LG.PHILIPS LCD

SPECIFICATION
FOR
APPROVAL

(●) **Preliminary Specification**

(   ) **Final Specification**

Title	47.0" WUXGA TFT LCD

BUYER	
MODEL	

SUPPLIER	LG.Philips LCD Co., Ltd.
*MODEL	LC470WU4
SUFFIX	SLA1

*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
P.Y. Kim / Manager	
REVIEWED BY	
Y.N. Lee / Engineer	
PREPARED BY	
S.M. Lee / Engineer	

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

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Product Specification

1. General Description

The LC470WU4 is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp(CCFL) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive display type which is 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 arrayed in vertical stripes. Gray scale or the luminance of the sub-pixel color is determined with a 8-bit gray scale signal for each dot. Therefore, it can present a palette of more than 16.7M(true) colors.

It has been designed to apply the 8-bit 2-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 response time are important.
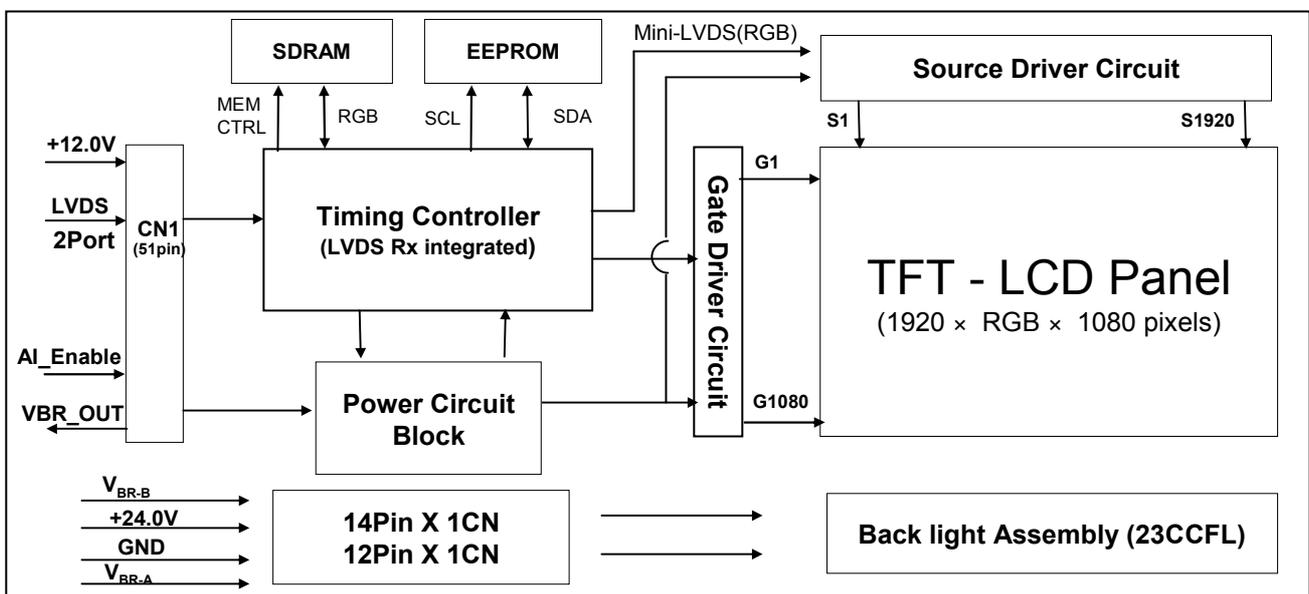
General Features

|	
Active Screen Size	46.96 inch (1192.87mm) diagonal
Outline Dimension	1096.0(H) x 640.0 (V) x 51 mm(D) (Typ.)
Pixel Pitch	0.5415 mm x 0.5415 mm
Pixel Format	1920 horiz. by 1080 vert. Pixels, RGB stripe arrangement
Color Depth	8-bit, 16.7 M colors
Luminance, White	500 cd/m^2 (Center 1point ,Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Typ.), U/D 178 (Typ.))
Power Consumption	Total 247.2 W (Typ.) (Logic=7.2 W, Inverter= 240 W [V_{BR-A} = 1.65V])
Weight	16.5 Kg (Typ.)
Display 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	LCM	V_{LCD}	8.0	+14.0	V_{DC}	at 25 ± 2 ℃
	Backlight inverter	V_{BL}	21.6	+27.0	V_{DC}	
ON/OFF Control Voltage		$V_{ON/OFF}$	-0.3	+5.25	V_{DC}	
Brightness Control Voltage		V_{BR-B}	0	+5.0	V_{DC}	
Operating Temperature		T_{OP}	0	+40	℃	Note 1
Storage Temperature		T_{ST}	-20	+50	℃	
Operating Ambient Humidity		H_{OP}	10	90	%RH	
Storage Humidity		H_{ST}	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.
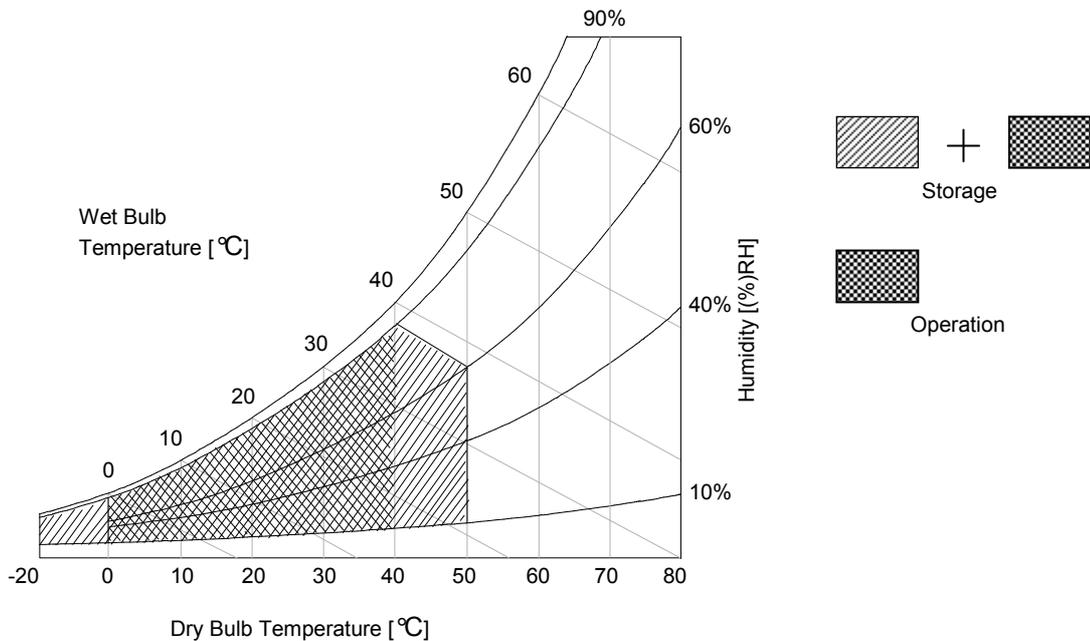
3. Electrical Specifications
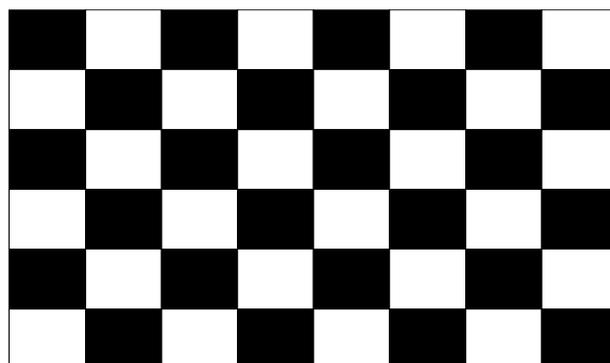
3-1. Electrical Characteristics

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

The other Is used for the CCFL backlight and inverter circuit.

Table 2. ELECTRICAL CHARACTERISTICS

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}	-	600	900	mA	1
		-	870	1300	mA	2
Power Consumption	P_{LCD}	-	7.2	10.80	Watt	1
Rush current	I_{RUSH}	-	-	5	A	3

Note : 1. The specified current and power consumption are under the V_{LCD}=12.0V, 25 ± 2℃, f_V=60Hz

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 : 255 Gray
Black : 0 Gray

Mosaic Pattern(8 x 6)

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Table 2. ELECTRICAL CHARACTERISTICS (Continue)

Parameter		Symbol	Min	Typ	Max	Unit	Notes
Inverter :							
Power Supply Input Voltage		VBL	22.8	24.0	26.2	Vdc	1
Unloading Input Voltage					28	Vdc	
Power Supply Input Voltage Ripple			-0.2		0.2	Vp-p	1
Power Supply Input Current	After Aging	IBL_A	-	10.0	11.0	A	V_{BR-A} = 1.65V … 1
				11.0	12.0	A	V_{BR-A} = 3.3V … 1
	Before Aging	IBL_B	-	11.0	12.5	A	V_{BR-A} = 1.65V … 2
			-	12.0	14.0	A	V_{BR-A} = 3.3V … 2
Power Supply Input Current (In-Rush)		Irush	-	-	14	A	V_{BL} = 24V V_{BR-B} = 3.3V V_{BR-A} = 1.65V
Power Consumption		PBL	-	240	264	W	V_{BR-A} = 1.65V … 1
		PBL	-	264	290	W	V_{BR-A} = 3.3V … 1
Input Voltage for Control System Signals	Brightness Adjust	V_{BR-A}	0.0	1.65	3.3	Vdc	3
	On/Off — On	V on	2.5	-	5.0	Vdc	
	On/Off — Off	V off	-0.3	0.0	0.8	Vdc	
Brightness Adj	PWM Duty Ratio	V_{BR-B}	0(30%)		3.3(100%)	V	
	PWM Frequency	NTSC/PAL	205	215	225	Hz	
Output Voltage (V_{BR-B} = 3.3V)		Vout	1200	1400	1600	V(rms)	V_{BR-A} = 1.65V
Output Current (V_{BR-B} = 3.3V)		IO-MIN	135	145	155	mA(rms)	V_{BR-A} = 0.0V
		IO-TYP	150	160	170	mA(rms)	V_{BR-A} = 1.65V
		IO-MAX	165	175	185	mA(rms)	V_{BR-A} = 3.3V
Life Time			50,000			Hrs	V_{BR-A} = 0~1.65V … 4

Notes :
1. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 120 minutes at 25± 2℃. The specified current and power consumption are under the typical supply Input voltage 24V, it is total power consumption.
   The ripple voltage of the power supply input voltage is under 0.4 Vp-p. LPL recommend Input Voltage is 24.0V ± 5%.
2. Electrical characteristics are determined within 30 minutes at 25± 2℃.
   The specified currents are under the typical supply Input voltage 24V.
3. Brightness Control.
   This V_{BR-A} Voltage control brightness.

V_{BR-A} Voltage	Function	V_{BR-A} Voltage	Function
0V	Minimum Brightness (90%)	3.3V	Maximum Brightness (110%)

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 (V_{BR-A} = 1.65V) on condition of continuous operating at 25 ± 2℃
5. 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, a 51-pin connector is used for the module electronics and Two connectors(14-pin / 12-pin) are used for the integral backlight system.

3-2-1. LCD Module

- LCD Connector(CN1): GT05L-51S-H38(manufactured by LS Cable),

KN25-51P-0.5SH(manufactured by HIROSE)

- Mating Connector : FI-RE51HL(manufactured by JAE)

Table 3. MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	GND	Ground or No connection	27	GND	Ground
2	Reserved (NC)	No connection(Reserved for I²C)	28	RE0N	SECOND CHANNEL 0-
3	Reserved (NC)	No connection(Reserved for I²C)	29	RE0P	SECOND CHANNEL 0+
4	Reserved (NC)	No connection	30	RE1N	SECOND CHANNEL 1-
5	Reserved (NC)	No connection	31	RE1P	SECOND CHANNEL 1+
6	Reserved (NC)	No connection	32	RE2N	SECOND CHANNEL 2-
7	LVDS Select	Logic 'L or NC':LG format,'H':DISM	33	RE2P	SECOND CHANNEL 2+
8	VBR_EXT	External VBR Input	34	GND	Ground
9	VBR_OUT	VBR Output	35	RECLKN	SECOND CLOCK CHANNEL C-
10	AI Enable	Logic 'L' Level : Disable	36	RECLKP	SECOND CLOCK CHANNEL C+
11	GND	Ground	37	GND	Ground
12	RO0N	FIRST CHANNEL 0-	38	RE3N	SECOND CHANNEL 3-
13	RO0P	FIRST CHANNEL 0+	39	RE3P	SECOND CHANNEL 3+
14	RO1N	FIRST CHANNEL 1-	40	Reserved (NC)	No connection (Res for 10Bits)
15	RO1P	FIRST CHANNEL 1+	41	Reserved (NC)	No connection (Res for 10Bits)
16	RO2N	FIRST CHANNEL 2-	42	GND	Ground
17	RO2N	FIRST CHANNEL 2+	43	GND	Ground
18	GND	Ground	44	GND	Ground
19	ROCLKN	FIRST CLOCK CHANNEL C-	45	GND	Ground
20	ROCLKP	FIRST CLOCK CHANNEL C+	46	GND	Ground
21	GND	Ground	47	NC	NC
22	RO3N	FIRST CHANNEL 3-	48	VLCD	Power Supply +12.0V
23	RO3P	FIRST CHANNEL 3+	49	VLCD	Power Supply +12.0V
24	Reserved (NC)	No connection (Res for 10Bits)	50	VLCD	Power Supply +12.0V
25	Reserved (NC)	No connection (Res for 10Bits)	51	VLCD	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 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, #8~#10) are used for internal data process of the LCD module.
   If not used, these pins are no connection.

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Table 4. Required signal assignment for Flat Link (NS:DS90C387) Transmitter

Pin	Pin Name	Require Signal	Pin	Pin Name	Require Signal
1	VCC	Power Supply for TTL Input	29	GND	Ground pin for TTL
2	D5	TTL Input(R7)	30	D26	TTL Input(DE)
3	D6	TTL Input(R5)	31	TxCLKIN	TTL Level clock Input
4	D7	TTL Input(G0)	32	PWR DWN	Power Down Input
5	GND	Ground pin for TTL	33	PLL GND	Ground pin for PLL
6	D8	TTL Input(G1)	34	PLL VCC	Power Supply for PLL
7	D9	TTL Input(G2)	35	PLL GND	Ground pin for PLL
8	D10	TTL Input(G6)	36	LVDS GND	Ground pin for LVDS
9	VCC	Power Supply for TTL Input	37	TxOUT3+	Positive LVDS differential data output3
10	D11	TTL Input(G7)	38	TxOUT3-	Negative LVDS differential data output3
11	D12	TTL Input(G3)	39	TxCLKOUT+	Positive LVDS differential clock output
12	D13	TTL Input(G4)	40	TxCLKOUT-	Negative LVDS differential clock output
13	GND	Ground pin for TTL	41	TxOUT2+	Positive LVDS differential data output2
14	D14	TTL Input(G5)	42	TxOUT2-	Negative LVDS differential data output2
15	D15	TTL Input(B0)	43	LVDS GND	Ground pin for LVDS
16	D16	TTL Input(B6)	44	LVDS VCC	Power Supply for LVDS
17	VCC	Power Supply for TTL Input	45	TxOUT1+	Positive LVDS differential data output1
18	D17	TTL Input(B7)	46	TxOUT1-	Negative LVDS differential data output1
19	D18	TTL Input(B1)	47	TxOUT0+	Positive LVDS differential data output0
20	D19	TTL Input(B2)	48	TxOUT0-	Negative LVDS differential data output0
21	GND	Ground pin for TTL Input	49	LVDS GND	Ground pin for TTL
22	D20	TTL Input(B3)	50	D27	TTL Input(R6)
23	D21	TTL Input(B4)	51	D0	TTL Input(R0)
24	D22	TTL Input(B5)	52	D1	TTL Input(R1)
25	D23	TTL Input(RSVD)	53	GND	Ground pin for TTL
26	VCC	Power Supply for TTL Input	54	D2	TTL Input(R2)
27	D24	TTL Input(HSYNC)	55	D3	TTL Input(R3)
28	D25	TTL Input(VSYNC)	56	D4	TTL Input(R4)

Notes : 1. Refer to LVDS Transmitter Data Sheet for detail descriptions.
2. 7 means MSB and 0 means LSB at R,G,B pixel data

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3-2-2. Backlight Inverter

<u>Master (A board)</u>
- Inverter Connector : S14B-PH-SMC(manufactured by JST) or Equivalent
- Mating Connector : PHR-14 or Equivalent

<u>Slave(B,board)</u>
- Inverter Connector : S12B-PH-SMC(manufactured by JST) or Equivalent
- Mating Connector : PHR-12 or Equivalent

Table 5. INVERTER CONNECTOR PIN CONFIGURATION

Pin No	Symbol	Description	Master	Slave	Note
1	V_{BL}	Power Supply +24.0V	V_{BL}	V_{BL}	
2	V_{BL}	Power Supply +24.0V	V_{BL}	V_{BL}	
3	V_{BL}	Power Supply +24.0V	V_{BL}	V_{BL}	
4	V_{BL}	Power Supply +24.0V	V_{BL}	V_{BL}	
5	V_{BL}	Power Supply +24.0V	V_{BL}	V_{BL}	
6	GND	POWER GND	GND	GND	
7	GND	POWER GND	GND	GND	
8	GND	POWER GND	GND	GND	2
9	GND	POWER GND	GND	GND	
10	GND	POWER GND	GND	GND	
11	V_{BR-A}	0.0V ~ 3.3V	V_{BR-A}	Don't care	3
12	$V_{ON/OFF}$	0.0V ~ 5.0V	On/Off	Don't care	
13	V_{BR-B}	0.0V ~ 3.3V	V_{BR-B}	-	4
14	Open	Open	Open	-	

Notes : 1. Pin 1~10 should connect to master and slave connector
2. GND is connected to the LCD's metal frame.
3. "Open" : V_{BR-A} = 1.65V
4. Pin#13 can be opened. (if Pin #13 is open , V_{BR-B} is 3.3V)
5. Each impedance of pin #11, 12 and 13 is 410 k-ohm,273 k-ohm and 98 k-ohm.

◆ **Rear view of LCM**

PCB

PCB

14

1

1

12

\<Master\>

\<Slave\>

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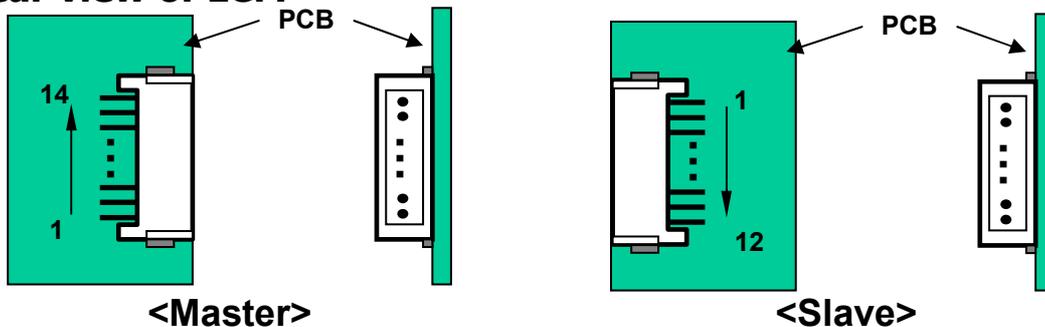
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3-3. Signal Timing Specifications

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 (DE Only Mode)

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	tHV	-	960	-	tclk	
	Blank	tHB	100	140	320	tclk	
	Total	tHP	1060	1100	1280	tclk	2200/2
Vertical	Display Period	tVV	-	1080	-	Lines	
	Blank	tVB	11	45	69	Lines	
	Total	tVP	1091	1125	1149	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Note
Frequency	DCLK	fCLK	70	74.25	77	MHz	148.5/2
	Horizontal	fH	65.5	67.5	68.9	KHz	
	Vertical	fV	57	60	63	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.
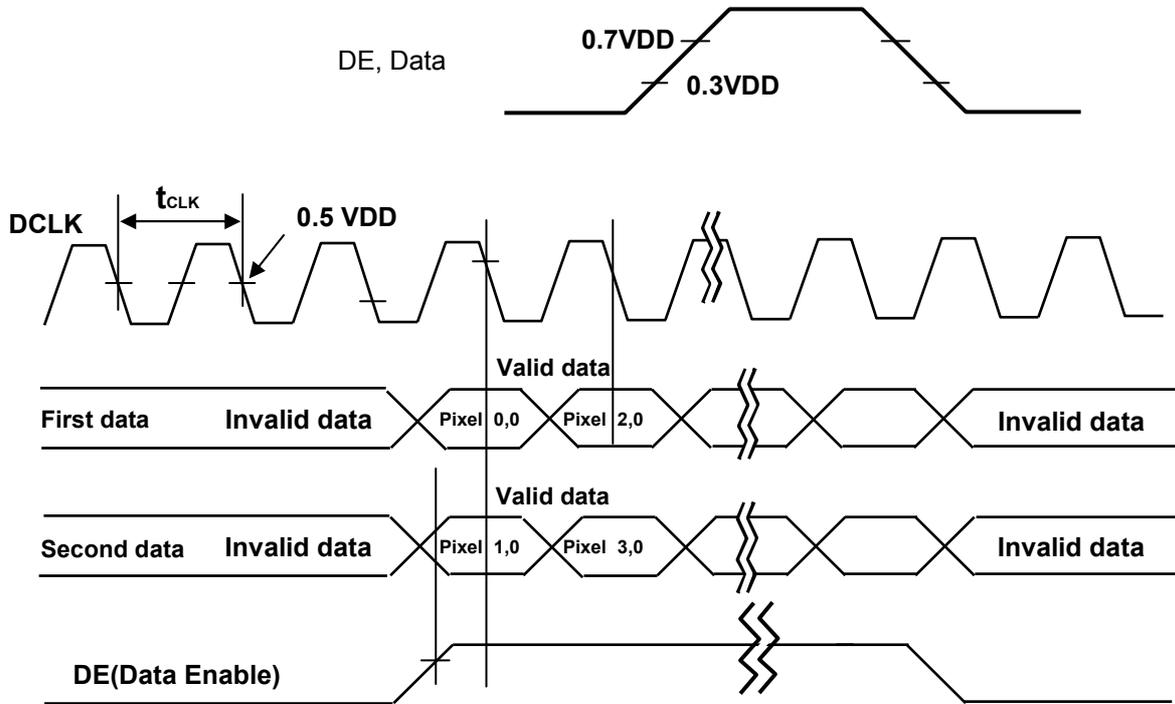
Table 7. TIMING TABLE for PAL (DE Only Mode)

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	tHV	-	960	-	tclk	
	Blank	tHB	100	140	240	tclk	
	Total	tHP	1060	1100	1200	tclk	2200/2
Vertical	Display Period	tVV	-	1080	-	Lines	
	Blank	tVB	25	45	65	Lines	
	Total	tVP	1105	1125	1145	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Note
Frequency	DCLK	fCLK	59.63	61.88	67.5	MHz	123.75/2
	Horizontal	fH	55.25	56.25	57.25	KHz	
	Vertical	fV	47	50	53	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.
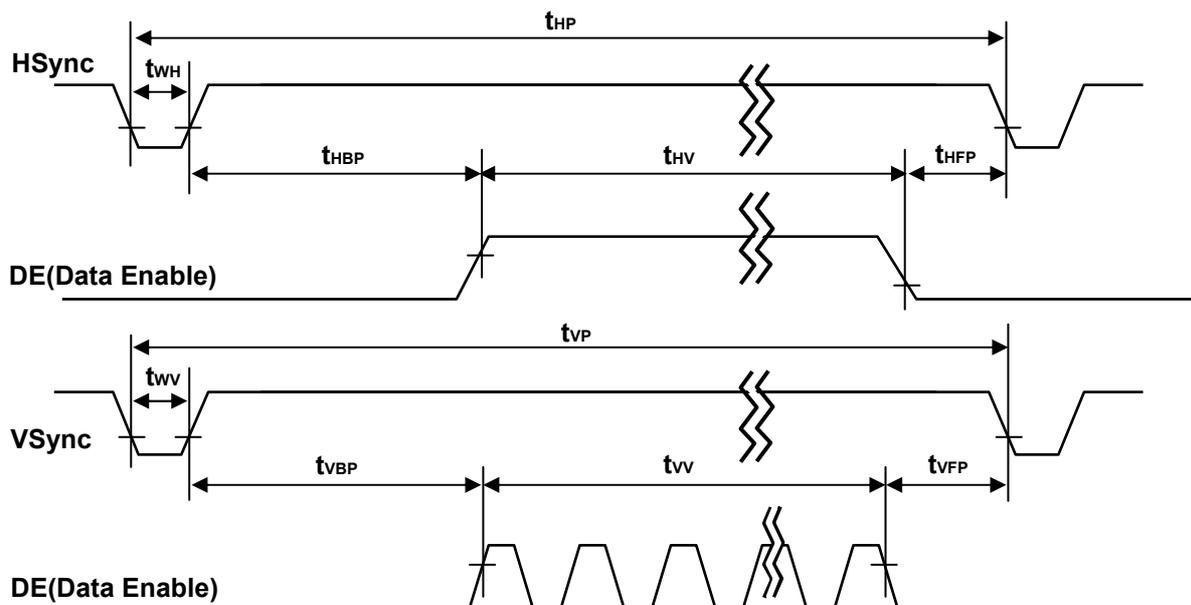
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3-4. Signal Timing Waveforms

DE, Data

0.7VDD
0.3VDD

DCLK t_{CLK} 0.5 VDD

Valid data

First data   **Invalid data**   Pixel 0,0   Pixel 2,0   **Invalid data**

Valid data

Second data   **Invalid data**   Pixel 1,0   Pixel 3,0   **Invalid data**

DE(Data Enable)

* **Reference : Sync. Relation**

* tHB = tHFP + tWH + tHBP
* tVB = tVFP + tWV + tVBP

t_{HP}

HSync t_{WH}

t_{HBP} t_{HV} t_{HFP}

DE(Data Enable)

t_{VP}

VSync t_{WV}

t_{VBP} t_{VV} t_{VFP}

DE(Data Enable)

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3-5. Color Data Reference

The brightness of each primary color(red,green,blue) is based on the 8-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 MSB ... LSB								GREEN MSB ... LSB								BLUE MSB ... LSB								
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	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
	Red (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	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	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
RED	RED (000) Dark	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	...				...								...								...				
	RED (254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (000) Dark	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	1	0	0	0	0	0	0	0	0
	...				...								...								...				
	GREEN (254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	GREEN (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE (000) Dark	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	1
	...				...								...								...				
	BLUE (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	BLUE (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

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3-6. Power Sequence

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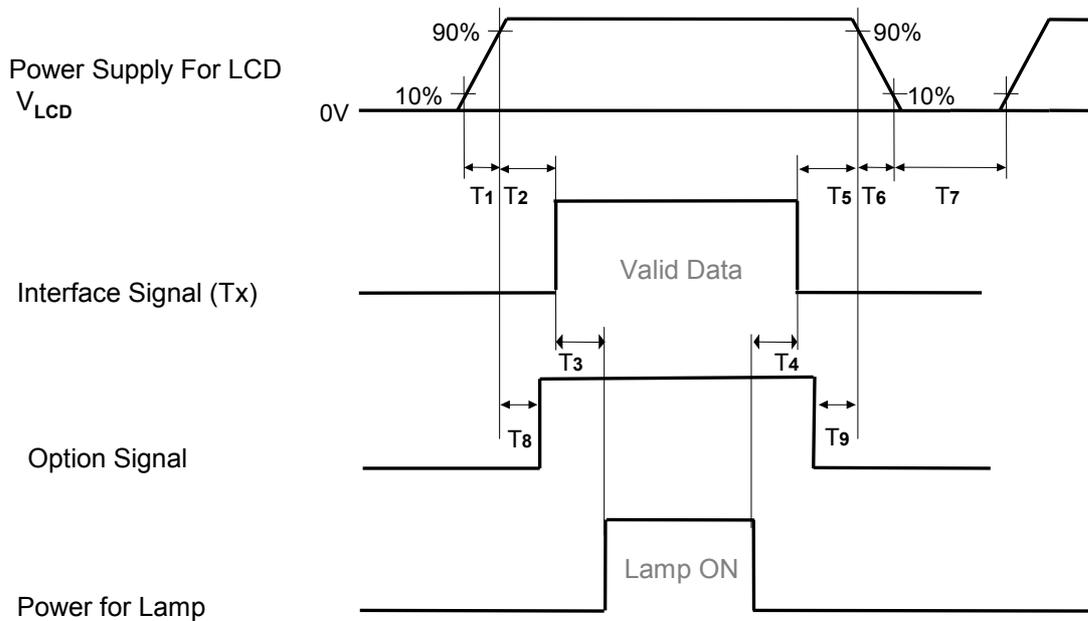
Table 9. POWER SEQUENCE

Parameter	Value			Unit
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0.5	-	50	ms
T3	200	-	-	ms
T4	200	-	-	ms
T5	0.5	-	50	ms
T6	0.01	-	300	ms
T7	1.0	-	-	s
T8	0 < T8 < T2			ms
T9	0 < T9 < T5			ms

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. Flicker would come out when power on-off(T7=under 2s) is tested over several ten-times.
4. The case when the T2/T5 exceed maximum specification, it operates protection
   pattern(Black pattern) till valid signal inputted. There is no reliability problem.
5. 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.

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3-6-2. Sequence for Inverter
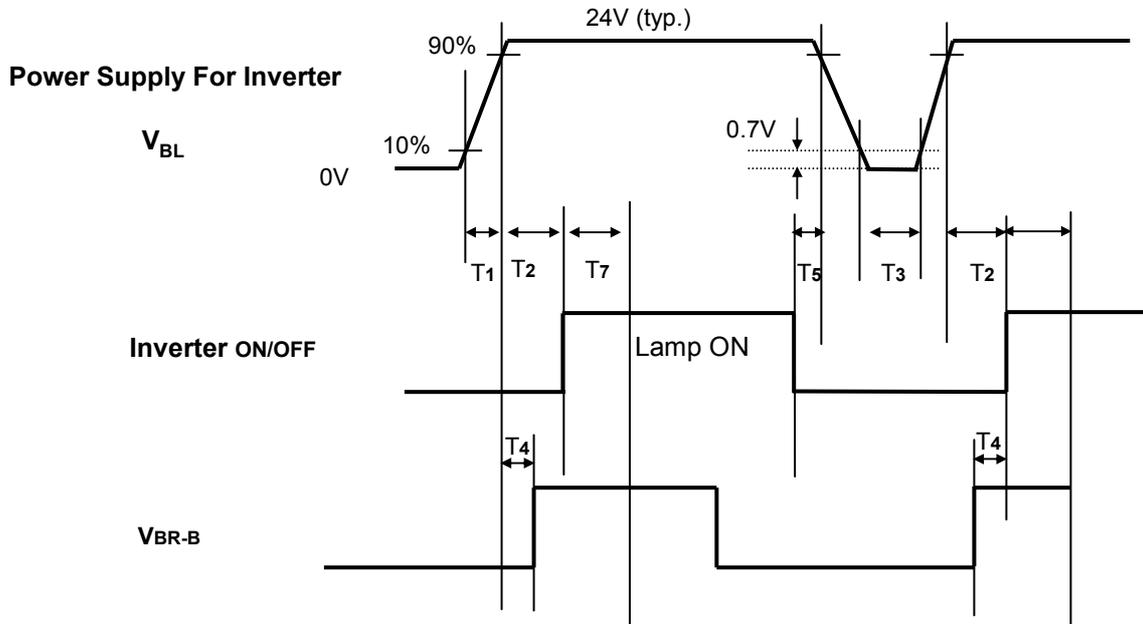
3-6-3. Deep condition for Inverter
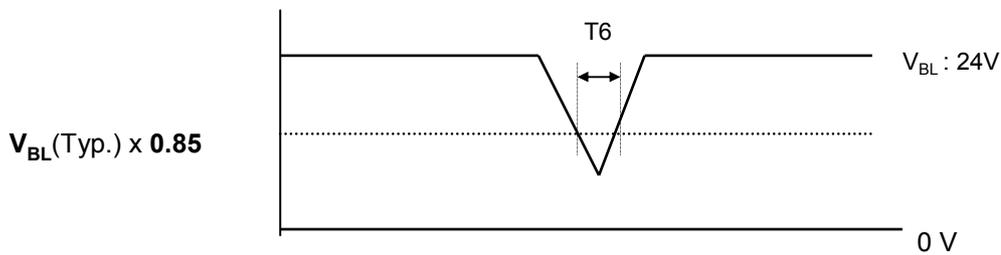
Table 11. Power Sequence for Inverter

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 0.85
T7	1000	-	-	ms	3

Notes : 1. T1 describes rising time of 0V to 24V and is not applied at restarting time.

2. T4(max) is less than T2.

3. In T7 section, V_{BR-B} should be 3.3V (Max).

4. When V_{BL}[24V] is supplied always, there is no reliability problem.

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Product Specification

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 min in a dark environment at 25± 2℃. The specified optical values are measured at an approximate 50cm distance from the LCD surface on condition that viewing angle of Φ and θ equal to 0 °.
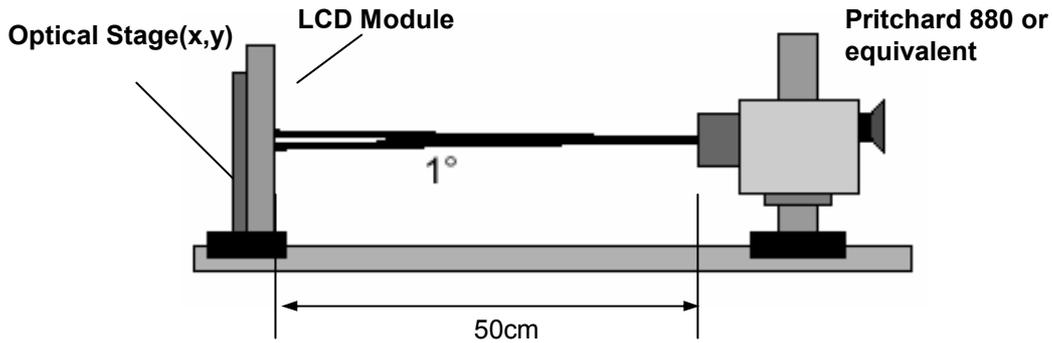FIG. 1 shows additional information concerning the measurement equipment and method.

FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 11. OPTICAL CHARACTERISTICS

Ta= 25± 2℃, V_{LCD}=12.0V, f_V=60Hz, Dclk=148.5MHz, V_{BR-A}=3.3V, V_{BR-B}=3.3V

Parameter		Symbol		Value			Unit	Note
				Min	Typ	Max		
Contrast Ratio		CR		700	1000	-		1
		CR With AI		1400	2000	-		
Surface Luminance, white		L_{WH}		400	500		cd/m²	2
Luminance Variation		δ_{WHITE}	5P			1.3		3
Response Time (Gray-to-Gray)		Tr_R , Tr_D			8	16	ms	4
Color Coordinates [CIE1931]	RED	Rx			0.638			
		Ry			0.340			
	GREEN	Gx			0.279			
		Gy		Typ -0.03	0.611	Typ +0.03		
	BLUE	Bx			0.146			
		By			0.062			
	WHITE	Wx			0.279			
		Wy			0.292			
Viewing Angle (CR>10)								
	x axis, right(φ=0°)	θr		85	89	-		5
	x axis, left (φ=180°)	θl		85	89	-	degree	
	y axis, up (φ=90°)	θu		85	89	-		
	y axis, down (φ=270°)	θd		85	89	-		
Gray Scale								6

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Note :

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

CR = The Maximum Value of CRn

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

Measure Position : 5-point. See FIG. 2 for more information

2. Surface Luminance(LWH) is the luminance value measured at an approximate 50cm distance from

the center 1-point of LCD surface as all pixels displaying white. See FIG. 2 for more information.

3. The variation of surface luminance , δ WHITE is defined as :

δ WHITE(5P) = Maximum(Lon1,Lon2, Lon3, Lon4, Lon5) / Minimum(Lon1,Lon2, Lon3, Lon4, Lon5)

Where Lon1 to Lon5 are the luminance with all pixels displaying white at 5 locations .
For more information, see the FIG. 2.

4. Response time is defined as the required time for the transition from G(N) to G(M) (Rise Time, TrR) and from G(M) to G(N) (Decay Time, TrD). For additional information see the FIG. 3. (N<M)

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. 4.

6. See Table 12 for gray scale specification

Table 12. GRAY SCALE SPECIFICATION

Gray Level	Luminance [%] (Typ.)	Luminance [%] (Typ.) with AI
L0	0.16	0.06
L15	0.33	0.13
L31	0.96	0.64
L47	2.36	1.80
L63	4.67	3.56
L79	7.95	6.20
L95	12.2	10.3
L111	17.2	14.2
L127	22.5	19.5
L143	28.9	25.5
L159	36.5	32.6
L175	44.1	40.8
L191	54.3	50.4
L207	64.4	60.2
L223	75.3	72.4
L239	87.3	85.0
L255	100	100

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Product Specification

Measuring point for surface luminance & measuring point for luminance variation.

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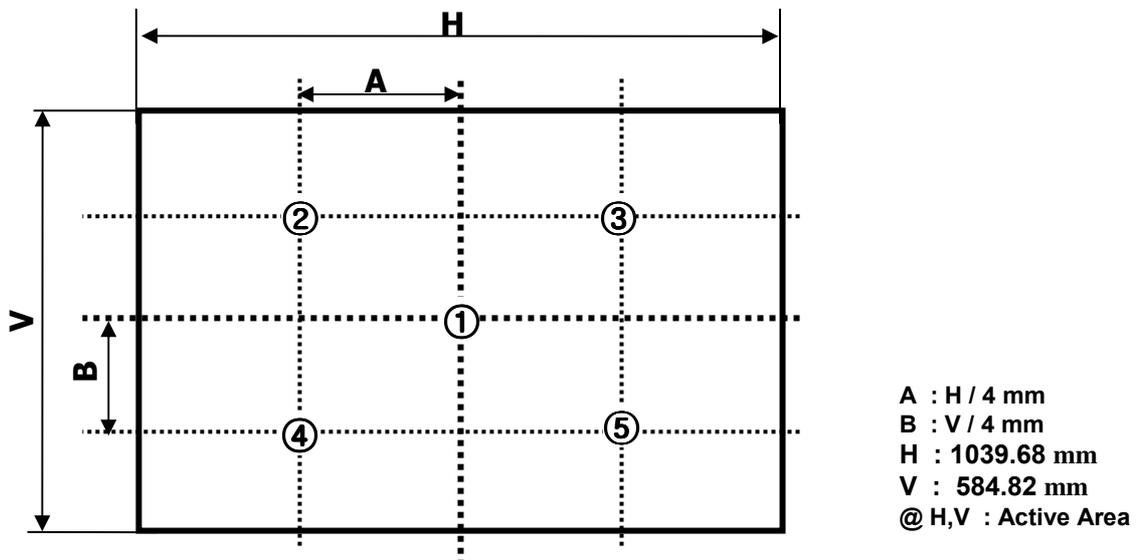H : 1039.68 mm
V : 584.82 mm
@ H,V : Active Area

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)".
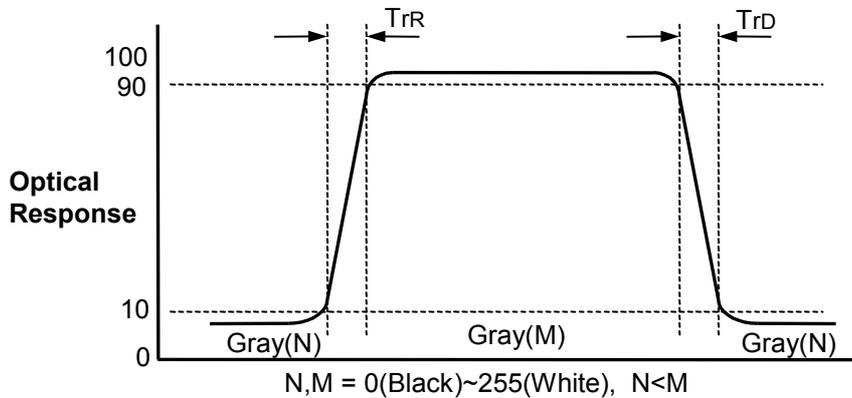

N,M = 0(Black)~255(White), N<M

FIG. 3 Response Time

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Product Specification

Dimension of viewing angle range

Normal

E

Y

ϕ = 90 °, Up

ϕ = 180 °, Left

θ

ϕ

ϕ = 0 °, Right

ϕ = 270 °, Down
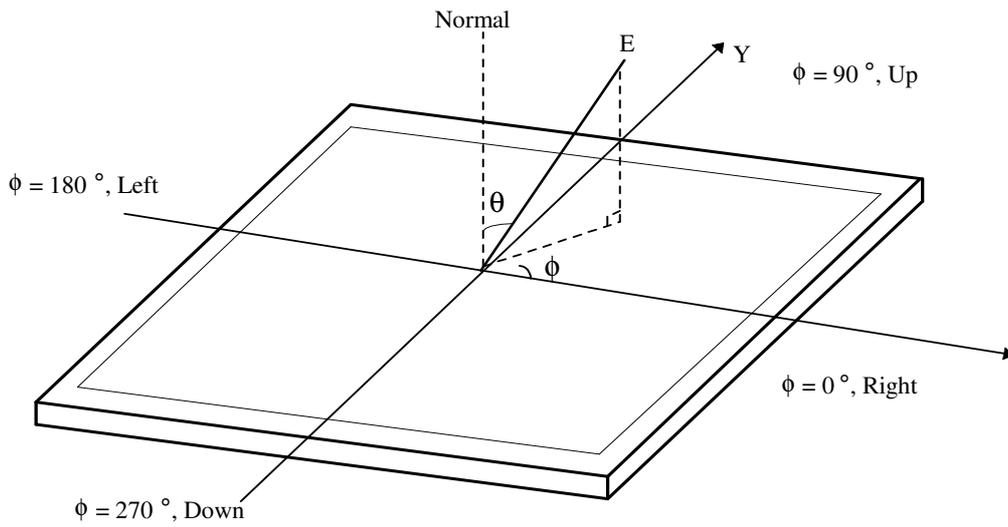
FIG. 4 Viewing Angle

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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	16.5 Kg (Typ.)	
Surface Treatment	Hard coating(3H) Anti-glare treatment of the front polarizer	

Note : Please refer to page21 and 22 for mechanic drawings in terms of tolerance.

Product Specification

<FRONT VIEW>

NOTES
1. Unspecified tolerances are to be ±1.0mm.
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 ≤ 1.5mm
   (2) Y-Direction : IC-DI ≤ 1.5mm
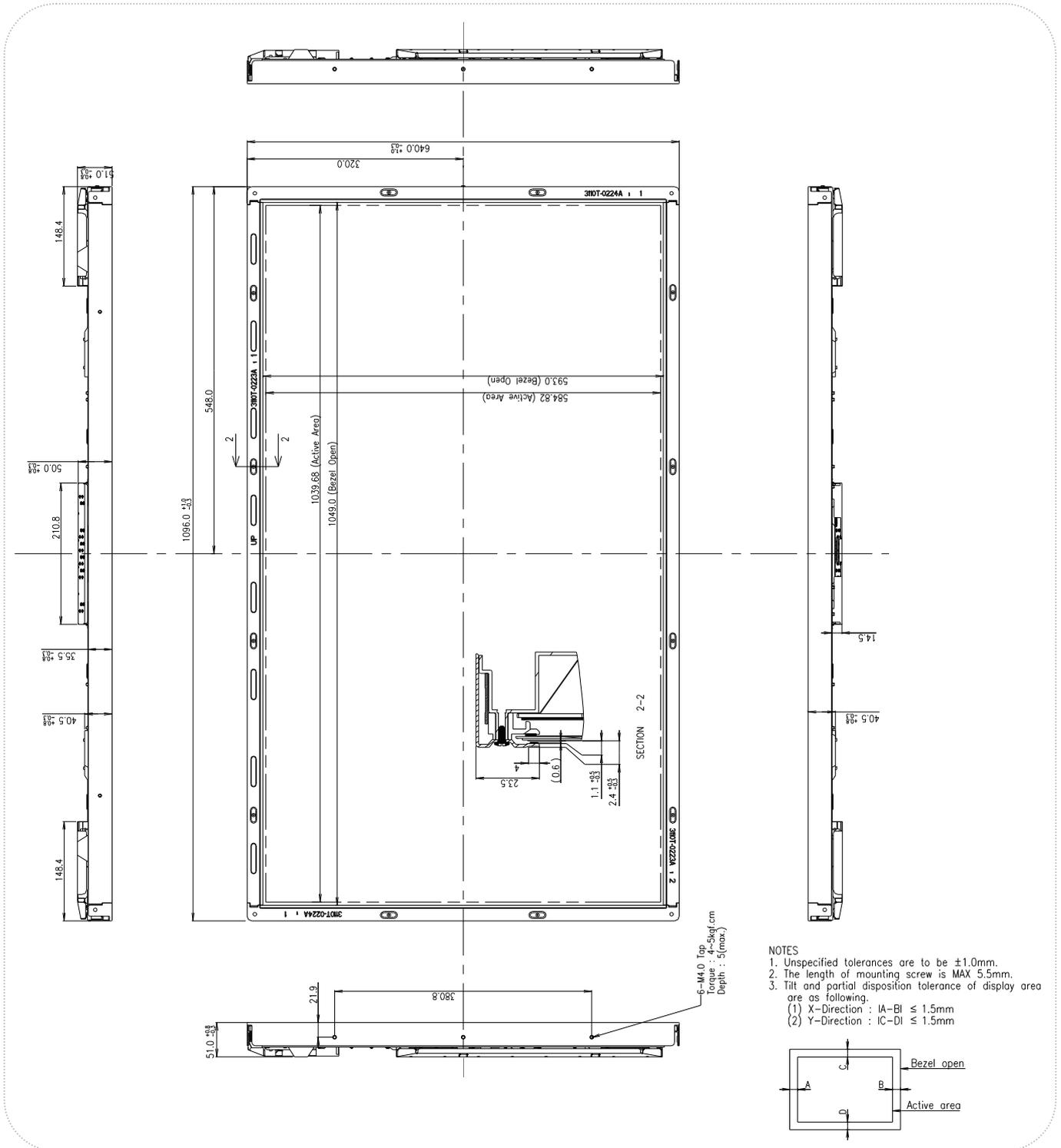
Product Specification

<REAR VIEW>

6. Reliability

Table 14. ENVIRONMENT TEST CONDITION

No.	Test Item	Condition
1	High temperature storage test	Ta= 50℃ 240h
2	Low temperature storage test	Ta= -20℃ 240h
3	High temperature operation test	Ta= 40℃ 50%RH 240h
4	Low temperature operation test	Ta= 0℃ 240h
5	Vibration test (non-operating)	Wave form : random Vibration level : 1.0G RMS Bandwidth : 10-300Hz Duration : 30 min for X,Y,Z axis 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 ℃, 90%RH
8	Altitude operating storage / shipment	0 - 14,000 feet(4267.2m) 0 - 40,000 feet(12192m)

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) C.I.S.P.R. "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special Committee on Radio Interference.
c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electrotechnical Standardization.(CENELEC), 1998
(Including A1: 2000)

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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 ~ 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

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.

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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℃ and 35℃ 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.
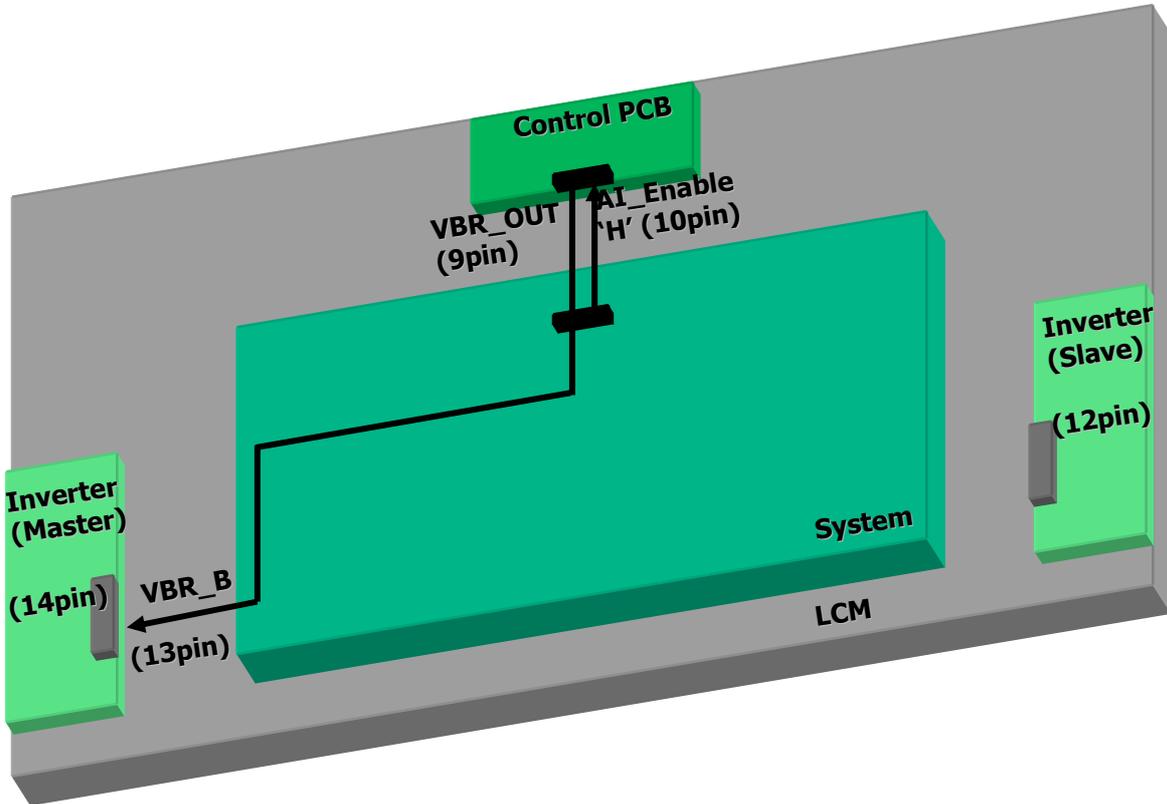
APPENDIX - I

■ AI Application Block Diagram example

Fig. AI Application By-pass on System Board