SPECIFICATION
FOR
APPROVAL

(●) **Preliminary Specification**

( ) **Final Specification**

Title	55.0” WUXGA TFT LCD

BUYER	Skyworth
LCD MODEL	LC550EQD-FGF2
SET MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LC55EQD
SUFFIX	FGF2 (RoHS Verified)

APPROVED BY	SIGNATURE / DATE
/	
/	
/	

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

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TV Product Development Dept.
LG Display Co., Ltd.

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RECORD OF REVISIONS

Revision No.	Revision Date	Page	Description
0.0	Feb,23, 2013	-	Preliminary Specification(First Draft)

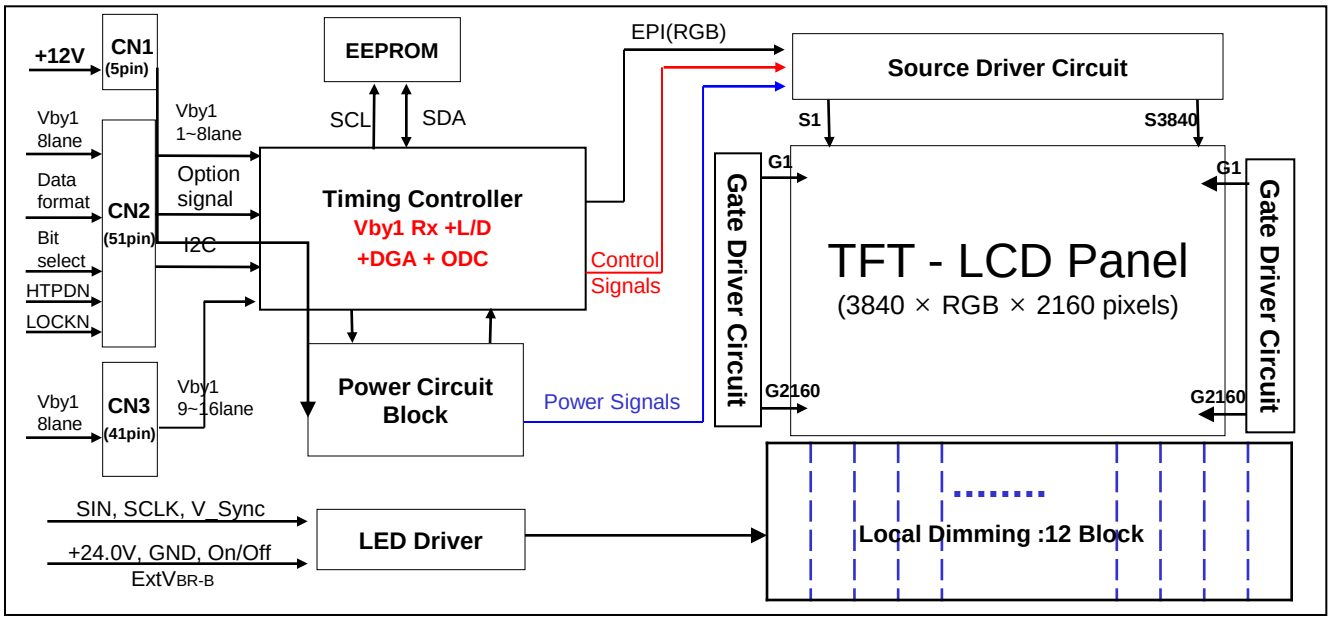
1. General Description

The LC550EQD is a Color Active Matrix Liquid Crystal Display with an integral Source PCB and the Gate PCB at each side. 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 54.64 inch diagonally measured active display area with QWUXGA resolution progressive mode (2160 vertical by 3840 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 10-bit gray scale signal for each dot. Therefore, it can present a palette of more than 1.06Bilion colors.

It has been designed to apply the 10-bit 16 Lane V by One 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	54.64 inches(1387.8mm) diagonal
Outline Dimension	1223.4 (H) x 697.2 (V) x11.7 (B) (Typ.)
Pixel Pitch	0.315 mm x 0.315 mm
Pixel Format	3840 horiz. by 2160 vert. Pixels, RGB stripe arrangement
Color Depth	10bit(D), 1.06Billon colors
Luminance, White	450cd/m^2 (Center 1point ,Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Min.), U/D 178 (Min.))
Power Consumption	Total 117.3W (Typ.) [Logic= 11.5W, LED Driver=105.8W (ExtVbr_B=100%)] (TBD)
Weight	16.5kg(Typ.) (TBD)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(2H), Anti-glare treatment of the front polarizer 1%(Typ)

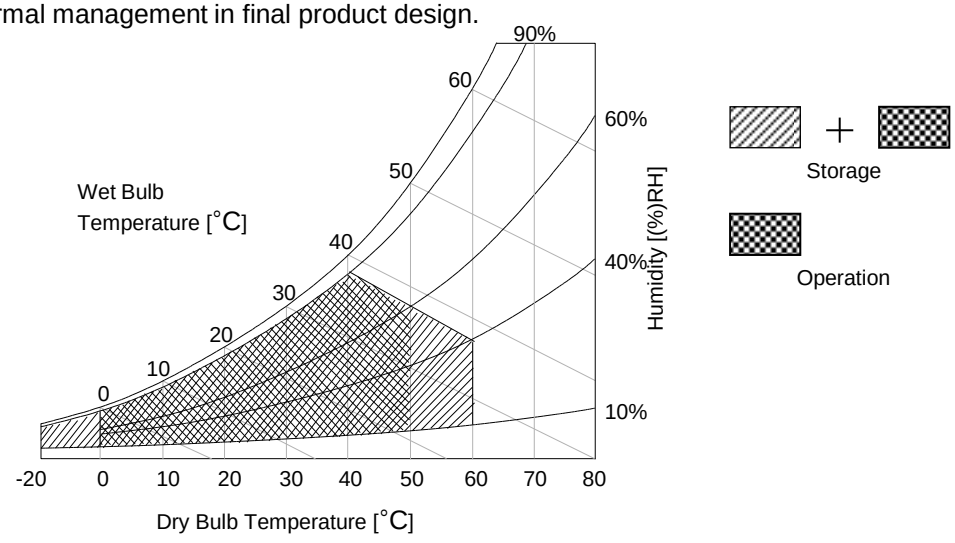
2. Absolute Maximum Ratings

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

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Value		Unit	Notes
			Min	Max		
Power Input Voltage	LCD Circuit	V_{LCD}	-0.3	+14.0	V_{DC}	1
	Driver	V_{BL}	-0.3	+ 27.0	V_{DC}	
Driver Control Voltage	ON/OFF	V_{OFF} / V_{ON}	-0.3	+3.9	V_{DC}	
	Brightness	$EXTV_{BR-B}$	-0.3	+3.9	V_{DC}	
	Status	Status	-0.3	+3.9		
T-Con Option Selection Voltage		V_{LOGIC}	-0.3	+4.0	V_{DC}	
Operating Temperature		T_{OP}	0	+50	°C	2,3
Storage Temperature		T_{ST}	-20	+60	°C	
Panel Front Temperature		T_{SUR}	-	+68	°C	4
Operating Ambient Humidity		H_{OP}	10	90	%RH	2,3
Storage Humidity		H_{ST}	10	90	%RH	

Notes
1. Ambient temperature condition (Ta = 25 ± 2 °C)
2. Temperature and relative humidity range are shown in the figure below.
   Wet bulb temperature should be Max 39°C, and no condensation of water.
3. Gravity mura can be guaranteed below 40°C condition.
4. The maximum operating temperatures is based on the test condition that the surface temperature of display area is less than or equal to 68°C with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 68℃. The range of operating temperature may be degraded in case of improper thermal management in final product design.



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 LED backlight and LED Driver circuit.

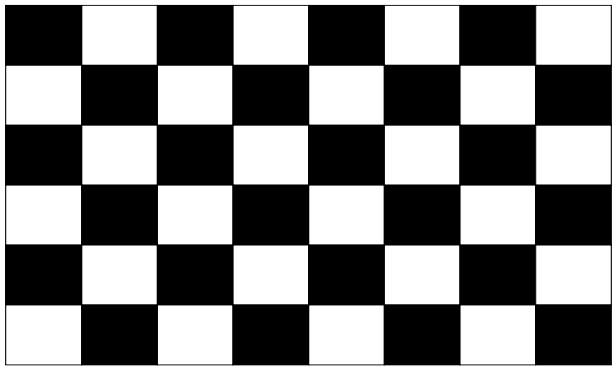
Table 2. ELECTRICAL CHARACTERISTICS

Parameter		Symbol	Value			Unit	Note
			Min	Typ	Max		
Circuit :							
Power Input Voltage		V_{LCD}	10.8	12.0	13.2	V_{DC}	
Power Input Current		I_{LCD}	-	953(TBD)	1240	mA	1
			-	984(TBD)	1280	mA	2
T-CON Option Selection Voltage	Input High Voltage	V_{IH}	2.7	-	3.6	V_{DC}	
	Input Low Voltage	V_{IL}	0	-	0.7	V_{DC}	
Power Consumption		P_{LCD}	-	11.5(TBD)	15	Watt	1
Rush current		I_{RUSH}	-	-	12	A	3

notes

1. The specified current and power consumption are under the V_{LCD}=12.0V, Ta=25 ± 2°C, f_V=120Hz condition, and 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 0.5ms (min.).
4. Ripple voltage level is recommended under ±5% of typical voltage

White : 1023 Gray
Black : 0 Gray



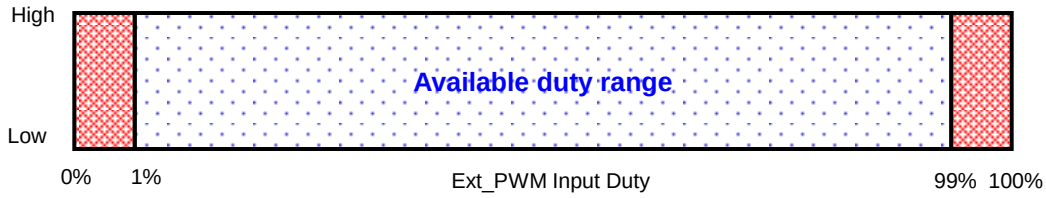
Mosaic Pattern(8 x 6)

Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter			Symbol	Values			Unit	Notes
				Min	Typ	Max		
LED Driver :								
Power Supply Input Voltage			VBL	22.8	24.0	25.2	Vdc	1
Power Supply Input Current			IBL	-	4.4	TBD	A	1
Power Supply Input Current (In-Rush)			In-rush	-	-	TBD	A	V_{BL} = 22.8V Ext V_{BR-B} = 100% 4
Power Consumption			PBL	-	105.8	TBD	W	1
Input Voltage for Control System Signals	On/Off	On	V on	2.5	-	3.6	Vdc	
		Off	V off	-0.3	0.0	0.7	Vdc	
	Brightness Adjust		ExtVBR-B	1	-	100	%	On Duty 6
	PWM Frequency for NTSC & PAL		PAL		100		Hz	3
			NTSC		120		Hz	3
	Pulse Duty Level (PWM)		High Level	2.5	-	3.6	Vdc	HIGH : on duty LOW : off duty
			Low Level	0.0	-	0.7	Vdc	
LED :								
Life Time				30,000	50,000		Hrs	2

Notes :

1. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 60 minutes at 25±2°C. The specified current and power consumption are under the typical supply Input voltage 24Vand V_{BR} ($Ext V_{BR-B}$: 100%), it is total power consumption.
2. The life time (MTTF) is determined as the time which luminance of the LED is 50% compared to that of initial value at the typical LED current (ExtVBR-B :100%) on condition of continuous operating in LCM state at 25±2°C.
3. LGD recommend that the PWM freq. is synchronized with One time harmonic of V_sync signal of system. Though PWM frequency is over 120Hz (max 252Hz), function of LED Driver is not affected.
4. The duration of rush current is about 200ms. This duration is applied to LED on time.
5. Even though inrush current is over the specified value, there is no problem if I^2T spec of fuse is satisfied.
6. Ext_PWM Signal have to input available duty range.
   Between 99% and 100% $Ext V_{BR-B}$ duty have to be avoided. (99% < $Ext V_{BR-B}$ < 100%)
   But $Ext V_{BR-B}$ 0% and 100% are available.



3-2. Interface Connections

This LCD module employs three kinds of interface connection, 5-pin connector, 51pin connector and 41-pin Connector are used for the module electronics

3-2-1. LCD Module

- LCD Connector(CN1): SM05B-PASS-TB (manufactured by JST)
- Mating Connector : PAP-05V-S(JST) or compatible

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

Pin No	Symbol	Description	Note
1	GND	Ground	
2	GND	Ground	
3	VLCD	Power Supply +12.0V	
4	VLCD	Power Supply +12.0V	
5	VLCD	Power Supply +12.0V	

- LCD Connector(CN1): FI-RE51S-HF(manufactured by JAE)
- Mating Connector : FI-R51HL(JAE) or compatible

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

No	Symbol	Description	No	Symbol	Description
1	NC (Reserved)	Power Supply +12.0V (reserved)	27	GND	Ground
2	NC (Reserved)	Power Supply +12.0V (reserved)	28	Rx0n	V-by-One HS Data Lane 0
3	NC (Reserved)	Power Supply +12.0V (reserved)	29	Rx0p	V-by-One HS Data Lane 0
4	NC (Reserved)	Power Supply +12.0V (reserved)	30	GND	Ground
5	NC (Reserved)	Power Supply +12.0V (reserved)	31	Rx1n	V-by-One HS Data Lane 1
6	NC (Reserved)	Power Supply +12.0V (reserved)	32	Rx1p	V-by-One HS Data Lane 1
7	NC (Reserved)	Power Supply +12.0V (reserved)	33	GND	Ground
8	NC (Reserved)	Power Supply +12.0V (reserved)	34	Rx2n	V-by-One HS Data Lane 2
9	NC	NO CONNECTION	35	Rx2p	V-by-One HS Data Lane 2
10	GND	Ground	36	GND	Ground
11	GND	Ground	37	Rx3n	V-by-One HS Data Lane 3
12	GND	Ground	38	Rx3p	V-by-One HS Data Lane 3
13	GND	Ground	39	GND	Ground
14	GND	Ground	40	Rx4n	V-by-One HS Data Lane 4
15	Data format 0	Input Data Format [1:0] : '00'=Mode1, '01'=Mode2, '10'=Mode3, '11'=Mode4	41	Rx4p	V-by-One HS Data Lane 4
16	Data format 1		42	GND	Ground
17	PCID_EN	'H' : PCID Enable 'L' or 'NC' : PCID Disable	43	Rx5n	V-by-One HS Data Lane 5
18	SDA	SDA (For I2C)	44	Rx5p	V-by-One HS Data Lane 5
19	SCL	SCL (For I2C)	45	GND	Ground
20	NC	NO CONNECTION	46	Rx6n	V-by-One HS Data Lane 6
21	Bit SEL	'H' or NC= 10bit(D) , 'L' = 8bit	47	Rx6p	V-by-One HS Data Lane 6
22	L-DIM Enable	'H'=Enable, 'L' or NC=Disable	48	GND	Ground
23	AGP or NSB	'H' or NC : AGP 'L' : NSB (No signal Black)	49	Rx7n	V-by-One HS Data Lane 7
24	GND	Ground	50	Rx7p	V-by-One HS Data Lane 7
25	HTPDN	Hot plug detect	51	GND	Ground
26	LOCKN	Lock detect	-	-	-

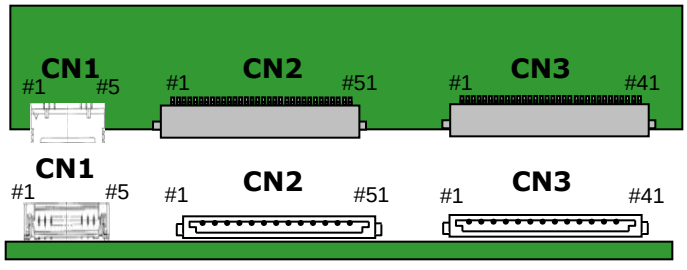
Note
1. All GND (ground) pins should be connected together to the LCD module's metal frame.
2. #1~#8NC(No connection) : These pin are used for back up power source, Vlcd(power input) These pin are should be connected together.
3. All Input levels of V-by-One signals are based on the V-by-One-HS Standard Version 1.3
4. #9 & #20 NC(No Connection) : These pins are used only for LGD (Do not connect)
5. About specific pin(#15, #16), Please see the Appendix
7. Specific pin No. #23 is used for "No signal detection" of system signal interface. It should be GND for NSB (No Signal Black) while the system interface signal is not. If this pin is "H", LCD Module displays AGP (Auto Generation Pattern).

-LCD Connector (CN2) : FI-RE41S-HF(manufactured by JAE)
- Mating Connector : FI-RE41HL

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

No	Symbol	Description	No	Symbol	Description
1	GND	Ground	22	GND	Ground
2	Rx8n	V-by-One HS Data Lane 8	23	Rx15n	V-by-One HS Data Lane 15
3	Rx8p	V-by-One HS Data Lane 8	24	Rx15p	V-by-One HS Data Lane 15
4	GND	Ground	25	GND	Ground
5	Rx9n	V-by-One HS Data Lane 9	26	NC	NO CONNECTION
6	Rx9p	V-by-One HS Data Lane 9	27	NC	NO CONNECTION
7	GND	Ground	28	NC	NO CONNECTION
8	Rx10n	V-by-One HS Data Lane 10	29	NC	NO CONNECTION
9	Rx10p	V-by-One HS Data Lane 10	30	NC	NO CONNECTION
10	GND	Ground	31	NC	NO CONNECTION
11	Rx11n	V-by-One HS Data Lane 11	32	NC	NO CONNECTION
12	Rx11p	V-by-One HS Data Lane 11	33	NC	NO CONNECTION
13	GND	Ground	34	NC	NO CONNECTION
14	Rx12n	V-by-One HS Data Lane 12	35	NC	NO CONNECTION
15	Rx12p	V-by-One HS Data Lane 12	36	NC	NO CONNECTION
16	GND	Ground	37	NC	NO CONNECTION
17	Rx13n	V-by-One HS Data Lane 13	38	NC	NO CONNECTION
18	Rx13p	V-by-One HS Data Lane 13	39	NC	NO CONNECTION
19	GND	Ground	40	NC	NO CONNECTION
20	Rx14n	V-by-One HS Data Lane 14	41	NC	NO CONNECTION
21	Rx14p	V-by-One HS Data Lane 14	-		

notes : 1. All GND (ground) pins should be connected together to the LCD module's metal frame.
2. #26~#41 NC (No Connection) : These pins are used only for LGD (Do not connect)



Rear view of LCM

3-2-2. Backlight Module

Master

-LED Driver Connector

: 20022WR - H14B2(Yeonho) or Compatible

- Mating Connector

: 20022HS - 14B2 or Compatible

Table 5-1. LED DRIVER CONNECTOR PIN CONFIGURATION

Pin No	Symbol	Description	Note
1	V_{BL}	Power Supply +24.0V	
2	V_{BL}	Power Supply +24.0V	
3	V_{BL}	Power Supply +24.0V	
4	V_{BL}	Power Supply +24.0V	
5	V_{BL}	Power Supply +24.0V	
6	GND	Backlight Ground	
7	GND	Backlight Ground	
8	GND	Backlight Ground	1
9	GND	Backlight Ground	
10	GND	Backlight Ground	
11	Status	Back Light Status	2
12	$V_{ON/OFF}$	Backlight ON/OFF control	3
13	NC	Don't care	
14	EXTVBR-B	External PWM	3

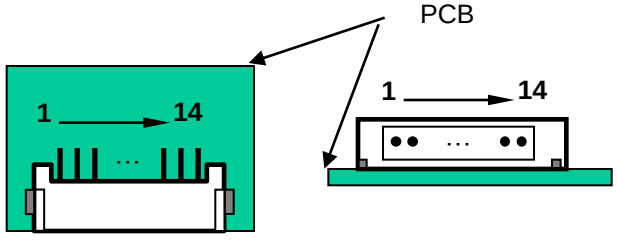
Notes :1. GND should be connected to the LCD module's metal frame.

2. Normal : Low (under 0.7V) / Abnormal : Open

3. High : on duty / Low : off duty, Pin#14 can be opened. (if Pin #14 is open , EXTVBR-B is 100%)

4. Each impedance of pin #12 and 14 is over 50 [KΩ] .

◆ Rear view of LCM



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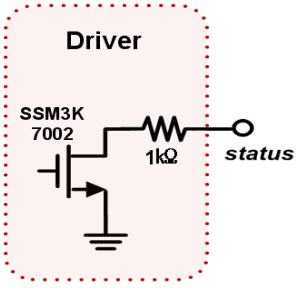
◆ Status



3-3. Signal Timing Specifications

Table 4 shows the signal timing required at the input of the Vx1 transmitter. All of the interface signal timings should be satisfied with the following specification for normal operation.

Table 4. TIMING TABLE (DE Only Mode)

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	t_{HV}	240	240	240	t_{CLK}	3840/16
	Blank	t_{HB}	25	35	60	t_{CLK}	1
	Total	t_{HP}	265	275	300	t_{CLK}	
Vertical	Display Period	t_{VV}	2160	2160	2160	Lines	
	Blank	t_{VB}	40 (456)	90 (540)	172 (600)	Lines	1
	Total	t_{VP}	2200 (2616)	2250 (2700)	2332 (2760)	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Note
Frequency	DCLK	f_{CLK}	67	74.25	78.00	MHz	1188/16
	Horizontal	f_H	244	270	280	KHz	1
	Vertical	f_V	108 (95)	120 (100)	122 (104)	Hz	2 NTSC (PAL)

notes: 1. The input of HSYNC & VSYNC signal does not have an effect on normal operation (DE Only Mode). If you use spread spectrum of EMI, add some additional clock to minimum value for clock margin.

2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate and the horizontal frequency

※ Timing should be set based on clock frequency.

3-4. V by One input signal Specifications

3-4-1. V by One input Signal Timing Diagram

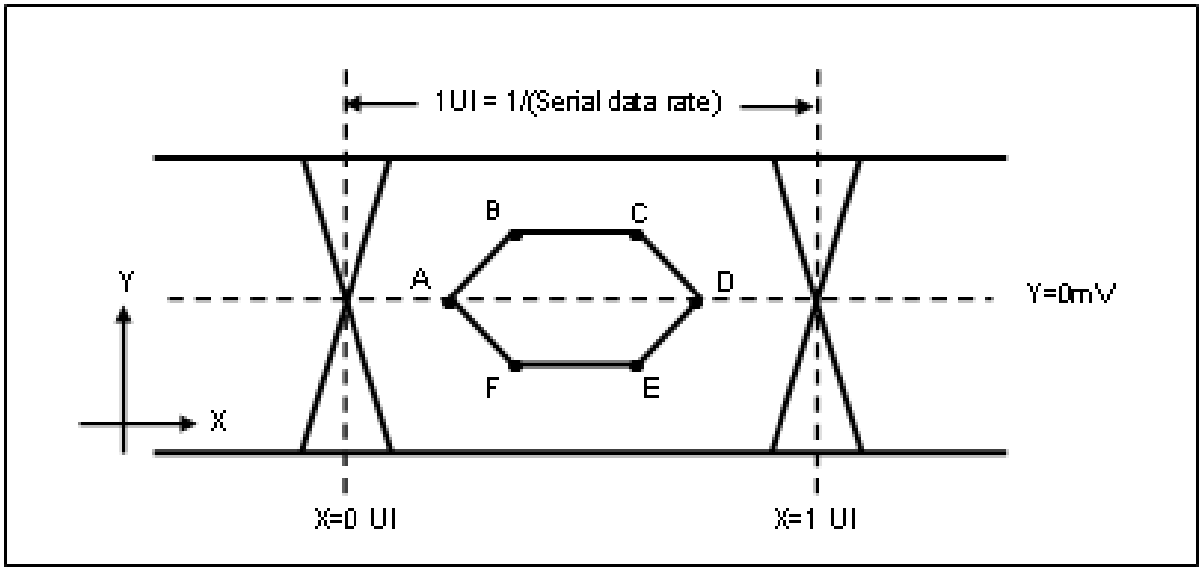


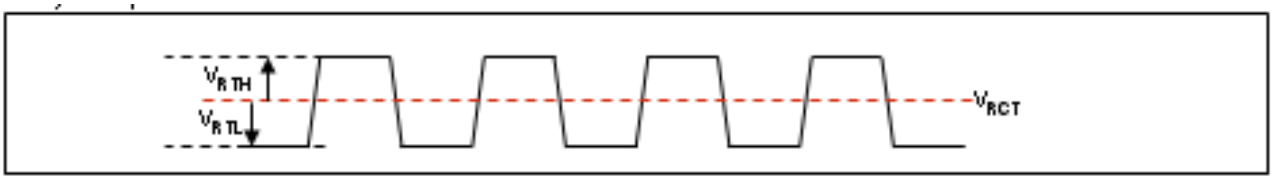
Table7. Eye Mask Specification

	X[UI]	Note	Y[mV]	Note
A	0.25 (max)	2	0	-
B	0.3 (max)	2	50	3
C	0.7(min)	3	50	3
D	0.75(min)	3	0	-
E	0.7(min)	3	| -50 |	3
F	0.3(max)	2	| -50 |	3

notes 1. All Input levels of Vby One signals are based on the Vby One HS Standard Ver. 1.3
2. This is allowable maximum value.
3. This is allowable minimum value.
4. The eye diagram is measured by the oscilloscope and receiver CDR characteristic must be emulated.
   - PLL bandwidth : 11 Mhz
   - Damping Factor : 1

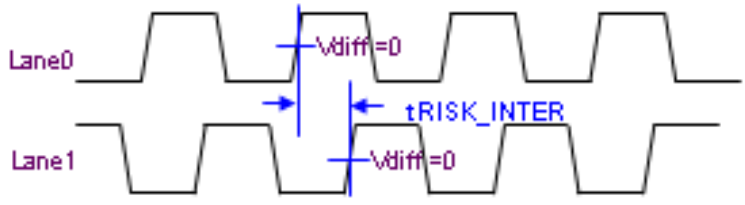
3-4-2. V by One Input Signal Characteristics

1) DC Specification

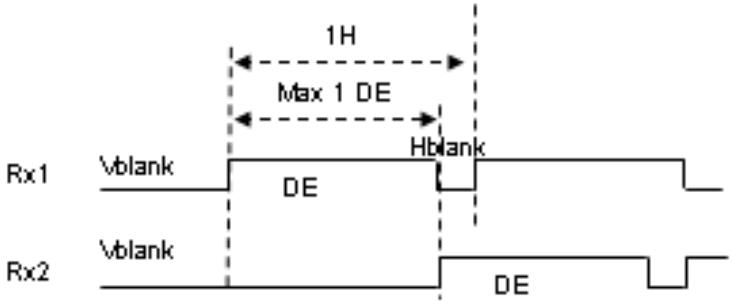


Description	Symbol	Min	Max	Unit	notes
CML Differential input High threshold	V_{RTH}	-	50	mV	-
CML Differential input Low threshold	V_{RTL}	-50	-	mV	-
CML Common mode Bias Voltage	V_{RCT}	0.6	0.8	V	-

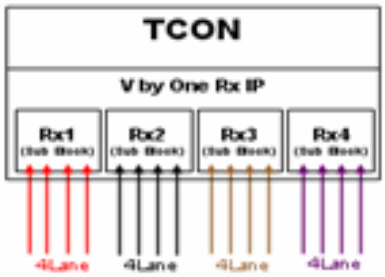
2) AC Specification



<Inter-pair Skew between two Lanes>



<Inter-pair Skew between two sub Blocks>



<TCON – Vby One Brief Diagram >

Description	Symbol	Min	Max	Unit	notes
Allowable inter-pair skew between lanes	tRISK_INTER	-	5	UI	1,3
Allowable iner-pair skew between sub-blocks	tRISK_BLOCK	-	1	DE	1,4

Notes 1.1UI = 1/serial data rate

2. it is the time difference between the true and complementary single-ended signals.
3. it is the time difference of the differential voltage between any two lanes in one sub block.
4. it is the time difference of the differential voltage between any two blocks in one IP.

3-5. Color Data Reference

The brightness of each primary color (red, green, blue) is based on the 10bit or 8bit gray scale data input for the color. The higher binary input, the brighter the color. Table 5 provides a reference for color versus data input.

Table 5. COLOR DATA REFERENCE

Packer input & Unpacker output		30bpp RGB (10bit)	24bpp RGB (8bit)
Byte0	D[0]	R[2]	R[0]
	D[1]	R[3]	R[1]
	D[2]	R[4]	R[2]
	D[3]	R[5]	R[3]
	D[4]	R[6]	R[4]
	D[5]	R[7]	R[5]
	D[6]	R[8]	R[6]
	D[7]	R[9]	R[7]
Byte1	D[8]	G[2]	G[0]
	D[9]	G[3]	G[1]
	D[10]	G[4]	G[2]
	D[11]	G[5]	G[3]
	D[12]	G[6]	G[4]
	D[13]	G[7]	G[5]
	D[14]	G[8]	G[6]
	D[15]	G[9]	G[7]
Byte2	D[16]	B[2]	B[0]
	D[17]	B[3]	B[1]
	D[18]	B[4]	B[2]
	D[19]	B[5]	B[3]
	D[20]	B[6]	B[4]
	D[21]	B[7]	B[5]
	D[22]	B[8]	B[6]
	D[23]	B[9]	B[7]
Byte4	D[24]	Don't care	
	D[25]	Don't care	
	D[26]	B[0]	
	D[27]	B[1]	
	D[28]	G[0]	
	D[29]	G[1]	
	D[30]	R[0]	
	D[31]	R[1]	

3-6. Power Sequence

3-6-1. LCD Driving circuit

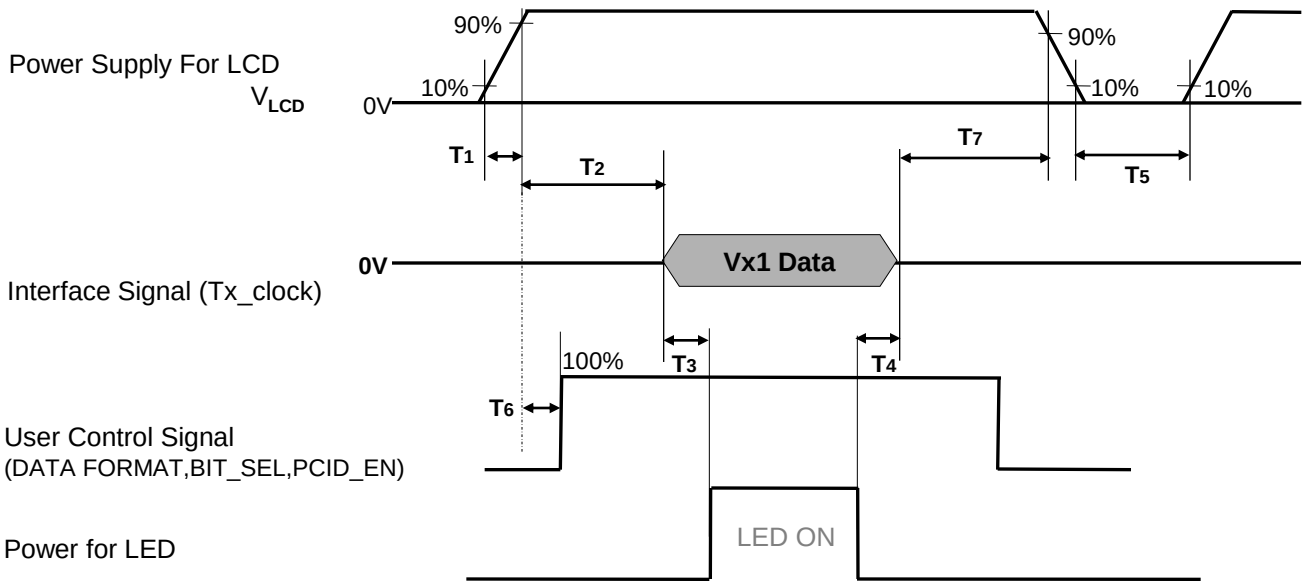


Table 6. POWER SEQUENCE

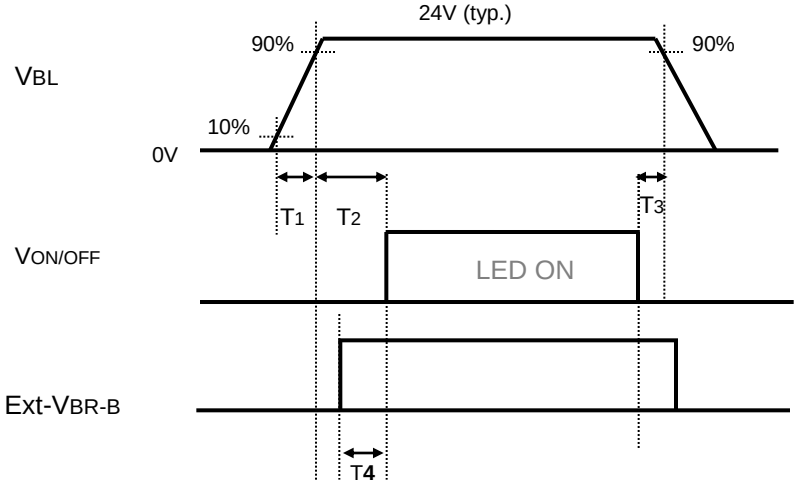
Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	0.5	-	20	ms	1
T2	0	-	-	ms	2
T3	400	-	-	ms	3
T4	200	-	-	ms	3
T5	1.0	-	-	s	4
T6	0	-	T2	ms	5
T7	0	-	-	ms	6

Note : 1. Even though T1 is over the specified value, there is no problem if I2T spec of fuse is satisfied.
2. If T2 is satisfied with specification after removing LVDS Cable, there is no problem.
3. 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.
4. T5 should be measured after the Module has been fully discharged between power off and on period.
5. If the on time of signals (Interface signal and user control signals) precedes the on time of Power (V_{LCD}), it will be happened abnormal display. When T6 is NC status, T6 doesn't need to be measured.
6. It is recommendation specification that T7 has to be 0ms as a minimum value.

※ Please avoid floating state of interface signal at invalid period.
※ When the power supply for LCD (VLCD) is off, be sure to pull down the valid and invalid data to 0V.

3-6-2. Sequence for LED Driver

Power Supply For LED Driver



3-6-3. Dip condition for LED Driver

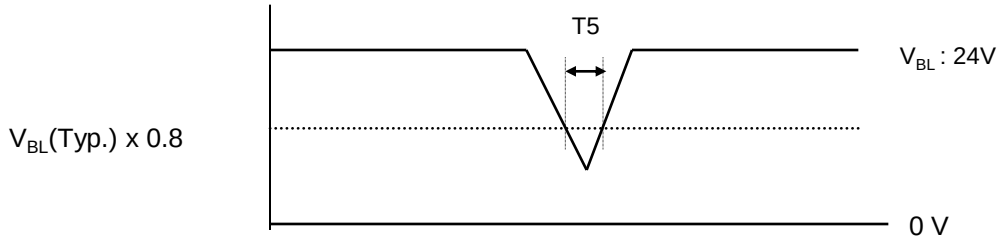


Table 9. Power Sequence for LED Driver

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

notes : 1. T1 describes rising time of 0V to 24V and this parameter does not applied at restarting time.
Even though T1 is over the specified value, there is no problem if I^2T spec of fuse is satisfied.

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 are specified at 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.

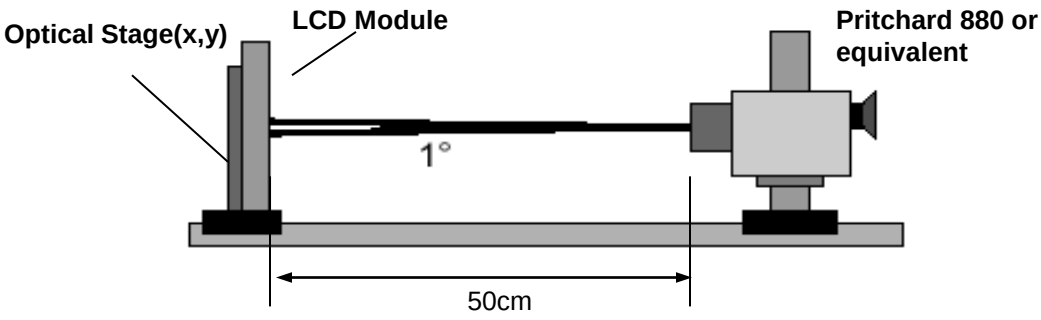


FIG. 1 Optical Characteristic Measurement Equipment and Method

Ta= 25±2°C, V_{LCD}=12.0V, fv=120Hz, Dclk=74.25MHz
EXTVbr-B=100%

Table 7. OPTICAL CHARACTERISTICS

Parameter			Symbol		Value Min	Value Typ	Value Max	Unit	notes
Contrast Ratio			CR		1000	1400(TBD)	-		1
Surface Luminance, white			L_{WH}	2D	360	450		cd/m²	2
				3D	110	170			7
Luminance Variation			δ_{WHITE}	9P	70				3
Response Time		Gray-to-Gray	G to G			5	8	ms	4
		MPRT	MPRT		-	8	12		5
		Uniformity	δ_{MPRT}		-	-	1		5
		Uniformity	$\delta_{G\ TO\ G}$		-	-	1		5
Color Coordinates [CIE1931]		RED	Rx		Typ -0.03	0.650(TBD)	Typ +0.03		
			Ry			0.333(TBD)			
		GREEN	Gx			0.305(TBD)			
			Gy			0.603(TBD)			
		BLUE	Bx			0.151(TBD)			
			By			0.055(TBD)			
		WHITE	Wx			0.281			
			Wy			0.288			
Color Temperature						10,000		K	
Color Gamut						72		%	
Viewing Angle	2D (CR>10)	right(ϕ=0°)	θr (x axis)		89	-	-	degree	6
		left (ϕ=180°)	θl (x axis)		89	-	-		
		up (ϕ=90°)	θu (y axis)		89	-	-		
		down (ϕ=270°)	θd (y axis)		89	-	-		
	3D (CT≤10%)	up + down	θu (y axis) +θd (y axis)		16	20	-	degree	
		up	θu (y axis)		5	-	-	degree	8
		down	θd (y axis)		5	-	-	degree	
3D Crosstalk			3D C/T		-	1	3	%	
Gray Scale					-	-	-		7

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

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

It is measured at center 1-point.

2. Surface luminance is determined after the unit has been 'ON' and 1 Hour after lighting the backlight in a dark environment at 25±2°C. Surface luminance is the luminance value at center 1-point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see the FIG. 2.

3. Response time is the time required for the display to transit 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)
※ G to G Spec stands for average value of all measured points.
Photo Detector : RD-80S / Field : 2°

4. 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.

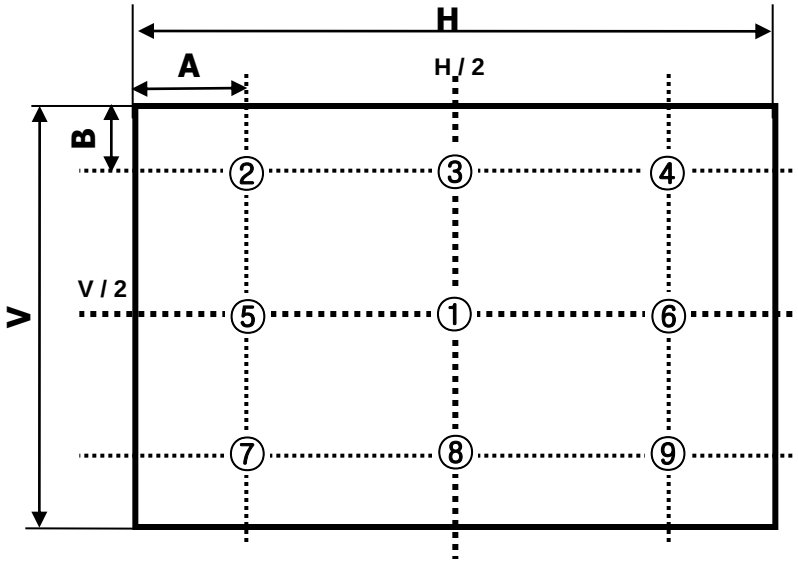
5. Gray scale specification
Gamma Value is approximately 2.2. For more information, see the Table 8.

6. 3D performance specification is expressed by 3D luminance, 3D Crosstalk and 3D viewing angle. 3D luminance and 3D crosstalk is measured at center 1-point. For more information, see the FIG13~16.

Table 8. GRAY SCALE SPECIFICATION

Gray Level	Luminance [%] (Typ)
L0	0.07
L15	0.27
L31	1.04
L47	2.49
L63	4.68
L79	7.66
L95	11.5
L111	16.1
L127	21.6
L143	28.1
L159	35.4
L175	43.7
L191	53.0
L207	63.2
L223	74.5
L239	86.7
L255	100

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



A : H / 6 mm
B : V / 6 mm
@ H,V : Active Area

FIG. 2 9 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)".

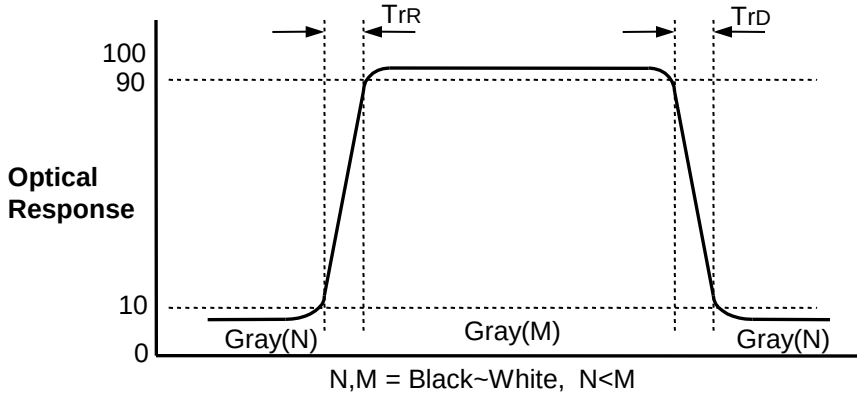
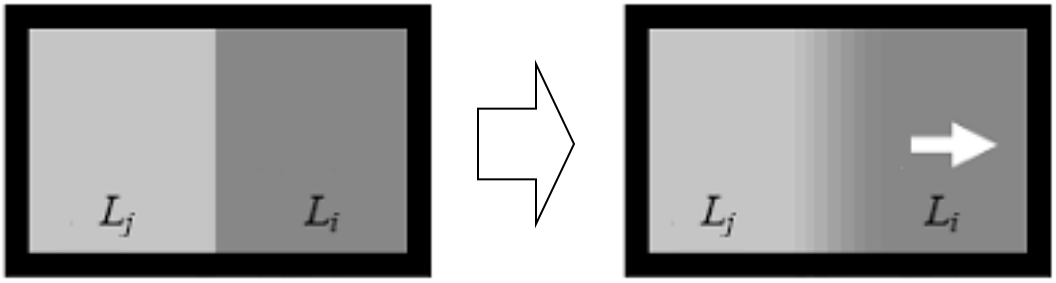
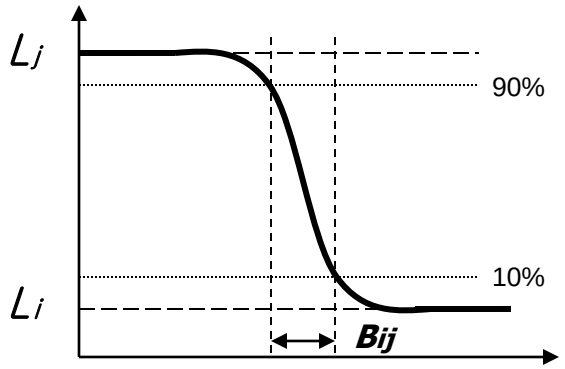


FIG. 3 Response Time

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

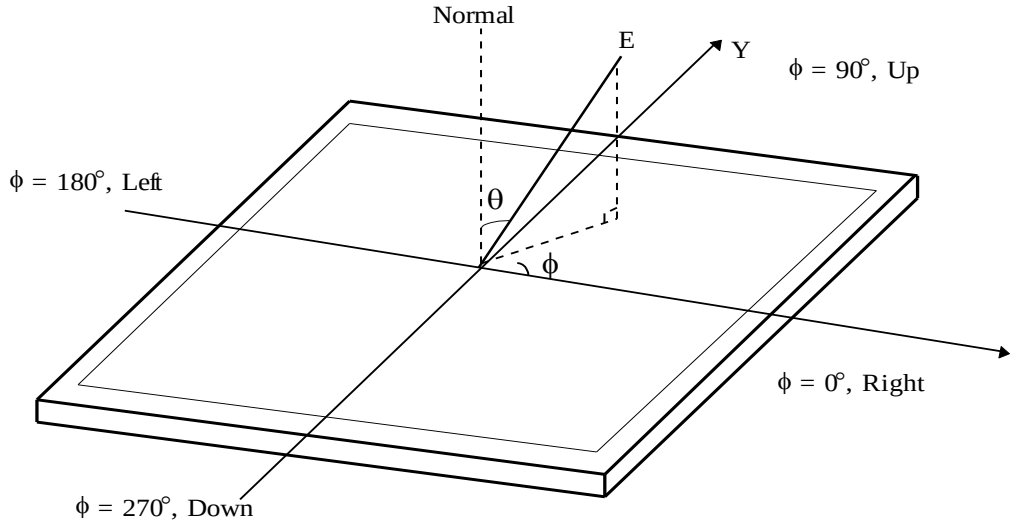
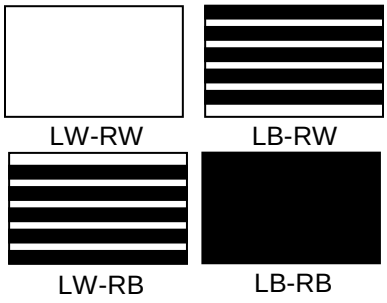
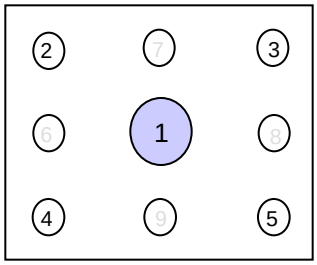


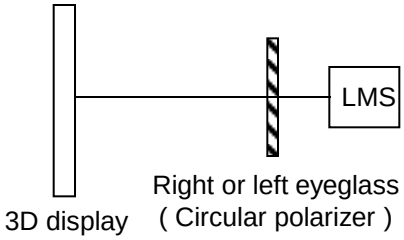
FIG. 5 Viewing Angle



(a) Test pattern image

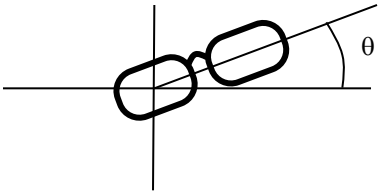


(b) Measurement position

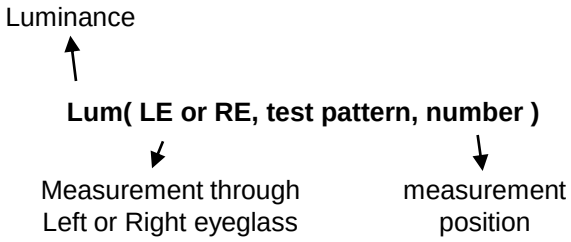


(c) Setup

< Figure 13. Measurement configuration>



< Figure 14. Positioning eyeglass >



< Figure 15. notation of luminance measurement >

In order to measure 3D luminance, 3D crosstalk and 3D viewing angle, it need to be prepared as below;

1) Measurement configuration

4-Test pattern images. Refer to FIG 13.

-. LW-RW : White for left and right eye

-. LW-RB : White for left eye and Black for right eye

-. LB-RW : Black for left eye and white for right eye

-. LB-RB : Black for left eye and right eye

Image files where black and white lines are displayed on even or odd lines.

Luminance measurement system (LMS) with narrow FOV (field of view) is used. Refer to FIG 13.

2) Positioning Eyeglass (refer to appendix-VI for standard specification of eyeglass)

Find angle of minimum transmittance.

This value would be provided beforehand or measured by the following steps;

(i) Test image (LB-RW) is displayed.

(ii) Left eyeglass are placed in front of LMS and luminance is measured,
rotating right eyeglass such as FIG 14. The notation for luminance measurement is “Lum(LE, LB-RW,1)”.

(iii) Find the angle where luminance is minimum.

* Following measurements should be performed at the angle of minimum transmittance of eyeglass.

3) Measurement of 3D luminance
(i) Test image (LW-RW) is displayed.
(ii) Left or right eyeglass are placed in front of LMS successively and luminance is measured at center 1 point where the notation for luminance measurement is “Lum(LE, LW-RW,1)” or “Lum(RE, LW-RW,1).

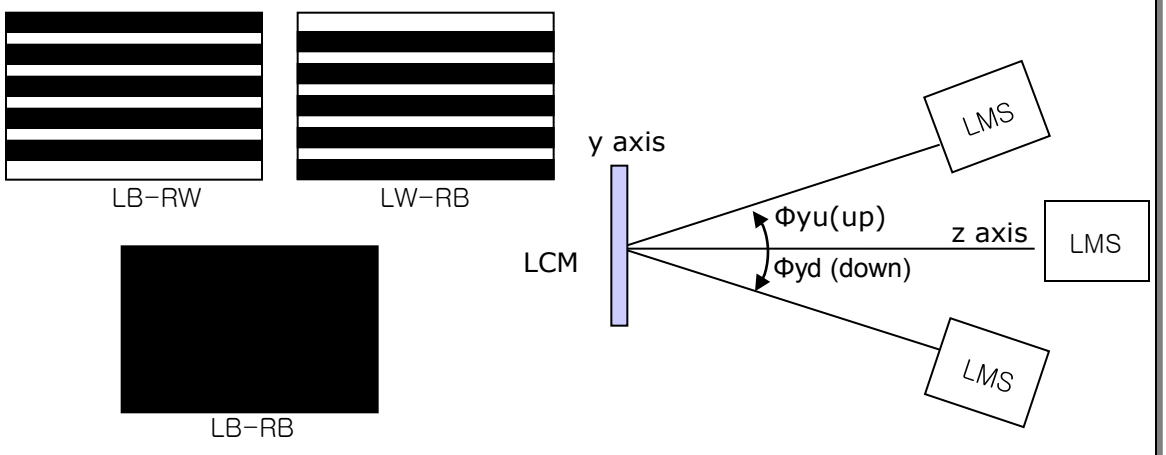
4) Measurement of 3D crosstalk
(i) Test image (LB-RW, LW-RB and LB-RB) is displayed.
(ii) Right or left eyeglass are placed in front of LMS successively and luminance is measured for position 1.
with rotating LMS or sample vertically.

$$\frac{\text{Lum(LE, LB-RW,1) - Lum(LE, LB-RB,1)}}{\text{Lum(LE, LW-RB,1) - Lum(LE, LB-RB,1)}}$$

or

$$\frac{\text{Lum(RE, LW-RB,1) - Lum(RE, LB-RB,1)}}{\text{Lum(RE, LB-RW,1) - Lum(RE, LB-RB,1)}}$$

5) Measurement of 3D Viewing Angle
3D viewing angle is the angle at which the 3D crosstalk is under 10%. The angles are determined for the vertical or y axis with respect to the z axis which is normal to the LCD module surface and measured for position 1. For more information , see the Fig 16



(a) Test pattern image (b) Measurement of 3D viewing angle (up/down)

< Figure 16. Measurement of 3D crosstalk and 3D viewing angle >

5. Mechanical Characteristics

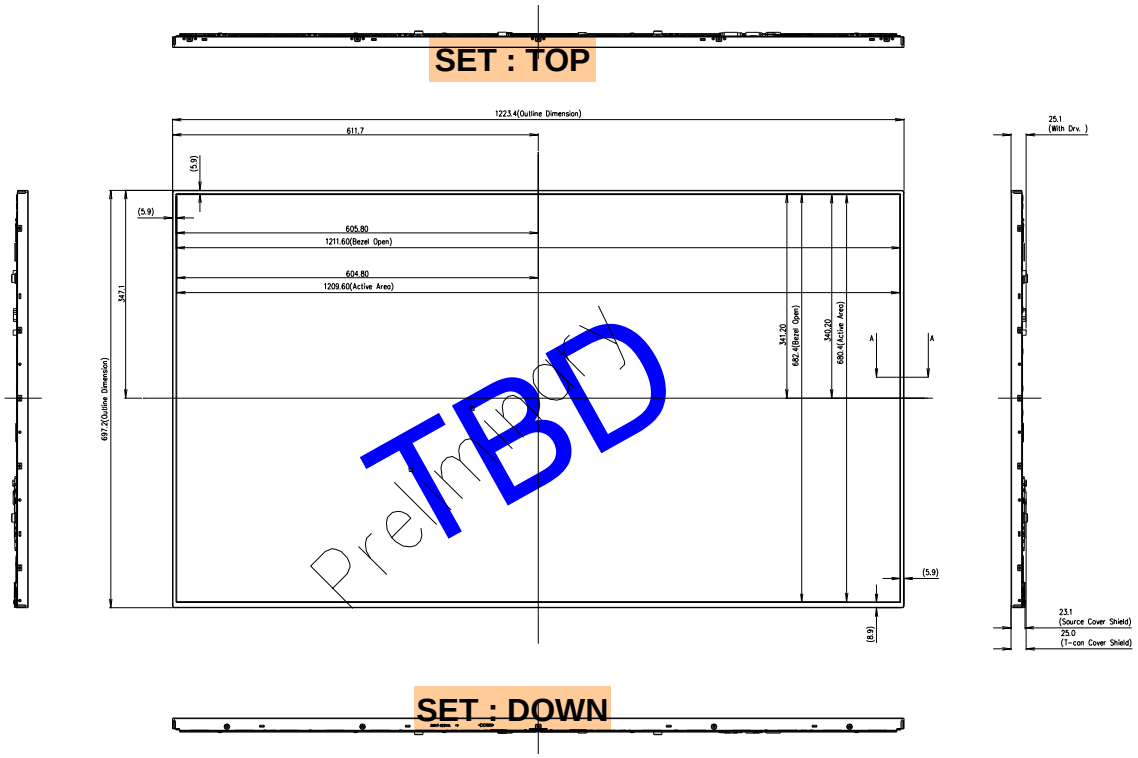
Table 9 provides general mechanical characteristics.

Table 9. MECHANICAL CHARACTERISTICS

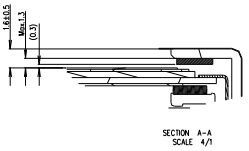
Item		Value
Outline Dimension	Horizontal	1223.4 mm
	Vertical	697.2 mm
	Thickness	11.7 mm
Active Display Area	Horizontal	1209.6 mm
	Vertical	680.4 mm
Weight		16.5 Kg (Typ.) TBD

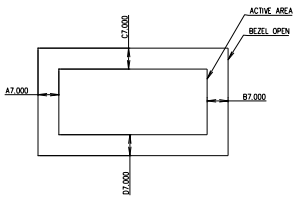
Note : Please refer to a mechanic drawing in terms of tolerance at the next page.

[FRONT VIEW]

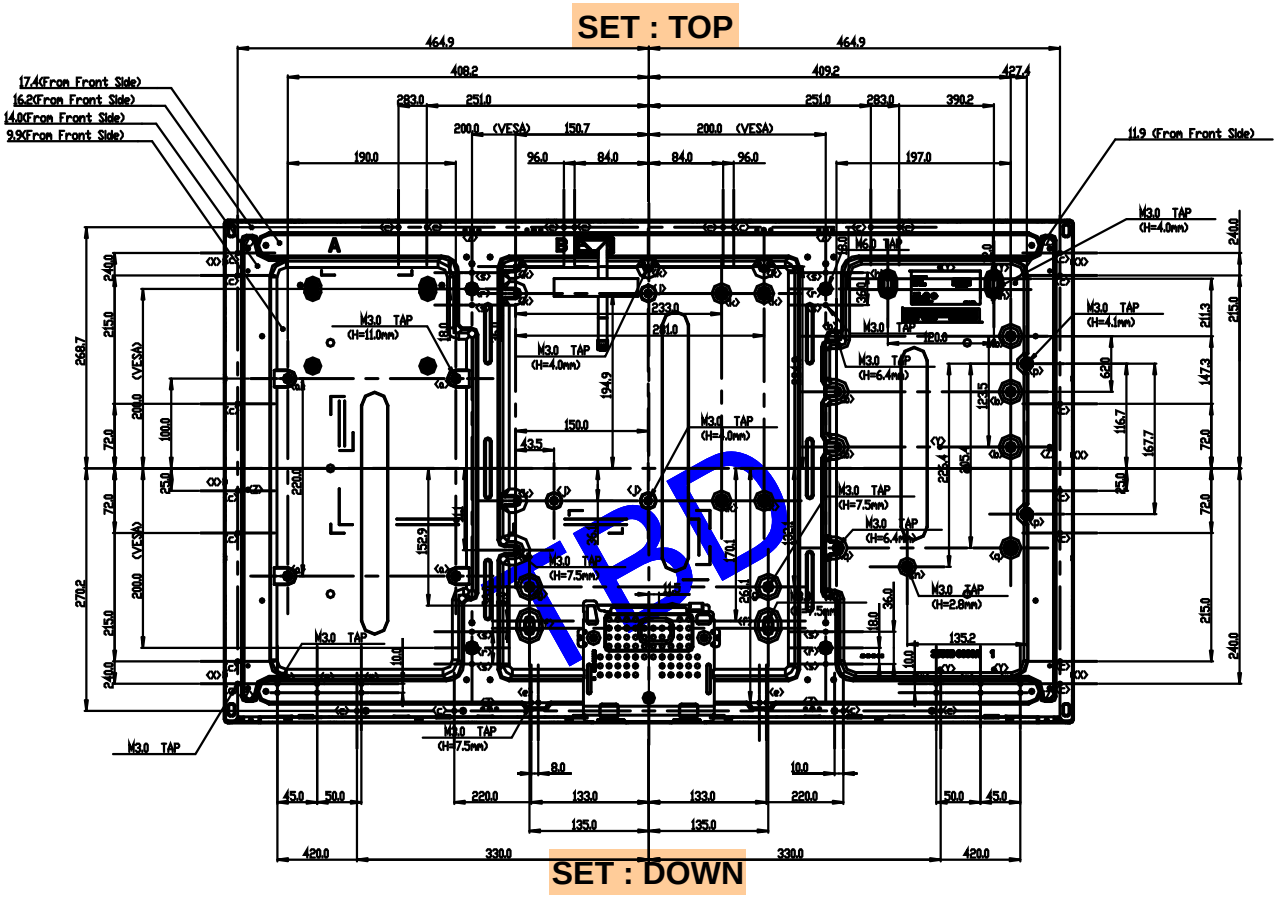


NOTES
1. UNSPECIFIED TOLERANCE IS ±1.0mm.
2. TILT AND PARTIAL DISPOSITION TOLERANCE OF DISPLAY AREA AS FOLLOWING.
 (a) X-DIRECTION : IA-BI ≦ 1.0mm.
 (b) Y-DIRECTION : IC-DI ≦ 1.0mm.
3. Max. TORQUE : REFER TO TABLE.
4. Max. DEPTH : REFERTO TABLE.
5. THE SAME FEATURE MEANS THEE SAME DIMENSION.
6. SCREW HEAD Mx. PROTRUSION: <x> 1.0mm
7. SCREW Max PROTRUSION. : <z> 2.5MM





[REAR VIEW]



ITEM	TAP	UDM Height (mm)	Max Depth (mm)	Torque (Kgf.cm)	Notes
<a>	M3	11.0	MAX 10.0	MAX 8.0	
<b>	M3	6.4	MAX 6.0	MAX 8.0	
<c>	M3	-	MAX 5.0	MAX 8.0	
<d>	M3	7.5	MAX 7.0	MAX 8.0	
<e>	M3	7.5	MAX 7.0	MAX 8.0	
<f>	M3	7.5	MAX 7.0	MAX 8.0	
<g>	M3	7.5	MAX 7.0	MAX 8.0	
<h>	M3	4.0	MAX 3.5	MAX 8.0	
<j>	M3	4.0	MAX 4.5	MAX 8.0	
<k>	M3	4.0	MAX 4.5	MAX 8.0	
<n>	M3	-	MAX 7.0	MAX 8.0	
<n>	M3	2.8	MAX 4.0	MAX 8.0	
<p>	M3	4.1	MAX 3.5	MAX 8.0	
<q>	M3	6.4	MAX 6.0	MAX 8.0	
<r>	M6	8.3	MAX 12.0		
<s>	M3	-	MAX 7.0	MAX 8.0	

NOTES

1. Screw Head Max Protrusion : <X>1.0MM
2. Screw Max Protrusion : <Y>1.8MM, <Z>2.5MM

6. Reliability

Table 10. 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	Humidity condition Operation	Ta= 40 ˚C ,90%RH
6	Altitude operating storage / shipment	0 - 16,400 ft 0 - 40,000 ft

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

7. International Standards

7-1. Safety

a) UL 60065, Underwriters Laboratories Inc.
Audio, Video and Similar Electronic Apparatus - Safety Requirements.

b) CAN/CSA C22.2 No.60065:03, Canadian Standards Association.
Audio, Video and Similar Electronic Apparatus - Safety Requirements.

c) EN 60065, European Committee for Electrotechnical Standardization (CENELEC).
Audio, Video and Similar Electronic Apparatus - Safety Requirements.

d) IEC 60065, The International Electrotechnical Commission (IEC).
Audio, Video and Similar Electronic Apparatus - Safety Requirements.
(Including report of IEC60825-1:2001 clause 8 and clause 9)

notes

1. Laser (LED Backlight) Information

Class 1M LED Product IEC60825-1 : 2001 Embedded LED Power (Class1M)

2. Caution
: LED inside.
Class 1M laser (LEDs) radiation when open.
Do not open while operating.

7-2. EMC

a) ANSI C63.4 “American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.” American National Standards Institute (ANSI), 2003.

b) CISPR 22 “Information technology equipment – Radio disturbance characteristics – Limit and methods of measurement." International Special Committee on Radio Interference (CISPR), 2005.

c) CISPR 13 “Sound and television broadcast receivers and associated equipment – Radio disturbance characteristics – Limits and method of measurement." International Special Committee on Radio Interference (CISPR), 2006.

7-3. Environment

a) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27 January 2003

8. Packing

8-1. Information of LCM Label

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.

notes

1. YEAR

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mark	A	B	C	D	E	F	G	H	J	K

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 : 22 pcs TBD

b) Pallet Size : 1140 mm(W) X 990 mm(D) X 810 mm(H) TBD

9. Precautions

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

9-1. Mounting Precautions

(1) You must mount a module using specified mounting holes (Details refer to the drawings).
(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to 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) Response time depends on the temperature.(In lower temperature, it becomes longer.)
(2) 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
(3) 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.
(4) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(5) 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.
(6) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
(7) 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)
(8) Please do not set LCD on its edge.
(9) The conductive material and signal cables are kept away from LED driver inductor to prevent abnormal display, sound noise and temperature rising.

9-3. Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4. Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

9-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.
(3) Storage condition is guaranteed under packing conditions.
(4) The phase transition of Liquid Crystal in the condition of the low or high storage temperature will be recovered when the LCD module returns to the normal condition.

9-6. Operating condition guide

(1) The LCD product should be operated under normal conditions. Normal condition is defined as below;
- Temperature : 5 ~ 40 ℃, normal humidity
- Display pattern : continually changing pattern (Not stationary)

(2) If the product will be used in extreme conditions such as high temperature, display patterns or operation time etc..,
It is strongly recommended to contact LGD for Qualification engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems. The LCD product should be applied by global standard environment. (refer ETSI EN 300, IEC 60721)

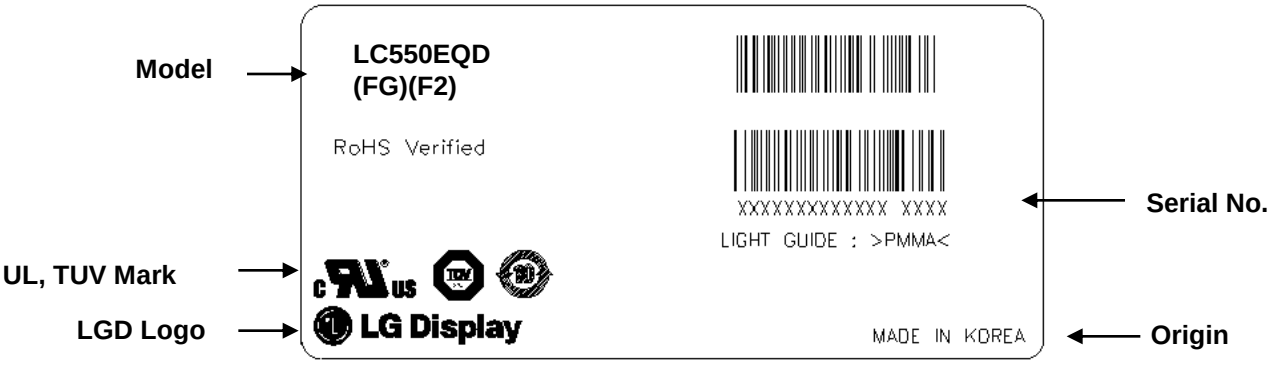
APPENDIX- I

■ Pallet Ass'y

TBD

APPENDIX- II-1

■ LCM Label



APPENDIX- II-2

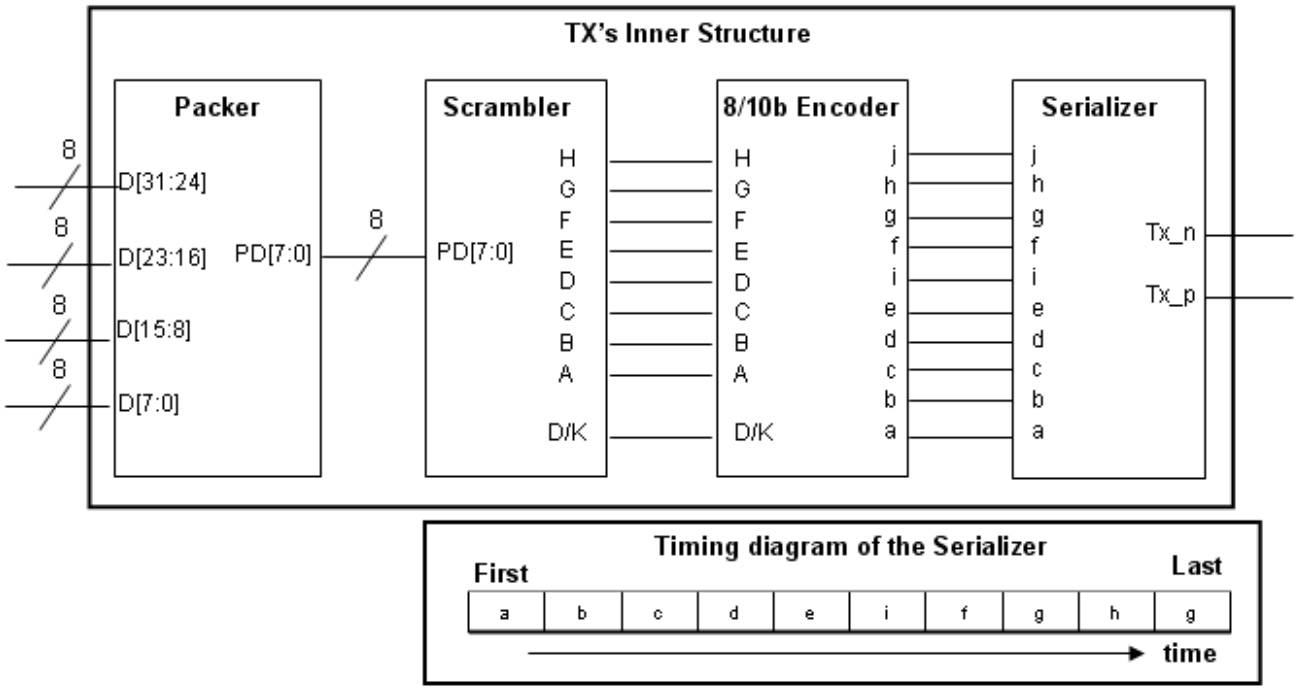
■ Box Label

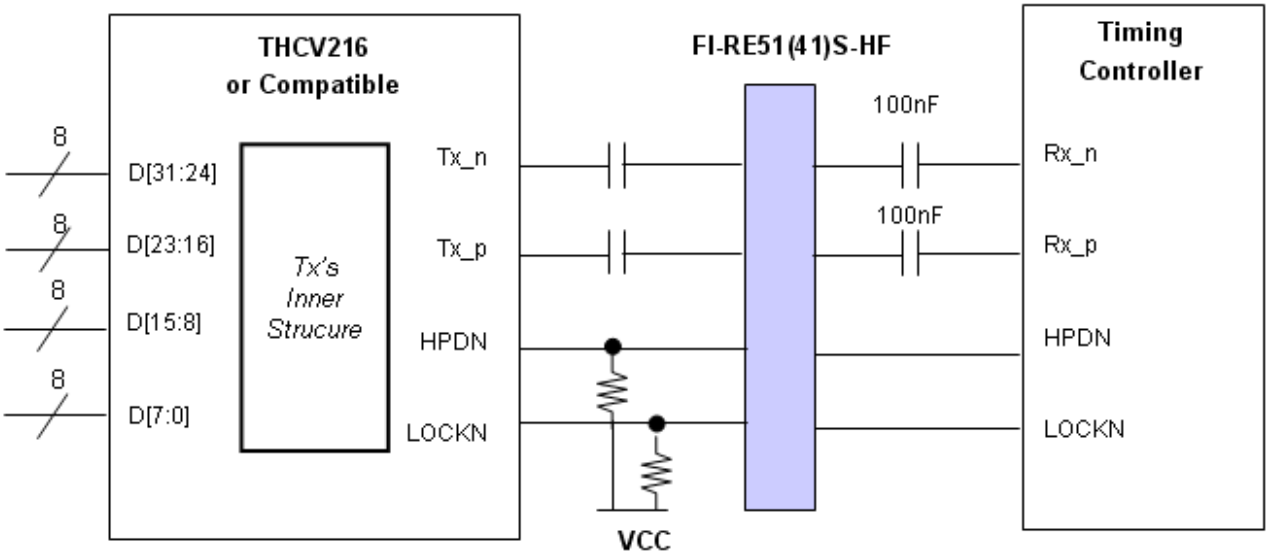
■ Pallet Label

TBD

APPENDIX- III-1

■ Required signal assignment for Flat Link (Thine : THCV216) Transmitter



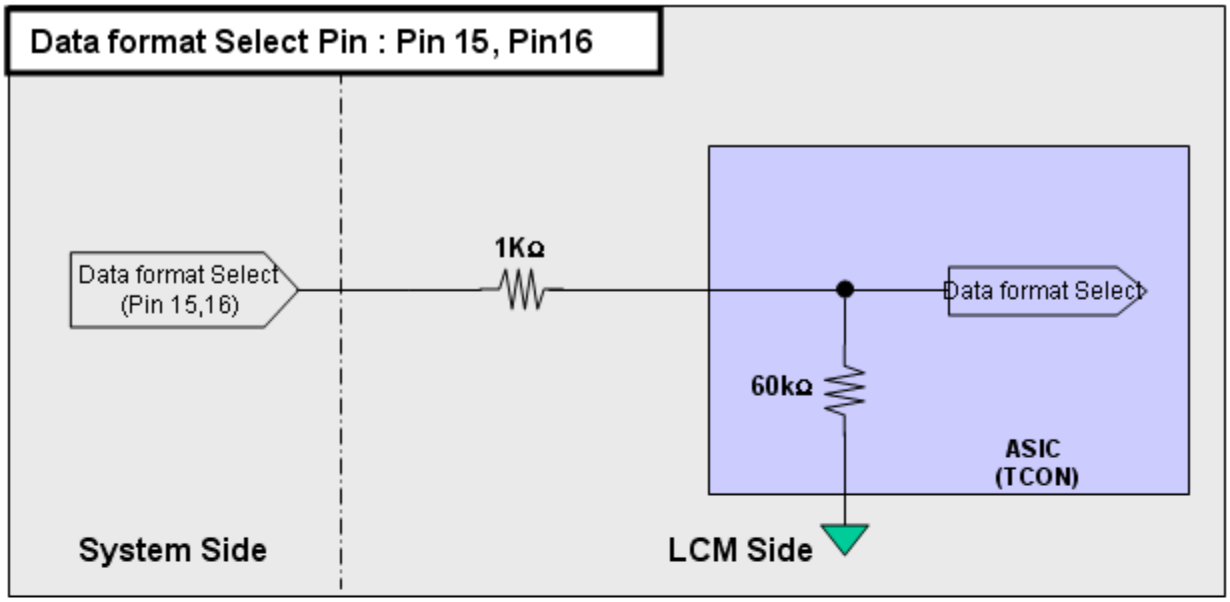


notes: 1. The LCD module uses a 100 nF capacitor on positive and negative lines of each receiver input.
2. Refer to Vx1 Transmitter Data Sheet for detail descriptions. (THCV216 or Compatible)
3. About Module connector pin configuration, Please refer to the Page 8~9.

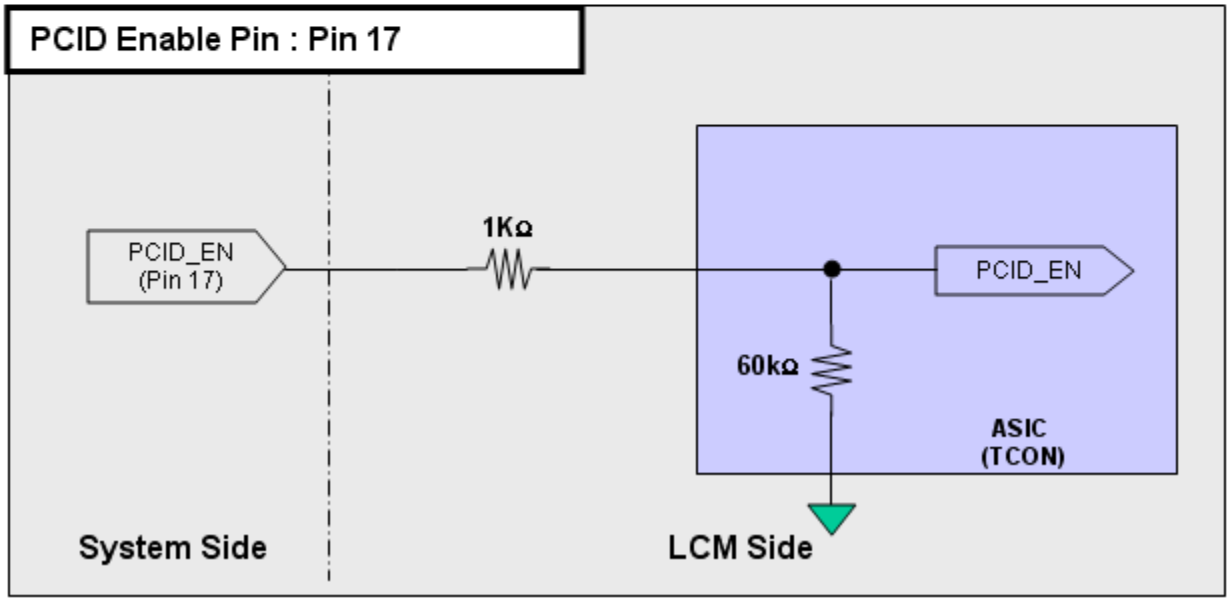
APPENDIX- V-1

■ **Option Pin** Circuit Block Diagram

1) Circuit Block Diagram of Data format Selection pin



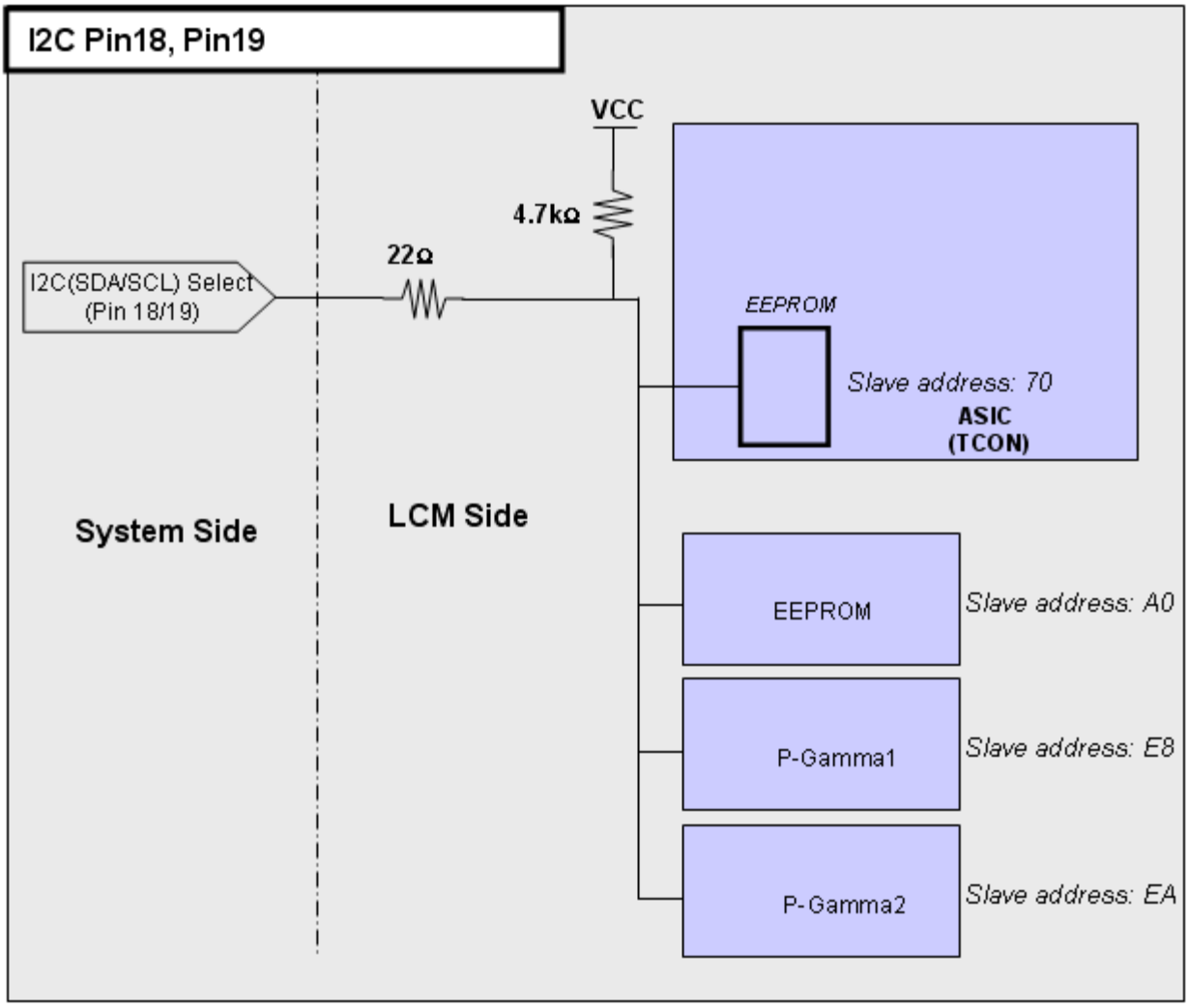
2) Circuit Block Diagram of PCID Enable pin



APPENDIX- V-2

■ **Option Pin** Circuit Block Diagram

3) I2C (SDA/SCL) Selection pin



notes: 1. I2C Line of Set SoC avoid using slave address A0,E8,EA because LCD module uses those

APPENDIX- VI

■ Standard specification of Eyeglasses

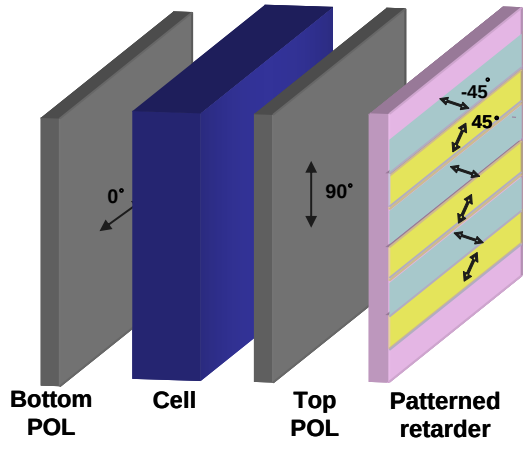
This is recommended data of Eyeglasses for LC550EQK-FGK1 model. (details refer to table 11)

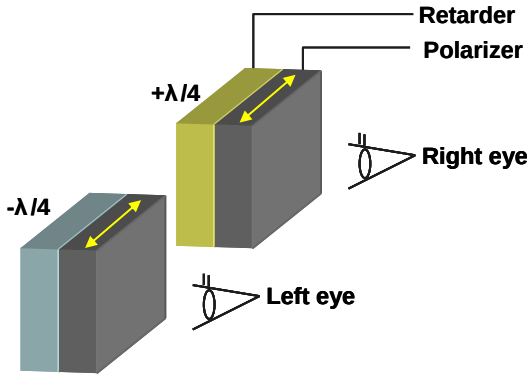
For each item, depending on the eyeglass manufacturer tolerances may occur, this tolerance can affect 3D performance. (3D Crosstalk, 3D luminance, 3D viewing angle)

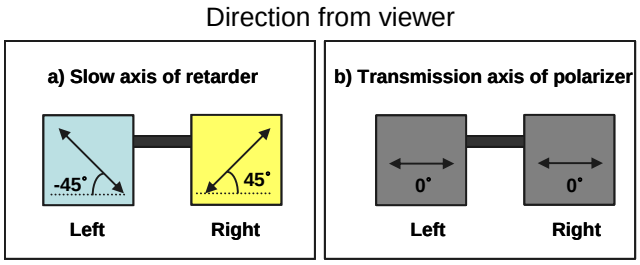
<Table 11. Standard specification of Eyeglasses>

Design item of Eyeglasses		Left	Right	Remark
Optical axis	a) Slow axis of retarder	-45˚	45˚	Refer to drawing
	b) Transmission axis of polarizer	0˚	0˚	
Retardation value	Retarder	125nm		@550nm

※Recommended polarizer
Polarization efficiency: more than 99.90%







(b) Configuration of Eyeglasses

<Drawing. Information of optical axis>