SPECIFICATION
FOR
APPROVAL

( ) **Preliminary Specification**

(●) **Final Specification**

Title	55.0” QWUXGA TFT LCD

BUYER	
SET MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LC550EQE
SUFFIX	PHF1 (RoHS Verified)

APPROVED BY	SIGNATURE / DATE
/	
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/	

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

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J. T. Kim / Team Leader	2014. 11. 17
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TV Product Development Dept.
LG Display Co., Ltd.

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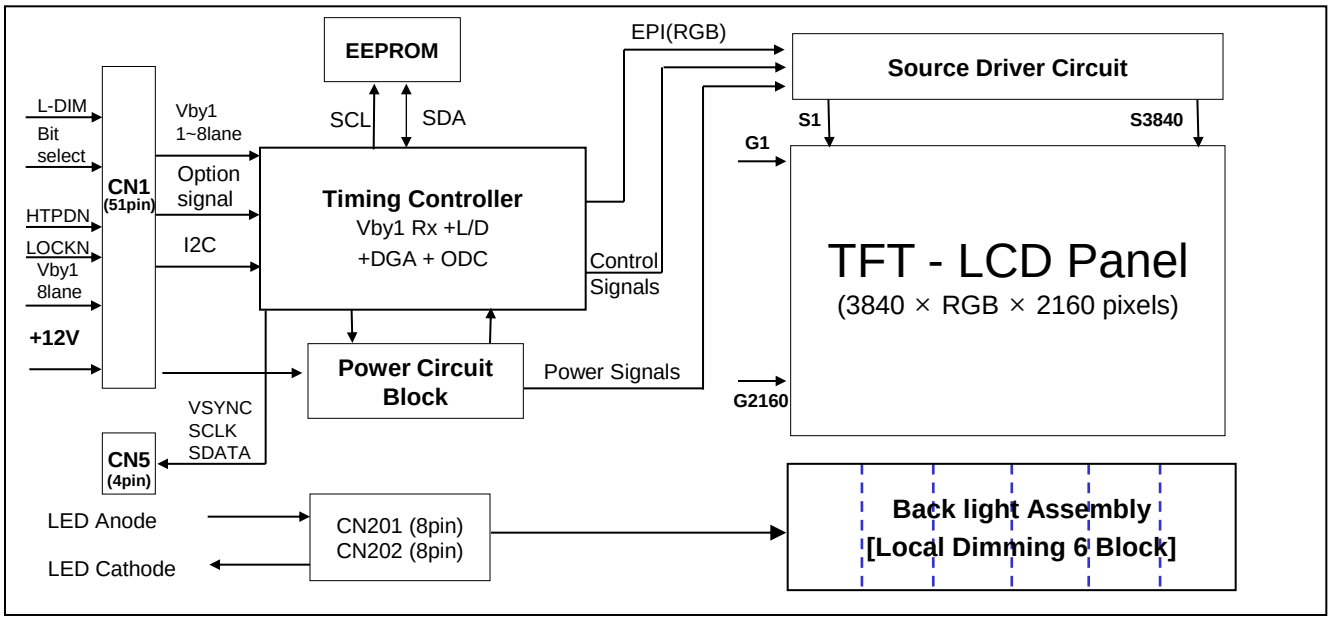
1. General Description

The LC550EQE is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode (LED) 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 54.64 inch diagonally measured active display area with QWUXGA resolution (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 1.07Bilion colors.
It has been designed to apply the 10-bit 8 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	1226.0(H) X 704.1(V) X 9.2(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), 1.07Billon 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=77.05W (Typ.) [Logic= 6.95W, LED Backlight=70.1 W (IF_cathode=180mA)]
Weight	13.0Kg (Typ.) 13.7Kg (Max)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(2H), Anti-glare treatment of the front polarizer (Haze 1% Typ.)

2. Absolute Maximum Ratings

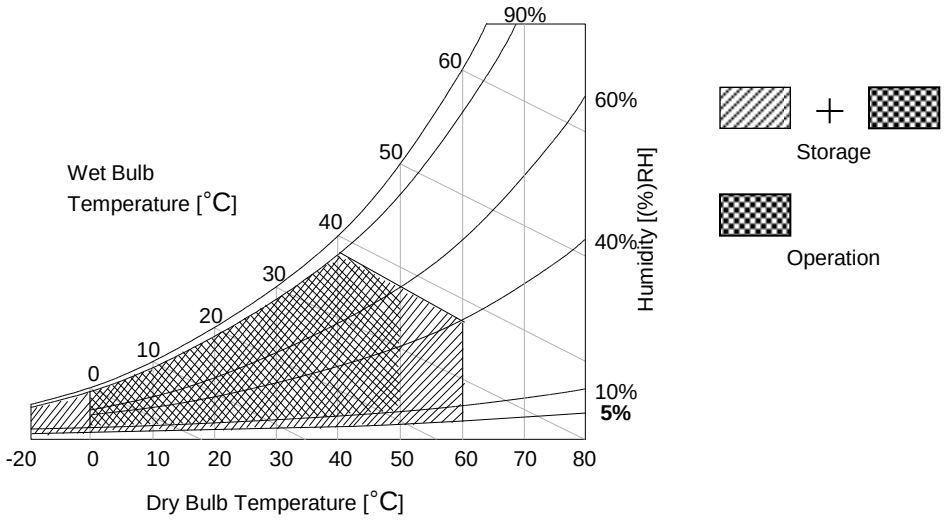
The following items are maximum values which, if exceeded, may cause faulty operation or permanent damage to the LCD module.

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
LED Input Voltage	Forward Voltage	V_F	-	80.1	V_{DC}	
T-Con Option Selection Voltage		V_{LOGIC}	-0.3	+4.0	V_{DC}	
Operating Temperature		T_{OP}	0	+50	°C	2,3
Storage Temperature (without packing)		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}	5	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.

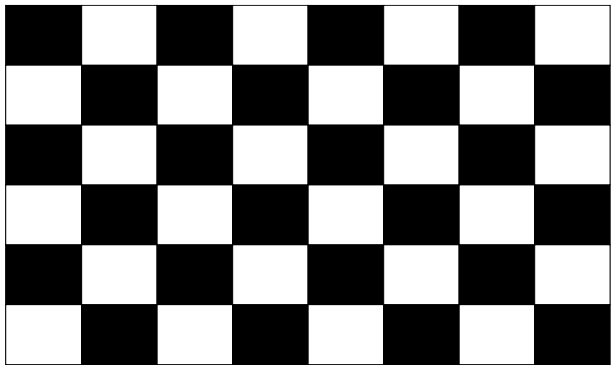
Table 2. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
Circuit :						
Power Input Voltage	V_{LCD}	10.8	12.0	13.2	V_{DC}	5
Power Input Current	I_{LCD}	-	580	755	mA	1
		-	1540	2000	mA	2
Power Consumption	P_{LCD}	-	6.95	9.04	Watt	1
Rush current	I_{RUSH}	-	-	10	A	3

Notes

1. The specified current and power consumption are under the V_{LCD}=12.0V, Ta=25 ± 2°C, f_V=60Hz 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
5. Maximum of Power Input Voltage is included with ripple.

White : 1023 Gray
Black : 0 Gray



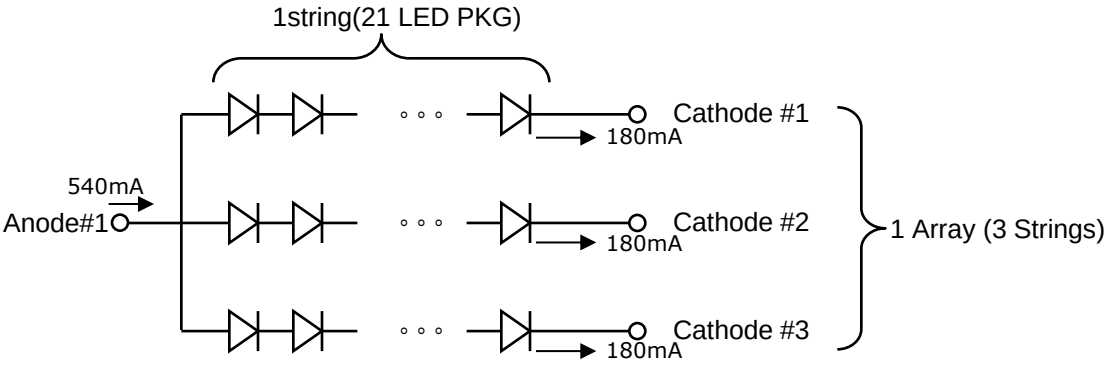
Mosaic Pattern(8 x 6)

Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter		Symbol	Values			Unit	Note
			Min	Typ	Max		
Backlight Assembly :							
Forward Current (one array)	Anode	$I_{F\ (anode)}$		540		mAdc	±5%
	Cathode	$I_{F\ (cathode)}$	171	180	189	mAdc	2, 3
Forward Voltage		V_F	59.6	64.9	70.1	Vdc	4
Forward Voltage Variation		$\triangle V_F$			1.7	Vdc	5
Power Consumption		P_{BL}	66.6	70.1	73.7	W	6
Burst Dimming Duty		On duty	1		100	%	
Burst Dimming Frequency		1/T	95		182	Hz	8
LED Array : (APPENDIX-V)							
Life Time			30,000			Hrs	7

Notes :The design of the LED driver must have specifications for the LED array in LCD Assembly.
The electrical characteristics of LED driver are based on Constant Current driving type.
The performance of the LED in LCM, for example life time or brightness, is extremely influenced by the characteristics of the LED Driver. So, all the parameters of an LED driver should be carefully designed.
When you design or order the LED driver, please make sure unwanted lighting caused by the mismatch of the LED and the driver (no lighting, flicker, etc) has never been occurred. When you confirm it, the LCD–Assembly should be operated in the same condition as installed in your instrument.

1. Electrical characteristics are based on LED Array specification.
2. Specified values are defined for a Backlight Assembly. (IBL :2 LED array/LCM)
3. Each LED array has one anode terminal and three cathode terminals.
   The forward current(I_F) of the anode terminal is 540mA and it supplies 180mA into three strings, respectively



4. The forward voltage(V_F) of LED array depends on ambient temperature (Appendix-Ⅵ)
5. ΔV_F means Max string V_F-Min string V_F in one Backlight. So VF variation in a Backlight isn't over Max. 1.7V
6. Maximum level of power consumption is measured at initial turn on.
   Typical level of power consumption is measured after 1hrs aging at 25 ± 2°C.
7. The life time(MTTF) is determined as the time at which brightness of the LED is 50% compared to that of initial value at the typical LED current on condition of continuous operating at 25 ± 2°C, based on duty 100%.
8. The reference method of burst dimming duty ratio.
   It is recommended to use synchronous V-sync frequency to prevent waterfall
   (Vsync * 2 =Burst Frequency)

3-2. Interface Connections

This LCD module employs three kinds of interface connection, 51-pin connector is used for the module electronics and 8-pin, 8-pin connectors are used for the integral backlight system.

3-2-1. LCD Module

- LCD Connector(CN1): FI-RXE51S-HF(manufactured by JAE) or GT05S-51S-H38(manufactured by LSM) or IS050-C51B-C39-C (manufactured by UJU)
- Mating Connector : FI-RE51HL(manufactured by JAE) or compatible

Table 4. MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	VLCD	Power Supply +12.0V	27	GND	Ground
2	VLCD	Power Supply +12.0V	28	Rx0n	V-by-One HS Data Lane 0
3	VLCD	Power Supply +12.0V	29	Rx0p	V-by-One HS Data Lane 0
4	VLCD	Power Supply +12.0V	30	GND	Ground
5	VLCD	Power Supply +12.0V	31	Rx1n	V-by-One HS Data Lane 1
6	VLCD	Power Supply +12.0V	32	Rx1p	V-by-One HS Data Lane 1
7	VLCD	Power Supply +12.0V	33	GND	Ground
8	VLCD	Power Supply +12.0V	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	NC	NO CONNECTION (Note 3)	40	Rx4n	V-by-One HS Data Lane 4
15	NC	NO CONNECTION (Note 3)	41	Rx4p	V-by-One HS Data Lane 4
16	NC	NO CONNECTION (Note 3)	42	GND	Ground
17	NC	NO CONNECTION (Note 3)	43	Rx5n	V-by-One HS Data Lane 5
18	SDA	SDA (For Local Dimming)	44	Rx5p	V-by-One HS Data Lane 5
19	SCL	SCL (For Local Dimming)	45	GND	Ground
20	NC	NO CONNECTION (Note 3)	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 EN	H : On, L or NC Off	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. All Input levels of V-by-One signals are based on the V-by-One-HS Standard Version 1.4
3. #14,#15,#16,#17 & #20 NC(No Connection) : These pins are used only for LGD (Do not connect)
4. About specific pin(#22), Please see the Appendix IV-1.
5. 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).

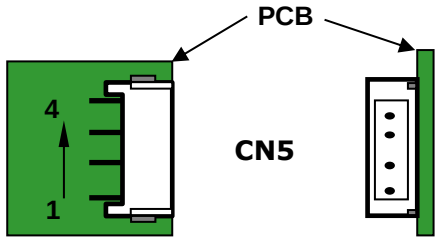
3-2-2. Local Dimming Interface

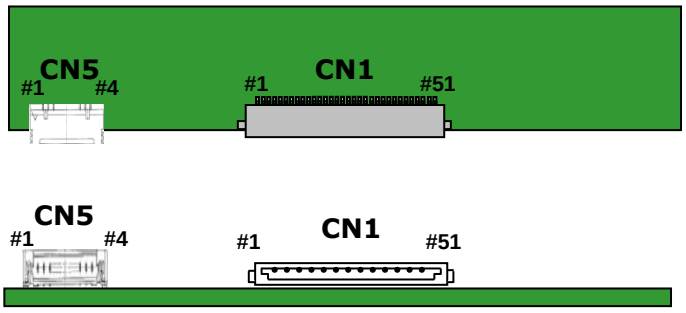
Table 5-1. LOCAL DIMMING INTERFACE CONNECTOR PIN CONFIGULATION (CN5)

Pin No	Symbol	Description	Note
1	VSYNC	Vertical Sync signal	
2	GND	Backlight Ground	1
3	SIN	Local Dimming Serial Data (SPI)	
4	SCLK	Local Dim Serial Clock (SPI)	

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

◆ **Rear view of LCM (CN5)**





Rear view of LCM

3-2-3. Backlight Module

[CN201]

1) LED Array FFC A'ssy Connector (Plug)
: GF10C-8S-E2000 (black color, manufactured by LS Cable)
2) Mating Connector (Receptacle)
: HS100-L08N-N62 (black color, manufactured by UJU)

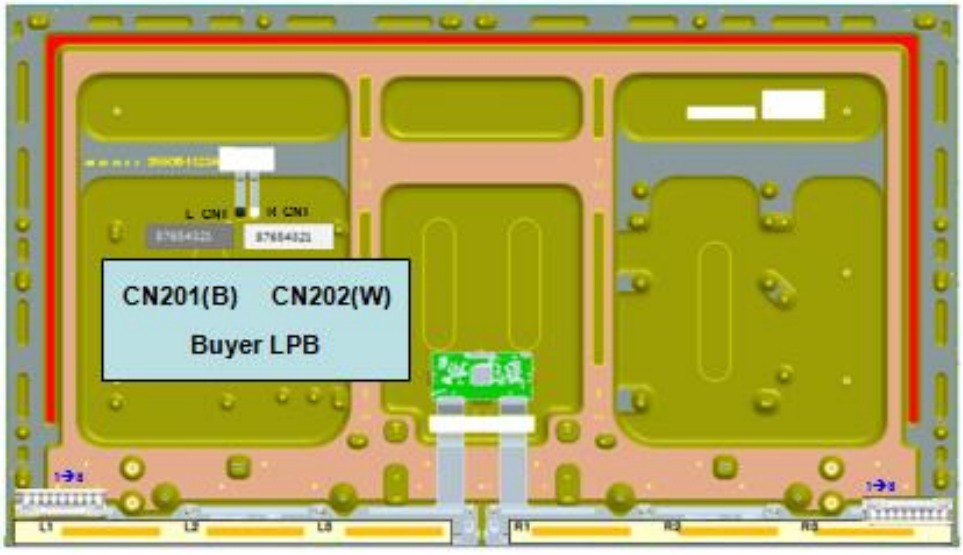
[CN202]

1) LED Array FFC A'ssy Connector (Plug)
: GF10C-8S-E2000 (White color, manufactured by LS Cable)
2) Mating Connector (Receptacle)
: HS100-L08N-N62 -A (black color, manufactured by UJU)

Table 5-2. BACKLIGHT CONNECTOR PIN CONFIGURATION(CN201,CN202)

No	Symbol	Description	Note
1	L1 Cathode	LED Output Current	
2	L2 Cathode	LED Output Current	
3	L3 Cathode	LED Output Current	
4	N.C	Open	
5	N.C	Open	
6	N.C	Open	
7	N.C	Open	
8	Anode_L	LED Input Current	

No	Symbol	Description	Note
1	Anode_R	LED Input Current	
2	N.C	Open	
3	N.C	Open	
4	N.C	Open	
5	N.C	Open	
6	R1 Cathode	LED Output Current	
7	R2 Cathode	LED Output Current	
8	R3 Cathode	LED Output Current	



3-3. Signal Timing Specifications

Table 6 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 6. TIMING TABLE (DE Only Mode)

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	t_{HV}	480	480	480	t_{CLK}	3840/8
	Blank	t_{HB}	60	70	120	t_{CLK}	1
	Total	t_{HP}	540	550	600	t_{CLK}	
Vertical	Display Period	t_{VV}	2160	2160	2160	Lines	
	Blank	t_{VB}	40	90	600	Lines	1
	Total	t_{VP}	2200	2250	2760	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Note
Frequency	DCLK	f_{CLK}	67.00	74.25	78.00	MHz	
	Horizontal	f_H	121.8	135	140	KHz	2
	Vertical	f_V	47	60	63	Hz	2

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

3. Spread Spectrum Rate (SSR) is limited to ±0.5% center spread at 30KHz

※ Timing should be set based on clock frequency.

3-4. V by One input signal Characteristics

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

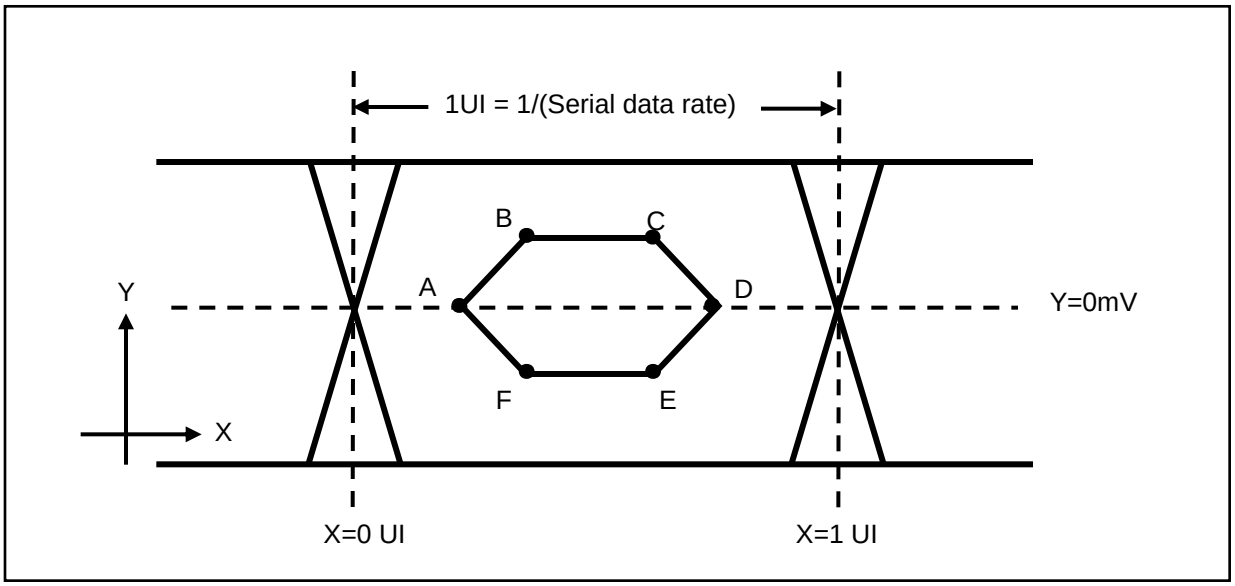
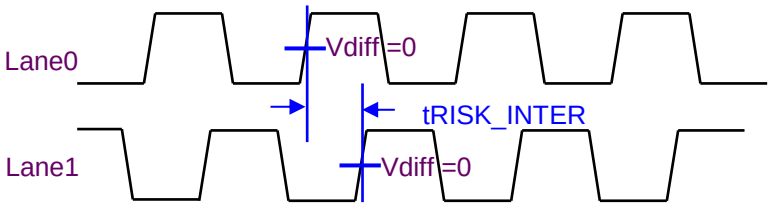


Table7. Eye Mask Specification

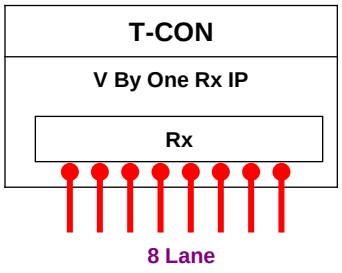
	X[UI]	Note	Y[mV]	Note
A	0.25 (max)	2	0	-
B	0.3 (max)	2	50	3
C	0.7(min)	3	50	3
D	0.75(min)	3	0	-
E	0.7(min)	3	l -50 l	3
F	0.3(max)	2	l -50 l	3

notes 1. All Input levels of V by One signals are based on the V by One HS Standard Ver. 1.4
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 : 15 Mhz
   - Damping Factor : 1.5

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



<Inter-pair Skew between two Lanes>



<TCON – VbyOne Brief Diagram >

Description	Symbol	Min	Max	Unit	notes
Allowable inter-pair skew between lanes	tRISK_INTER	-	5	UI	1,2

Notes 1.1UI = 1/serial data rate

2. it is the time difference of the differential voltage between any two lanes in one sub block.

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 8 provides a reference for color versus data input.

Table 8. 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]
Byte3	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

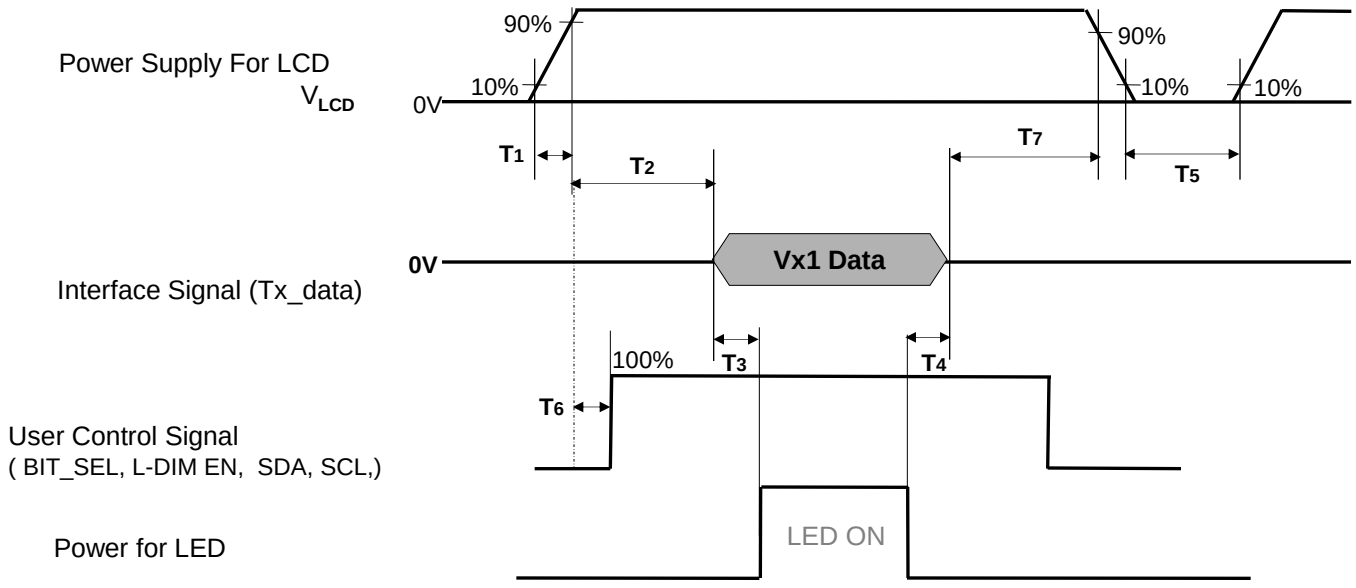


Table 9. POWER SEQUENCE

Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	0.5	-	20	ms	1
T2	0	-	-	ms	2
T3	400	-	-	ms	3
T4	100	-	-	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 V by One 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.

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.

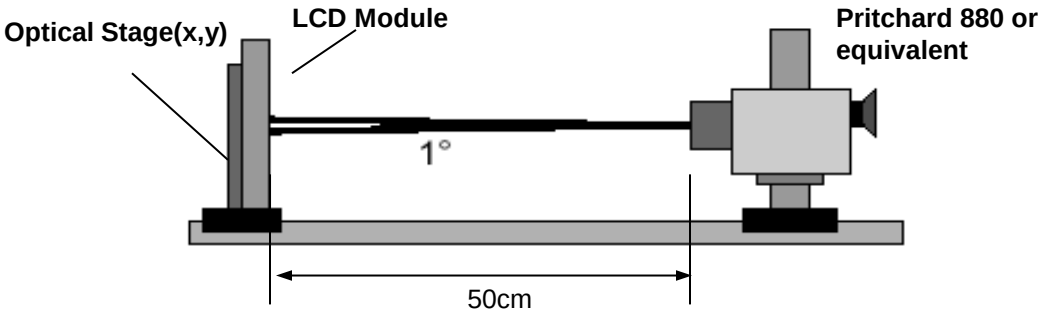


FIG. 1 Optical Characteristic Measurement Equipment and Method

Ta= 25±2°C, V_{LCD}=12.0V, fv=60Hz, Dclk=74.25MHz
EXTVbr-B=100%

Table 10. OPTICAL CHARACTERISTICS

Parameter		Symbol		Value Min	Value Typ	Value Max	Unit	notes
Contrast Ratio		CR		800	1200	-		1
Surface Luminance, white		L_{WH}	2D	360	450		cd/m²	2
			3D	136	170			7
Luminance Variation		δ_{WHITE}	9P	60	70		%	3
Response Time	Gray-to-Gray	G to G		-	8	12	ms	4
	Uniformity	$\delta_{G\ TO\ G}$		-	-	1		
Color Coordinates [CIE1931]	RED	Rx		Typ -0.03	0.646	Typ +0.03		
		Ry			0.336			
	GREEN	Gx			0.303			
		Gy			0.606			
	BLUE	Bx			0.150			
		By			0.060			
	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	5
		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)	11	-	-	degree	7
3D Crosstalk		3D C/T			3	5	%	
Gray Scale				-	-	-		6

notes : 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. The variation in surface luminance , WHITE is defined as :
WHITE(9P) = Minimum (Lon1,Lon2~ Lon8, Lon9) / Maximum (Lon1,Lon2~ Lon8, Lon9)*100
Where Lon1 to Lon9 are the luminance with all pixels displaying white at 9 locations
For more information, see the FIG. 2.

4. Response time is the time required for the display to transit from G(N) to G(M) (Rise Time, Tr_R) and from G(M) to G(N) (Decay Time, Tr_D). For additional information see the FIG. 3. (N<M)
※ G to G Spec stands for average value of all measured points.
Photo Detector : RD-80S / Field : 2°

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.

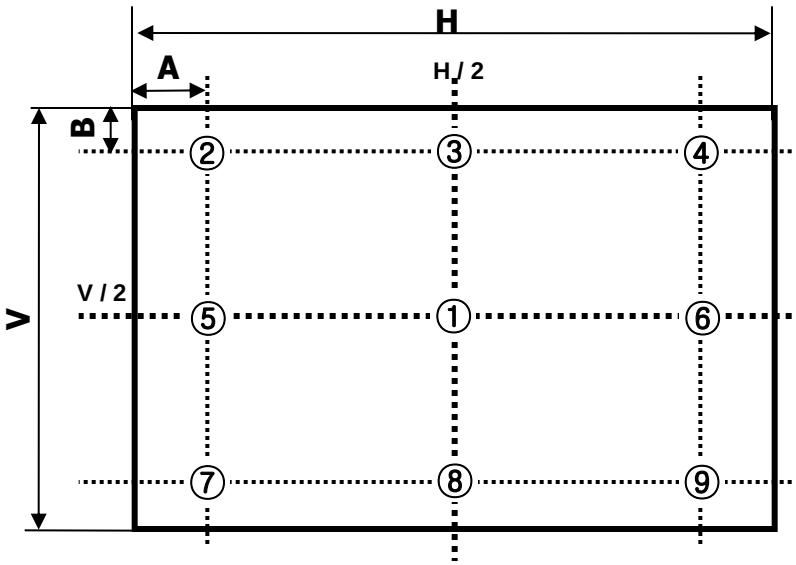
6. Gray scale specification
Gamma Value is approximately 2.2. For more information, see the Table 11.

7. 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 FIG 5~8

Table 11. GRAY SCALE SPECIFICATION

Gray Level	Luminance [%] (Typ)
L0	0.083
L63	0.27
L127	1.04
L191	2.49
L255	4.68
L319	7.66
L383	11.5
L447	16.1
L511	21.6
L575	28.1
L639	35.4
L703	43.7
L767	53.0
L831	63.2
L895	74.5
L959	86.7
L1023	100

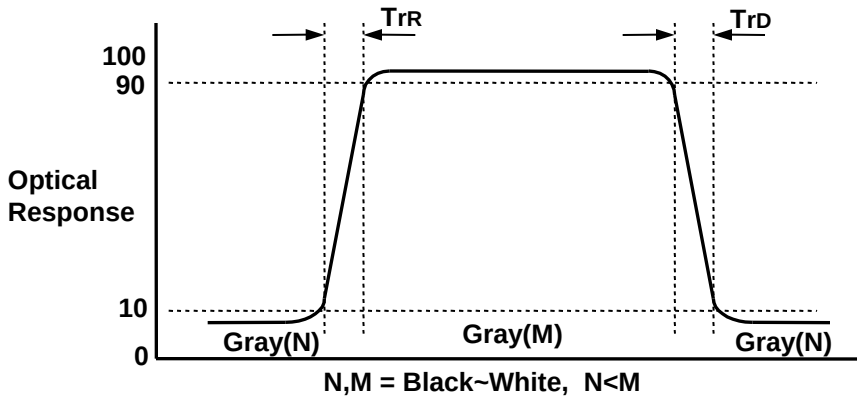
Measuring point for surface luminance & measuring point for luminance variation.



A : H / 9 mm
B : V / 9 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)".



N,M = Black~White, N<M

FIG. 3 Response Time

Dimension of viewing angle range

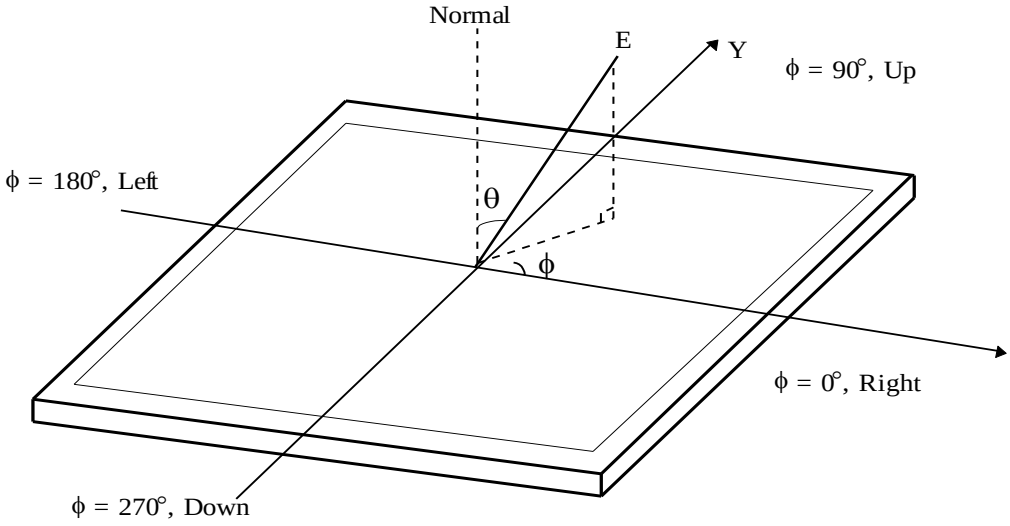
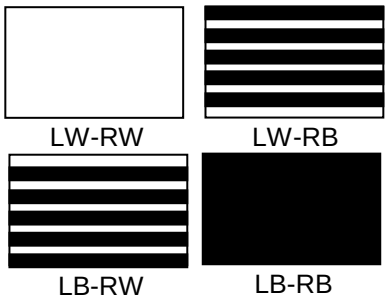
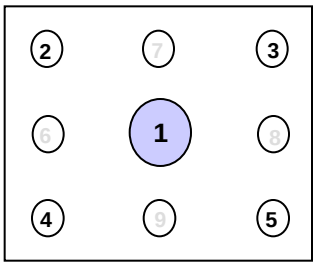


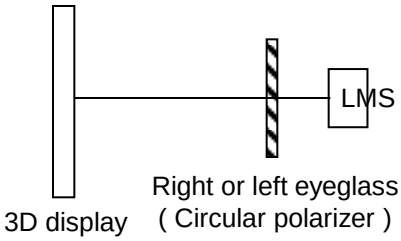
FIG.4 Viewing Angle



(a) Test pattern image

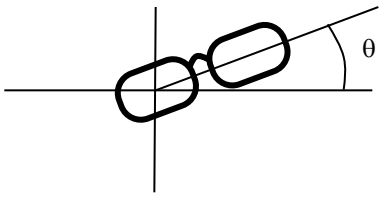


(b) Measurement position

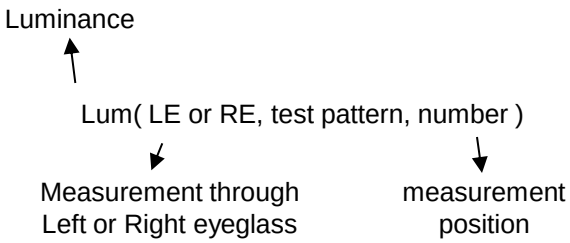


(c) Setup

< FIG5. Measurement configuration>



< FIG.6. Positioning eyeglass >



< FIG. 7. 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 5.

-. 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 1.

2) Positioning Eyeglass (refer to appendix-VII 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 6. 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).

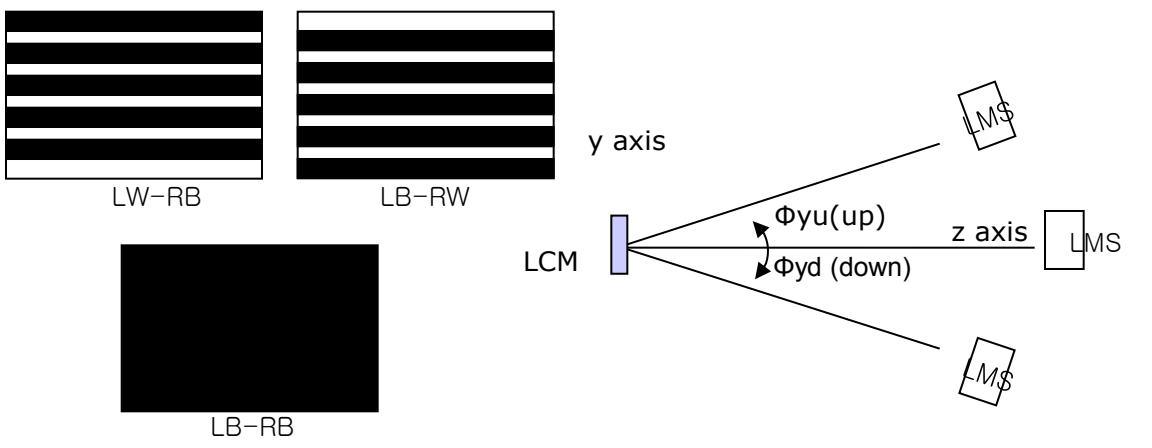
4) Measurement of 3D crosstalk
(i) Test image (LB-RW, LW-RB and LB-RB) is displayed.
(ii) Right or left eyeglass are placed in front of LMS successively and luminance is measured for position 1.
with rotating LMS or sample vertically.

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

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 8



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

< FIG.8. Measurement of 3D crosstalk and 3D viewing angle >

5. Mechanical Characteristics

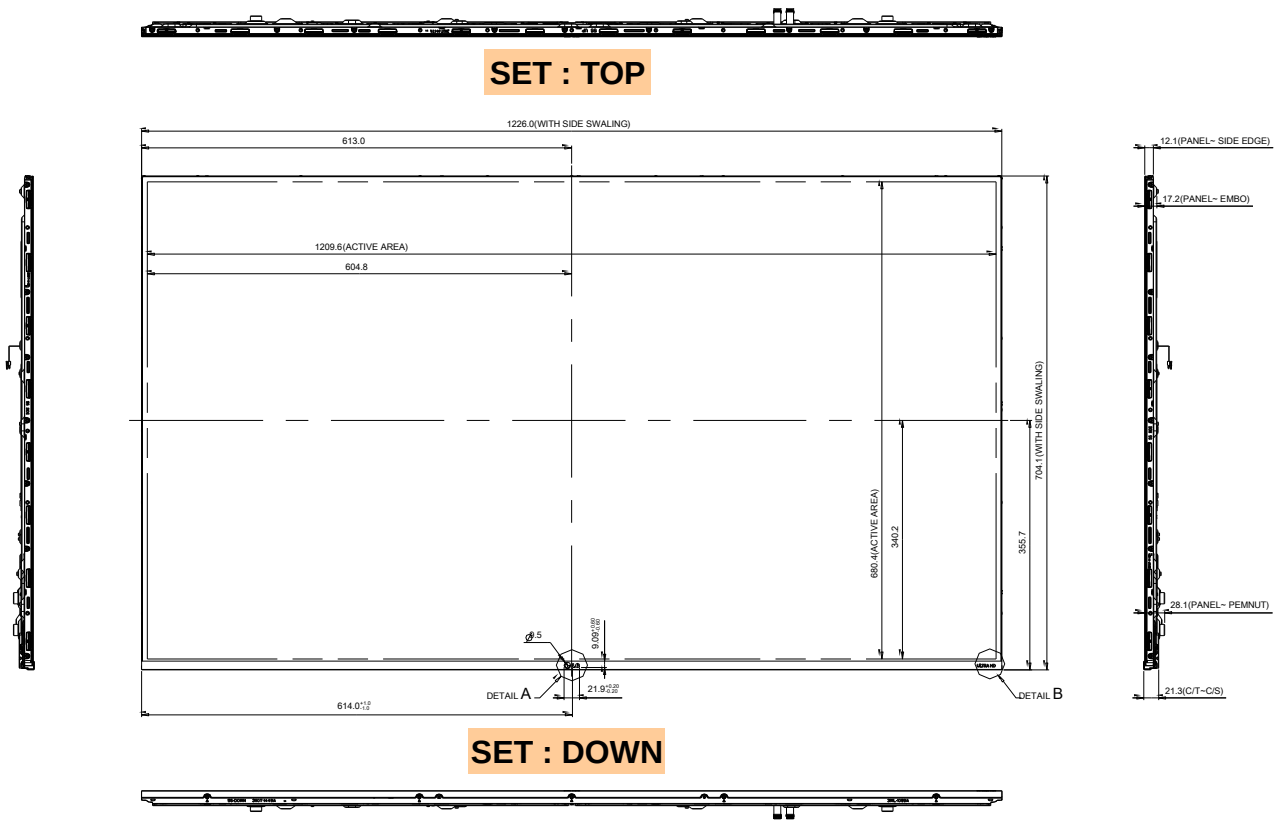
Table 12 provides general mechanical characteristics.

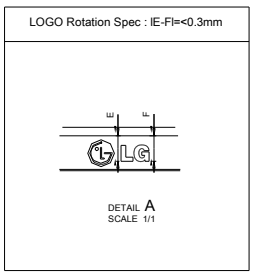
Table 12. MECHANICAL CHARACTERISTICS

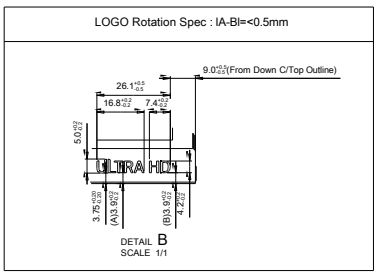
Item	Value	
Outline Dimension	Horizontal	1226.0 mm
	Vertical	704.1 mm
	Depth	9.2 mm
Active Display Area	Horizontal	1209.6 mm
	Vertical	680.4 mm
Weight	13.0Kg (Typ.) 13.7Kg (Max)	

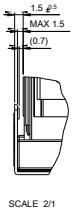
Note : Please refer to a mechanic drawing in terms of tolerance at the next page.

[FRONT VIEW]





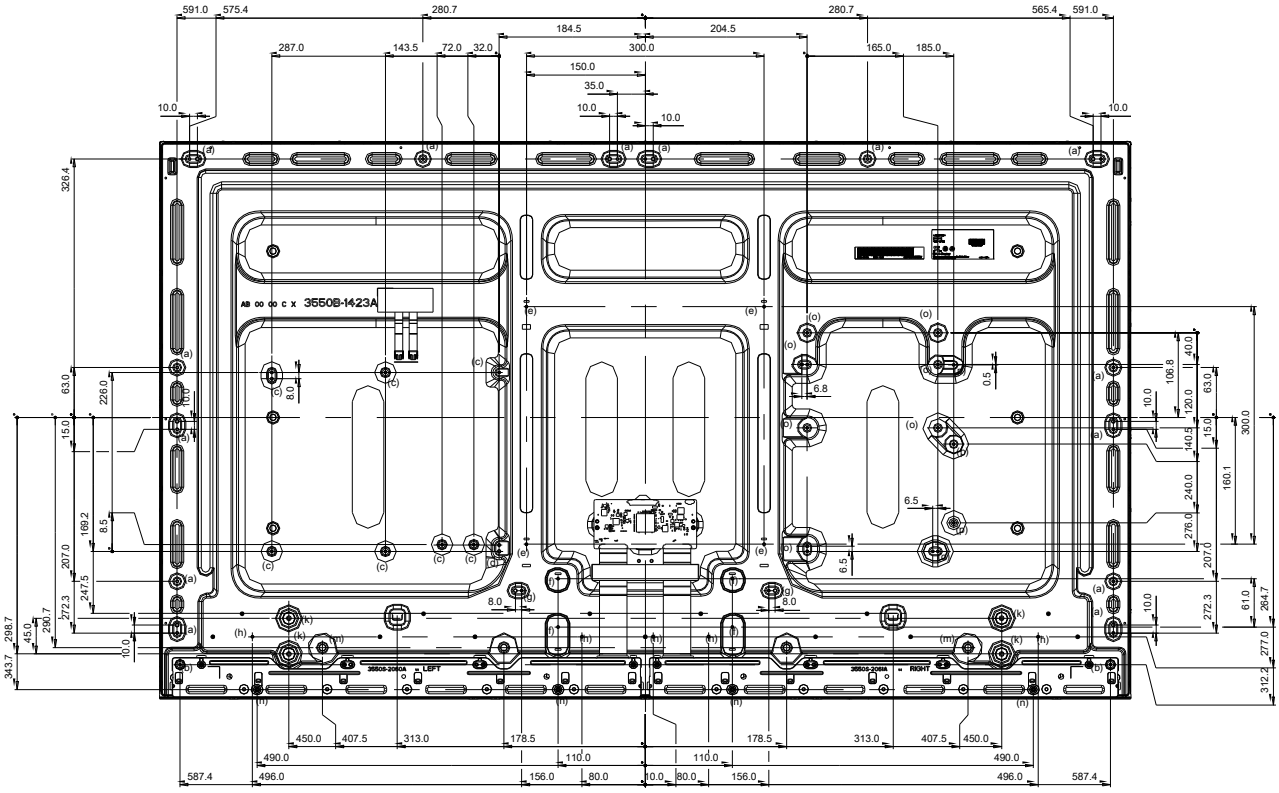




Date	Version
14.11.13	0.1

NOTES
1. Unspecified tolerance is ±1.0mm
2. Max. torque : refer to table
3. Max. depth : refer to table
4. The same feature means the same dimension.
5. Screw head Max. Protrusion : 1.0mm
6. Screw tip Max. Protrusion : 1.0mm
7. Version (0.1)

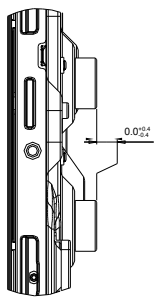
SET : TOP



SET : DOWN

ITEM	TAP	Height (mm)	Depth (mm)	Torque (Kgf-cm)	NOTES
(a)	M3.0	5.0	7.8	8.0	
(b)	M3.0	3.0	2.8	8.0	
(c)	M3.0	4.5	4.3	8.0	
(d)	M4.0	4.5	4.3	10.0	
(e)	M3.0	-	7.3	8.0	
(f)	M3.0	2.0	9.3	8.0	
(g)	M3.0	4.6	10.0	8.0	
(h)	M3.0	-	7.3	8.0	
(k)	M4.0	11.4	6.0	10.0	
(m)	∅8.0	7.6	10.0	-	Burring (No TAP)
(n)	M3.0	4.5	2.0	8.0	
(o)	M3.0	9.8	9.6	8.0	
(p)	M3.0	6.6	6.4	8.0	

Stand Pem Nut
(Left & Right Same Shape)



SCALE 1/1

6. Reliability

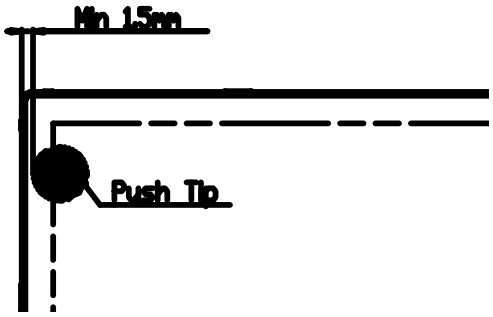
Table 13. ENVIRONMENT **TEST CONDITION**

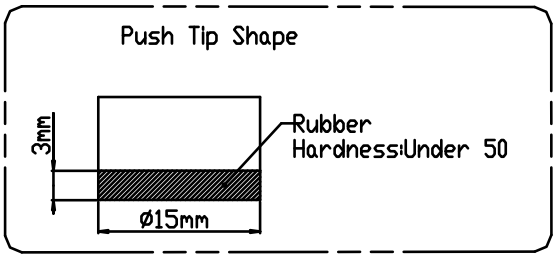
No.	Test Item	Condition
1	High temperature storage test	Ta= 60˚C 90% 240h
2	Low temperature storage test	Ta= -20˚C 240h
3	High temperature operation test	Ta= 50˚C 50%RH 500h
4	Low temperature operation test	Ta= 0˚C 500h
5	Humidity condition Operation	Ta= 40 ˚C ,90%RH
6	Altitude operating storage / shipment	0 – 16.400 ft 0 - 40,000 ft
7	Panel Push Test (Module Condition)	Max 6kgf (Test Method : Note 2)

notes : 1. Before and after Reliability test, LCM should be operated with normal function.

2. These conditions are for LGD's internal test. Please refer to Absolute Maximum Ratings (Table1) for guaranteed condition.

3. Panel Push Test Method





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.

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 2011/65/EU of the European Parliament and of the council of 8 June 2011

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 : 18 pcs

b) Pallet Size : 1440 mm(W) X 1140 mm(D) X 950 mm(H)

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, Concentrated 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

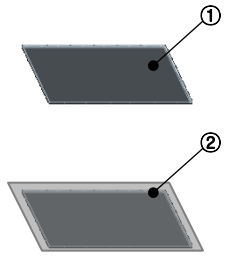
(1) The LCD product should be operated under normal conditions. Normal condition is defined as below;
- Temperature : 5 ~ 40 ℃, normal humidity
- Display pattern : continually changing pattern (Not stationary)

(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)

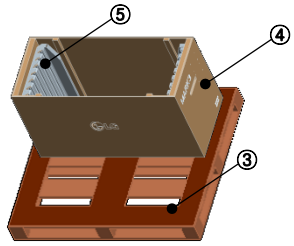
APPENDIX – I

■ Pallet Ass'y

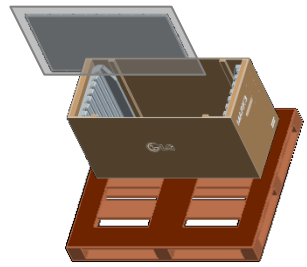
1



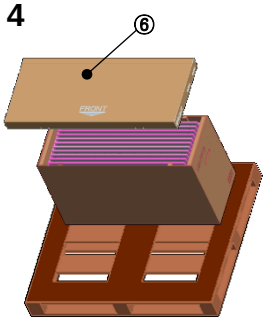
2



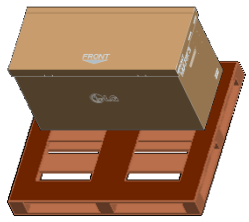
3



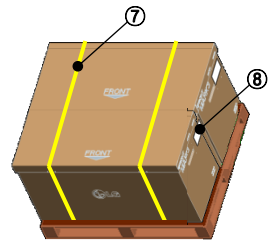
4



5



6



NO.	DESCRIPTION	MATERIAL
①	LCD Module	55INCH
②	Bag	AL Bag
③	PALLET	Plyeood 1440×1140×120mm
④	PACKING,BOTTOM	PAPER
⑤	PACKING,SIDE RIB	EPS
⑥	PACKING, TOP	PAPER
⑦	BAND,CLIP	STEEL or PP
⑧	LABEL	YUPO 80G 100X70

APPENDIX – II-1

■ LCM Label

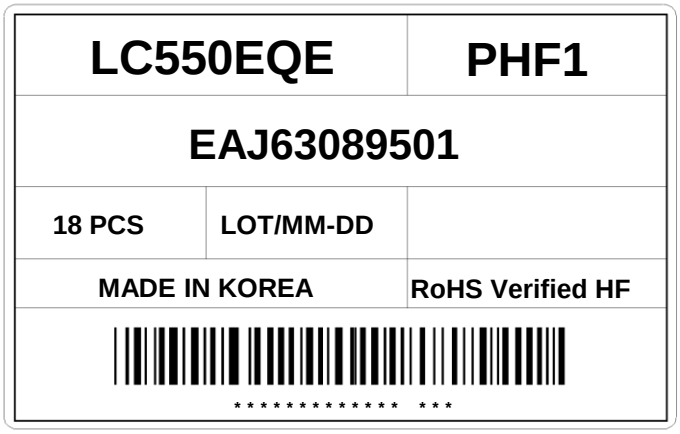
■ Production site

- LG Display (Yangju, Newoptics) CO., LTD

notes 1.The origin of LCM Label will be changed according to the production site.

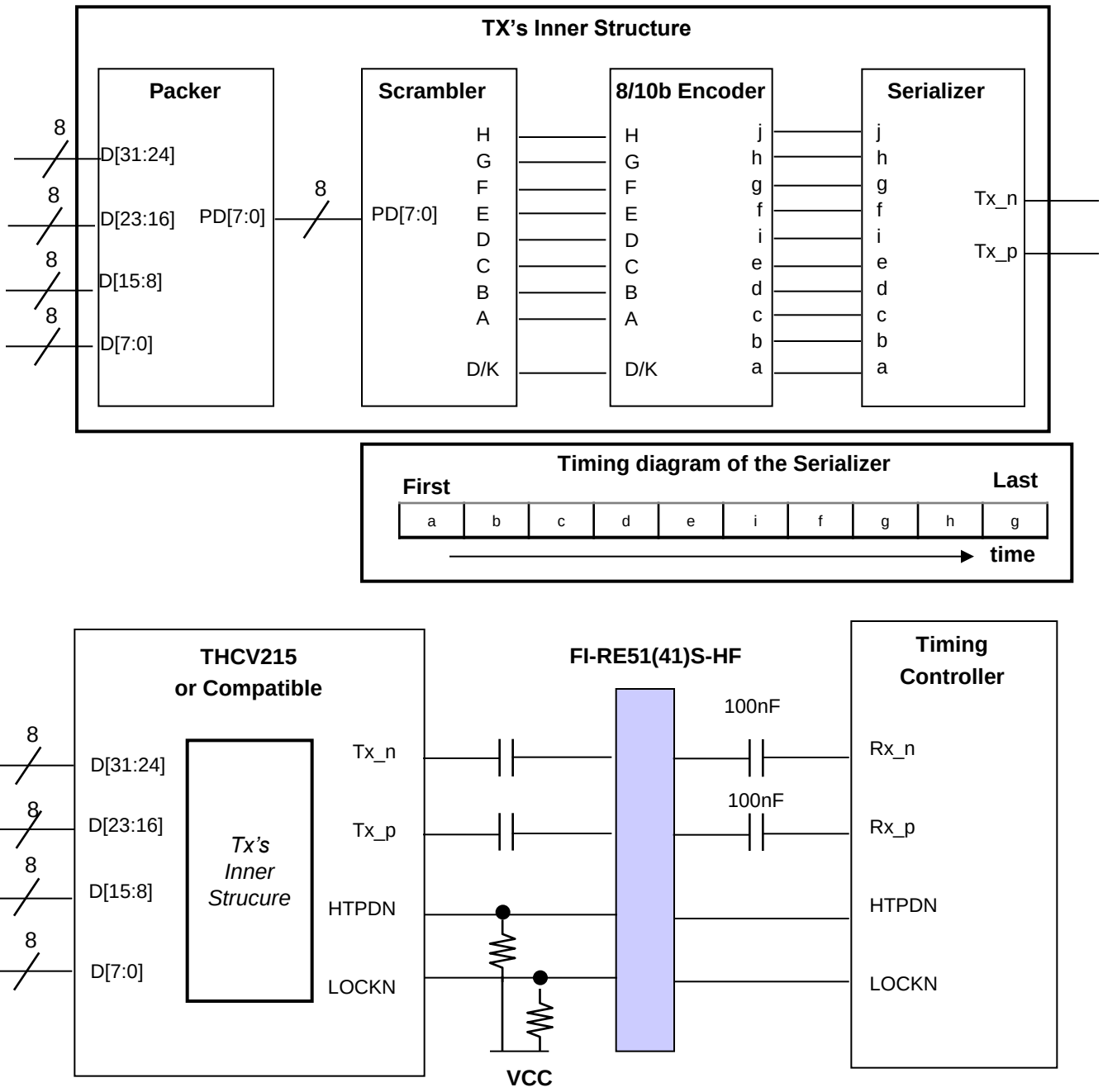
 # APPENDIX – II-2

■ Pallet Label



APPENDIX – III

■ Required signal assignment for Flat Link (Thine : THCV215) Transmitter

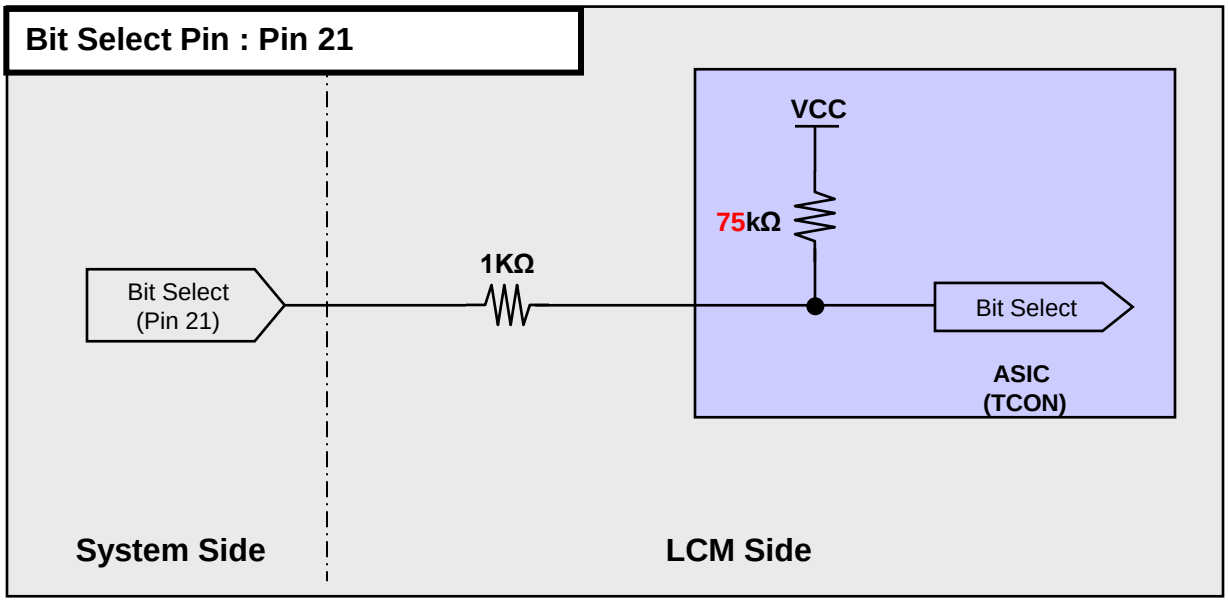


notes: 1. The LCD module uses a 100 nF capacitor on positive and negative lines of each receiver input.
2. Refer to Vx1 Transmitter Data Sheet for detail descriptions. (THCV215 or Compatible)
3. About Module connector pin configuration, Please refer to the Page 7

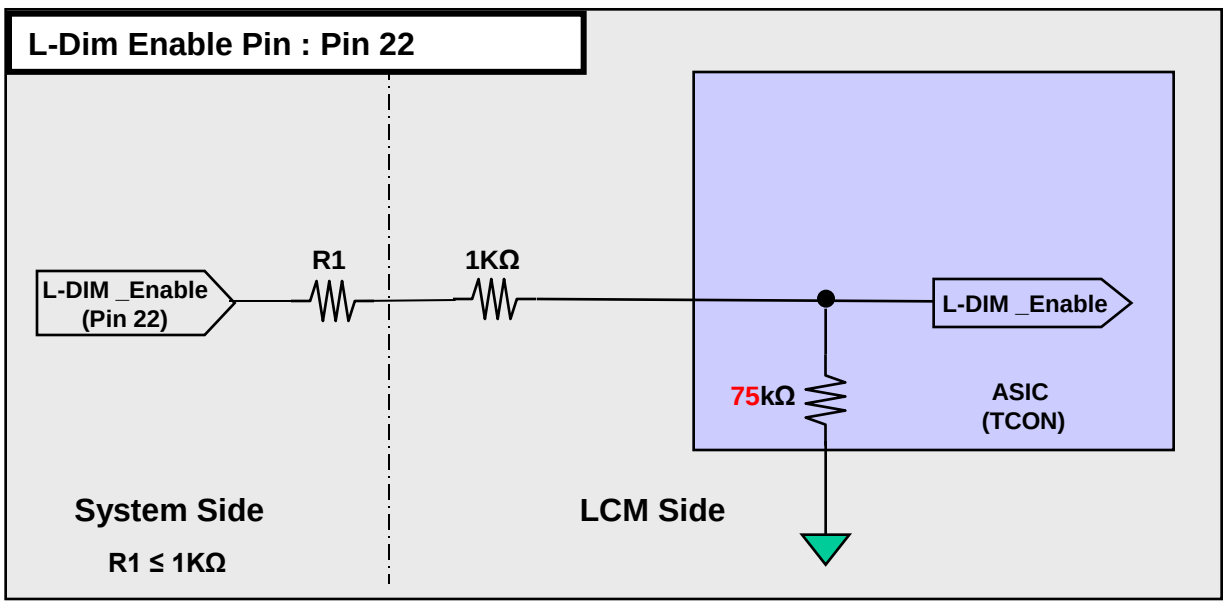
APPENDIX – IV-1

■ **Option Pin** Circuit Block Diagram

1) Circuit Block Diagram of Bit Selection pin



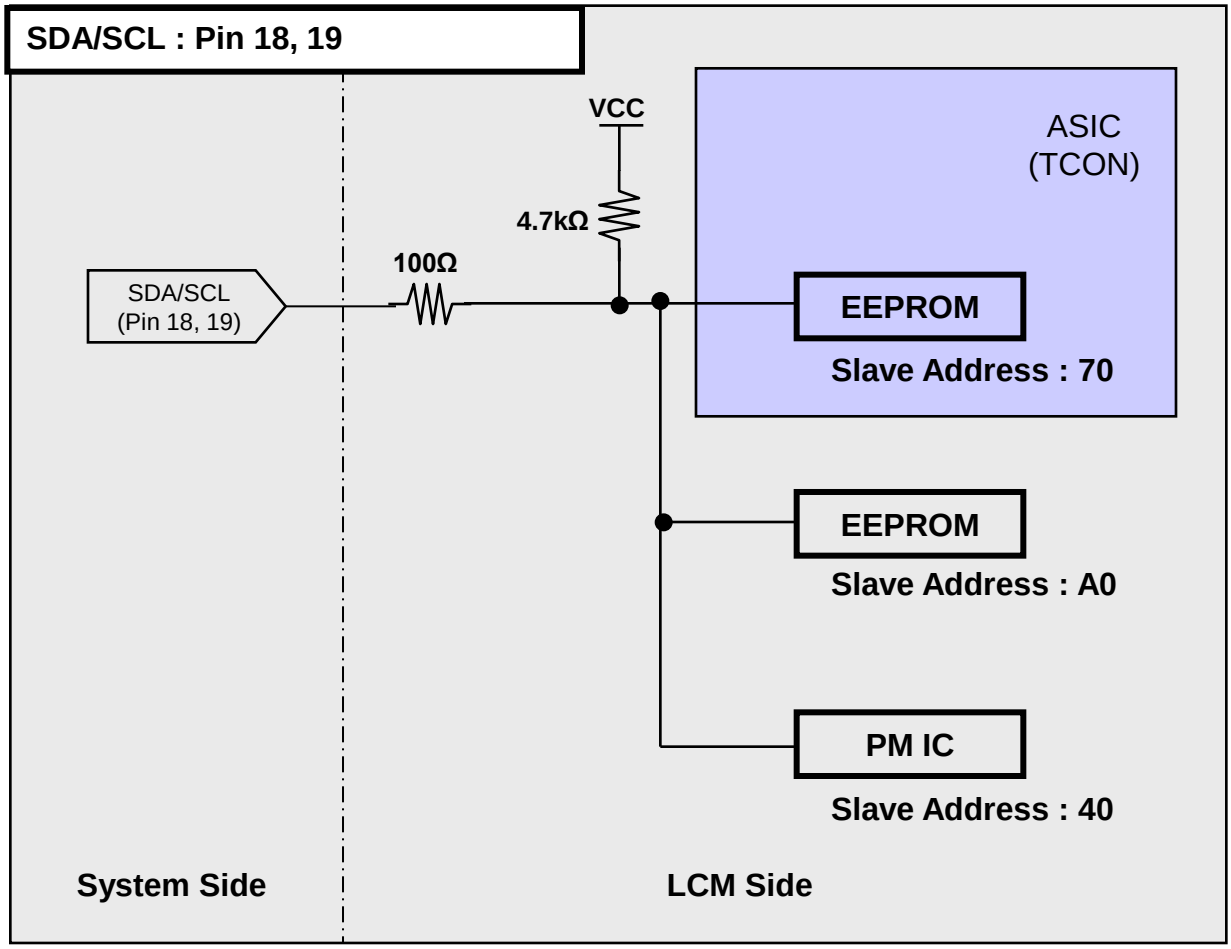
2) Circuit Block Diagram of L-Dim Enable Selection pin



APPENDIX ─ IV-2

■ **Option Pin** Circuit Block Diagram

3) I2C (SDA/SCL) Selection Pin

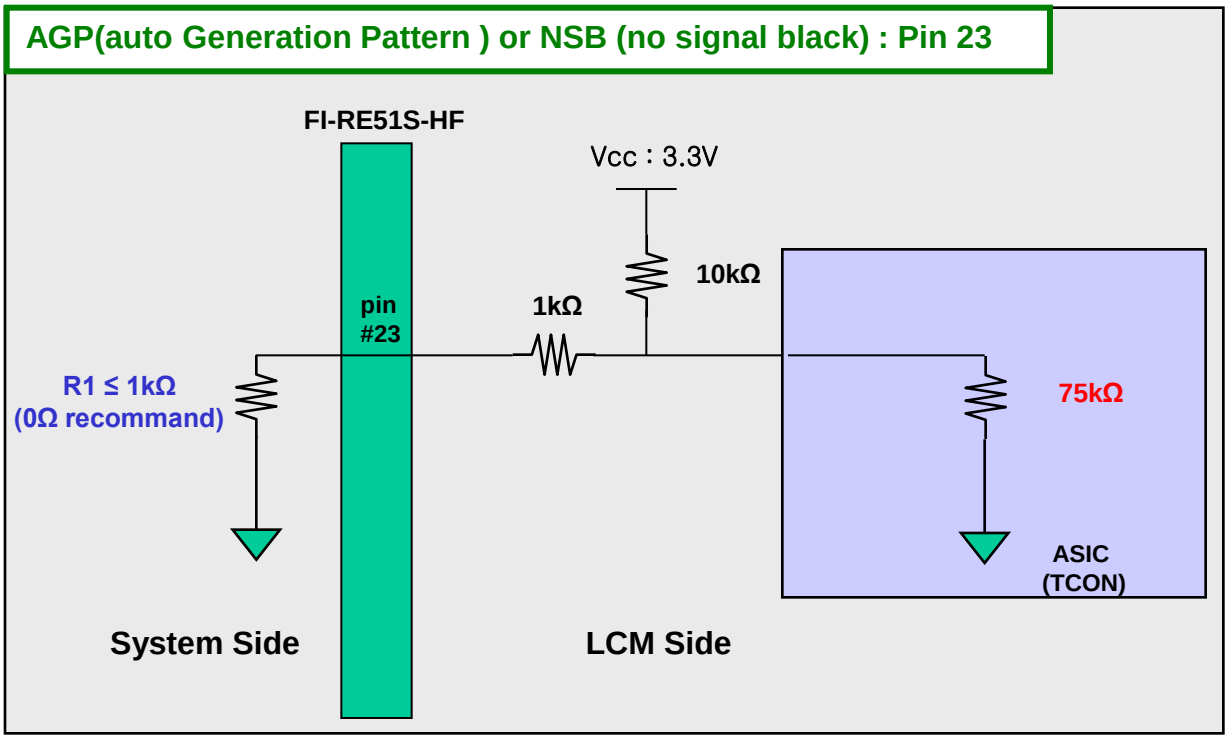


Note : I2C Line of Set Soc avoid using slave address 40, 70, A0 because LCD module uses those

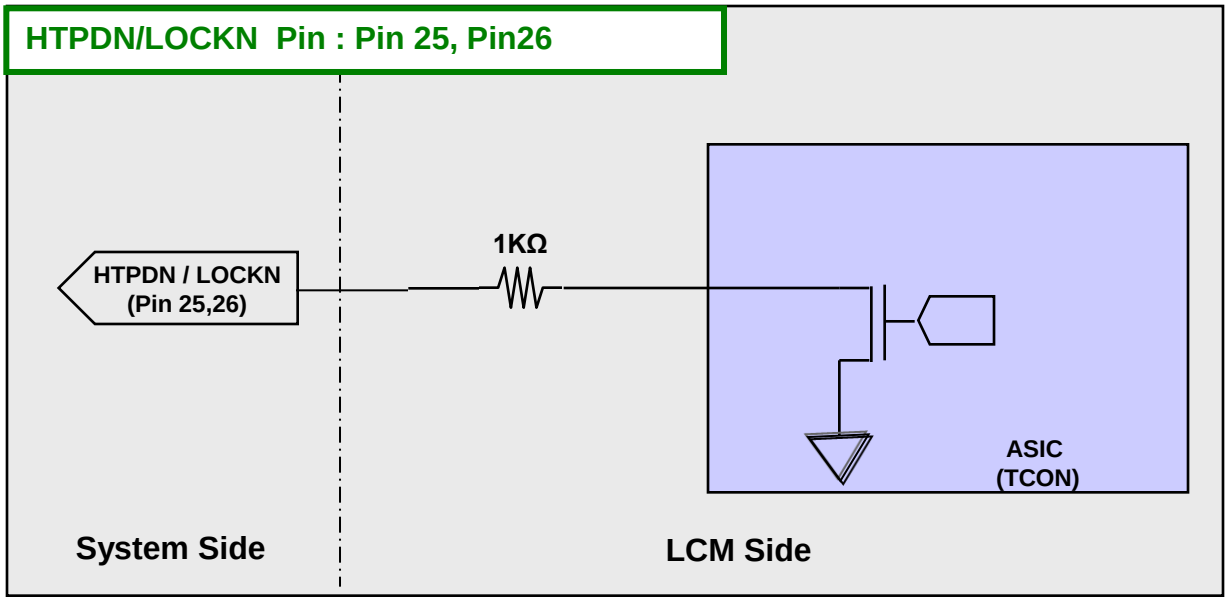
APPENDIX – IV-3

■ Option Pin Circuit Block Diagram

4) Circuit Block Diagram of AGP Selection pin



5) Circuit Block Diagram of HTPDN/ LOCKN Selection pin



APPENDIX – V-1

■ EXTVBR-B & Local Dimming Design Guide

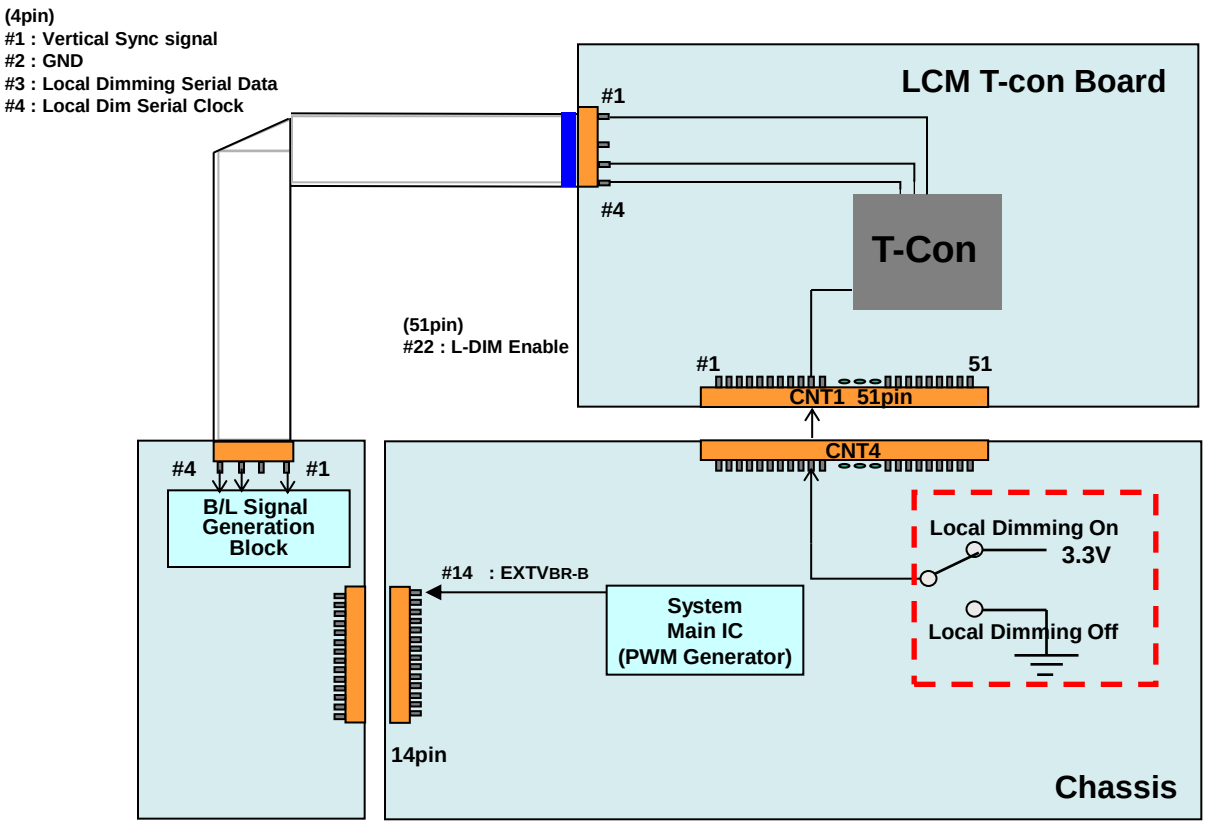
1) When L-Dim Enable is "L", Vertical Sync Signal = System Dimming with 100Hz or 120Hz frequency.

2) Local Dimming signals are synchronized with V-Sync Freq. of System in T-Con Board.

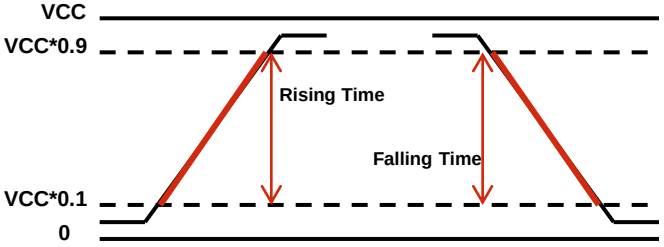
3) EXTVBR-B Specification (VCC = 3.3V) @ Local Dimming

a) High Voltage Range : 2.5 V ~ 3.6 V

b) Low Voltage Range : 0.0 V ~ 0.8 V



EXTVBR-B Frequency	100 Hz for PAL 120 Hz for NTSC
Rising Time	MAX 10.0 μs
Falling Time	MAX 10.0 μs



APPENDIX – Ⅴ-2 Local Dimming Interface Design Guide

▶ **Data Sequence (※ based on 6 block)**

8-bit : Indicator(1010_1010) / Command(8-bit) / Data1(8-bit) / Data2(8-bit) / ... / Data6(8-bit) / check_Sum(8-bit)

10-bit : Indicator(1010_0000_00) / Command(10-bit) / Data1(10-bit) / Data2(10-bit) / ... / Data6(10-bit) / check_Sum(10-bit)

▶ **Data Field Definition (※ based on 6 block)**

1. Indicator Byte : Start of data sequence

2. Command Byte

- Bit 0 : Local-Dimming Enable ('1' : Enable, '0' : Disable)

- Bit 1~7 : Reserved (Must be Low Level ('0'))

3. Data Byte 1 ~ 6 : 8 / 10 -bit Local-dimming gray value

4. Check_Sum Byte = Indicator ^ Command ^ Data1 ^ Data2 ^ … Data6 (※ ^ : Exclusive OR)

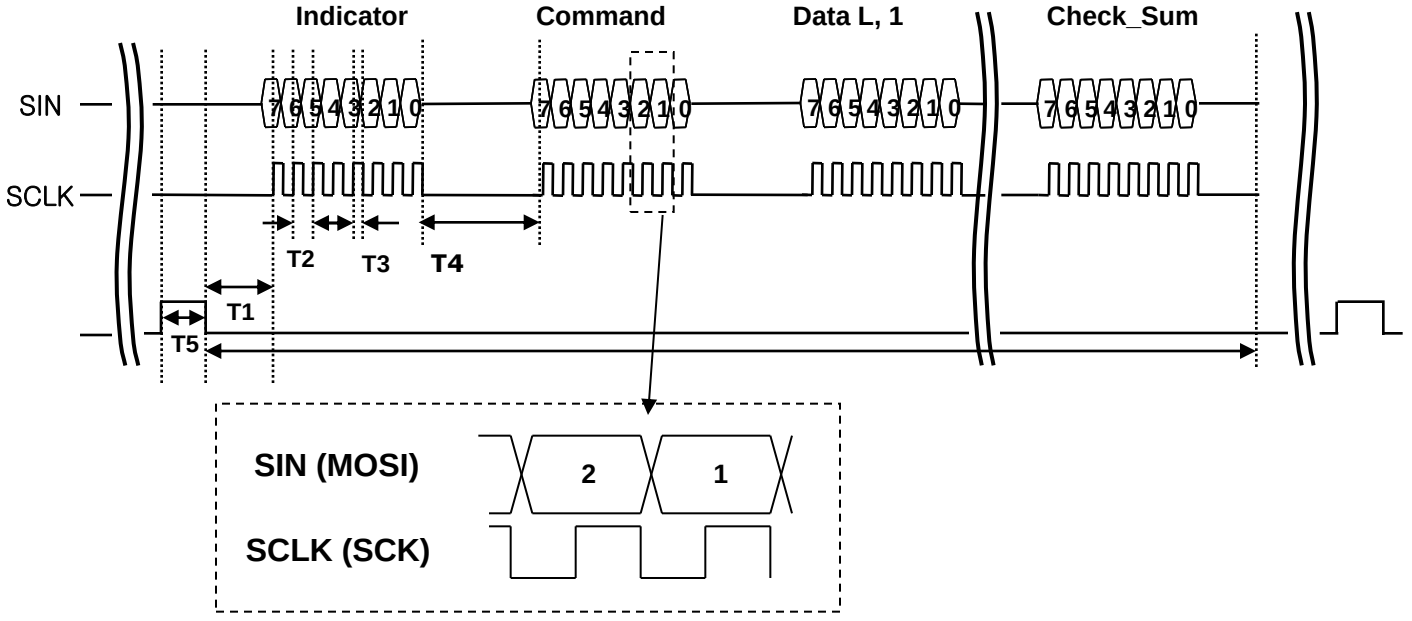


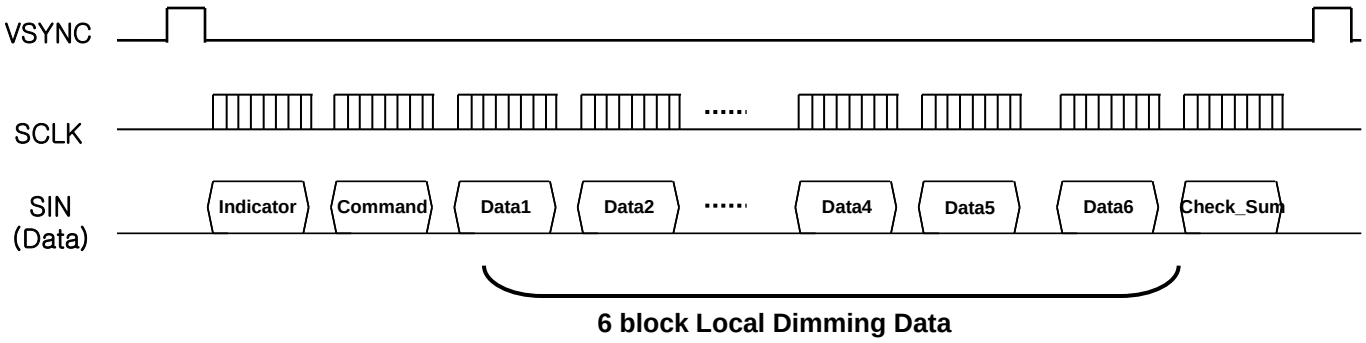
Table TIMING TABLE for Local Dimming Interface

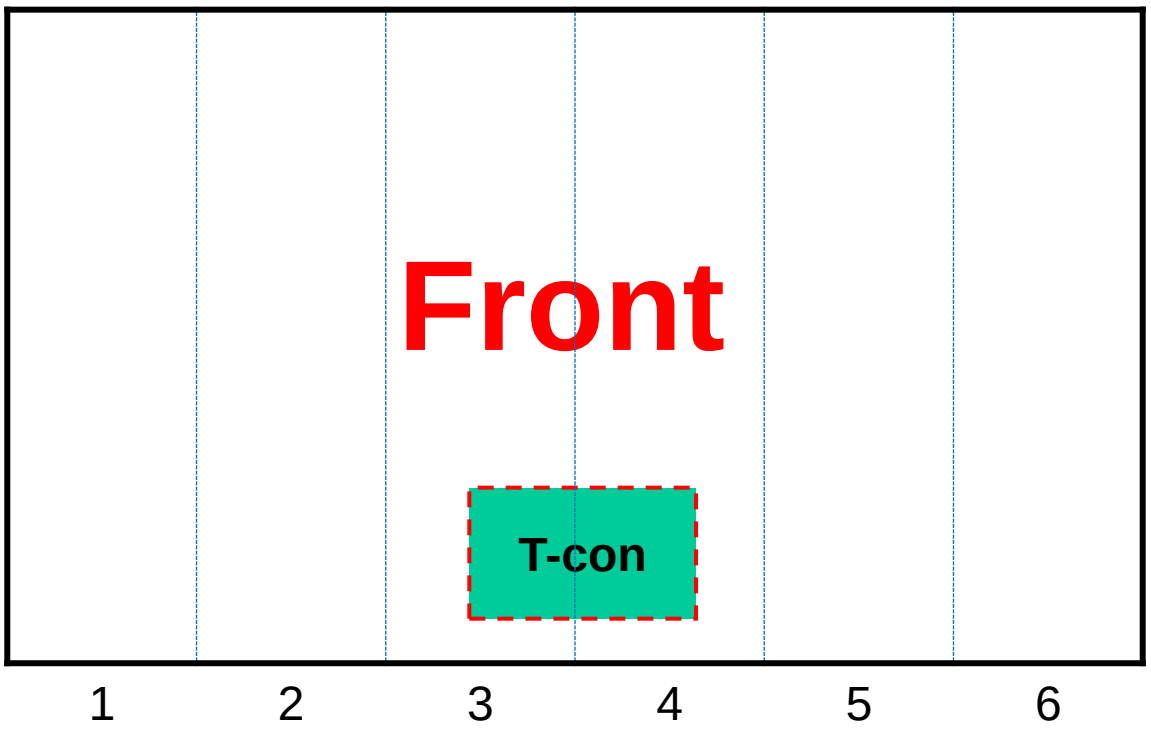
※ SPI Clock Range : Min 100 [KHz], Max 500 [KHz]

Parameter (DCLK rising edge기준)	Values			Units
	Min	Typ	Max	
T1	6.00	-	30.00	us
T2	2.00	-	10.00	us
T3	1.00	-	5.00	us
T4	6.00	-	30.00	us
T5	**10.00**	-	40.00	us

APPENDIX – V-3

▶ **Local Dimming Block Mapping**



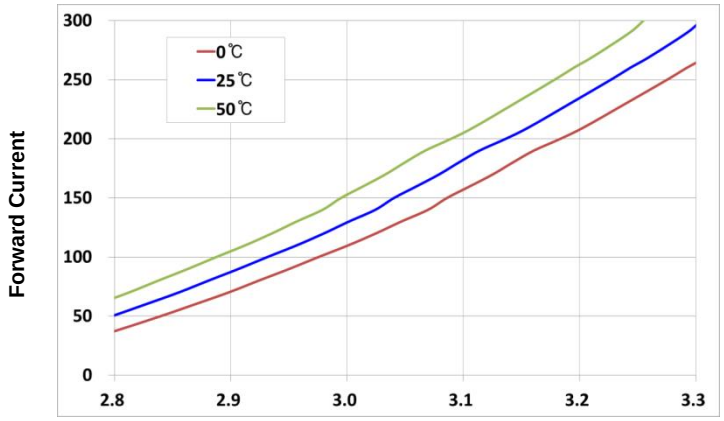


APPENDIX – VI

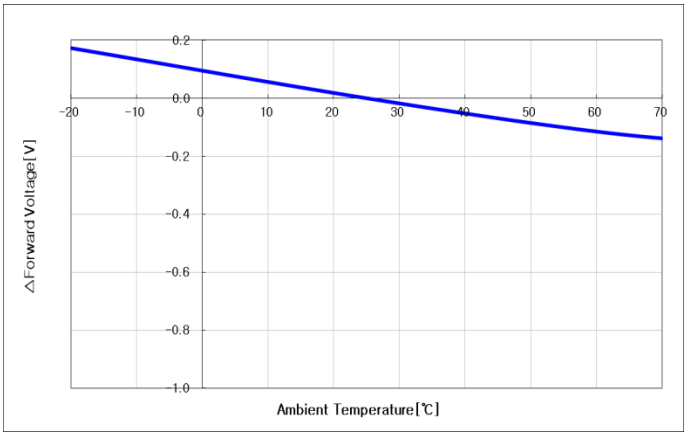
■ LED Array Electrical Spec

Item	Condition	Min	Typ	Max	Uint	Remark
Forward voltage(Vf)	Ifm=180mA	-	64.9	-	V	Ta=25℃
△Vf*1		-	-	1.7	V	

■ Forward Current vs. Forward Voltage



■ Ambient Temperature vs. Forward Voltage



APPENDIX – Ⅶ

Gray to Gray Response Time Uniformity

This is only the reference data of G to G and uniformity for LC550EQE-PHF1 model.

1. G to G Response Time :

Response time is defined as Figure3 and shall be measured by switching the input signal for "Gray (N) " and "Gray(M)".(32Gray Step at 8bit)

2. G to G Uniformity

The variation of G to G Uniformity , $\delta_{G\ to\ G}$ is defined as :

$$\text{G to G Uniformity} = \frac{Maximum(GtoG) - Typical(GtoG)}{Typical(GtoG)} \leq 1$$

***Maximum (G to G) means maximum value of measured time (N, M = 0 (Black) ~ 1023(White), 128 gray step).**

	0Gray	127ray	255Gray	…	895Gray	1023Gray
0Gray		TrR:0G→127G	TrR:0G→255G	…	TrR:0G→895G	TrR:0G→1023G
127Gray	TrD:127G→0G		TrR:127G→255G	…	TrR:127G→895G	TrR:127G→1023G
255Gray	TrD:255G→0G	TrD:255G→127G		…	TrR:255G→895G	TrR:255G→1023G
…	…	…	…		…	…
895Gray	TrD:895G→0G	TrD:895G→127G	TrD:895G→255G	…		TrR:895G→1023G
1023Gray	TrD:1023G→0G	TrD:1023G→127G	TrD:1023G→255G	…	TrD:1023G→895G	

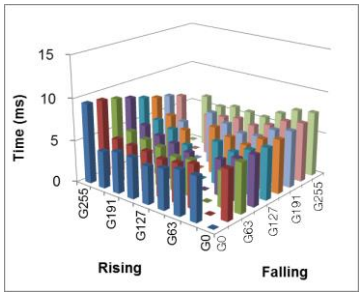
3. Sampling Size : 2 pcs

4. Measurement Method : Follow the same rule as optical characteristics measurement.

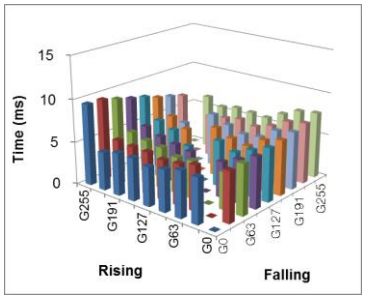
5. Current Status

Below table is actual data of production on Oct. 30. 2014 (LGD RV Event Sample)

	G to G Response Time [ms]		Uniformity
	Min.	Max.	
# 1	3.62	9.53	0.563
# 2	3.68	9.58	0.550



< # 1 >



< # 2 >

APPENDIX – Ⅷ

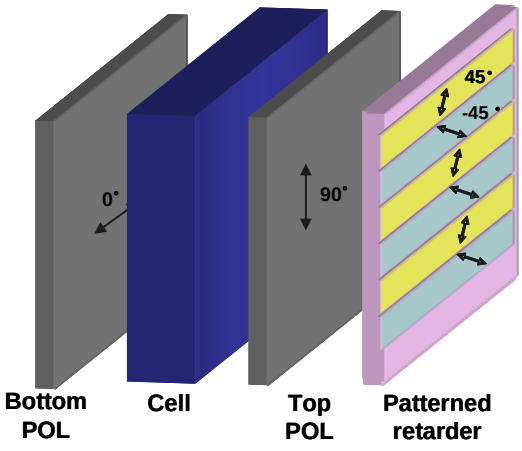
■ Standard specification of Eyeglasses

This is recommended data of Eyeglasses for LC550EQE-PHF1 model. (details refer to table) For each item, depending on the eyeglass manufacturer tolerances may occur, this tolerance can affect 3D performance. (3D Crosstalk, 3D luminance, 3D viewing angle)

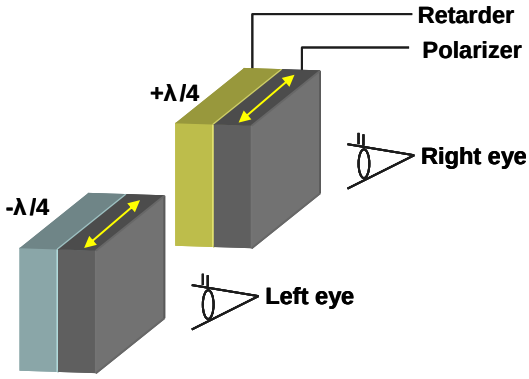
<Table. Standard specification of Eyeglasses>

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

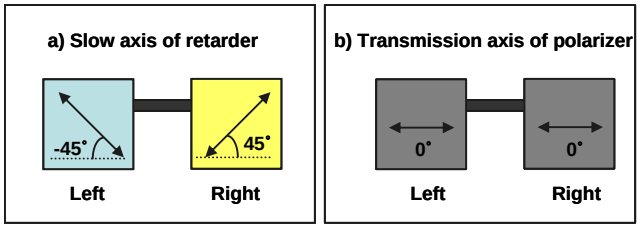
※Recommended polarizer
Polarization efficiency: more than 99.90%



(a) Configuration of 3D module



Direction from viewer



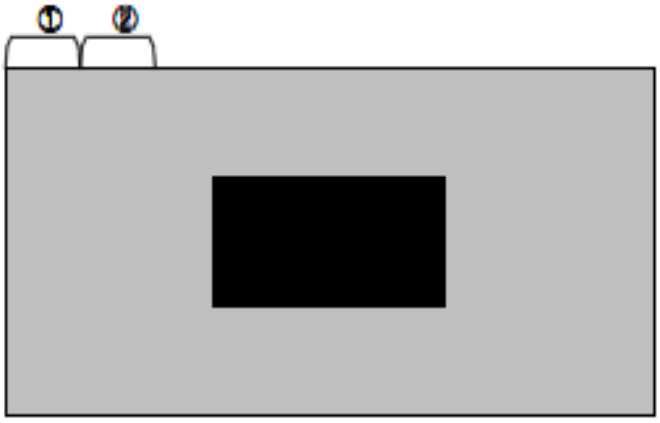
(b) Configuration of Eyeglasses

<Drawing. Information of optical axis>

APPENDIX – IX

■ input mode of pixel data

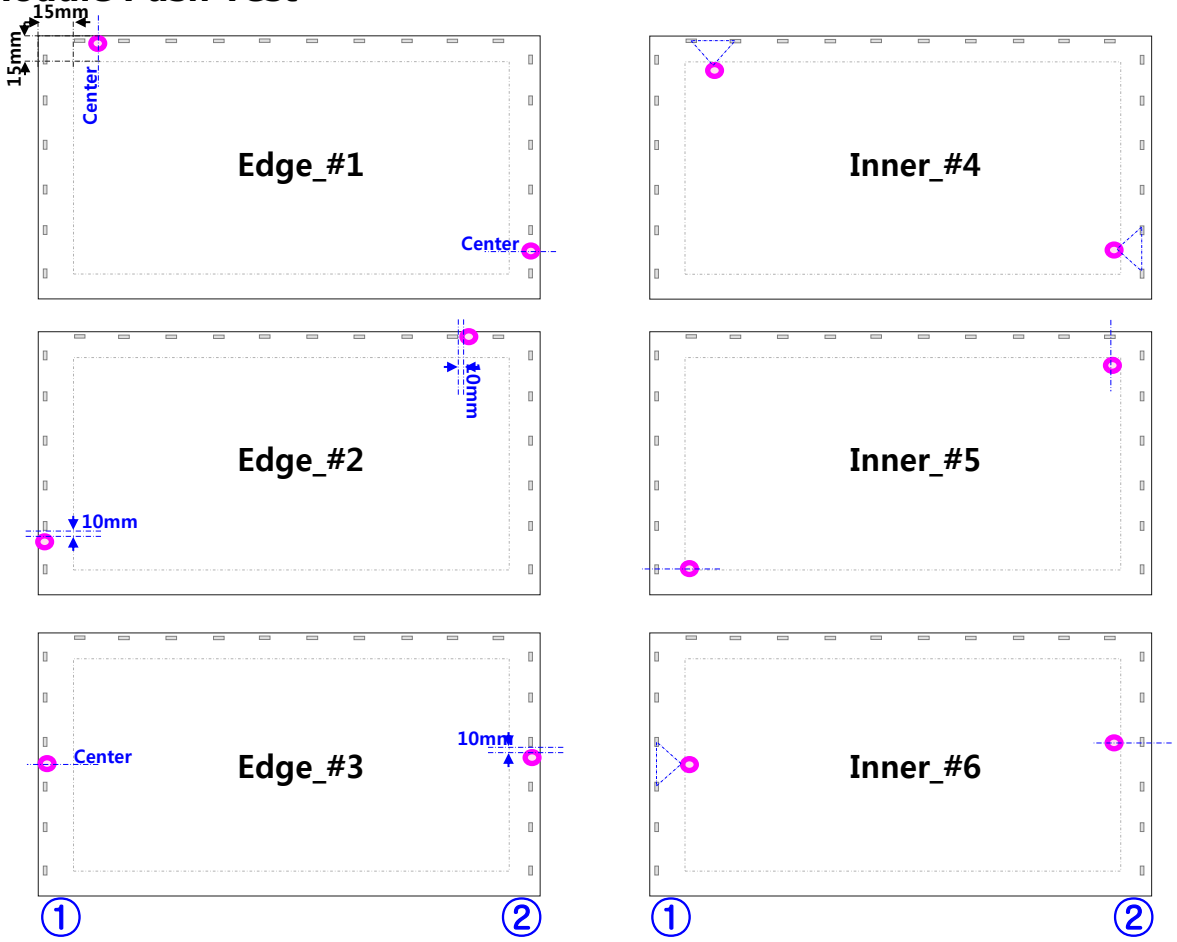
Mode : Non-Division



Lane	1st Data	2nd Data	Data#
Lane0	1	9	3833
Lane1	2	10	3834
Lane2	3	11	3835
Lane3	4	12	3836
Lane4	5	13	3837
Lane5	6	14	3838
Lane6	7	15	3839
Lane7	8	16	3840

APPENDIX – Ⅹ-1

■ Module Push Test



■ Test Result

			Sample No.					
	point		#1	#2	#3	#4	#5	#6
Measurement Position	Edge	1	50<	50<	50<	50<	39.9	50<
		2	50<	37.45	50<	33.8	30.2	50<
	Inner	1	40.2	30.5	50<	22.5	50<	39.3
		2	45.6	36.8	32.5	43.5	44	50<

APPENDIX – Ⅹ-2

■ Management for Micro-crack by Laser Cutting

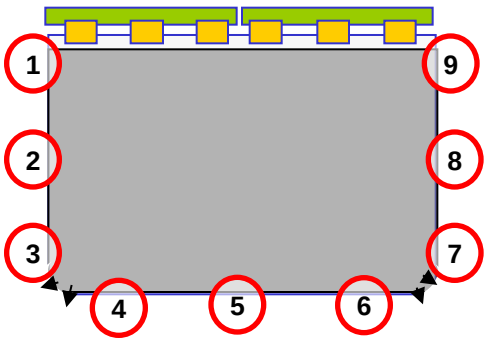
1. Subject of process : Laser cutting

2. Measuring cycle

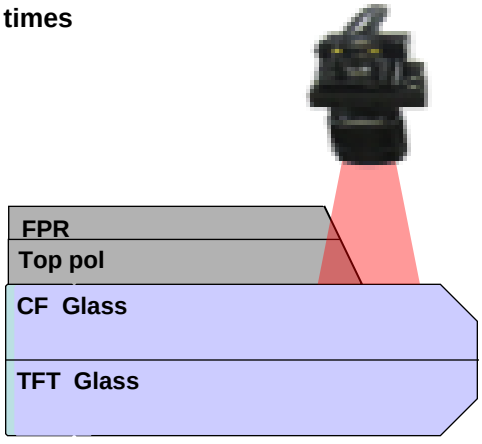
- **Regular measuring : One of Fixer Ass'Y is measured in every 8 hours**
- **Irregular measuring : One of Fixer Ass'Y is measured when a model is changed**

3. Measurement Method

- **Measuring point : 9 Points**



- **Measuring Condition**
  - **Magnification of microscope : 50 times**
  - **Lighting Mode : Reflection Mode**



4. Management standard

- **Micro-crack length : Smaller than 50㎛ at Start①/End⑨ point, no micro-crack at the rest of point**

APPENDIX –Ⅺ

■ Vibration Test & Shock Test (Non-operating)

No.	Test Item	Condition
1	Vibration test (non-operating)	Wave form : Random Vibration Level 0.5 Grms Bandwidth : 10 ~ 300Hz Duration : X, Y, Z Each direction Per 10min
2	Shock test (non-operating)	Shock Level : 10 Grms Waveform : Half Sine Wave, 11ms Duration : X, Y, Z One time each direction

Notes

1. Vibration Condition and Shock Condition are the result which verified with LCM condition, and they don't match with the Set Vibration and Drop result.

APPENDIX- XII

■ The reference method of BL dimming

It is recommended to use synchronous V-sync frequency to prevent waterfall
(Vsync * 2 =P-Dim Frequency)