

SPECIFICATION FOR APPROVAL

() Preliminary Specification

(●) Final Specification

Title	65.0" QWUXGA TFT LCD
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BUYER	
LCD MODEL	LC650EGE-FHM1
SET MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LC650EGE
SUFFIX	FHM1(RoHS Verified)

APPROVED BY	SIGNATURE DATE
/	_____
/	_____
/	_____

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

APPROVED BY	SIGNATURE DATE
Oh Hyun Lee / Team Leader	 15. 4. 24
REVIEWED BY	
Sang Jun Cho / Project Leader	 15. 4. 24
PREPARED BY	
Ho Joong Kim/ Engineer	 15. 04. 24

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

Product Specification

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RECORD OF REVISIONS

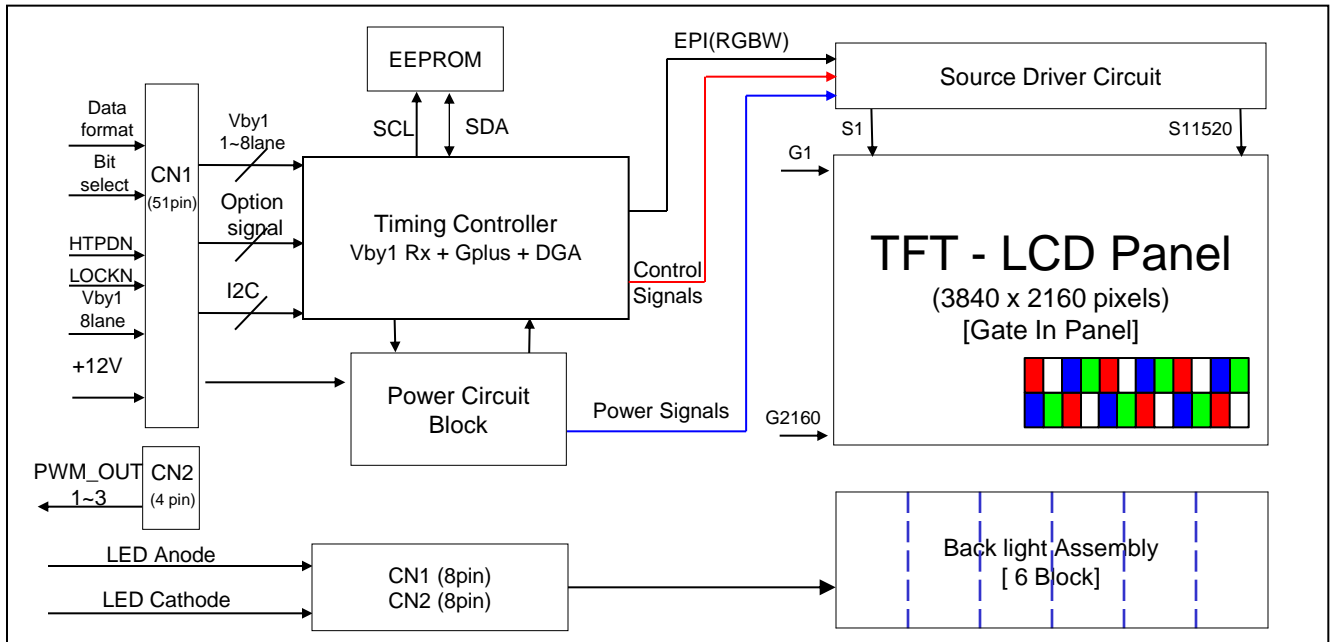
Revision No.	Revision Date	Page	Description
0.1	Jan. 16. 2015	-	Preliminary Specification (First Draft)
0.2	Feb. 28. 2015	4	Fixed the Luminance, White
		5	Fixed the LED Input Forward Voltage
		15	Fixed the Contrast Ratio min.
0.3	Mar. 20. 2015	21	Fixed Front view drawing
1.0	Apr. 28. 2015	22	Fixed Rear view drawing
			Final CAS

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1. General Description

The LC650EGE 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 64.53 inch diagonally measured active display area with QWUXGA resolution (2160 vertical by 3840 horizontal pixel array). Sub-pixels are constructed with Red, Green, Blue and White. Each pixel is divided into RGB or WRG or BWR or GBW or dots which are arranged in vertical stripes. Gray scale or the luminance of the sub-pixel color is determined with a 10-bit gray scale signal for each dot. Therefore, it can present a palette of more than 1.07Billion 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	64.53 inches(1639.062mm) diagonal
Outline Dimension	1452.2(H) X 830.0(V) X 13.5(D)
Pixel Pitch	0.372 mm x 0.372 mm
Pixel Format	3840 horiz. by 2160 vert. Pixels
Color Depth	10bit(D), 1.07Billion colors
Luminance, White	390cd/m ² (Center 1point ,Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Min.), U/D 178 (Min.))
Power Consumption	Total 91.5 W (Typ.) [Logic= 15.6 W (Typ.), BLU=75.9W(Typ)]
Weight	21.4kg(Typ.), 22.5kg(Max.)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer (Haze 1% Typ.)

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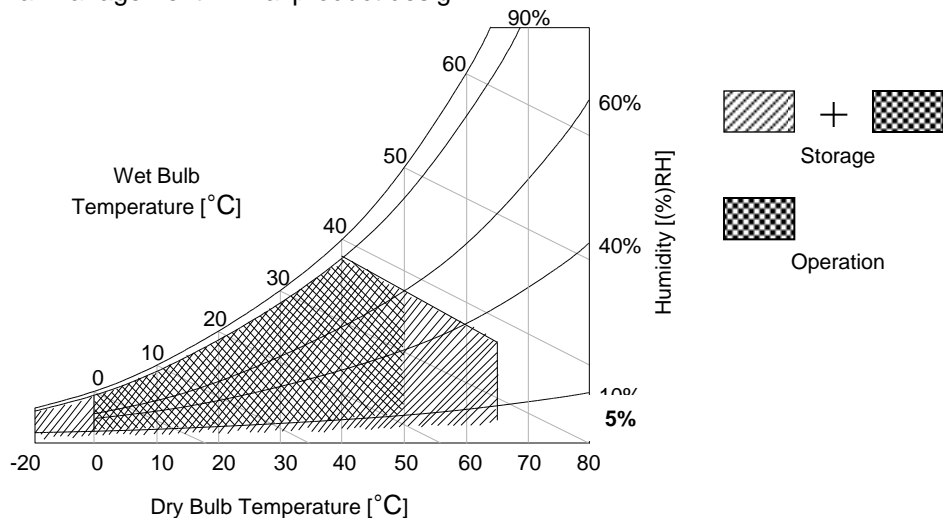
2. Absolute Maximum Ratings

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	Note
			Min	Max		
Power Input Voltage	LCD Circuit	V _{LCD}	-0.3	+14.0	V _{DC}	1
LED Input Voltage	Forward Voltage	V _F	-	+224.4	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		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 ($T_a = 25 \pm 2 \text{ }^\circ\text{C}$)
 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°C. The range of operating temperature may be degraded in case of improper thermal management in final product design.



Product Specification

3. Electrical Specifications

3-1. Electrical Characteristics

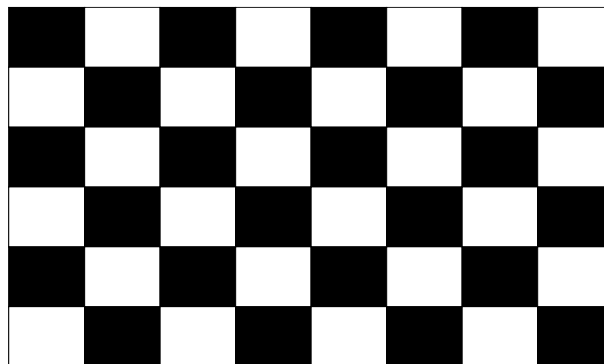
It requires two power inputs. One is employed to power for the LCD circuit. The other is used for the LED backlight and LED Driver circuit.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Value			Unit	Note	
		Min	Typ	Max			
Circuit :							
Power Input Voltage	V _{LCD}	10.8	12.0(12.7)	14	V _{DC}	5	
Power Input Current	I _{LCD}	-	1300	1690	mA	1	
		-	2000	2600	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}	-	15.6	20.28	Watt	1	
Rush current	I _{RUSH}	-	-	10.0	A	3	

- notes
1. The specified current and power consumption are under the V_{LCD}=12.0V, T_a=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



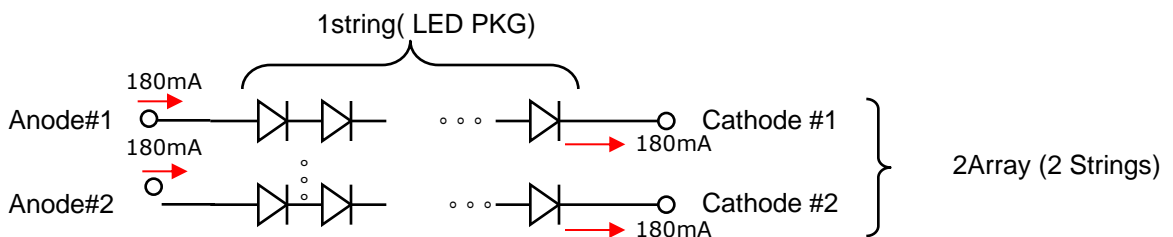
Mosaic Pattern(8 x 6)

Product Specification

Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter	Symbol	Values			Unit	Note	
		Min	Typ	Max			
Backlight Assembly :							
Forward Current (one array)	Anode	I_F (anode)		180		mAdc	±5%
	Cathode	I_F (cathode)		180		mAdc	2, 3
Forward Voltage		V_F	193.8	210.8	227.8	Vdc	4
Forward Voltage Variation		ΔV_F			5.5	Vdc	5
Power Consumption		P_{BL}	-	75.9	86.1		6
Burst Dimming Duty		On duty	1		100	%	
Burst Dimming Frequency		1/T	95		182	Hz	8
LED Array : (APPENDIX-VI)							
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 one cathode terminal.
The forward current(IF) of the anode terminal is 180mA and it supplies 180mA into one string.



4. The forward voltage(V_F) of LED array depends on ambient temperature (Appendix-VI)
5. ΔV_F means Max V_F -Min V_F in one Backlight. So V_F variation in a Backlight isn't over Max. (1.7)V
6. Maximum level of power consumption is measured at initial turn on.
Typical level of power consumption is measured after 1hrs aging at $25 \pm 2^\circ\text{C}$.
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 $25 \pm 2^\circ\text{C}$, 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
($V_{\text{sync}} * 1 = \text{Burst Frequency}$)
Though PWM frequency is over 182Hz (max252Hz), function of backlight is not affected.

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3-2. Interface Connections

This LCD module employs three kinds of interface connection, 51pin connector and 7-pin connector is used for the integral backlight system.

3-2-1. LCD Module

- LCD Connector(CN1): FI-RXE51S-HF(manufactured by JAE)

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	PWM TIN	External VBR (From System)	40	Rx4n	V-by-One HS Data Lane 4
15	PWM TOUT	External VBR (For System)	41	Rx4p	V-by-One HS Data Lane 4
16	Gplus Mode	'L' or 'NC' :Low Power, 'H' : High Luminance	42	GND	Ground
17	Gplus EN	'L': RGB Mode, 'H' or NC : Gplus Mode	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	NC	NO CONNECTION	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. #9 & #20 & #22: These pins are used only for LGD (Do not connect)
 4. About specific pin (#16~#19,#21~#23,#25,#26) , please see the Appendix IV.
 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" or "NC", LCD Module displays AGP (Auto Generation Pattern).

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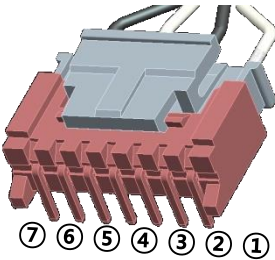
3-2-2. Backlight Module

1) BLU Connector (Plug)

: SMH200-H07M

2) Mating Connector (LPB, Socket)

: SMAW200A-H07AA2

Pin No	CNT (7pin)
Pic.	
	65"~43"(Edge)
색상	White
1	Cathode (L)
2	N.C
3	Anode (L)
4	N.C
5	Cathode (R)
6	N.C
7	Anode (R)

◆ Rear view of LCM



Product Specification

3-3. Signal Timing Specifications

Table 5 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 5. 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}	60	74.25	78.00	MHz	594/8
	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 $\pm 0.5\%$ center spread at 30KHz

※ Timing should be set based on clock frequency.

Product Specification

3-4. V by One input signal Characteristics

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

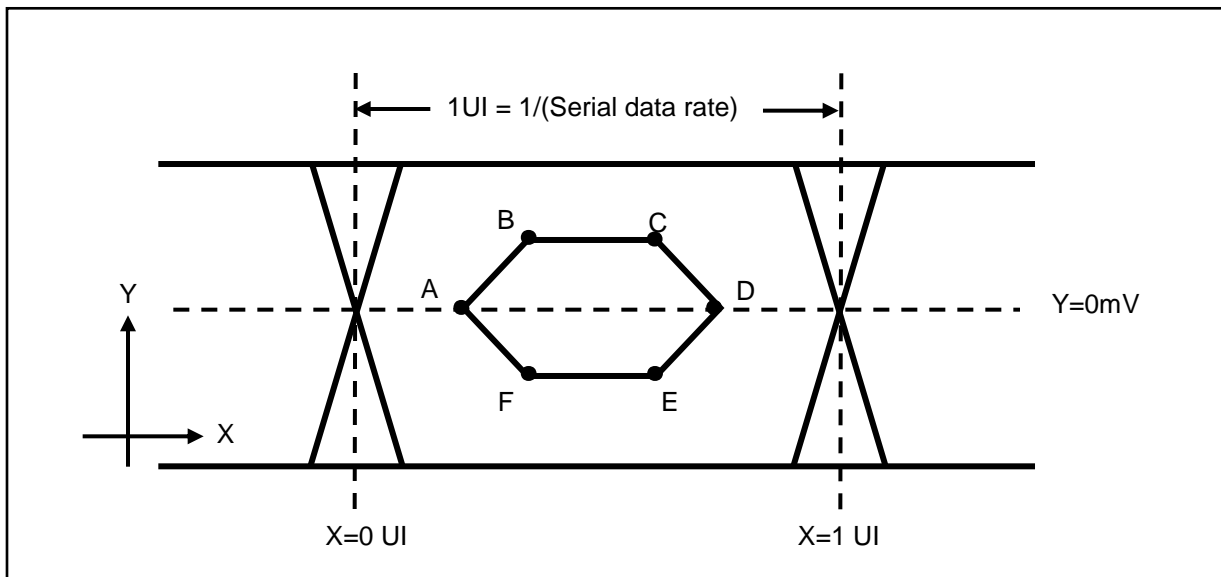


Table6. Eye Mask Specification

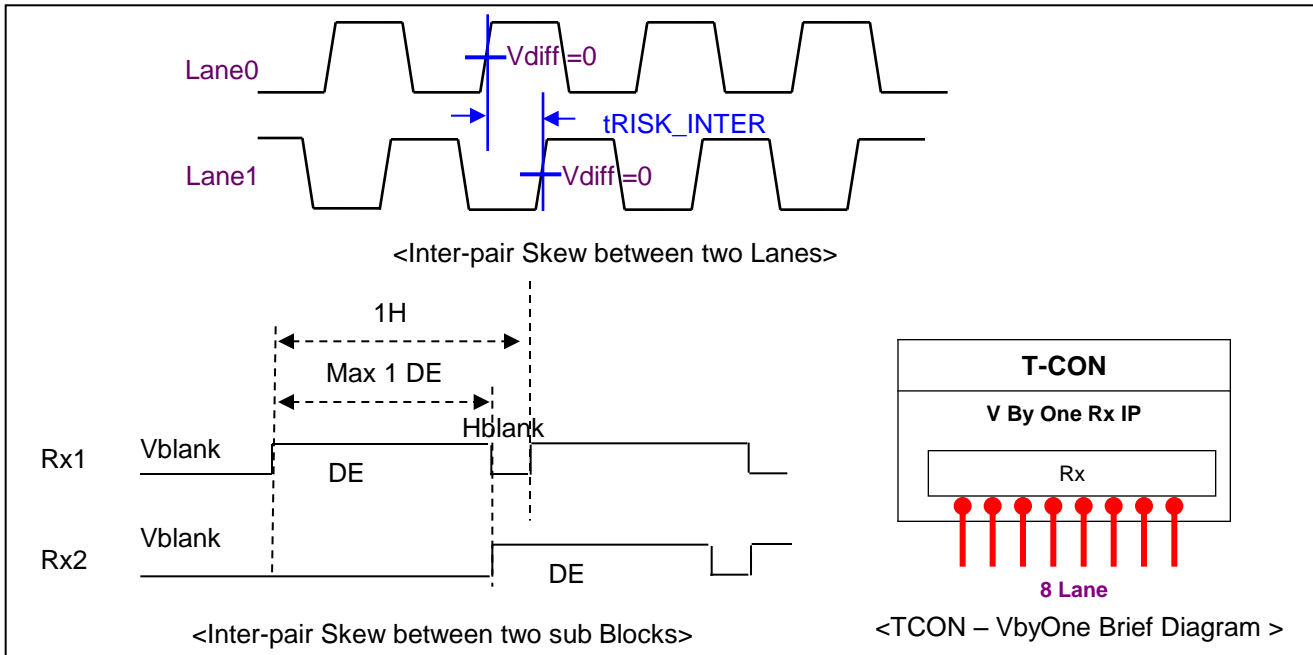
	X[UI]	Note	Y[mV]	Note
A	0.25 (max)	2	0	-
B	0.3 (max)	2	50	3
C	0.7(min)	3	50	3
D	0.75(min)	3	0	-
E	0.7(min)	3	-50	3
F	0.3(max)	2	-50	3

- notes 1. All Input levels of 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 : 20 Mhz
 - Damping Factor : 1.5

Product Specification

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

1) AC Specification



Description	Symbol	Min	Max	Unit	Notes
Allowable inter-pair skew between lanes	tRISK_INTER	-	5	UI	1,3

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.

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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 7 provides a reference for color versus data input.

Table 7. 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]	

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3-6. Power Sequence

3-6-1. LCD Driving circuit

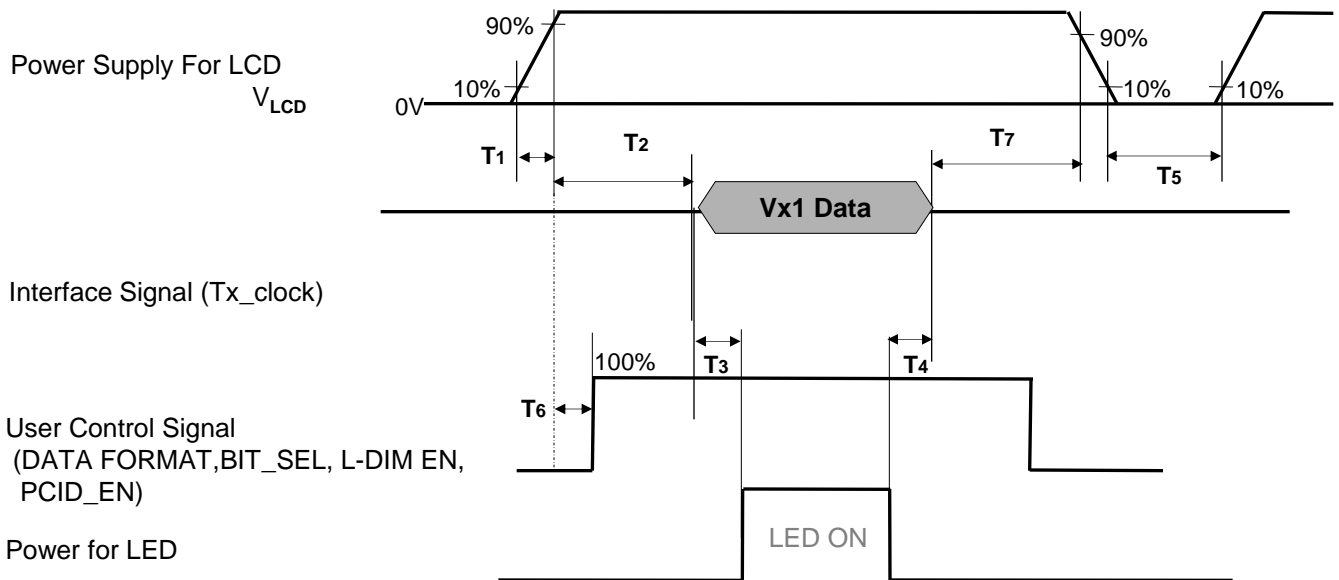


Table 8. POWER SEQUENCE

Parameter	Value			Unit	Note
	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 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.

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3-6. Power Sequence

3-6-1. LCD Driving circuit

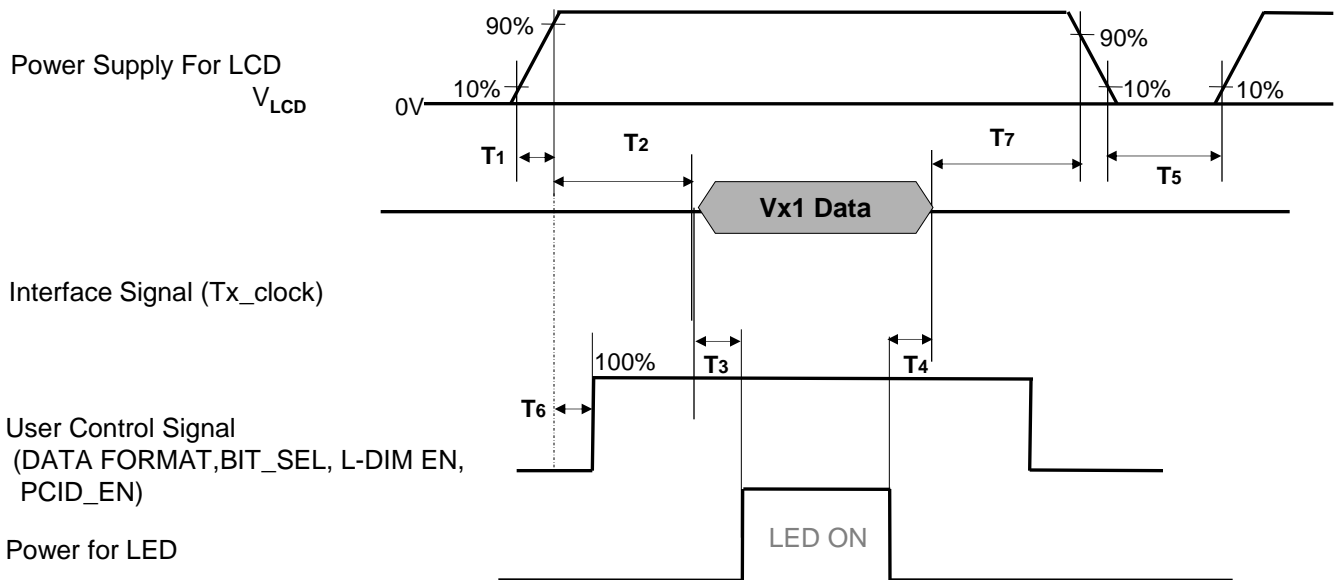


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T5	1.0	-	-	s	4
T6	0	-	T2	ms	5
T7	0	-	-	ms	6

- Note :
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 - ※ 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.

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4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at $25\pm 2^{\circ}\text{C}$. 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.

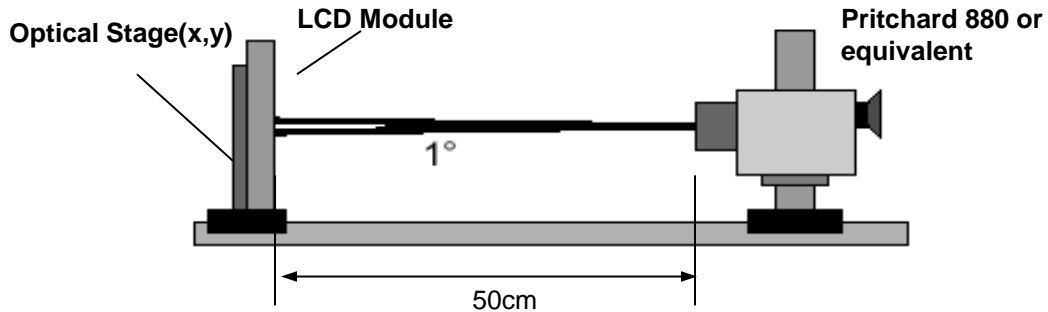


FIG. 1 Optical Characteristic Measurement Equipment and Method

$T_a = 25\pm 2^{\circ}\text{C}$, $V_{\text{LCD}} = 12.0\text{V}$, $f_V = 120\text{Hz}$, $D_{\text{clk}} = 74.25\text{MHz}$,

User Option : #16pin "L" (Low Power Mode), EXT VBR-B = 100%

Table 9. OPTICAL CHARACTERISTICS

Parameter		Symbol	Value			Unit	Note	
			Min	Typ	Max			
Contrast Ratio		CR	800	1100	-		1	
Surface Luminance, white		L_{WH}	208	260(L) 390(H)	-	cd/m^2	2	
Luminance Variation		δ_{WHITE}	65	-	-		3	
Response Time	Variation	G to G _{σ}		6	9		4	
	Gray to Gray (BW)	G to G _{BW}		8	12	ms	4	
Color Coordinates [CIE1931]	RED	Rx	Typ -0.03	0.639	Typ +0.03			
		Ry		0.335				
	GREEN	Gx		0.310				
		Gy		0.599				
	BLUE	Bx		0.154				
		By		0.059				
WHITE	Wx	0.281						
	Wy	0.288						
Color Temperature				10,000		K		
Color Gamut				68		%		
Viewing Angle	2D (CR>10)	right($\phi=0^{\circ}$)	θ_r (x axis)	89	-	-	degree	5
		left ($\phi=180^{\circ}$)	θ_l (x axis)	89	-	-		
		up ($\phi=90^{\circ}$)	θ_u (y axis)	89	-	-		
		down ($\phi=270^{\circ}$)	θ_d (y axis)	89	-	-		
Gray Scale				-	-	-		6

Product Specification

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 $25 \pm 2^\circ\text{C}$. 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 , δ WHITE is defined as :
 δ WHITE(9P) = Minimum ($L_{on1}, L_{on2} \sim L_{on8}, L_{on9}$) / Maximum ($L_{on1}, L_{on2} \sim L_{on8}, L_{on9}$)*100
 Where L_{on1} to L_{on9} are the luminance with all pixels displaying white at 9 locations.
 For more information, see the FIG. 2.
4. MPRT is defined as the 10% to 90% blur-edge width B_{ij} (pixels) and scroll speed U (pixels/frame) at the moving picture. For more information, see FIG. 4.
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. 5.
6. Gray scale specification
 Gamma Value is approximately 2.2. For more information, see the Table 10

Table 10. 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

Product Specification

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

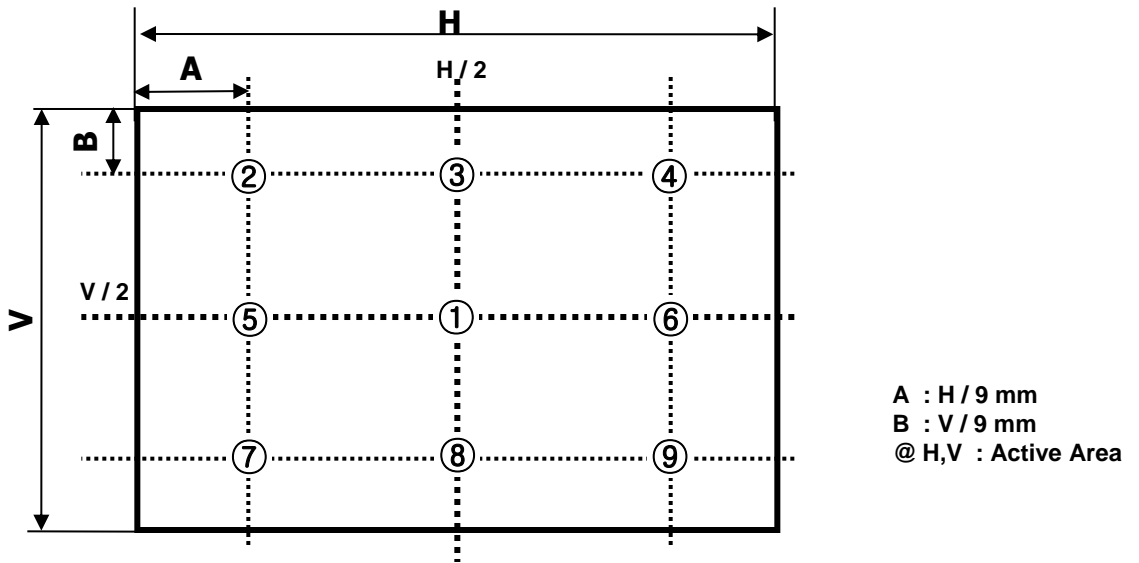


FIG. 2 9 Points for Luminance Measure

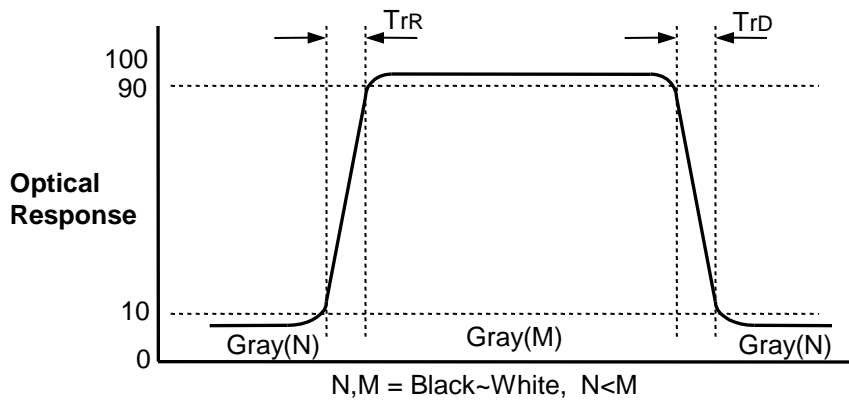


FIG. 3 Response Time

Product Specification

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

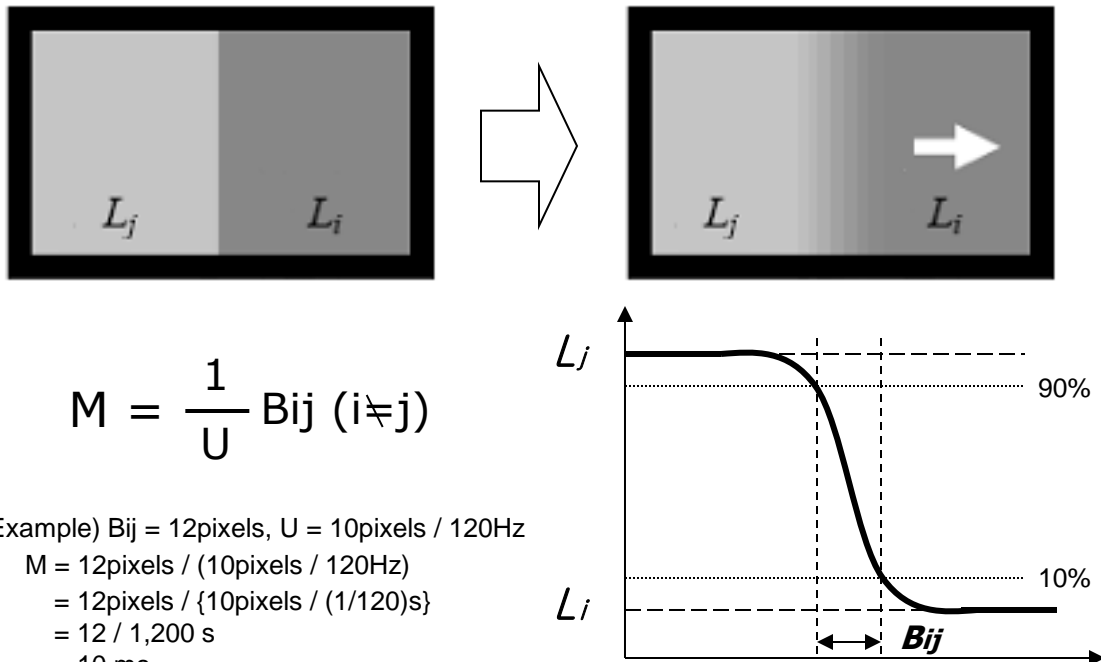


FIG. 4 MPRT

Dimension of viewing angle range

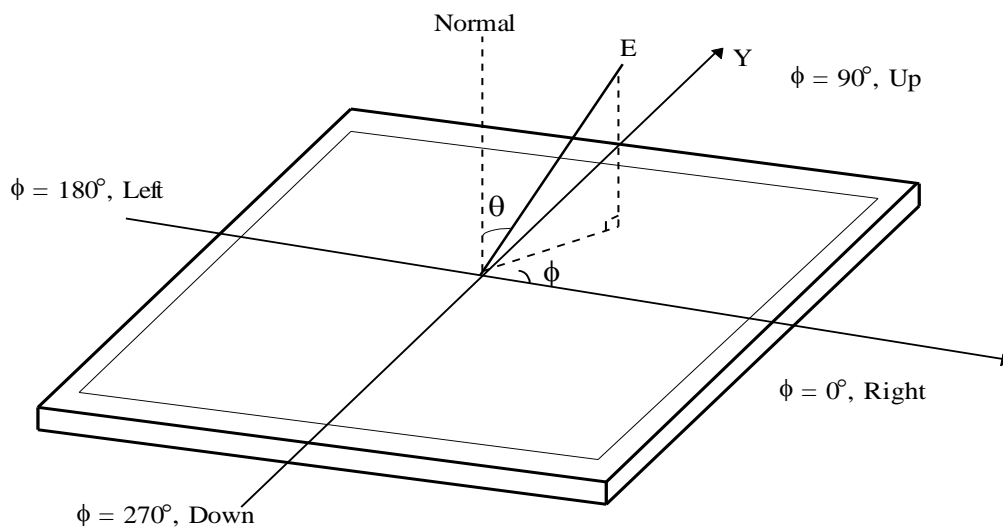


FIG. 5 Viewing Angle

Product Specification

5. Mechanical Characteristics

Table 11 provides general mechanical characteristics.

Table 11. MECHANICAL CHARACTERISTICS

Item	Value	
Outline Dimension	Horizontal	1452.2 mm
	Vertical	830.0 mm
	Depth	13.5 mm
Bezel Area	Horizontal	1430.48 mm
	Vertical	808.6 mm
Active Display Area	Horizontal	1428.48 mm
	Vertical	803.52 mm
Weight	21.4Kg (Typ.) 22.5Kg(Max.)	

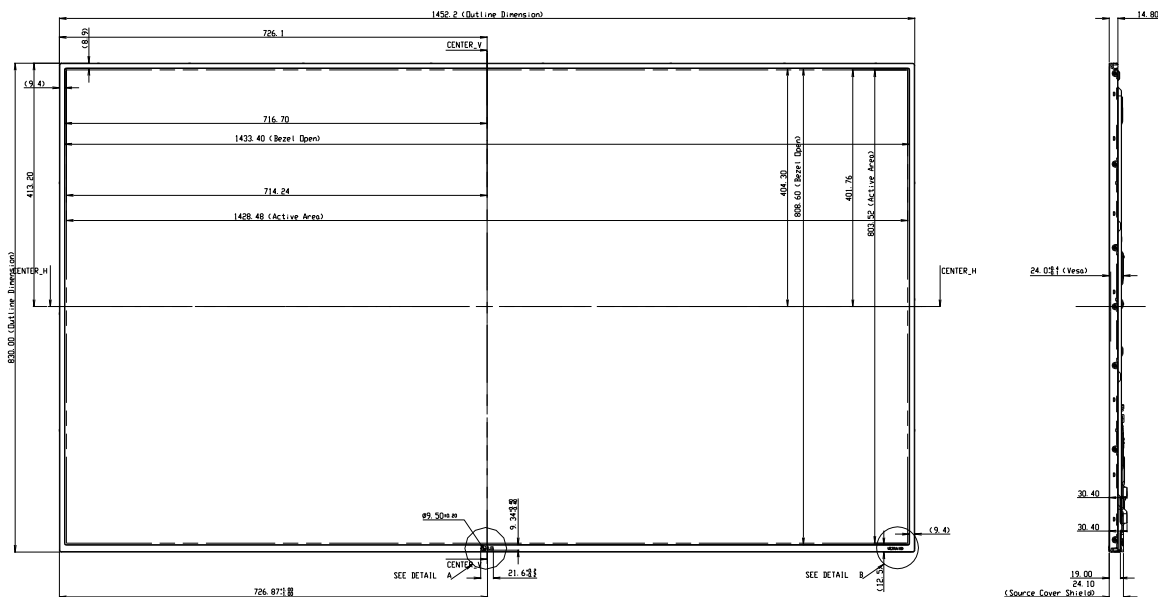
Note : Please refer to a mechanic drawing in terms of tolerance at the next page.

Product Specification

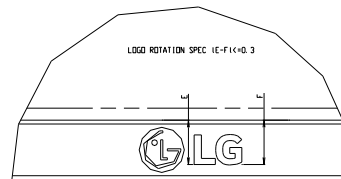
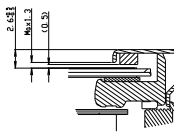
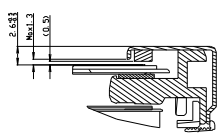
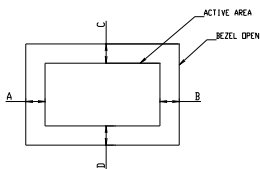
[FRONT VIEW]



SET : TOP

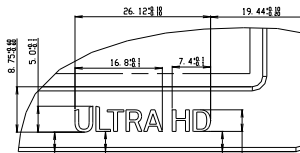


SET : DOWN



DETAIL A SCALE 2/1

Logo Tilt Spec (a-b) ≤ 0.4



DETAIL B SCALE 2/1

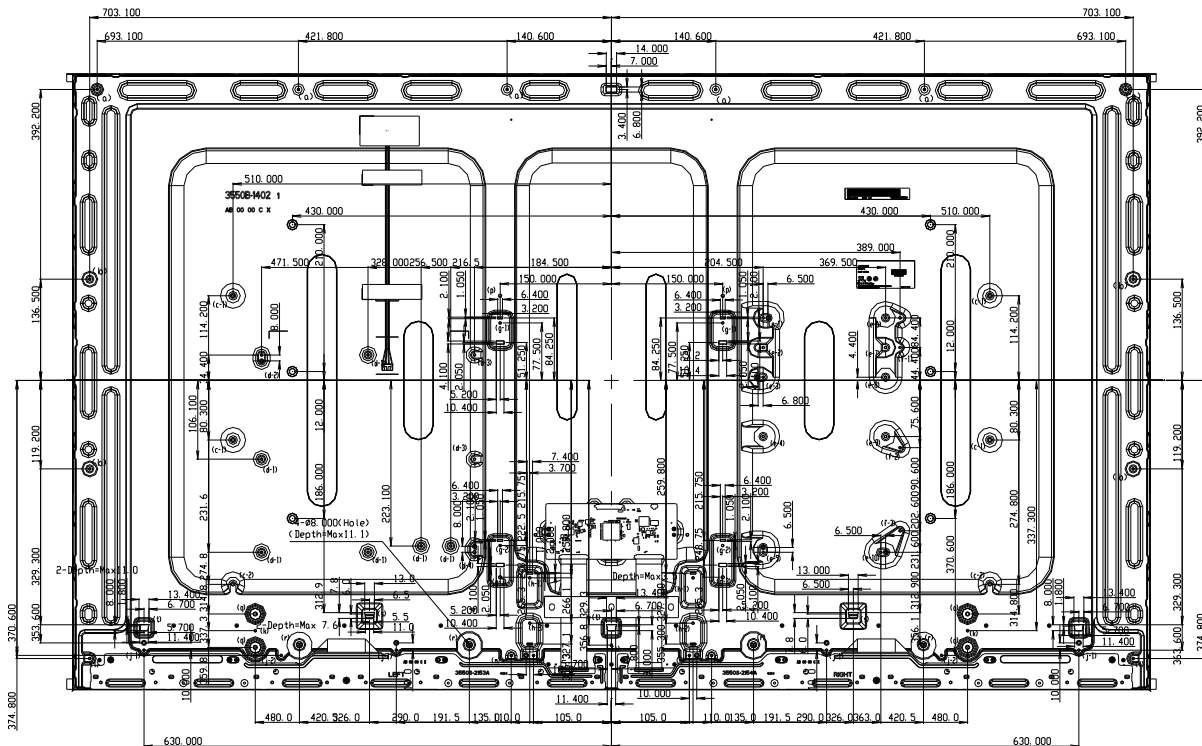
- NOTES
1. UNSPECIFIED TOLERANCE IS ±0.1mm
 2. TILT AND PARTIAL DISPERSION TOLERANCE OF DISPLAY AREA AS FOLLOWING
 3. Max. TORQUE REFER TO TABLE
 4. Max. DEPTH REFER TO TABLE
 5. THE SAME FEATURE MEANS THE SAME DIMENSION

Date	Version
2014.11.17	1.0
2014.12.09	1.1
2014.12.23	1.2

Product Specification

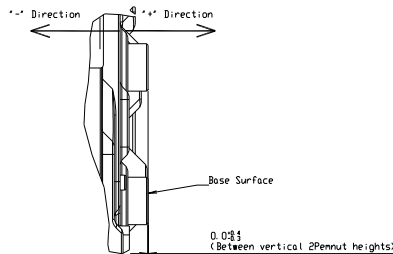
[REAR VIEW]

SET : TOP



SET : DOWN

ITEM	TAP	Max Depth (mm)	Torque (kgf.cm)	Notes
(a)	M3.0	4.8	Max 5.0	Emboss
(b)	M3.0	6.8	Max 5.0	Emboss
(c-1-2)	M4.0	8.3	Max 8.0	Emboss
(d-1-3)	M3.0	5.0	Max 5.0	Emboss
(d-4)	M4.0	5.0	Max 8.0	Emboss
(e-1-10)	M3.0	10.3	Max 5.0	Emboss
(f-1-3)	M3.0	4.6	Max 5.0	Emboss
(g-1-2)	M3.0	11.0	Max 5.0	Emboss
(g-3)	M4.0	11.0	Max 8.0	Emboss
(h-1-2)	M3.0	11.1	Max 5.0	Emboss
(i)	M3.0	2.5	Max 5.0	Tap
(j-1-2)	M3.0	8.0	Max 5.0	Emboss
(k)	M3.0	8.0	Max 5.0	Emboss
(l)	M3.0	3.5	Max 5.0	Emboss
(m)	M3.0	8.0	Max 5.0	Emboss
(n)	M3.0	8.0	Max 5.0	Emboss
(o)	M3.0	8.0	Max 5.0	Emboss
(o)	M3.0	Max 4.5 Top Section (2.2mm-4.5mm)	Max 5.0	Tap
(p)	M4.0	8.0	Max 8.0	Tap
(q)	M4.0	6.5	Max 8.0	Pen Nut
(r)	-	10.6	-	Emboss
(s)	-	7.6	-	Emboss
(t)	-	11.0	-	Emboss



Product Specification

6. Reliability

Table 12. 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	Vibration test (non-operating)	Wave form : Random Vibration Level 0.5Grms Bandwidth : 10 ~ 300Hz Duration : X, Y, Z Each direction Per 10min
8	Shock test (non-operating)	Shock Level : 10Grms Waveform : Half Sine Wave, 11ms Duration : X, Y, Z One time each direction
9	Panel Push Test (Module Condition)	Max 6kgf

notes : 1. 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.

7-2. Environment

- a) RoHS, Directive 2011/65/EU of the European Parliament and of the council of 8 June 2011

Product Specification

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)
E : MONTH

D : YEAR
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 : 1600 mm(W) X 1140 mm(D) X 1053 mm(H)

Product Specification

9. Precautions

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

9-1. Mounting Precautions

- (1) You must mount a module using 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 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 minimize 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 cause 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.

Product Specification

9-3. Electrostatic Discharge Control

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

9-4. Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

9-5. Storage

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

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.
- (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.

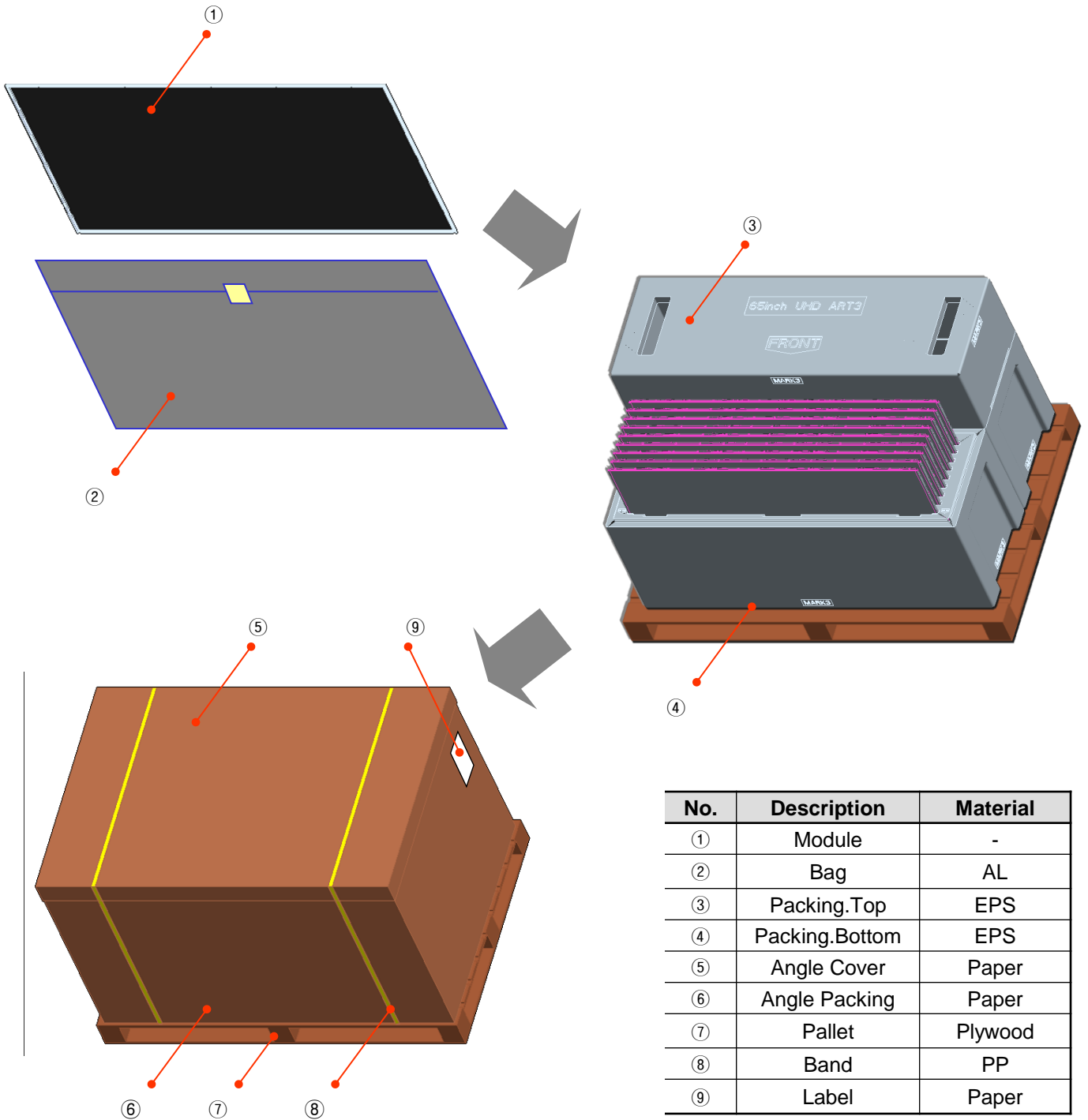
9-6. Operating condition guide

- (1) The LCD product should be operated under normal conditions. Normal condition is defined as below;
 - Temperature : 5 ~ 40 °C, 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)

Product Specification

APPENDIX- I

■ Pallet Ass'y

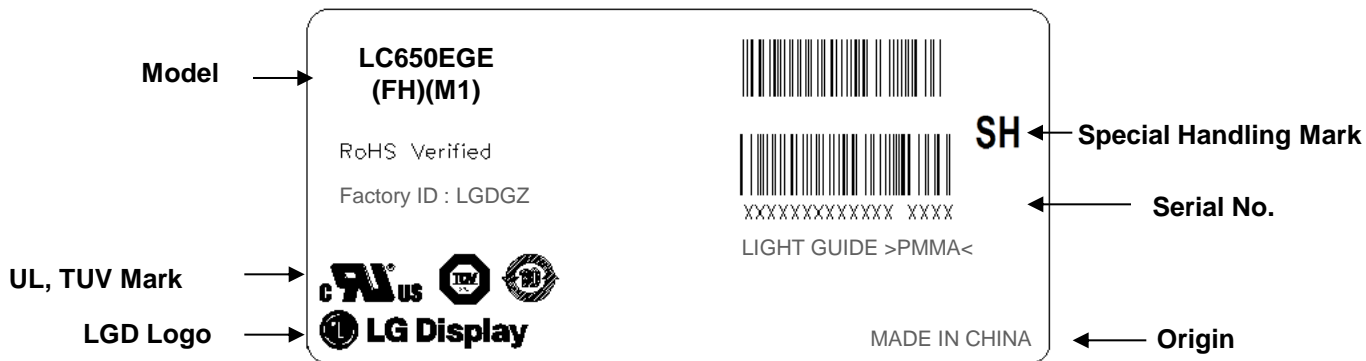


No.	Description	Material
①	Module	-
②	Bag	AL
③	Packing.Top	EPS
④	Packing.Bottom	EPS
⑤	Angle Cover	Paper
⑥	Angle Packing	Paper
⑦	Pallet	Plywood
⑧	Band	PP
⑨	Label	Paper

Product Specification

APPENDIX- II-1

■ LCM Label



■ Production site

– LG Display (Guangzhou, Heesung) CO., LTD

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

APPENDIX- II-2

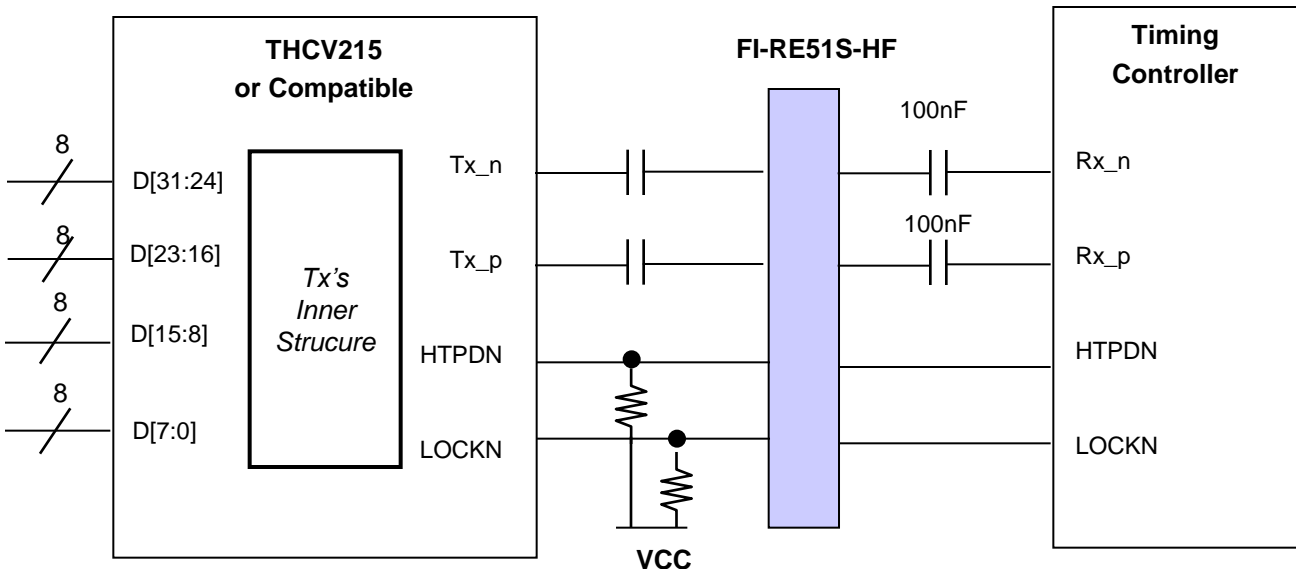
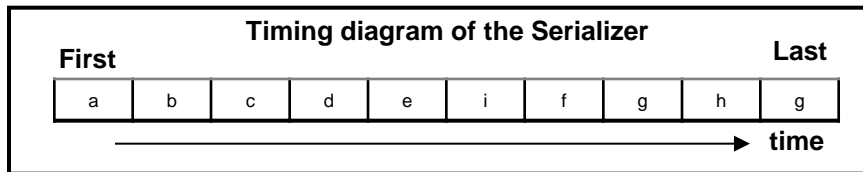
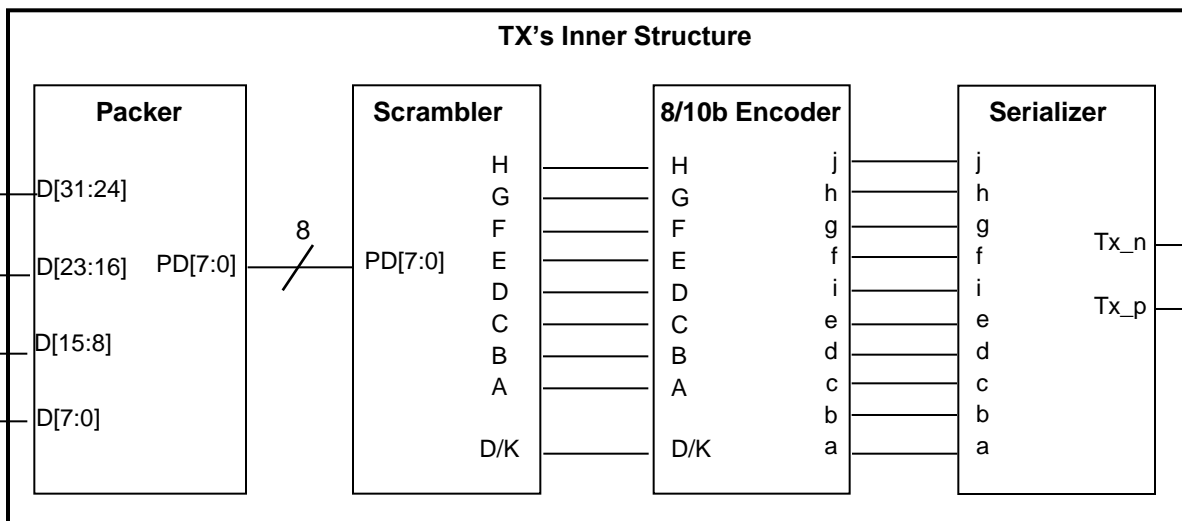
■ Pallet Label



Product Specification

APPENDIX- III-1

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

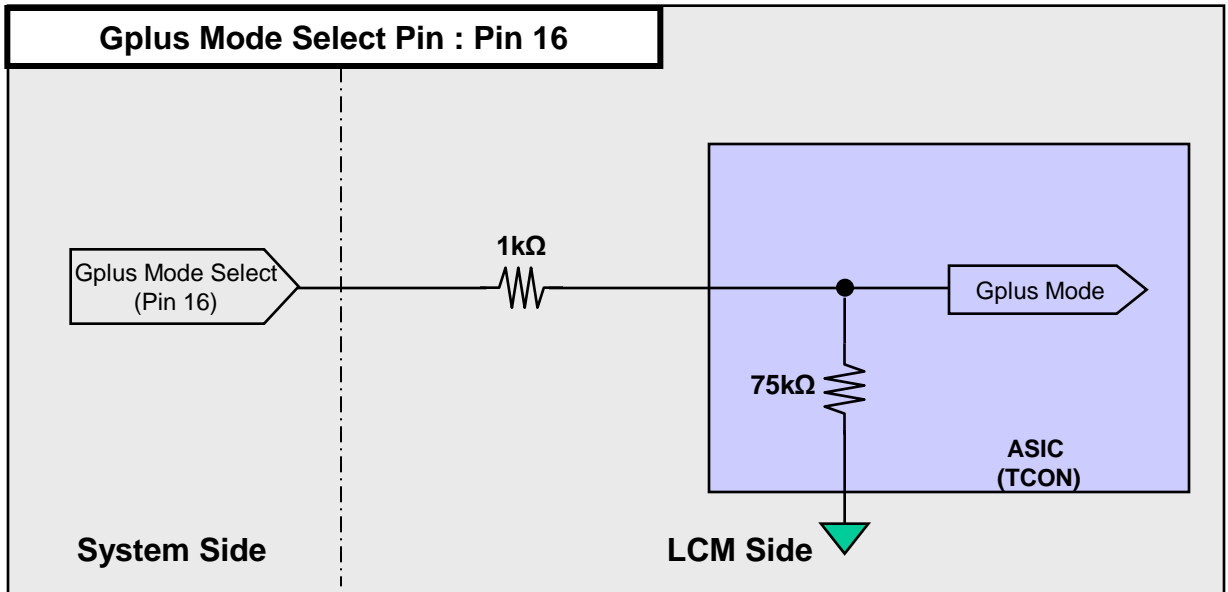


- notes: 1. The LCD module uses a 100 nF capacitor on positive and negative lines of each receiver input.
 2. Refer to Vx1 Transmitter Data Sheet for detail descriptions. (THCV215 or Compatible)
 3. About Module connector pin configuration, Please refer to the Page 8~9.

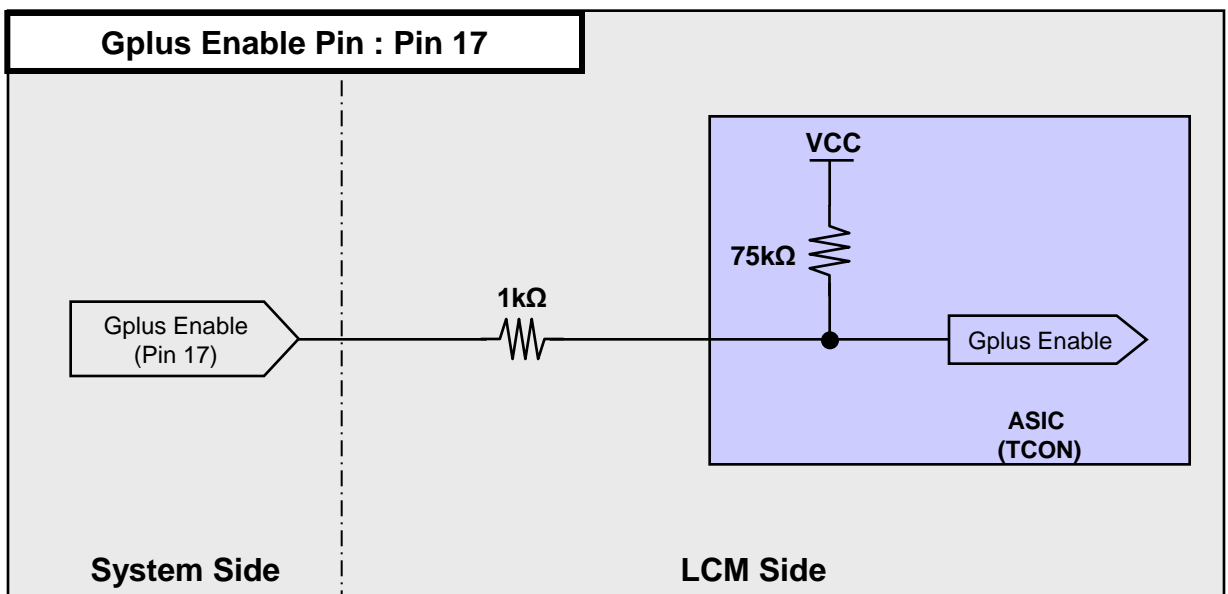
APPENDIX- IV-1

■ Option Pin Circuit Block Diagram

1) Circuit Block Diagram of Gplus Mode Selection pin



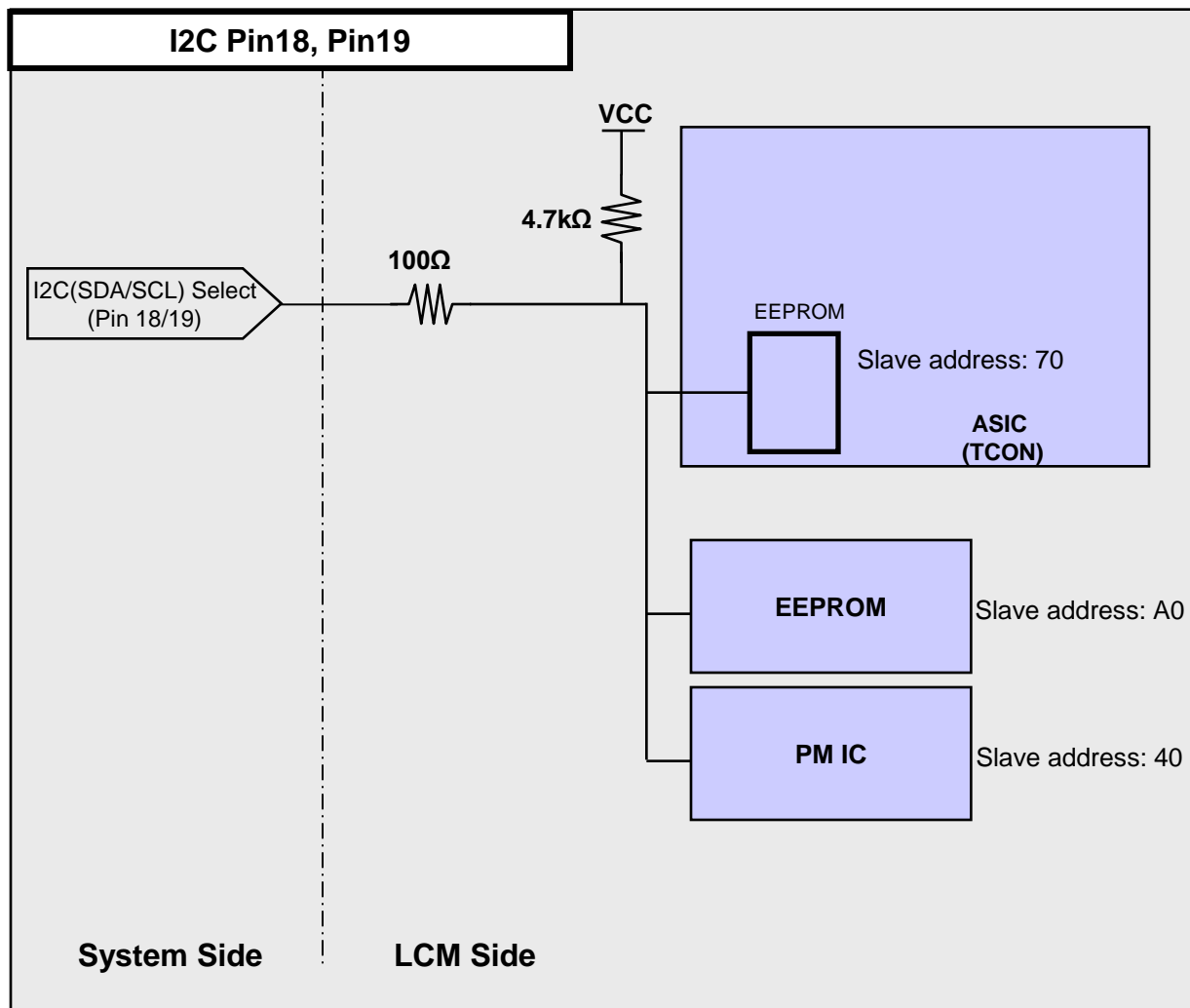
2) Circuit Block Diagram of Gplus Enable pin



APPENDIX- IV-2

■ Option Pin Circuit Block Diagram

3) I2C(SDA/SCL) Selection pin



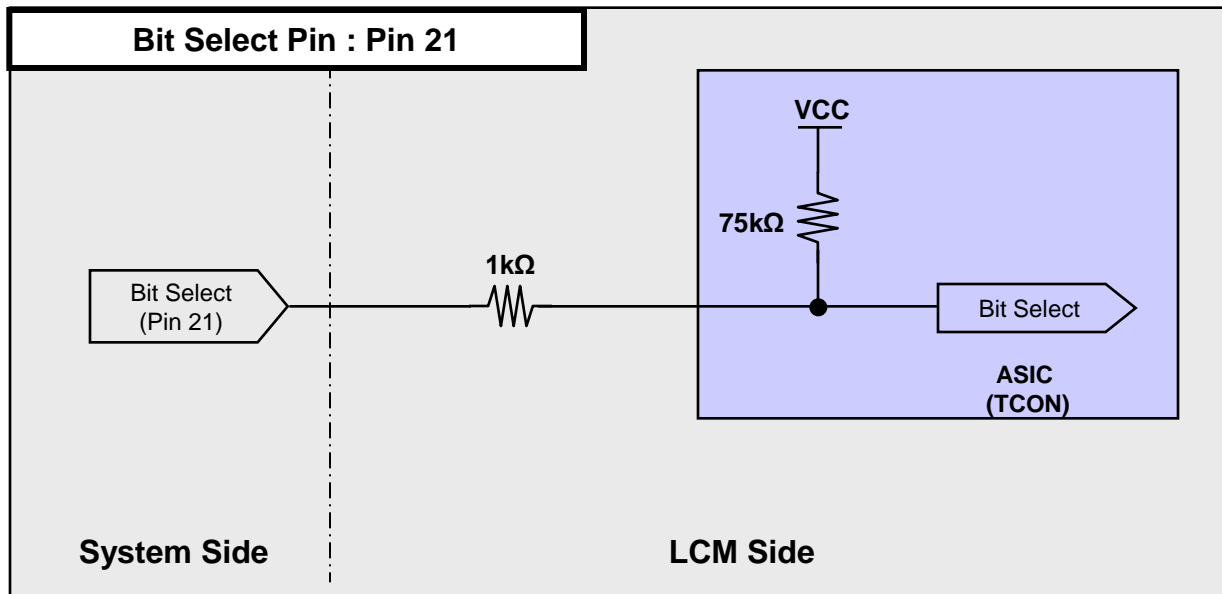
notes: 1. I2C Line of Set SoC avoid using slave address 40, 70, A0 because LCD module uses those

Product Specification

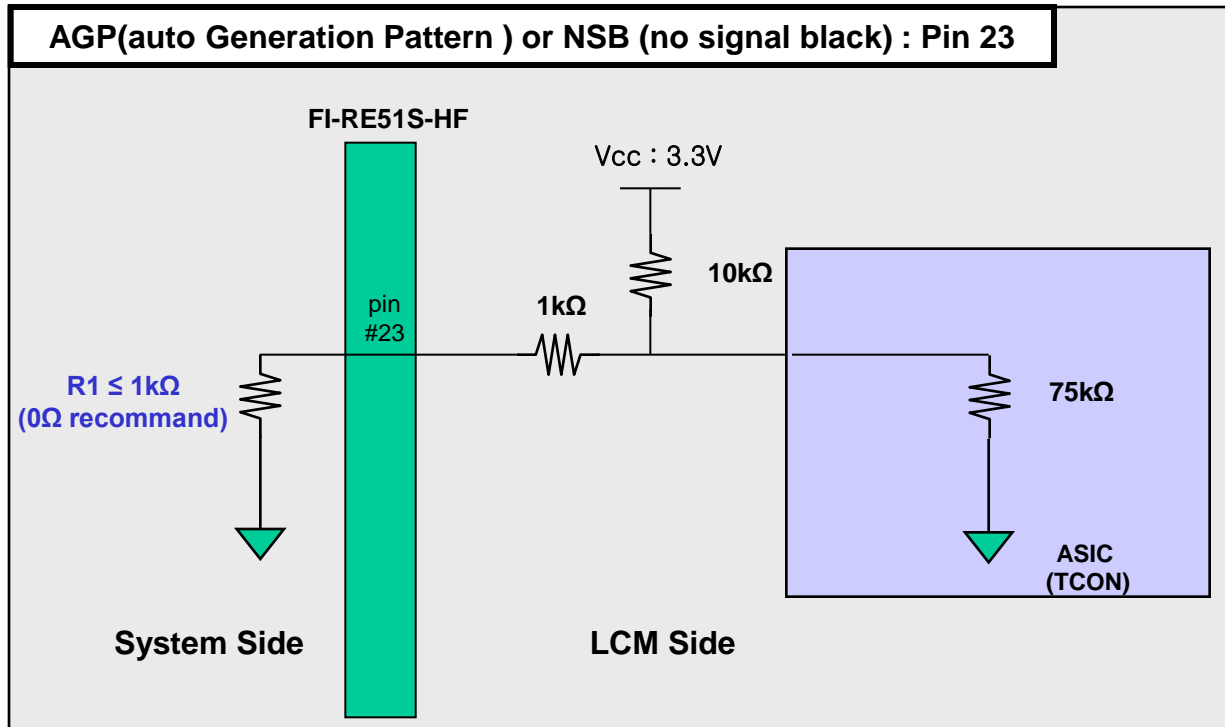
APPENDIX- IV-3

■ Option Pin Circuit Block Diagram

4) Circuit Block Diagram of Bit Selection pin



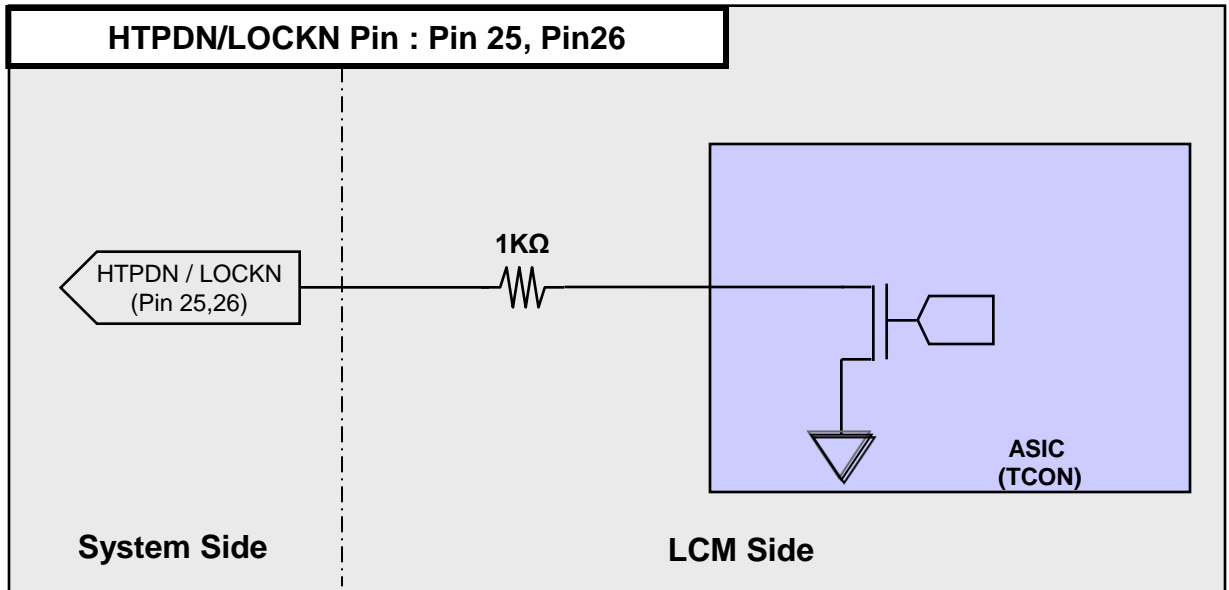
5) Circuit Block Diagram of AGP Selection pin



APPENDIX- IV-4

■ Option Pin Circuit Block Diagram

6) Circuit Block Diagram of HTPDN/ LOCKN Selection pin



Product Specification

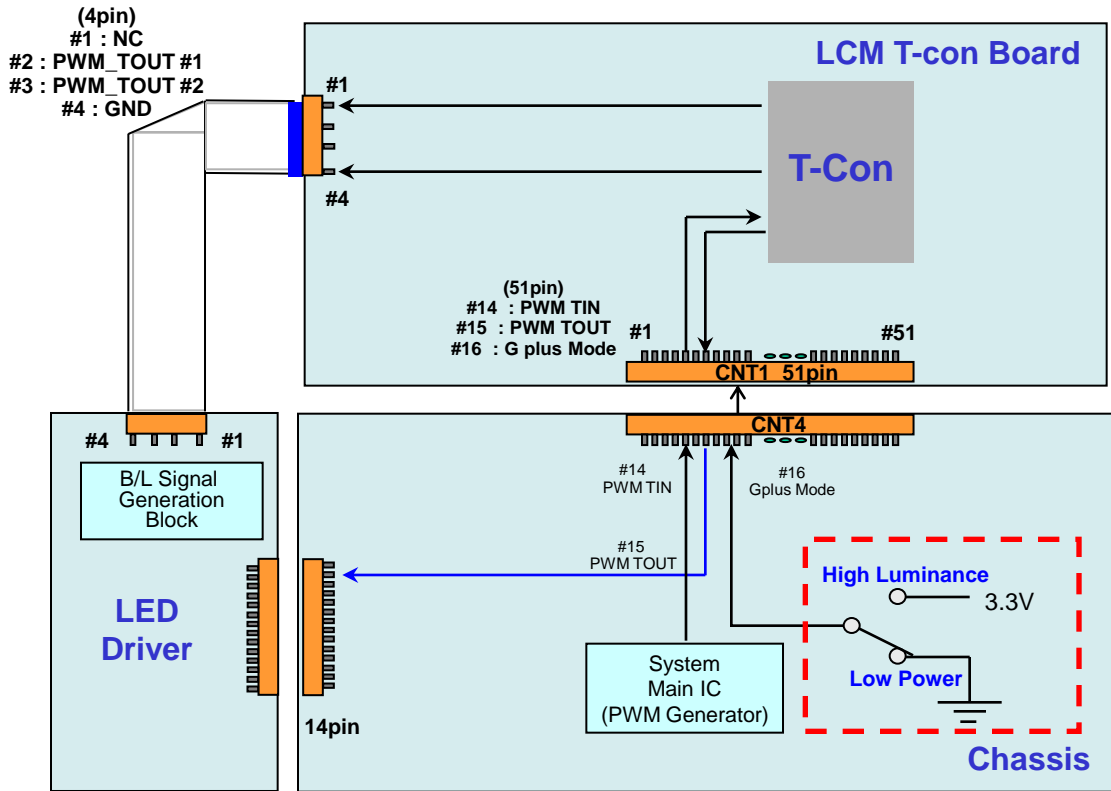
APPENDIX- V

■ Scanning and Gplus Mode Design Guide

◇ When Gplus Enable is "L", PWM TOUT = System Dimming.

PWM TOUT signals are synchronized with V-Sync Freq. of System in T-Con Board.

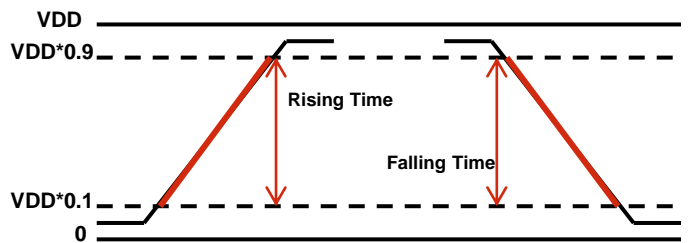
#15 PWM TOUT Pin must be connected to LED Driver, In case of non-Scanning mode.



◇ PWM Specification (VDD = 3.3V)

1. PWM High Voltage Range : 2.5V~3.6V
2. PWM Low Voltage Range : 0.0V~0.7V

EXTV _{BR-B} Frequency	50 Hz for PAL 60 Hz for NTSC
Rising Time	MAX 10.0 μs
Falling Time	MAX 10.0 μs



Product Specification

APPENDIX- VI

■ LED Array Electrical Spec

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
LED Array Voltage	$V_{FM}@25^{\circ}C$	$I_{FM}=180mA$	193.8	210.8	227.8	V
LED Array Voltage deviation(set)	ΔV_f				5.5	V

Product Specification

APPENDIX- VII

Gray to Gray Response Time Uniformity

This is only the reference data of G to G and uniformity for LC650EGE-FHM1 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 , $\delta_{G \text{ to } G}$ is defined as :

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

*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	

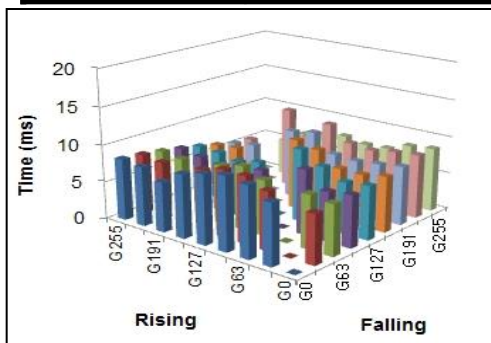
3. Sampling Size : 2 pcs

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

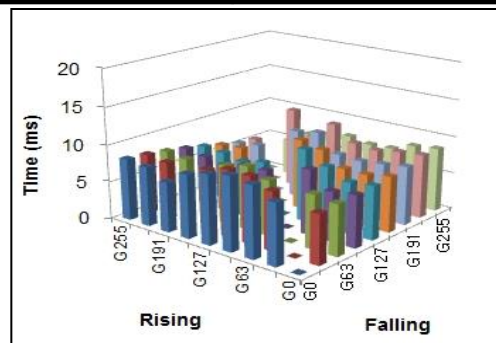
5. Current Status

Below table is actual data of production on Apr. 2015 (LGD RV Event Sample)

	G to G Response Time [ms]		Uniformity
	Min.	Max.	
# 1	4.77	7.60	1.23
# 2	4.56	7.50	1.19



< # 1 >



< # 2 >

APPENDIX- VIII**■ The reference method of BL dimming**

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