SPECIFICATION
FOR
APPROVAL

( ) Preliminary Specification
(●) Final Specification

Title	52.0” WUXGA TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG.Philips LCD Co., Ltd.
*MODEL	LD520WU1
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
Y.S. Park / Senior Manager	
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TV Product Development Dept.
LG. Philips LCD Co., Ltd

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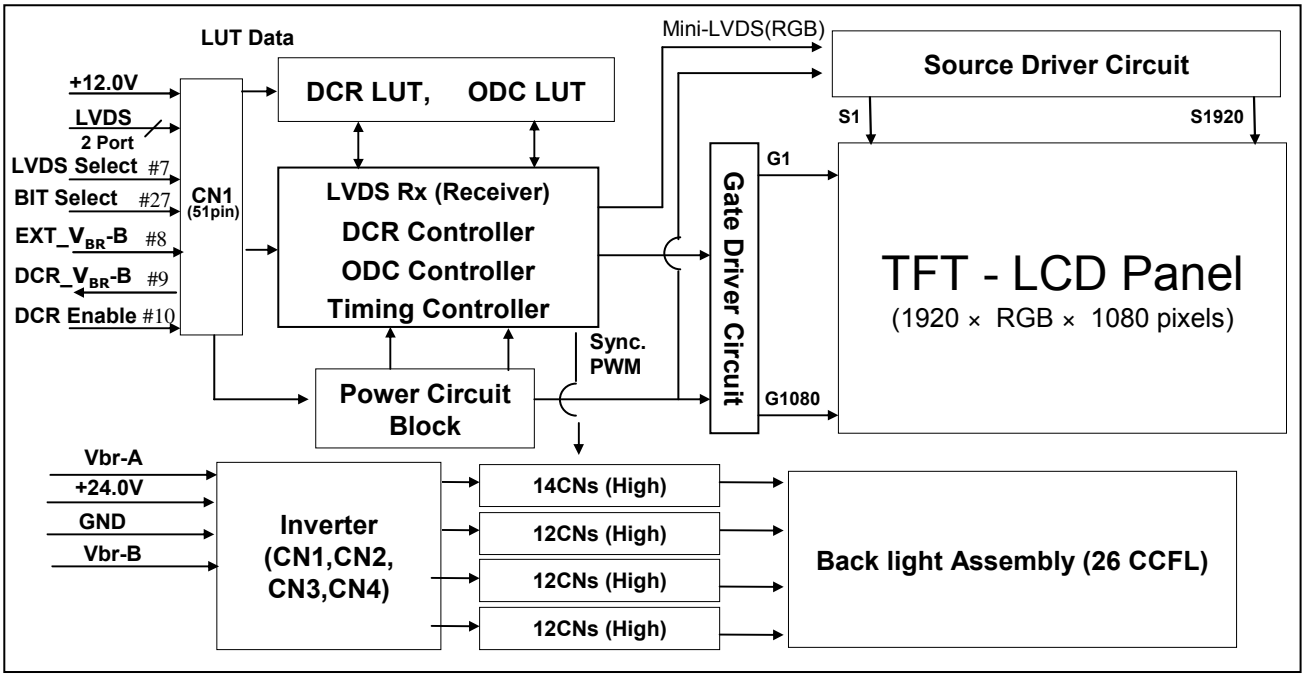
Record of Revisions

Revision No.	Revision Date	Page	Description
1.0	Nov.14.2007	-	Final specification

1. General Description

LD520WU1 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 type display operating in the normally black mode. It has a 52.04 inch diagonally measured active display area with WUXGA resolution (1080 vertical by 1920 horizontal pixel array) Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the luminance of the sub-pixel color is determined with a 10-bit gray scale signal for each dot, thus presenting a palette of more than 1Billon of colors.
It has been designed to apply the 10-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	52.04 inches(1321,816mm) diagonal
Outline Dimension	1236.0mm X 719.2mm X 59.5mm(Typ)
Pixel Pitch	0.200mm x 0.600mm x RGB
Pixel Format	1920 horiz. by 1080 vert. pixels RGB stripe arrangement
Color Depth	10bit, 1Billon 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 320.6 Watt (Typ.) (Logic= 8.58, **Inverter= 312 [V_{BR-A} = 1.65V])**
Weight	23.5Kg (Typ.)
Display Operating Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer

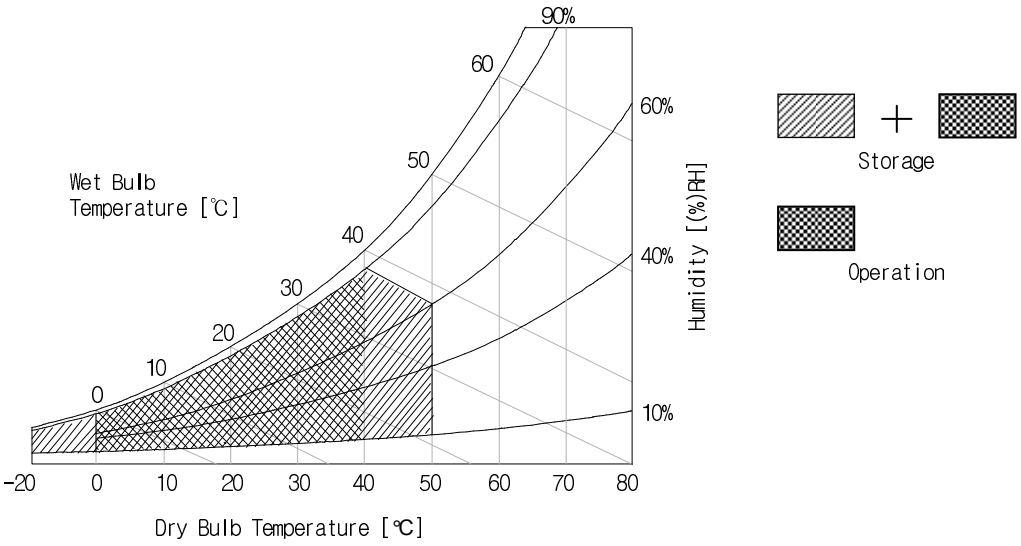
2. Absolute Maximum Ratings

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 ± 2 ℃
	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, #10, #27 Pin
ON/OFF Control Voltage		$V_{ON/OFF}$	-0.3	5.25	-	
Brightness Control Voltage		V_{BR}	0.0	5.0	-	
Operating Temperature		T_{OP}	0	50	℃	Note 2
Storage Temperature		T_{ST}	-20	50	℃	Note 1
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.
2. Gravity mura can be guaranteed under 55℃ condition (Panel surface's temperature)



3. Electrical Specifications

3-1. Electrical Characteristics

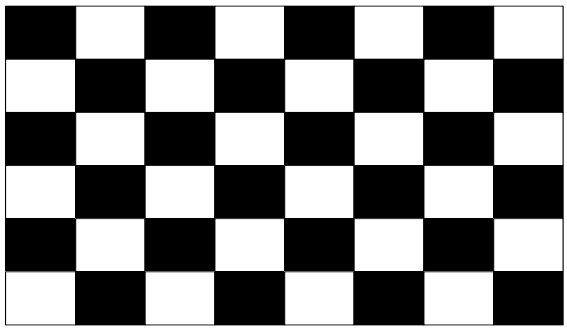
It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The other input power for the CCFL/Backlight is to power inverter.

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}	-	715	822	mA	1
		-	940	1080	mA	2
Power Consumption	P_{LCD}	-	8.58	10.34	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 : 255Gray(1023Gray)
Black : 0Gray



Mosaic Pattern(8 x 6)

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	-	13	14	A	V_{BR-A} = 1.65V … 1
				-	14	15	A	V_{BR-A} = 3.3V … 1
	Before Aging		IBL_B	-	16	17	A	V_{BR-A} = 1.65V … 2
				-	17	18	A	V_{BR-A} = 3.3V … 2
Power Supply Input Current (In-Rush)			Irush	-	-	19	A	V_{BL} = 22.8V V_{BR-B} = 3.3V V_{BR-A} = 1.65V
Power Consumption			PBL	-	312	336	W	V_{BR-A} = 1.65V … 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	
Lamp:								
Life Time				50,000	60,000		Hrs	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 and 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℃.
   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 value applies to lamp with horizontal alignment and also vertical alignment.
   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 at25± 2℃
5. The duration of rush current is about 10ms.

3-2. Interface Connections

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

3-2-1. LCD Module

- LCD Connector(CN1): FI-RE51S-HF or Equivalent
- Mating Connector : FI-RE51HL or Equivalent

Table 3. MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	GND	Ground	27	BIT Select	Logic 'L' : 8bit, 'H' : 10bit
2	NC	Reserved	28	RE0N	SECOND CHANNEL 0-
3	NC	Reserved	29	RE0P	SECOND CHANNEL 0+
4	NC	(I2C DATA Interface)	30	RE1N	SECOND CHANNEL 1-
5	NC	(I2C CLK Interface)	31	RE1P	SECOND CHANNEL 1+
6	NC	(EEPROM Write Protection)	32	RE2N	SECOND CHANNEL 2-
7	LVDS Select	Logic 'L': LG , 'H' : DISM	33	RE2P	SECOND CHANNEL 2+
8	EXT_V_{BR}-B	EXT_V_{BR}-B Input	34	GND	Ground
9	DCR_V_{BR}-B	DCR_V_{BR}-B Output	35	RECLKN	SECOND CLOCK CHANNEL C-
10	DCR 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-	38	RE4N	SECOND CHANNEL 4-
15	RO1P	FIRST CHANNEL 1+	39	RE4P	SECOND CHANNEL 4+
16	RO2N	FIRST CHANNEL 2-	42	GND	Ground
17	RO2N	FIRST CHANNEL 2+	43	GND	Ground
18	GND	Ground	44	GND	Ground (NSB)
19	ROCLKN	FIRST CLOCK CHANNEL C-	45	GND	Ground
20	ROCLKP	FIRST CLOCK CHANNEL C+	46	GND	Ground
21	GND	Ground	47	**NC**	No connection
22	RO3N	FIRST CHANNEL 3-	48	V_{LCD}	Power Supply +12.0V
23	RO3P	FIRST CHANNEL 3+	49	V_{LCD}	Power Supply +12.0V
24	RO4N	FIRST CHANNEL 4-	50	V_{LCD}	Power Supply +12.0V
25	RO4P	FIRST CHANNEL 4+	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 DCR test of the LCD module. If not used, these pins are no connection.
6. Specific pin No. #44 is used for 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).

3-2-2. Backlight Inverter

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

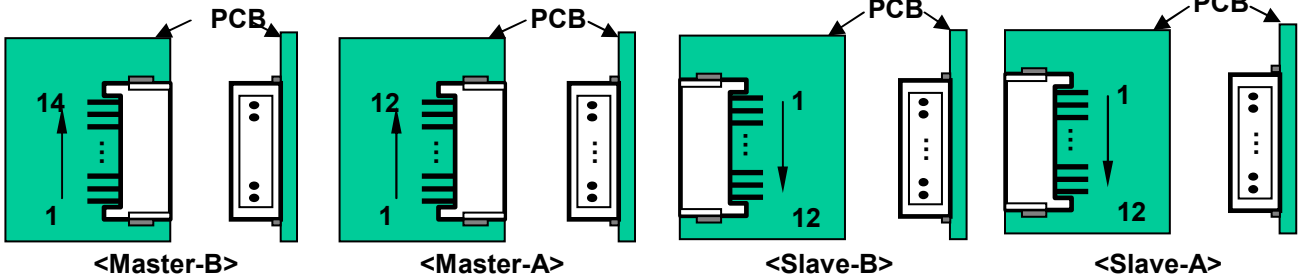
Slave (MA,SA,SB)
-Inverter Connector : S12B-PH-SMC (JST)
or Equivalent
-Mating Connector : PHR-12 or Equivalent

Table 7. INVERTER CONNECTOR PIN CONFIGULATION

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	Backlight Ground	GND	GND	1
7	GND	Backlight Ground	GND	GND	
8	GND	Backlight Ground	GND	GND	
9	GND	Backlight Ground	GND	GND	
10	GND	Backlight Ground	GND	GND	
11	V_{BR-A}	Analog dimming voltage DC 0.0V ~ 3.3V (Typ : 1.65V)	V_{BR-A}	Don't care	2, 3
12	$V_{ON/OFF}$	0.0V ~ 5.0V	On/Off	Don't care	
13	V_{BR-B}	Burst dimming voltage DC 0.0V ~ 3.3V	V_{BR-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, V_{BR-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 : V_{BR-B} =0V Maximum Brightness : V_{BR-B} = 3.3V
4. Even though Pin #14 is open, there is no effect on inverter operating, The output terminal of inverter.
5. Each impedance of pin #11,12 and 13 is 100[kΩ], 10 [kΩ], 100[kΩ]

◆ **Rear view of LCM**



<Master-B> <Master-A> <Slave-B> <Slave-A>

3-3. Signal Timing Specifications

Table 8 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 8. TIMING TABLE for NTSC (DE Only Mode)

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Period	t_{CLK}	12.99	13.47	14.29	ns	
	Frequency	-	70	74.25	77	MHz	=148.5/2
Hsync	Period	t_{HP}	1060	1100	1280	t_{CLK}	1
	Horizontal Valid	t_{HV}	-	960	-	t_{CLK}	
	Horizontal Blank	t_{HB}	100	140	320		
	Frequency	f_H	65.5	67.5	68.9	KHz	
	Width	t_{WH}	12	30	60	t_{CLK}	
	Horizontal Back Porch	t_{HBP}	12	78	120		
	Horizontal Front Porch	t_{HFP}	12	32	120		
Vsync	Period	t_{VP}	1091	1125	1149	t_{HP}	1
	Vertical Valid	t_{VV}	-	1080	-	t_{HP}	
	Vertical Blank	t_{VB}	12	45	68	t_{HP}	
	Frequency	f_V	57	60	63	Hz	
	Width	t_{WV}	4	5	10	t_{HP}	
	Vertical Back Porch	t_{VBP}	6	36	48		
	Vertical Front Porch	t_{VFP}	2	4	10		

Note : 1. $t_{HB} = t_{HFP} + t_{WH} + t_{HBP}$
$t_{VB} = t_{VFP} + t_{WV} + t_{VBP}$

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.

Table 9 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 9. TIMING TABLE for PAL (DE Only Mode)

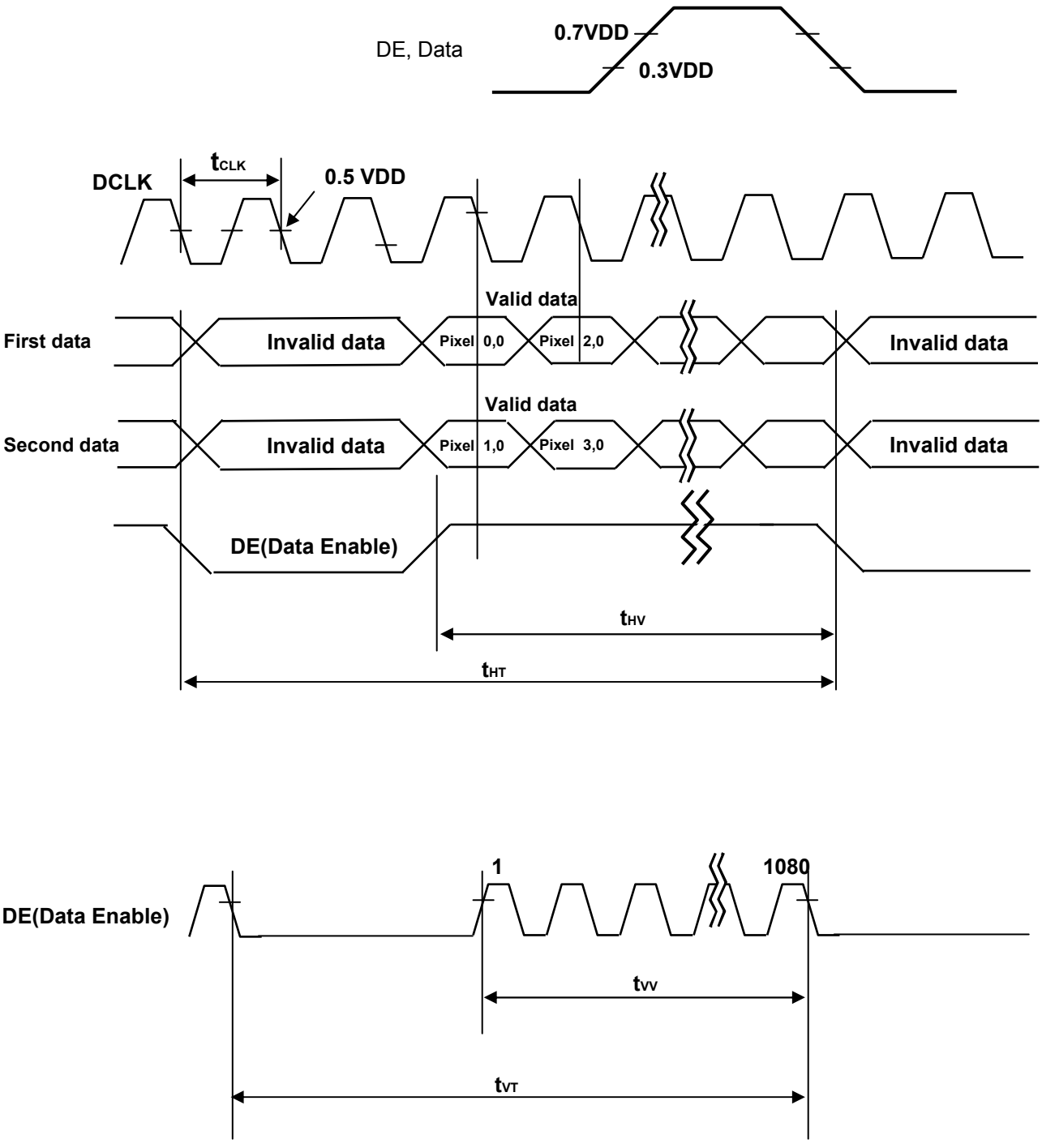
ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Period	t_{CLK}	14.81	16.16	16.77	ns	
	Frequency	-	59.63	61.88	67.5	MHz	=123.75/2
Hsync	Period	t_{HP}	1060	1100	1200	t_{CLK}	1
	Horizontal Valid	t_{HV}	-	960	-	t_{CLK}	
	Horizontal Blank	t_{HB}	100	140	240		
	Frequency	f_H	55.25	56.25	57.25	KHz	
	Width	t_{WH}	12	30	60	t_{CLK}	
	Horizontal Back Porch	t_{HBP}	12	78	120		
	Horizontal Front Porch	t_{HFP}	12	32	120		
Vsync	Period	t_{VP}	1105	1125	1145	t_{HP}	1
	Vertical Valid	t_{VV}	-	1080	-	t_{HP}	
	Vertical Blank	t_{VB}	25	45	65	t_{HP}	
	Frequency	f_V	47	50	53	Hz	
	Width	t_{WV}	4	5	10	t_{HP}	
	Vertical Back Porch	t_{VBP}	6	36	45		
	Vertical Front Porch	t_{VFP}	2	4	10		

Note : 1. $t_{HB} = t_{HFP} + t_{WH} + t_{HBP}$
$t_{VB} = t_{VFP} + t_{WV} + t_{VBP}$

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.

3-4. Signal Timing Waveforms



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 (0000)	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 (0001)	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 (0000)	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 (0001)	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 (0000)	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 (0001)	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

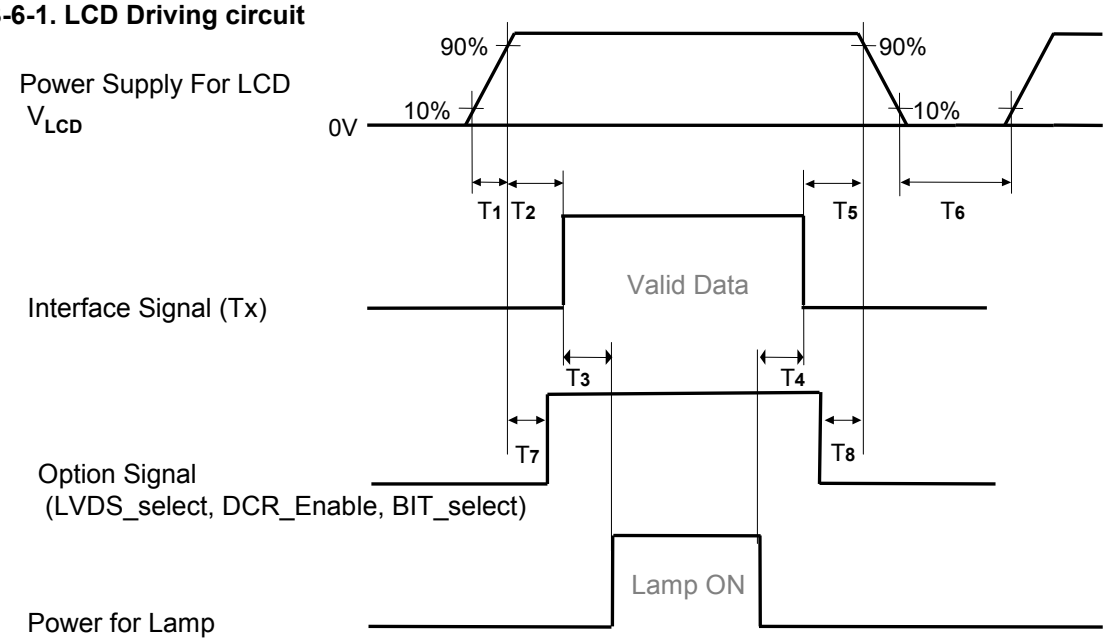


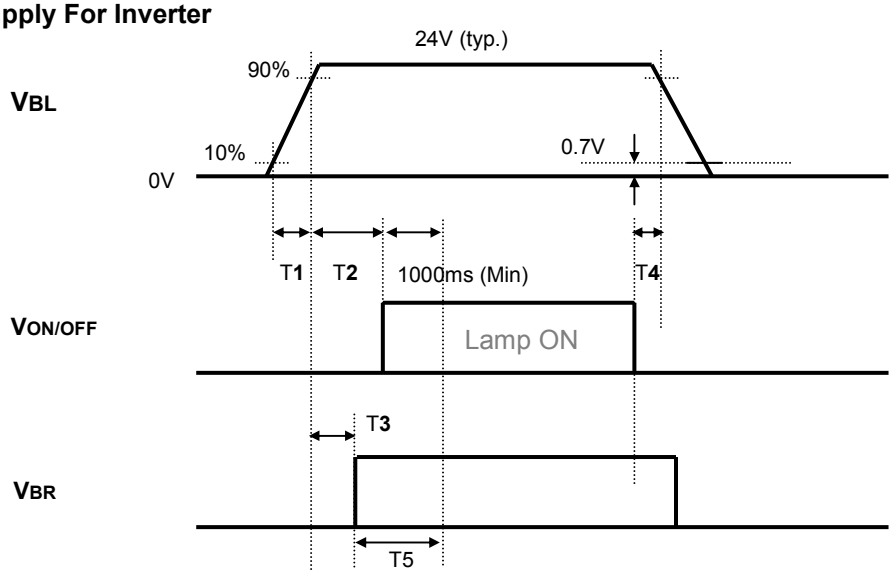
Table 9. POWER SEQUENCE

Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	0.5	-	20	ms	
T2	0.5	-	3 x (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. 60Hz : 3x(1/60Hz) = 50ms)
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.

3-6-2. On/Off for Inverter

Power Supply For Inverter



*** VBR: (VBR-A , VBR-B)**

3-6-3. Deep condition for Inverter

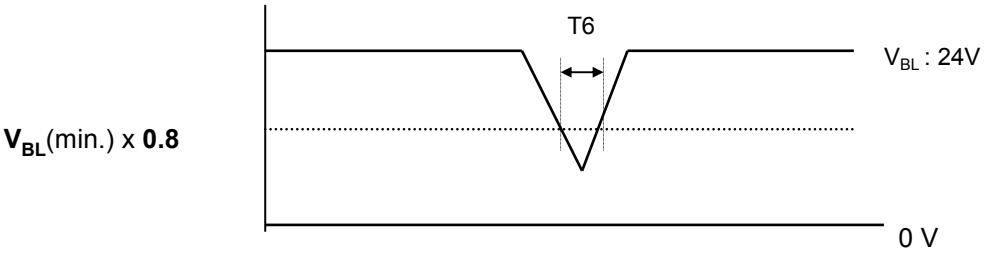


Table 11. Power Sequence for Inverter

Parameter	Values			Units	Remarks
	Min	Typ	Max		
T1	20	-	-	ms	1
T2	500	-	-	ms	
T3	0		-	ms	2
T4	10	-	-	ms	
T5	1000	-	-	ms	3
T6	-	-	10	ms	V_{BL}(min) x **0.8**

Notes : 1. T1 describes rising time of 0V to 24V and is not applied at restarting time.
2. T3(max) is less than T2.
3. In T5 section, VBR-B is 3.3V and VBR-A is 1.65V.

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable 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.

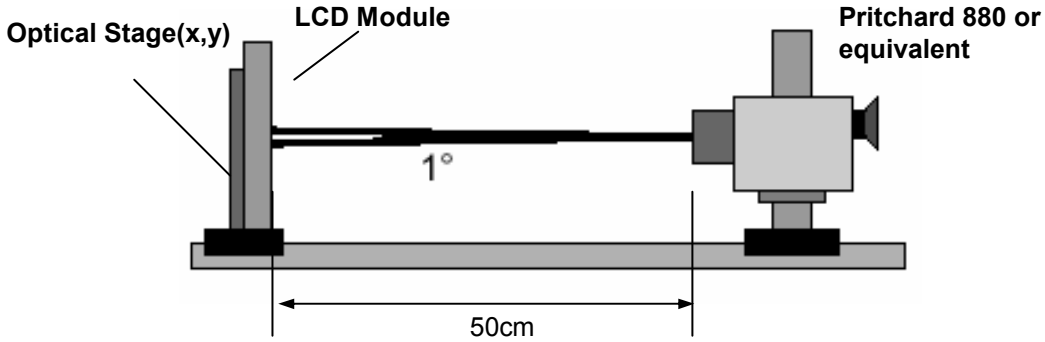


FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 11. OPTICAL CHARACTERISTICS

Ta= 25± 2℃, V_{LCD}=12.0V, fv=60Hz, Dclk=148.5MHz, V_{BR-A}=1.65V, V_{BR-B}=3.3V

Parameter		Symbol	Value			Unit	Note
			Min	Typ	Max		
Contrast Ratio		CR	600	800	-		1
Surface Luminance, white		L_{WH}	400	500	-	cd/m^2	2
Luminance Variation		δ_{WHITE} 5P	-	-	1.3		3
Response Time	G to G	-	-	9	14	ms	4
Color Coordinates [CIE1931]	RED	Rx	Typ -0.03	0.636	Typ +0.03		
		Ry		0.343			
	GREEN	Gx		0.284			
		Gy		0.616			
	BLUE	Bx		0.146			
		By		0.06			
	WHITE	Wx		0.272			
		Wy		0.278			
Viewing Angle (CR>10)							
	x axis, right(ϕ=0°)	θr	85	89	-	degree	5
	x axis, left (ϕ=180°)	θl	85	89	-		
	y axis, up (ϕ=90°)	θu	85	89	-		
	y axis, down (ϕ=270°)	θd	85	89	-		
Gray Scale							6

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

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

2. Surface luminance is luminance value at the center point across the LCD surface 50cm from the surface with all pixels displaying white.
For more information, see FIG 2.

3. The variation in surface luminance , δ WHITE is defined as :
δ WHITE(5P) = Maximum(L_{on1},L_{on2}, L_{on3}, ... , L_{on5}) / Minimum(L_{on1},L_{on2}, L_{on3}, ... , 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. Response time is defined as the required time for the 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)

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)
8bit	10bit	[Normal]
L0	L0	0.12
L15	L63	0.29
L31	L127	1.10
L47	L191	2.69
L63	L255	5.12
L79	L319	8.67
L95	L383	13.3
L111	L447	18.1
L127	L511	23.7
L143	L575	29.9
L159	L639	36.9
L175	L703	45.6
L191	L767	55.4
L207	L831	65.2
L223	L895	76.2
L239	L959	85.9
L255	L1023	100

Measuring point for surface luminance & measuring point for luminance variation

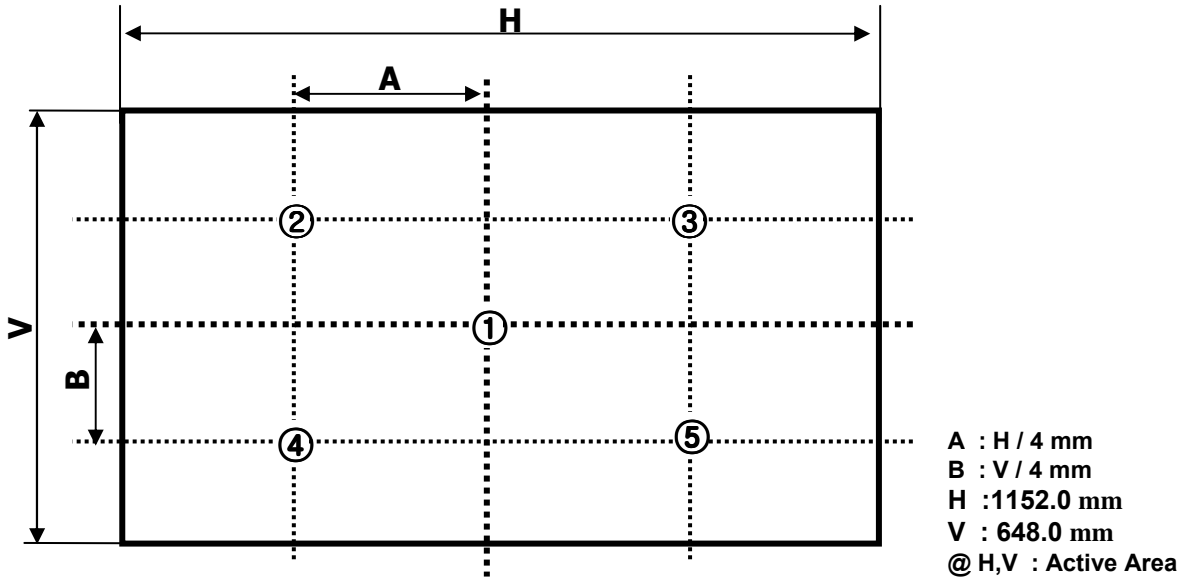


FIG. 2 Measure Point for Luminance

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

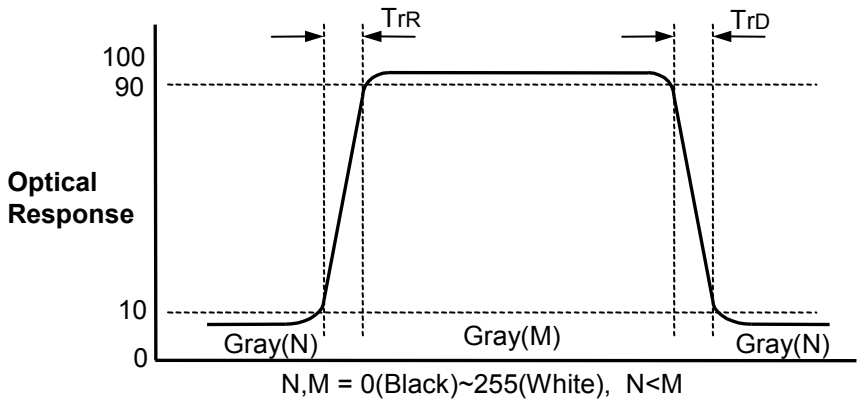


FIG. 3 Response Time

Dimension of viewing angle range

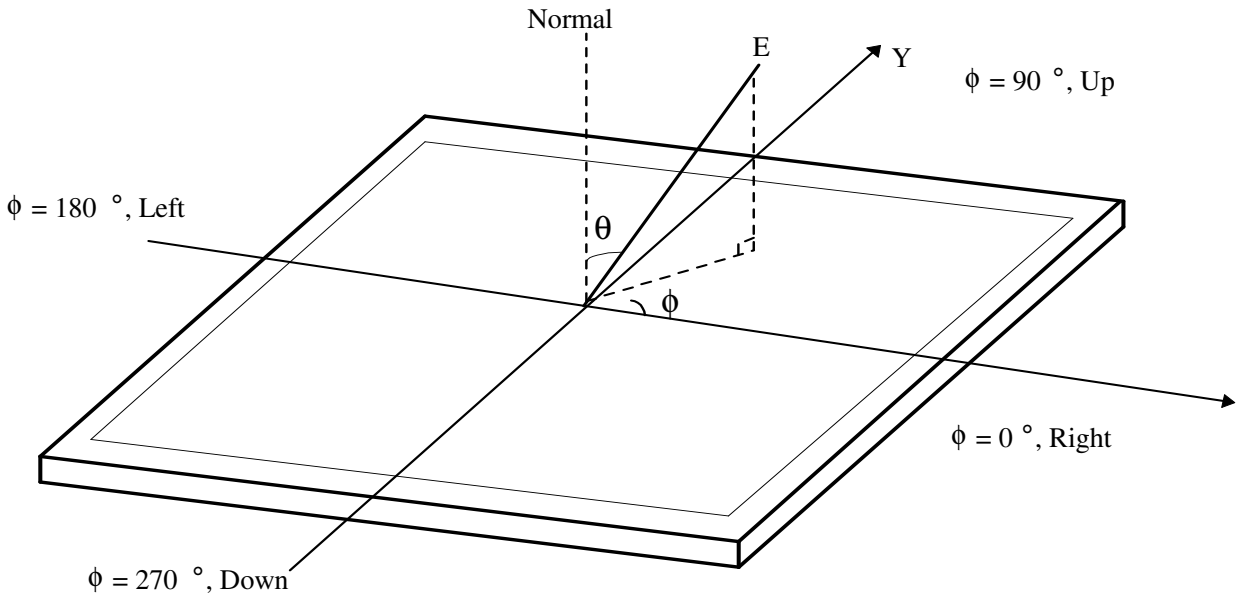


FIG. 4 Viewing angle

5. Mechanical Characteristics

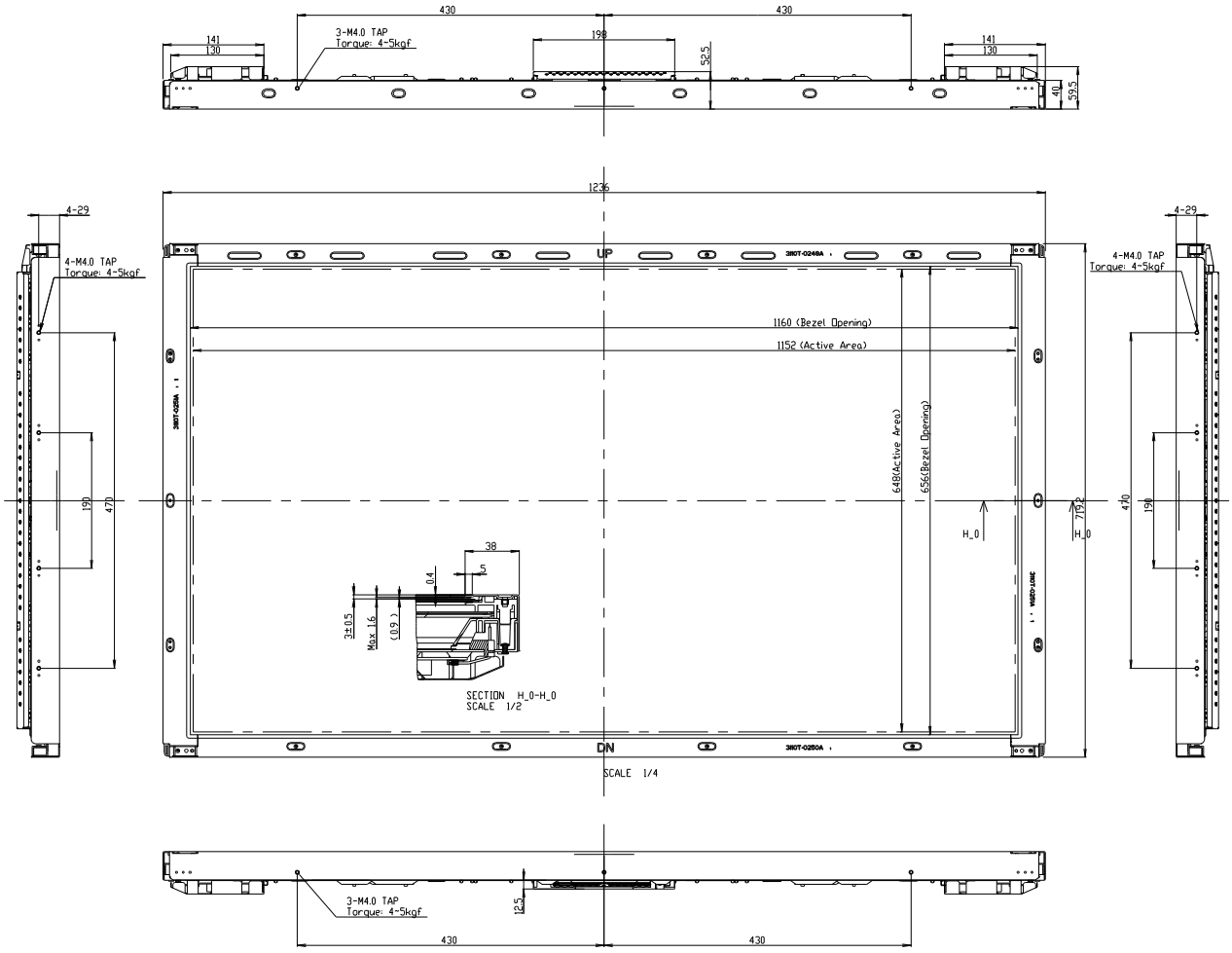
The following items provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD module.

Table 13. MECHANICAL CHARACTERISTICS

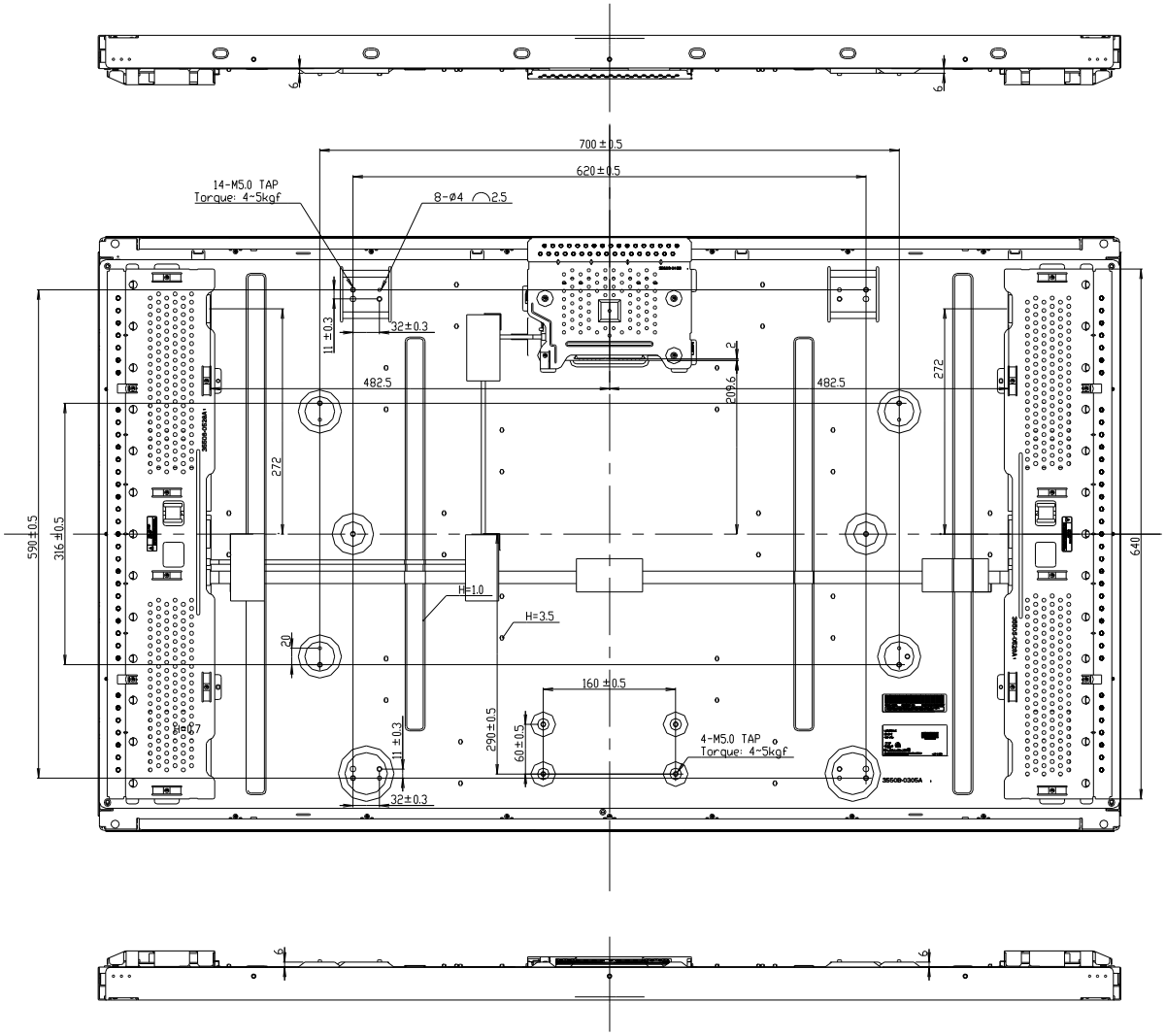
Outline Dimension	Horizontal	1236.0 mm
	Vertical	719.2 mm
	Depth	59.5 mm
Bezel Area	Horizontal	1160.0 mm
	Vertical	656.0 mm
Active Display Area	Horizontal	1152.0 mm
	Vertical	648.0 mm
Weight	23.5Kg(typ), 24.7kg(Max.)	
Surface Treatment	Hard coating(3H) Anti-glare treatment of the front polarizer **(Haze 13%)**	

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

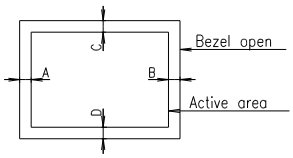
<FRONT VIEW>


430
430
141
130
3-M4.0 TAP
Torque: 4-5kgf
198
525
141
130
40
59.5
1236
4-29
4-M4.0 TAP
Torque: 4-5kgf
UP
1160 (Bezel Opening)
1152 (Active Area)
648(Active Area)
656(Bezel Opening)
H_0
H_0
191
470
38
5
0.4
3±0.5
Max 1.6
(0.9)
SECTION H_0-H_0
SCALE 1/2
DN
SCALE 1/4
3-M4.0 TAP
Torque: 4-5kgf
14.5
430
430

<REAR 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



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

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= 50℃ 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 : X,Y,Z, 30 min One time each direction
6	Shock test (non-operating)	Shock level : 50G 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) CISPR22 “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 Electro technical Standardization.(CENELEC), 1998
(Including A1: 2000)

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 : FACTORY CODE
G ~ 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

3. FACTORY CODE

Factory Code	Gumi	Nanjing	Paju
Mark	K	C	P

b) Location of Lot Mark

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

8-2. Packing Form

a) Package quantity in one Pallet : 10 pcs
b) Pallet Size : 1350mm× 1150mm× 950mm

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 can causes conductive particles 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.
(11) Partial darkness may happen during 3~5 minutes when LCM is operated initially in condition that luminance is under 40% at low temperature (under 5℃). This phenomenon is not a problem about reliability but LCD characteristic which disappears naturally after 3~5 minutes.

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.

9-7. Appropriate Condition for Public Display

- Generally large-sized LCD modules are designed for consumer applications (TV).
Accordingly, a long-term display like in Public Display (PD) application, can cause uneven display including image sticking. To optimize module's lifetime and function, several operating usages are required.

1. Normal operating condition
- Temperature: 0 ~ 40℃
- Operating Ambient Humidity : 10 ~ 90 %
- Display pattern: dynamic pattern (Real display)
Note) Long-term static display can cause image sticking.

2. Operating usages under abnormal condition1
a. Ambient condition
- Well-ventilated place is recommended to set up PD system.
b. Power and screen save
- Periodical power-off or screen save is needed after long-term display.[3.2)]

3. Operating usages to protect against image sticking due to long-term static display
   a. Suitable operating time: under 18 hours a day.
   b. Static information display recommended to use with moving image.
      - Cycling display between 5 minutes' information(static) display and 10 seconds' moving image.
   c. Background and character (image) color change
      - Use different colors for background and character, respectively.
      - Change colors themselves periodically.
   d. Avoid combination of background and character with large different luminance.
   1) Abnormal condition just means conditions except normal condition.
   2) Black image or moving image is strongly recommended as a screen save.

4. Lifetime in this spec. is guaranteed only when PD is used according to operating usages.

APPENDIX - I

■ AI Application Block Diagram example

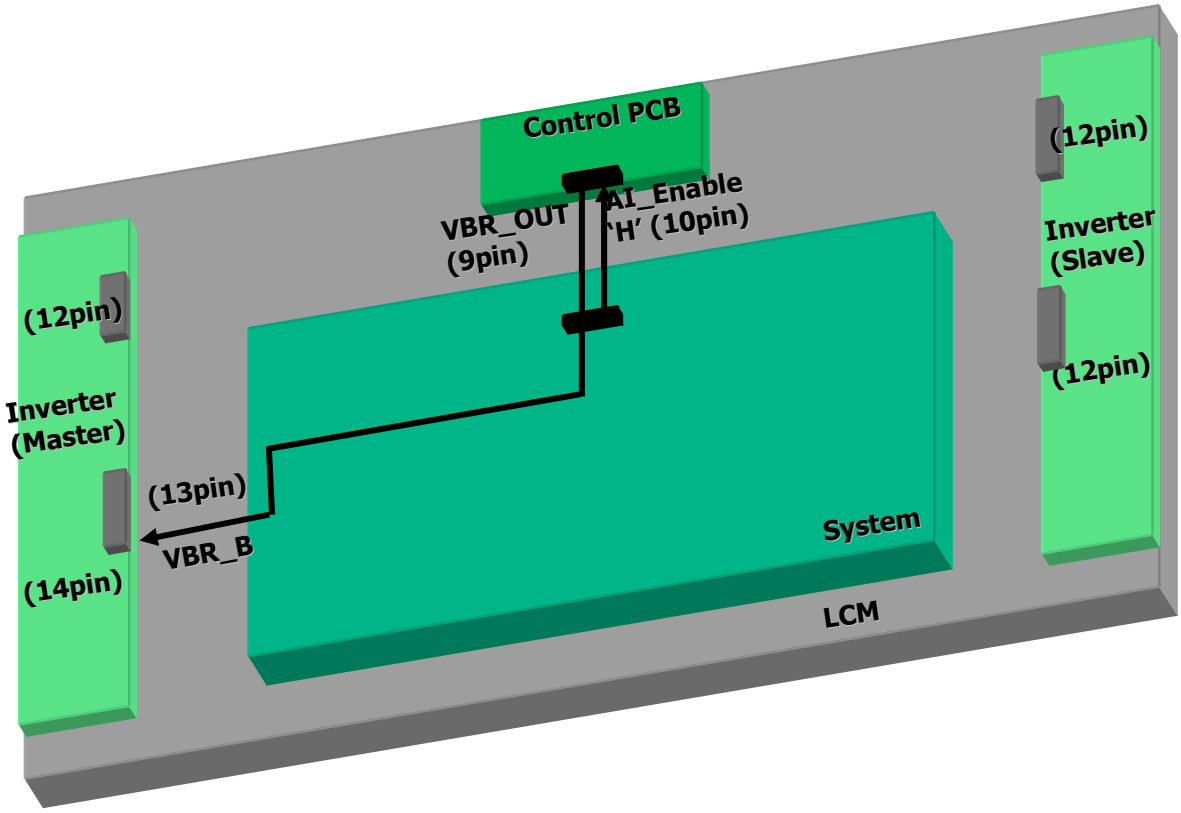


Fig. AI Application By-pass on System Board