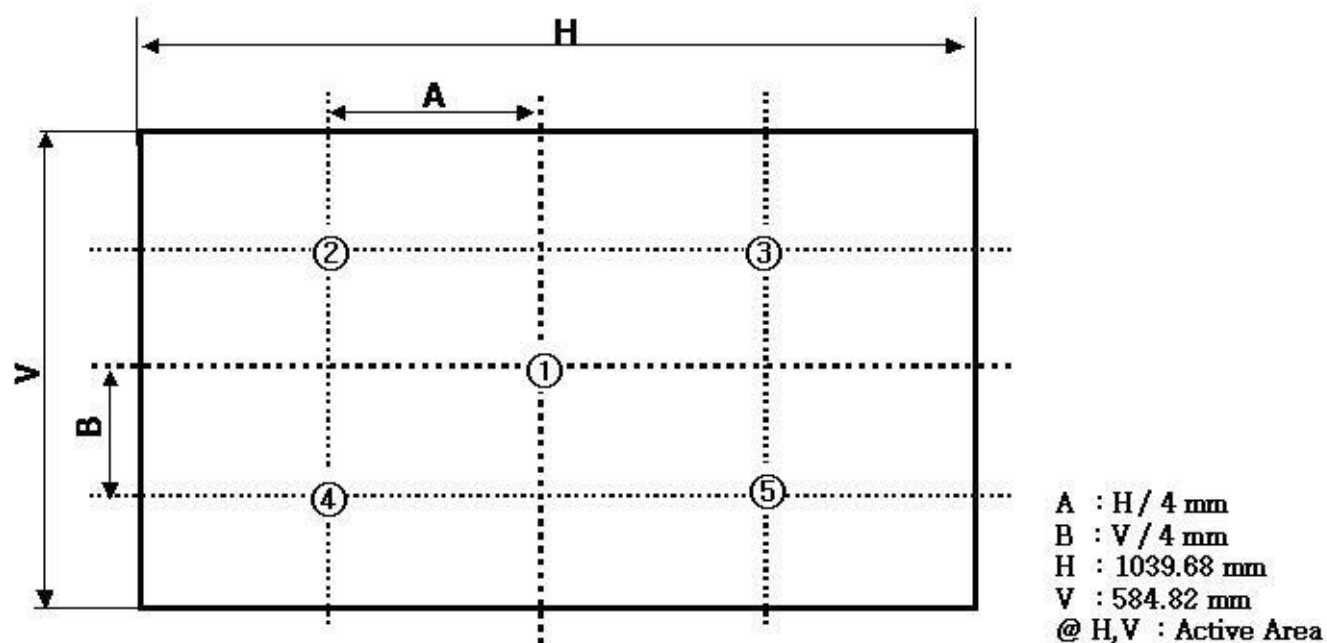H : 1039.68 mm
V : 584.82 mm
@ H,V : Active Area

FIG. 2 5 Points for Luminance Measure

Response time is defined as the following figure and shall be measured by switching the input signal for "Gray(N)" and "Gray(M)".
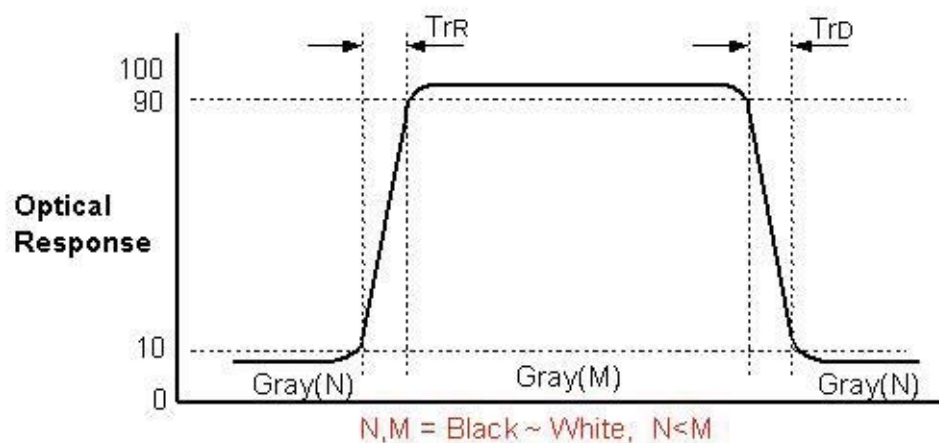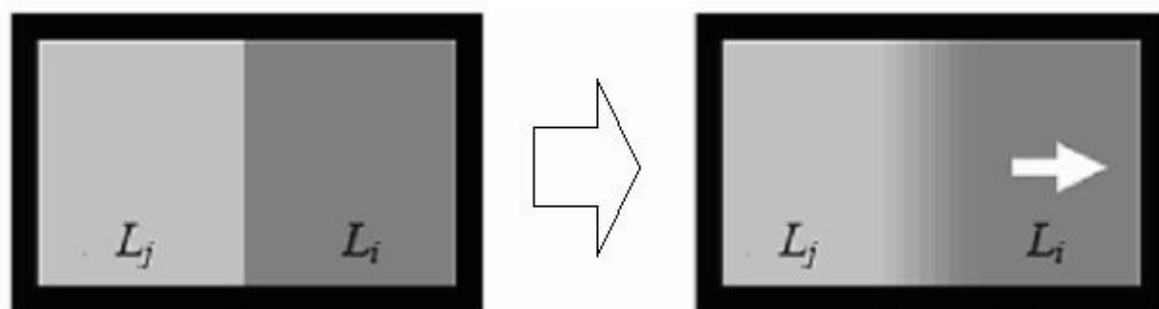

N,M = Black ~ White, N<M

FIG.3 Response Time

LC470WUD

Product Specification

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

$$M = \frac{1}{U} Bij \ (i \neq j)$$

Example) Bij = 12pixels, U = 10pixels / 120Hz

M = 12pixels / (10pixels / 120Hz)

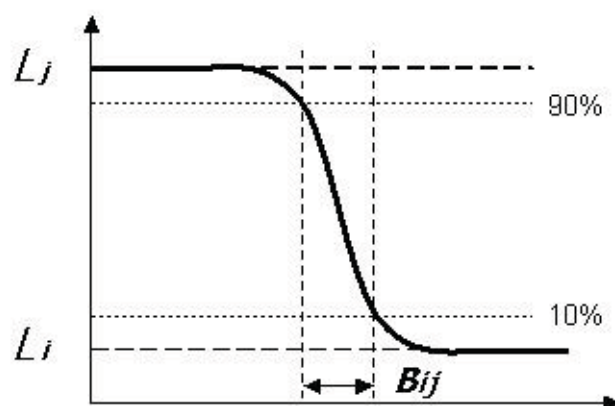= 12pixels / {10pixels / (1/120)s}

= 12 / 1,200 s

= 10 ms

FIG. 4 MPRT

Dimension of viewing angle range
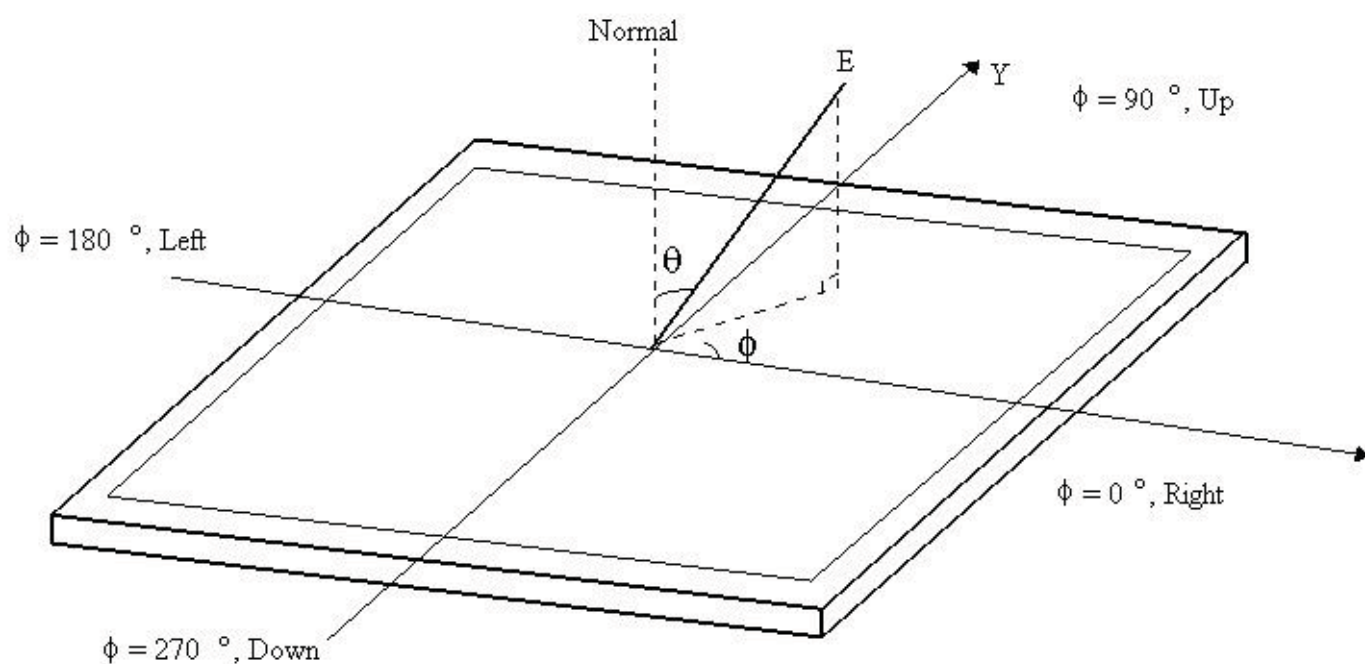
FIG. 5 Viewing angle

Product Specification

5. Mechanical Characteristics

Table 13 provides general mechanical characteristics.

Table 13. MECHANICAL CHARACTERISTICS

Item		Value
Outline Dimension	Horizontal	1096.0 mm
	Vertical	640.0 mm
	Depth	51.0 mm
Bezel Area	Horizontal	1049.0 mm
	Vertical	593.0 mm
Active Display Area	Horizontal	1039.68 mm
	Vertical	584.82 mm
Weight		14.5 Kg (Typ.), 15.5kg (Max.)

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

LC470WUD

Product Specification

<FRONT VIEW>
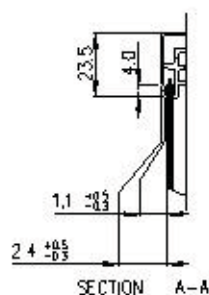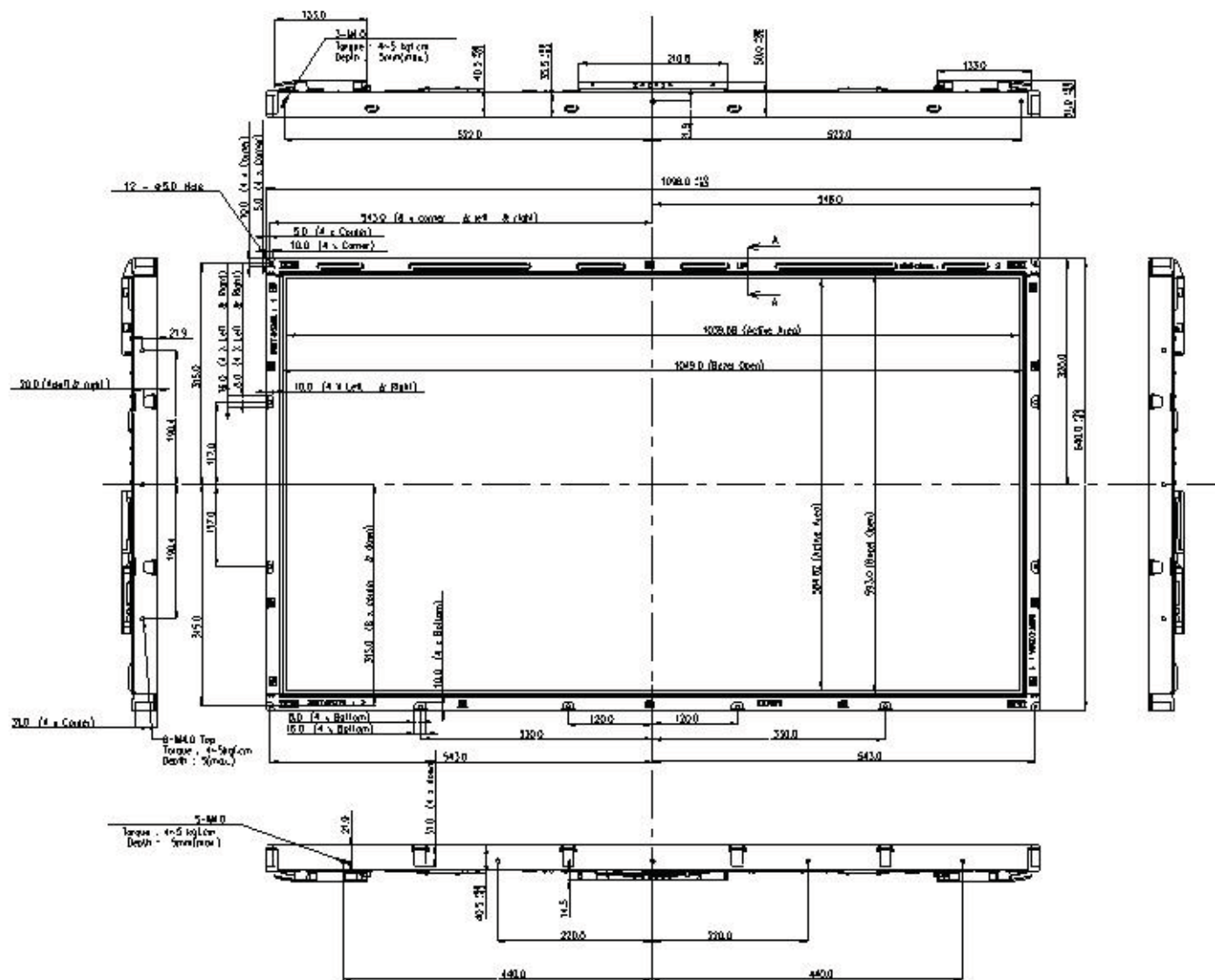
NOTES
1. Unspecified tolerances are to be ±1.0mm.
2. Tilt and partial disposition tolerance of display area
   are as following
   (1) X-Direction : IA-BI ≤ 1.5mm
   (2) Y-Direction : IC-DI ≤ 1.5mm

SECTION A-A

LC470WUD

Product Specification

<REAR VIEW>
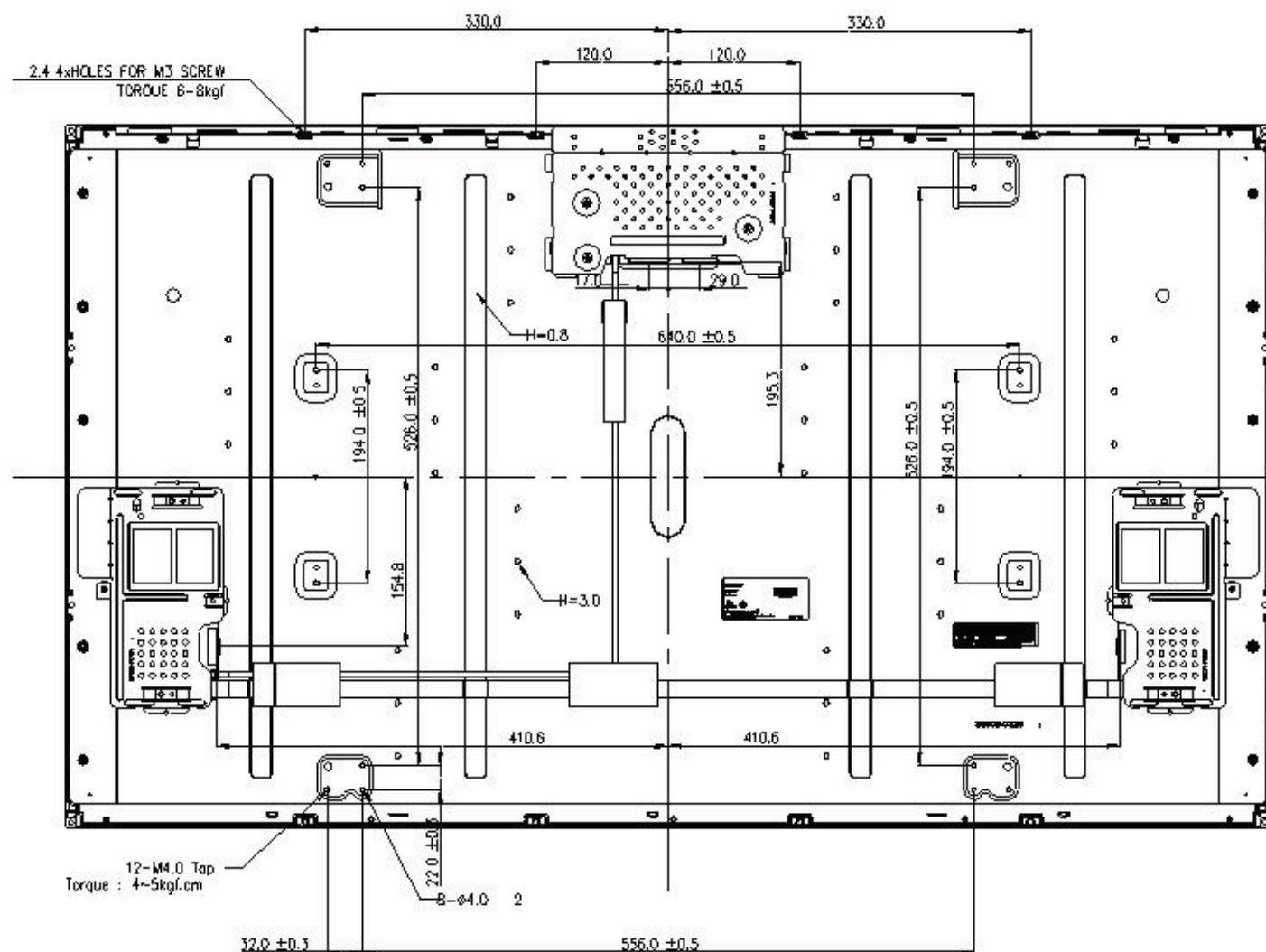
Product Specification

6. Reliability

Table 12. ENVIRONMENT TEST CONDITION

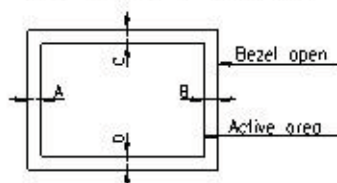| No.	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Vibration test (non-operating)	Wave form : random Vibration level : 1.0G RMS Bandwidth : 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.

Product Specification

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)
D : YEAR   E : MONTH
F : PANEL CODE   G : FACTORY CODE
H : ASSEMBLY 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 : 12 pcs

b) Pallet Size : 1220mm(W) X 1140mm(D) X 860mm(H)

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 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 the resist external force.

(4) You should adopt radiation structure to satisfy the temperature specification.

(5) Acetic acid type and chlorine type materials for the cover case are not 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=±200mV(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.

(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.

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) 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.

Product Specification

APPENDIX-I-1

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

Host System 30 Bit	THC63LVD103 or Compatible
RED0	33
RED1	34
RED2	35
RED3	36
RED4	37
RED5	38
RED6	59
RED7	61
RED8	4
RED9	5
GREEN0	40
GREEN1	41
GREEN2	42
GREEN3	44
GREEN4	45
GREEN5	46
GREEN6	62
GREEN7	63
GREEN8	6
GREEN9	8
BLUE0	48
BLUE1	49
BLUE2	50
BLUE3	52
BLUE4	53
BLUE5	54
BLUE6	64
BLUE7	1
BLUE8	9
BLUE9	11
Hsync	55
Vsync	57
Data Enable	58
CLOCK	12

FI-RE51S-HF

Timing Controller

THC63LVD103		FI-RE51S-HF			Timing Controller
TA-	31	12			RO0N
TA+	30	13	100Ω		RO0P
TB-	29	14			RO1N
TB+	28	15	100Ω		RO1P
TC-	25	16			RO2N
TC+	24	17	100Ω		RO2P
TCLK-	23	19			ROCLKN
TCLK+	22	20	100Ω		ROCLKP
TD-	21	22			RO3N
TD+	20	23	100Ω		RO3P
TE-	19	24			RO4N
TE+	18	25	100Ω		RO4P
		7			JEIDA / **VESA**

GND

LCM Module

Notes : 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.

LC470WUD

Product Specification

APPENDIX-I-2

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

Host System 30 Bit	THC63LVD103 or Compatible		FI-RE51S-HF			Timing Controller
RED0	4					
RED1	5					
RED2	59					
RED3	61	TA-	31	12		RO0N
RED4	33	TA+	30	13	100Ω	RO0P
RED5	34					
RED6	35					
RED7	36	TB-	29	14		RO1N
RED8	37	TB+	28	15	100Ω	RO1P
RED9	38					
GREEN0	6					
GREEN1	8	TC-	25	16		RO2N
GREEN2	62	TC+	24	17	100Ω	RO2P
GREEN3	63					
GREEN4	40	TCLK-	23	19		ROCLKN
GREEN5	41	TCLK+	22	20	100Ω	ROCLKP
GREEN6	42					
GREEN7	44					
GREEN8	45	TD-	21	22		RO3N
GREEN9	46	TD+	20	23	100Ω	RO3P
BLUE0	9					
BLUE1	11	TE-	19	24		RO4N
BLUE2	64	TE+	18	25	100Ω	RO4P
BLUE3	1					
BLUE4	48					
BLUE5	49			7		JEIDA /VESA
BLUE6	50					
BLUE7	52					
BLUE8	53					
BLUE9	54					
Hsync	55		Vcc		LCM Module	
Vsync	57					
Data Enable	58					
CLOCK	12					

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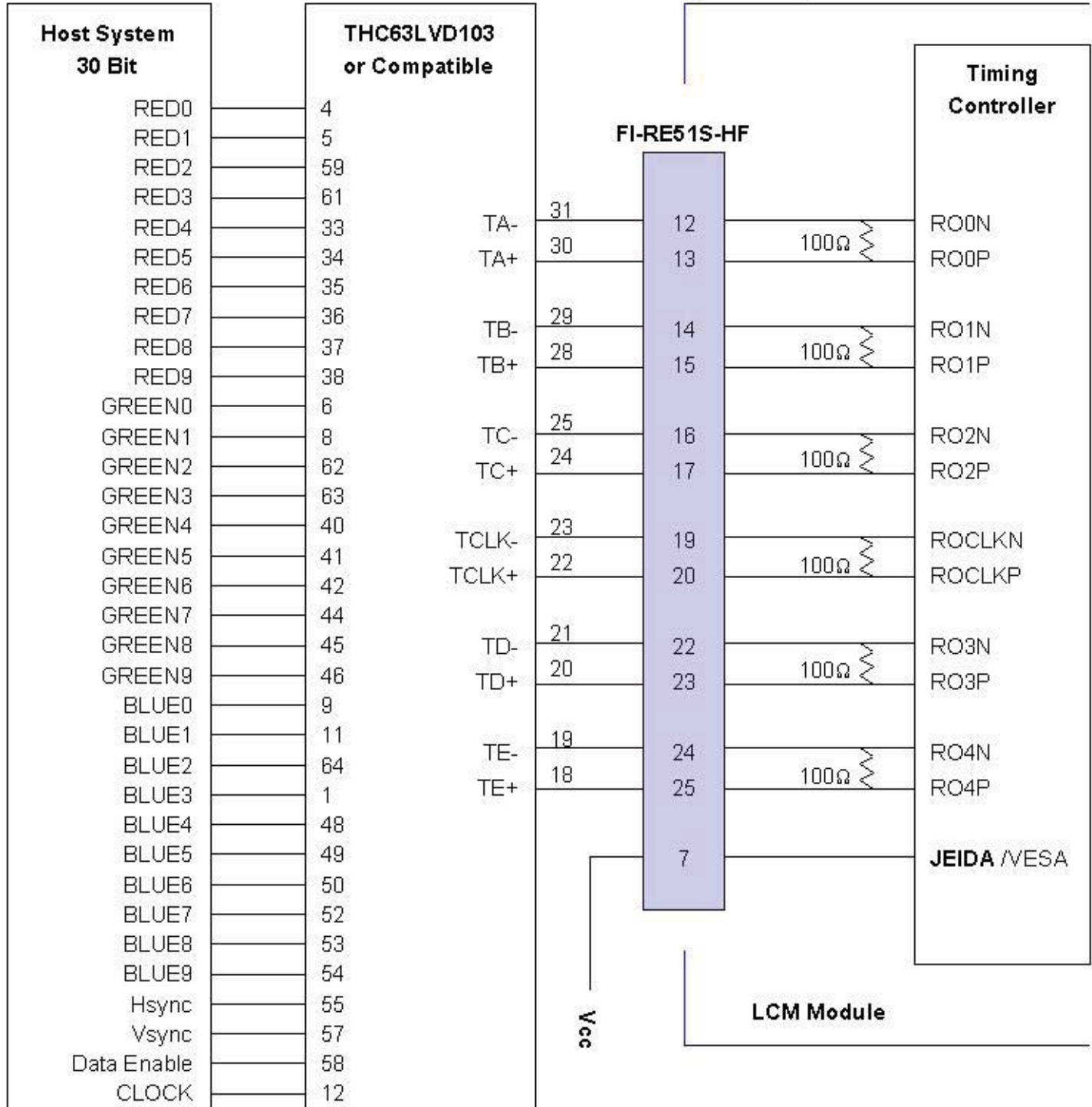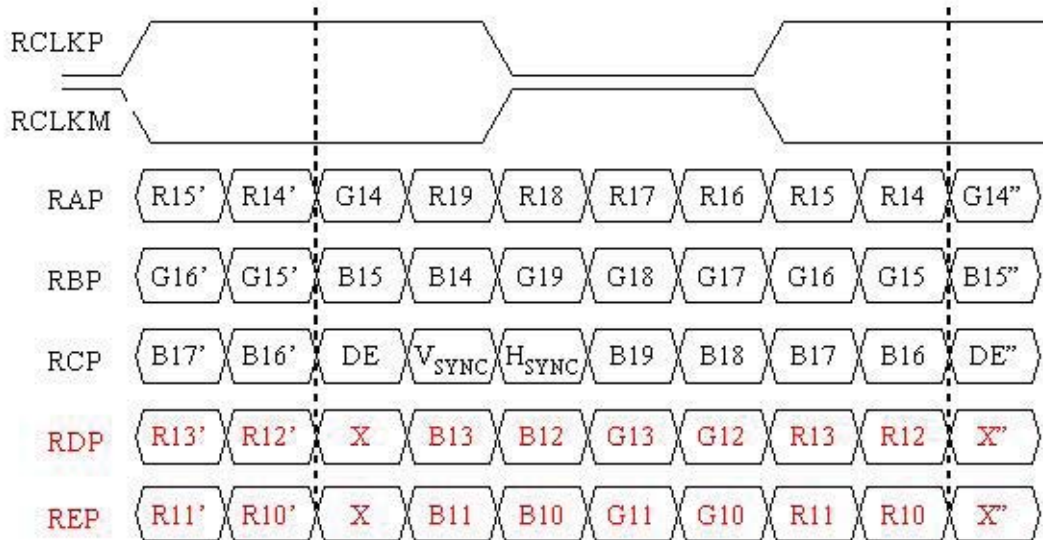　　　　2. Refer to LVDS Transmitter Data Sheet for detail descriptions. (THC63LVD103 or Compatible)
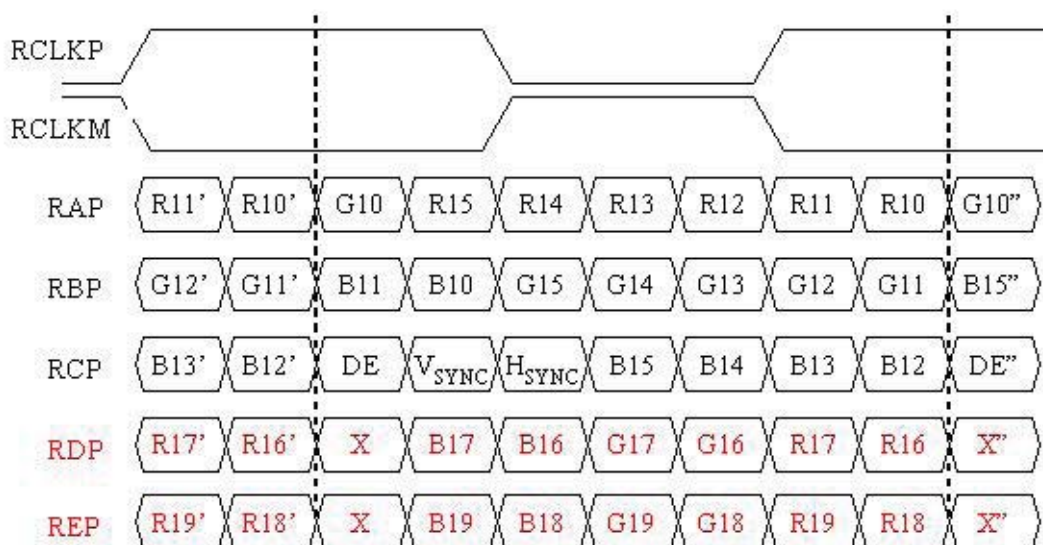　　　　3. '9' means MSB and '0' means LSB at R,G,B pixel data.

Product Specification

APPENDIX- II

LVDS Data-Mapping info. (10bit)

■ LVDS Select : "H" Data-Mapping (JEIDA format)

RAP	R15'	R14'	G14	R19	R18	R17	R16	R15	R14	G14"
RBP	G16'	G15'	B15	B14	G19	G18	G17	G16	G15	B15"
RCP	B17'	B16'	DE	V_{SYNC}	H_{SYNC}	B19	B18	B17	B16	DE"
RDP	R13'	R12'	X	B13	B12	G13	G12	R13	R12	X"
REP	R11'	R10'	X	B11	B10	G11	G10	R11	R10	X"

■ LVDS Select : "L" Data-Mapping (VESA format)

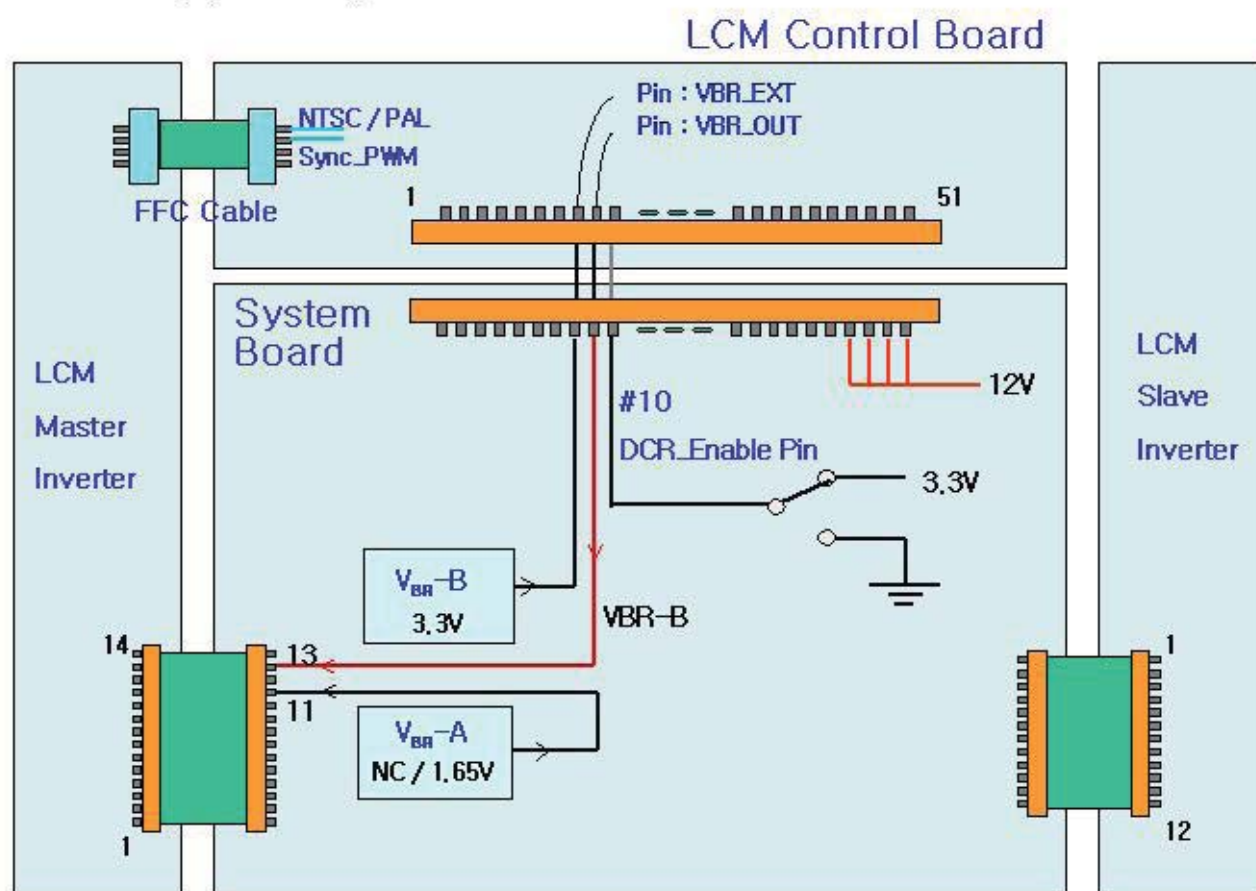|									
RAP	R11'	R10'	G10	R15	R14	R13	R12	R11	R10	G10"
RBP	G12'	G11'	B11	B10	G15	G14	G13	G12	G11	B15"
RCP	B13'	B12'	DE	V_{SYNC}	H_{SYNC}	B15	B14	B13	B12	DE"
RDP	R17'	R16'	X	B17	B16	G17	G16	R17	R16	X"
REP	R19'	R18'	X	B19	B18	G19	G18	R19	R18	X"

Product Specification

APPENDIX-III-1

■ LCM DCR Only (Reference)

■ DCR_Enable Option Pin Description

DCR_Enable	On(3.3V)	Off (0V)
VBR_OUT (V$_{BR}$-B) Signal Source	From T-Con (ASIC)	From System (VBR_EXT Pin)
V$_{BR}$-B	0V ~ 3.3V	3.3V
V$_{BR}$-A	1.65V or NC	1.65V or NC
DCR Level	2600 : 1	1300 : 1

Gray Level	Luminance [%] DCR On VBR-A = 1.65V
L0	0.05
L63	0.24
L127	0.82
L191	1.90
L255	3.64
L319	6.37
L383	9.8
L447	13.9
L511	18.5
L575	24.0
L639	31.1
L703	38.1
L767	46.7
L831	56.9
L895	69.5
L959	83.8
L1023	100

Product Specification

APPENDIX-III-2

■ **System DCR (Dynamic Contrast Ratio)- Max 13000:1 (Reference)**
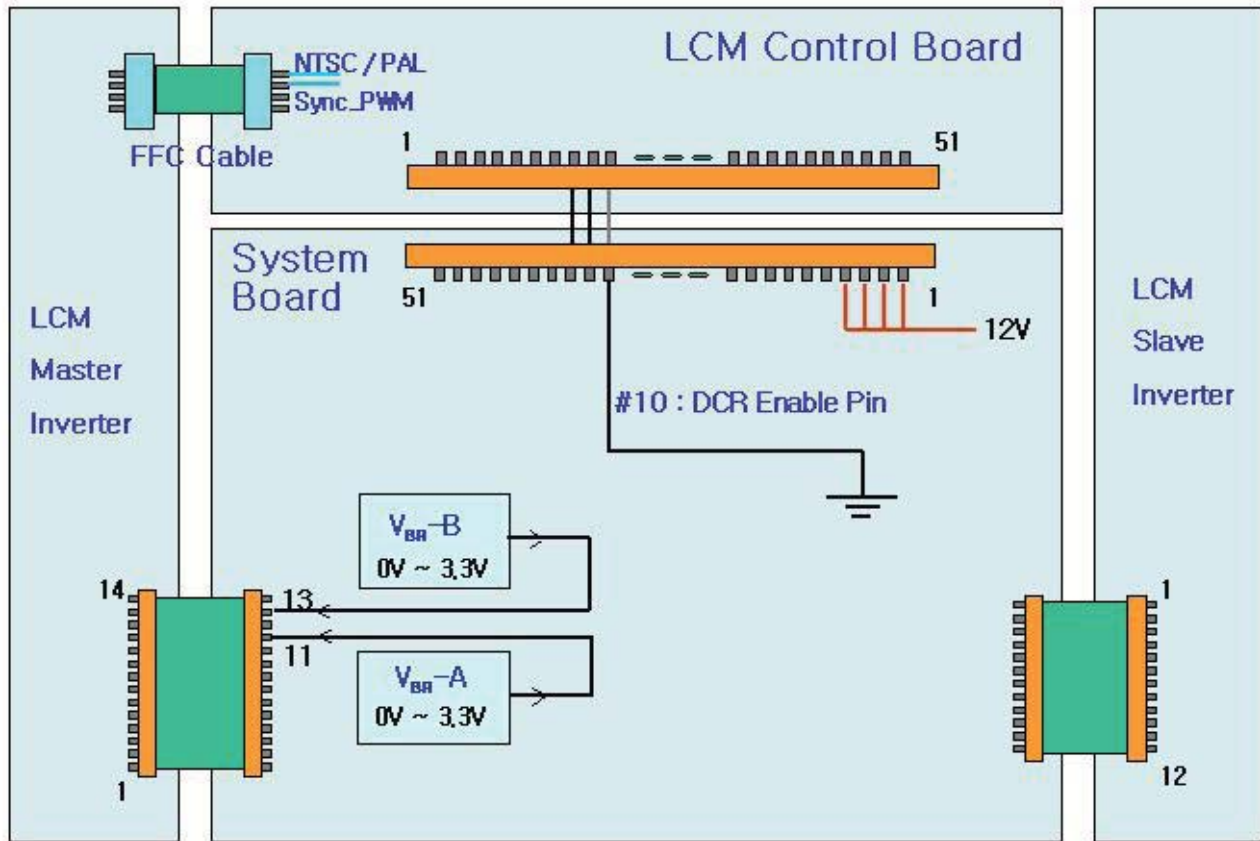
V_{BR}-B	0V ~ 3.3V	3.3V
V_{BR}-A	0V ~ 3.3V	1.65V
DCR Level	13000 : 1	1300 : 1

$V_{BR-A,B}$ Voltage	Function
3.3V	Maximum　Brightness (100%)
0V	Minimum Brightness (10%)

Note : 1. To make DCR Max 13000:1, V_{BR-A}A and V_{BR-B} must be given by system.

　　　 2. DCR Max 13000:1 is defined mathematically as :

　　　 DCR ＝ Maximum DCRn (n=1, 2, 3, 4, 5)

$$DCRn = \frac{\text{Surface Luminance at position n with all white pixels (VBR-B=3.3V, VBR-A=3.3V)}}{\text{Surface Luminance at position n with all black pixels (VBR-B=0V, VBR-A=0V)}}$$

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

　　 3. Measurement　Sequence (aging time 10 min each pattern) :

　　　 ① Turn On LCM

　　　 ② Measure Black Luminance (VBR-B=0V, VBR-A=0V)

　　　 ③ Measure White Luminance (VBR-B=3.3V, VBR-A=3.3V)

　　 4. In case the lowest minimum brightness is continued,

　　　 it can affect the lamp reliability and appear the partial darkness.