Product Specification

(   ) Product Information

(   ) Preliminary Specification

(√) Approval Specification

Any modification of Spec is not allowed without SDC's permission.

CUSTOMER	R/A Customer
DATE OF ISSUE	2022/07/10

MODEL NO.	LD650EQJ-SNA4-BL2.5K
EXTENSION CODE	-V(0)

Customer Approval & Feedback

Approved by	2022/07/10
Prepared by	2022/07/10

SPECIFICATION
FOR
APPROVAL

( ) **Preliminary Specification**
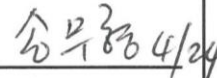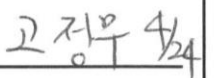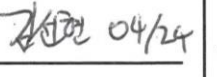
(●) **Final Specification**

Title	65.0" QWUXGA TFT LCD

BUYER	
SET MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LD650EQJ
SUFFIX	SNA4 (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.**

Product Specification

1. General Description

The LD650EQJ is a Color Active Matrix Liquid Crystal Display with an integral the Source PCB and Gate implanted on Panel (GIP). The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally black mode. It has a 6453 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 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 1.07Bilion 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.
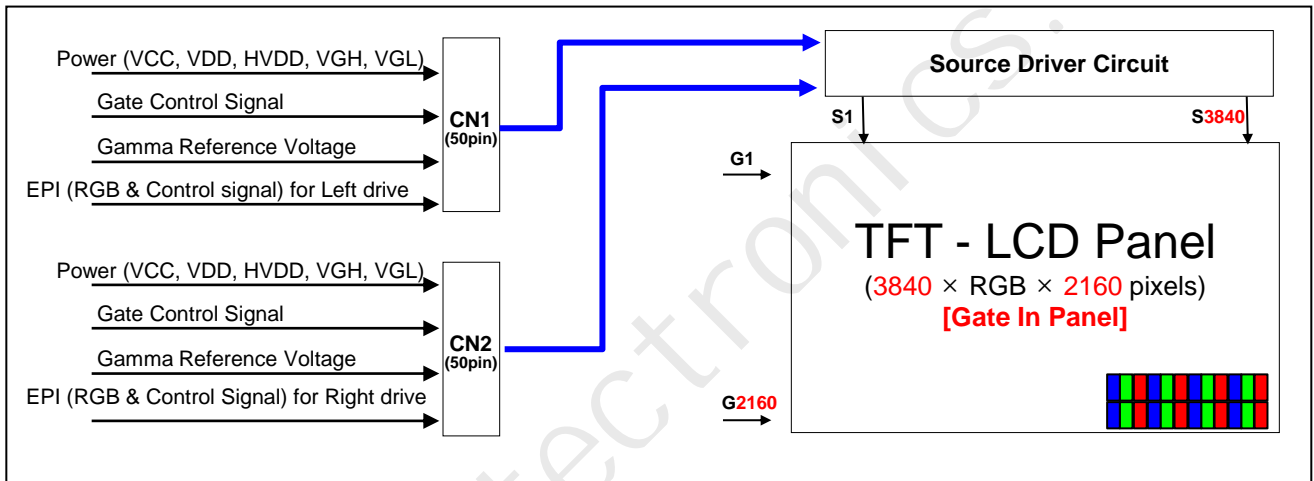
General Features

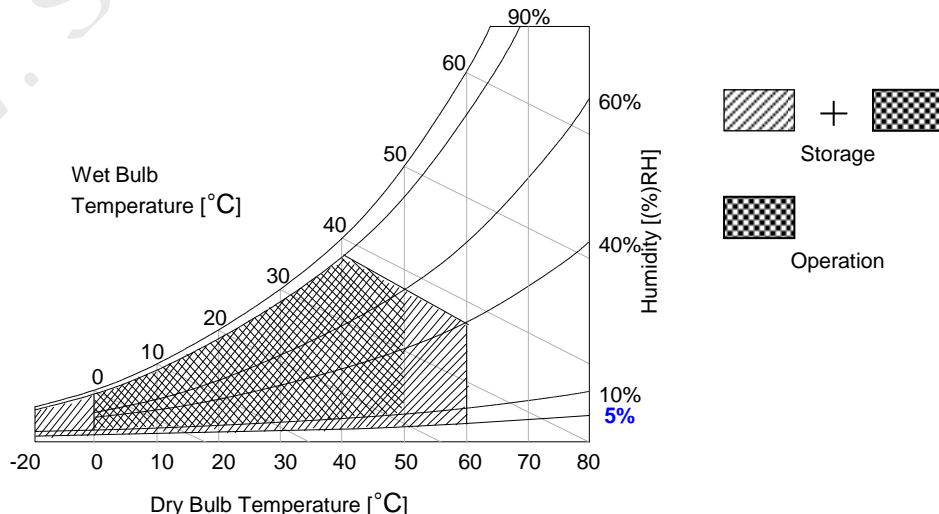|	
Active Screen Size	64.53 inches(1639.062mm) diagonal
Outline Dimension	1452.2(H) X 830.0(V) X 13.5(D)
Pixel Pitch	0.372 mm x 0.372 mm
Pixel Format	3840 horiz. by 2160 vert. Pixels.
Color Depth	10bit(D), 1.07Billon colors
Luminance, White	2500cd/m^2 (Center 1point ,Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Min.), U/D 178 (Min.))
Power Consumption	Total 447.84 W (Typ.) [Logic= 15.84 W (Typ.) , BLU=432.0W (IF_cathode=95mA)
Weight	21.5kg(Typ.) , 22.6kg(Max.)
Display Mode	Transmissive mode, Normally black
Surface Treatment	**Hard coating(2H), Anti-glare treatment of the front polarizer (Haze 28%(Typ.))**
Possible Display Type	Landscape and Portrait Enabled (counter clock wised)

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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.

Parameter	Symbol	Value		Unit	Note
		Min	Max		
Logic & EPI Power Voltage	VCC	-0.5	+2.2	V_{DC}	
Gate High Voltage	VGH	+18.0	+30.0	V_{DC}	
Gate Low Voltage	VGL1	-8.0	-4.0	V_{DC}	
	VGL2	-16.0	-4.0	V_{DC}	1
Source D-IC Analog Voltage	VDD	-0.3	+18.0	V_{DC}	
Gamma Ref. Voltage (Upper)	VGMH	½VDD-0.3	VDD+0.5	V_{DC}	
Gamma Ref. Voltage (Low)	VGML	-0.3	½ VDD+0.3	V_{DC}	
LED Input Voltage	V_F	-	+180.0	V_{DC}	
Panel Front Temperature	T_{PT}	-	+68	°C	4
Operating Temperature	T_{OP}	0	+50	°C	
Storage Temperature	T_{ST}	-20	+60	°C	2,3
Operating Ambient Humidity	H_{OP}	10	90	%RH	
Storage Humidity	H_{ST}	5	90	%RH	

Note 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 50℃ condition.
4. The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 68 ℃ 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 degrade 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}	-	1320	1720	mA	1
			-	2100	2730	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}	-	15.84	20.59	Watt	1
			-	25.2	32.76	Watt	2
Rush current		I_{RUSH}	-	-	10.0	A	3

notes

1. The specified current and power consumption are under the V_{LCD}=12.0V, Ta=25 $\pm$ 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 $\pm$5% of typical voltage

White : 1023 Gray
Black :   0 Gray
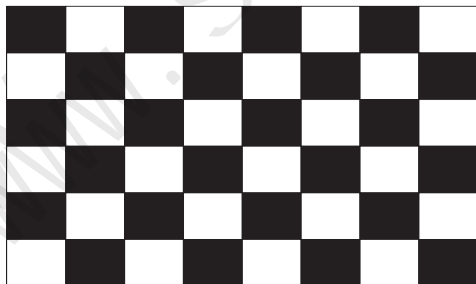
Mosaic Pattern(8 x 6)
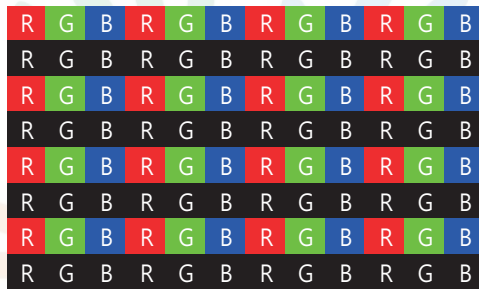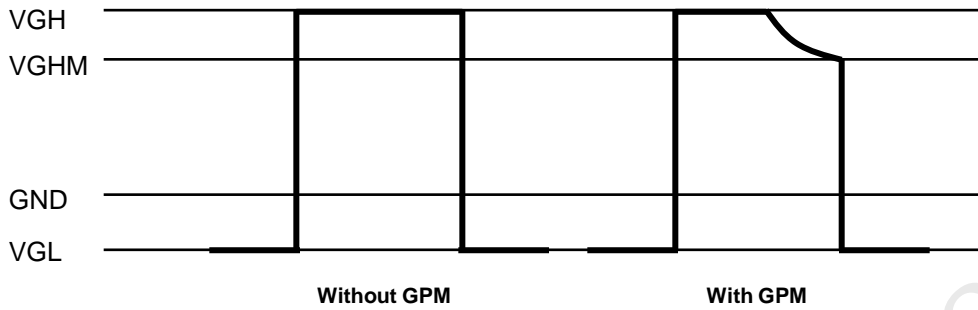

Max Current Pattern

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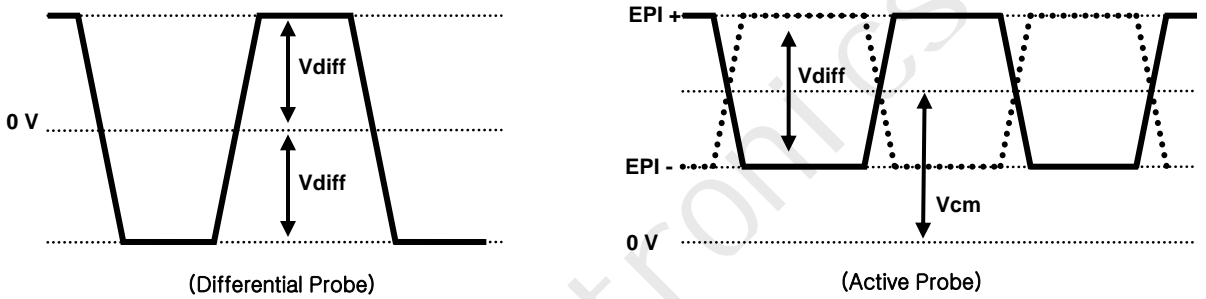**FIG. 1 Gate Output Wave form without GPM and with GPM**

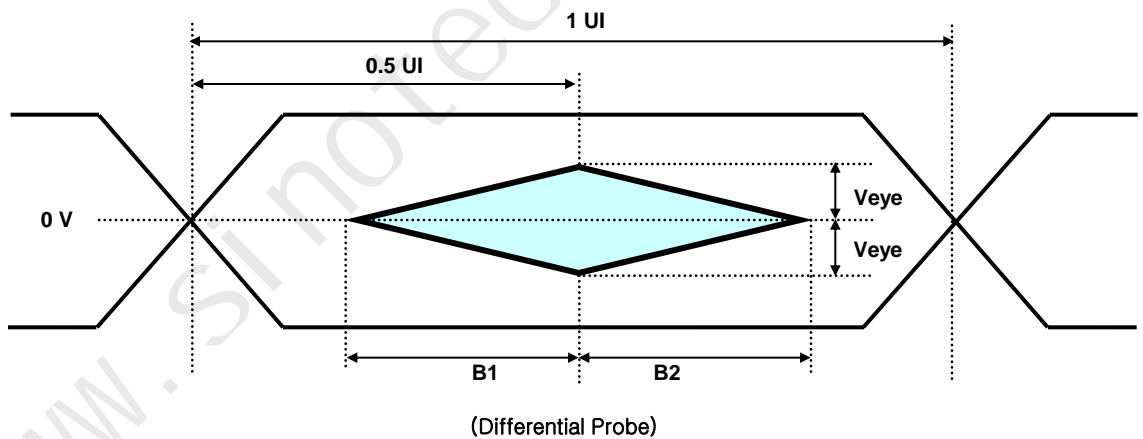**FIG. 2-1 EPI Differential signal characteristics**

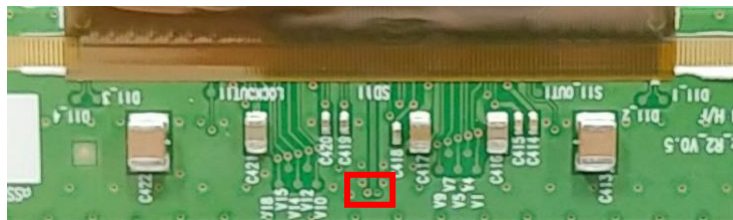**FIG. 2-2 Eye Pattern of EPI Input**

*Source PCB

FIG. 3 Measure point

Product Specification

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-RE51S-HF (manufactured by JAE)

    GT05P-51S-H38 (manufactured by LSM)

    IS050-C51B-C39-C (manufactured by UJU)

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	Input Mode	Vx1 Input Data Format 'L'=Non-Division , 'H'=2	42	GND	Ground
17	NC	NO CONNECTION	43	Rx5n	V-by-One HS Data Lane 5
18	NC	NO CONNECTION	44	Rx5p	V-by-One HS Data Lane 5
19	NC	NO CONNECTION	45	GND	Ground
20	NC	NO CONNECTION	46	Rx6n	V-by-One HS Data Lane 6
21	Bit SEL	'H' = 10bit(D) , 'L' = 8bit	47	Rx6p	V-by-One HS Data Lane 6
22	LOCAL_ON	H' = Enable , 'L' or NC = Disable	48	GND	Ground
23	RBF	'H' : 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 & #16~#20 & #22 NC(No Connection) : These pins are used only for LGD (Do not connect)
4. 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).

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Table 3. ELECTRICAL CHARACTERISTICS (Continue)   Ta = 25±2℃, On Duty 100%

parameter			Symbol	VALUES			Unit	Notes
				MIN	TYP	MAX		
Power supply input voltage			VBL	22.6	24	26.4	VDC	1
Power supply input current			IBL_A	-	18.0	-	A	VBR=3.3V
Power consumption			PBL		432.0		W	VBR=3.3V
Input signal for inverter control	On/off	on	V on	2.5	-	5	V	
		off	V off	0	-	0.5	V	
	Brightness adjust		EXTVBR-B	35		100	%	Automatic sensitization control

3-3. Signal Timing Specifications

Table 4. Timing Requirements

Parameter	Symbol	Condition	Min	Typ	Max	Unit	notes
Unit Interval	UI	-	0.687	-	0.800	ns	
Effective Veye width time	B1&B2	-	0.25	-	-	UI	Fig. 2
Modulation Ratio of SSC	Vspread	@100KHz	-	-	2	%	1
1st data to SOE rising time	Ts1	-	3	-	-	Packet	Fig.4
SOE rising to last data	Ts4	-	0	-	-	Packet	Fig.4
Last data to SOE falling	Ts5	-	10	-	-	Packet	Fig.4
EPI Bandwidth	BW	-	1.251	-	1.456	GBPS	

notes :1. VModulation Ratio of SSC for 20KHz ~ 100kHz Modulation Frequency is calculated by
(7 – 0.05*Fmod), where Fmod unit is KHz.

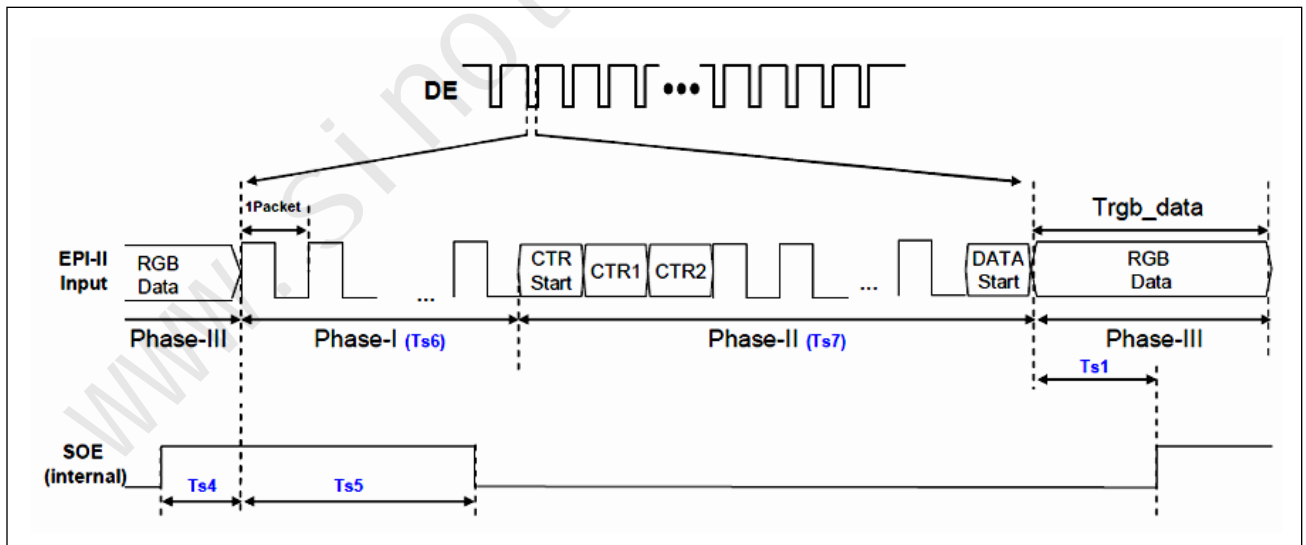**FIG 4. SOE Width & Timing**
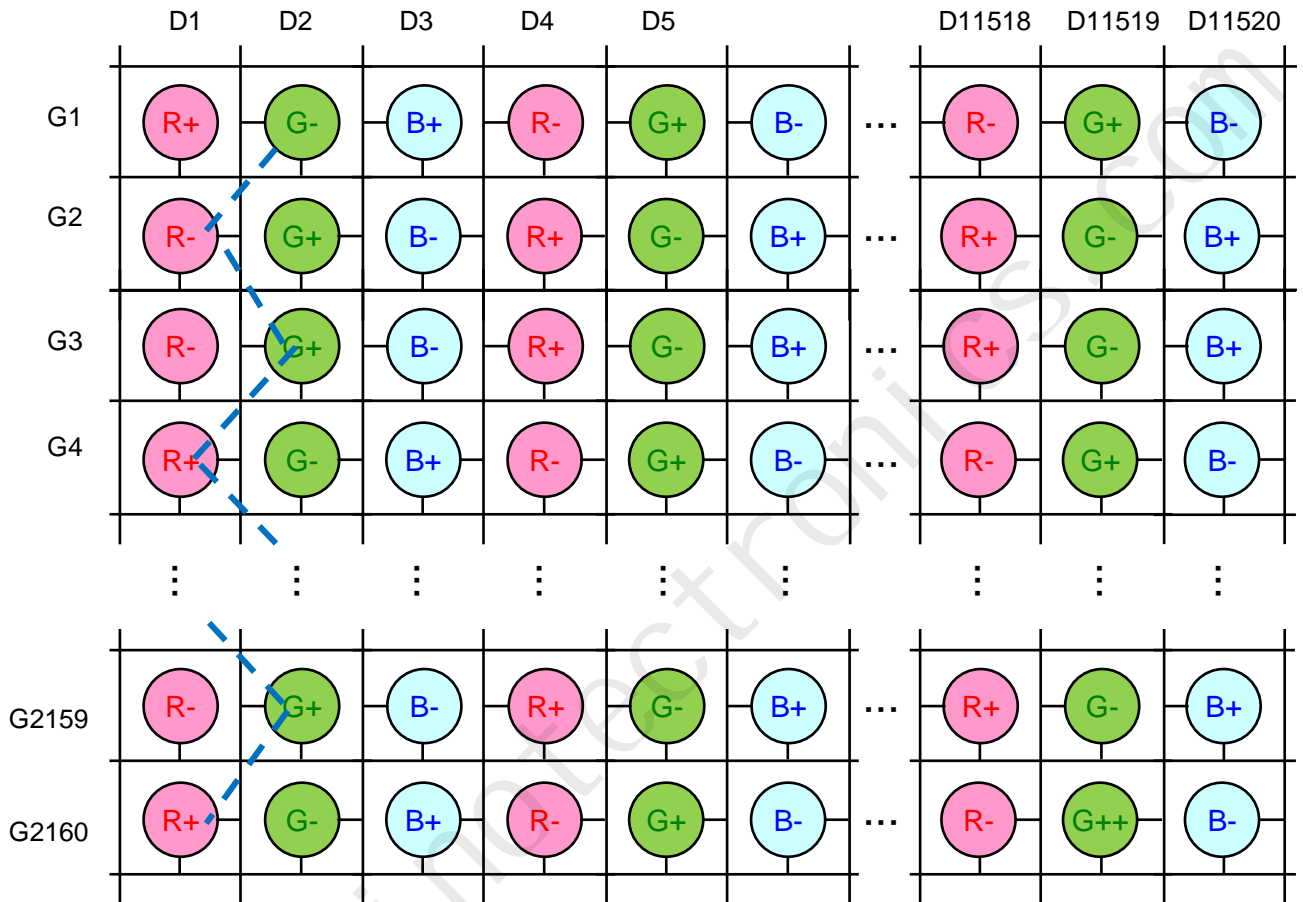
3-4. Panel Pixel Structure

FIG. 5 Panel Pixel Structure

Product Specification
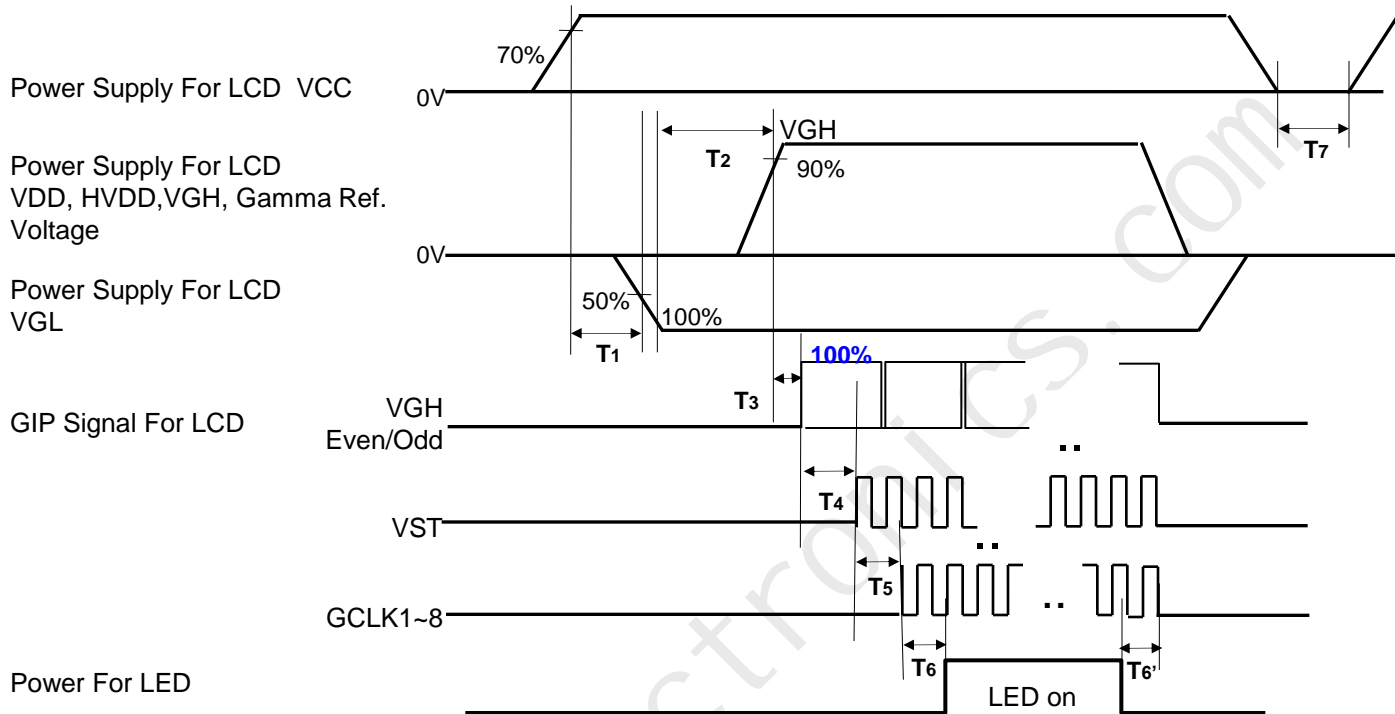
3-5. Power Sequence

3-5-1. LCD Driving circuit

Table 5. POWER SEQUENCE

Ta= 25±2°C, fv=60Hz,

Parameter	Value			Unit	notes
	Min	Typ	Max		
T₁	0.5	-	-	ms	
T₂	0.5	-	-	ms	
T₃	0	-	-	ms	
T₄	10	-	-	ms	2
T₅	0	-	-	ms	
T₆ / T₆'	20	-	-	ms	6
T₇	3	-	-	s	

notes : 1. Power sequence for Source D-IC must follow the Case1 & 2.

※ Please refer to Appendix Ⅲ for more details.

2. VGH Even & Odd can not be High at the same time.

3. Power Off Sequence order is reverse of Power On Condition including Source D-IC.

4. GCLK On/Off Sequence

: GCLK4 → GCLK3 →GCLK2 → GCLK1 → GCLK8 → GCLK7 → GCLK6 → GCLK5 → GCLK4

: GCLK should be turned Off before the EPI data signal Off

5. VGH_Even/Odd transition time should be within V_blank

6. In case of T6', If there is no abnormal display, no problem

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at $25\pm2°C$. The values are specified at distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °. FIG. 2 shows additional information concerning the measurement equipment and method.
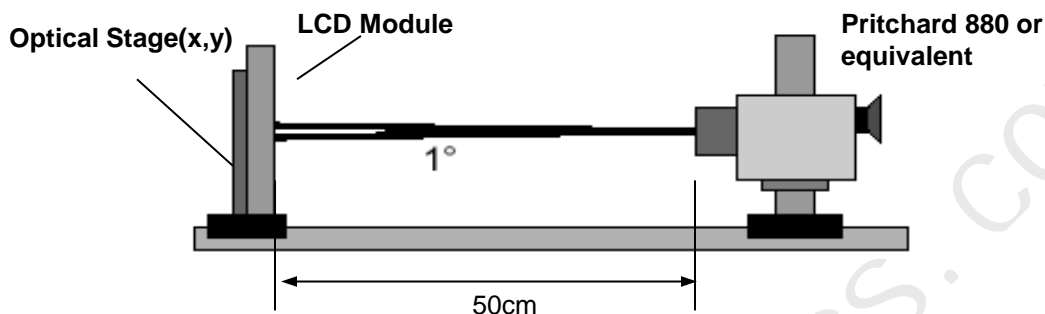

FIG. 6 Optical Characteristic Measurement Equipment and Method

Table 10. OPTICAL CHARACTERISTICS Ta= $25\pm2°C$, V_{LCD}=12.0V, fv=120Hz, Dclk=74.25MHz, **EXTV**BR-B =100%

Parameter			Symbol		Value			Unit	Note
					Min	Typ	Max		
Contrast Ratio			CR		800	1100	-		1
Surface Luminance, white			L_{WH}	2D	2250	2500	-	cd/m²	2
Luminance Variation			δ_{WHITE}	9P	65	-	-	%	3
Response Time		Gray to Gray	G to G			8	12	ms	4
		Uniformity	$\delta_{G To G}$		-	-	1		
Color Coordinates [CIE1931]		RED	Rx			0.648			
			Ry			0.332			
		GREEN	Gx			0.314			
			Gy		Typ -0.03	0.610	Typ +0.03		
		BLUE	Bx			0.153			
			By			0.057			
		WHITE	Wx			0.279			
			Wy			0.292			
Color Temperature						10,000		K	
Color Gamut						68		%	
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	-	-		
Gray Scale					-	-	-		6

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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. For more information, see the FIG. 2.
The value of CR should be extracted using the LGD sheet structure (Diffuser/Prism/Prism)

2. Response time is the time required for the display to transit from any gray to white (Rise Time, TrR)
and from any gray to black (Decay time, TrD). For additional information see the FIG. 3.
※ G to GBW Spec stands for average value of all measured points.
Photo Detector : RD-80S / Field : 2 °
The response time is valued with operating condition of LGD's standard BLU

3. G to G σ is Variation of Gray to Gray response time composing a picture

$$G\ to\ G\ (\sigma) = \sqrt{\frac{\Sigma(Xi-u)^2}{N}}$$

Xi = Individual Data
u = Data average
N : The number of Data

4. The value of transmittance should be extracted using the LGD standard sheet structure Diffuser/Diffuser)

5. The value of color coordinates should be extracted using the standard light source of D65

6. 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.

7. Gray scale specification
Gamma Value is approximately 2.2. For more information, see the Table 10.

Table 7. GRAY SCALE SPECIFICATION

Gray Level	Luminance [%] (Typ)
L0	0.09
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

	Gray Level	Gamma Ref.
Positive Voltage	L0	Gamma9
	L127	Gamma5
	L255	Gamma1
Negative Voltage	L255	Gamma18
	L127	Gamma14
	L0	Gamma10

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Measuring point for Contrast Ratio

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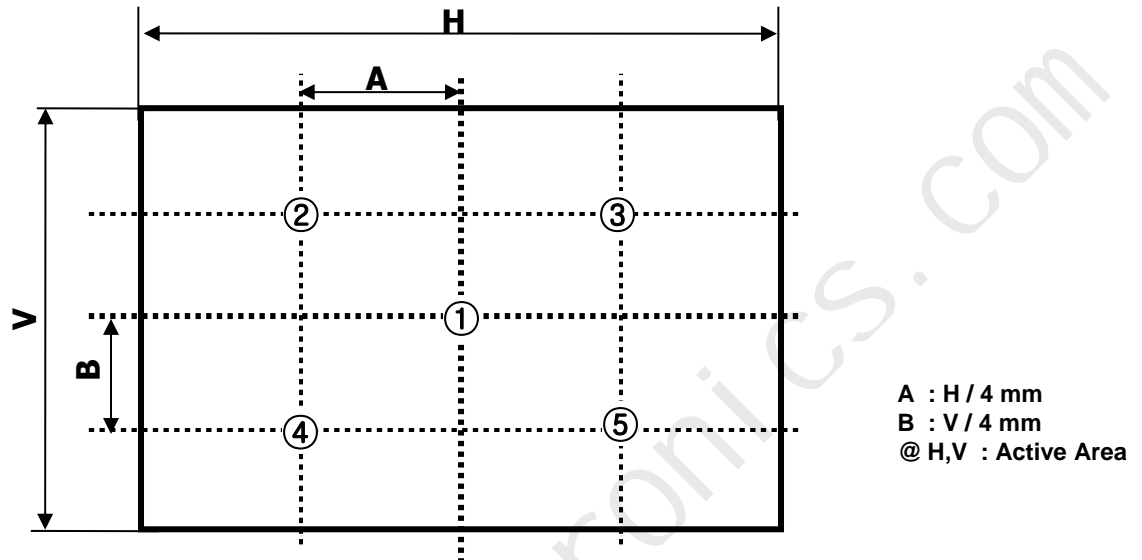B : V / 4 mm
@ H,V : Active Area

FIG.7 Points for Contrast Ratio Measure

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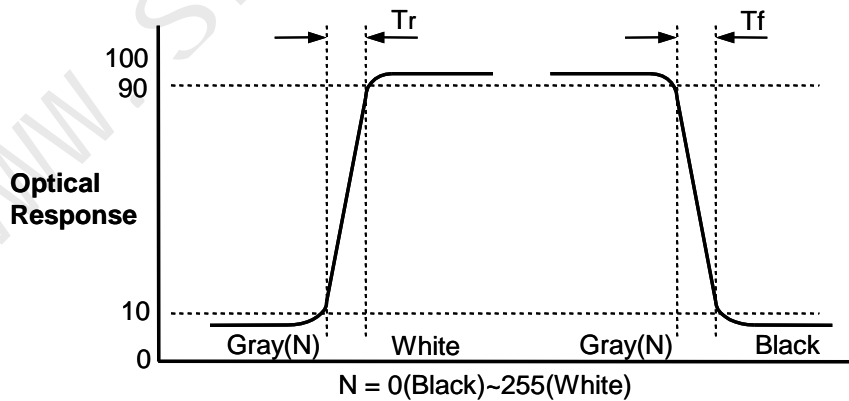

N = 0(Black)~255(White)

FIG. 3 Response Time

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Dimension of viewing angle range

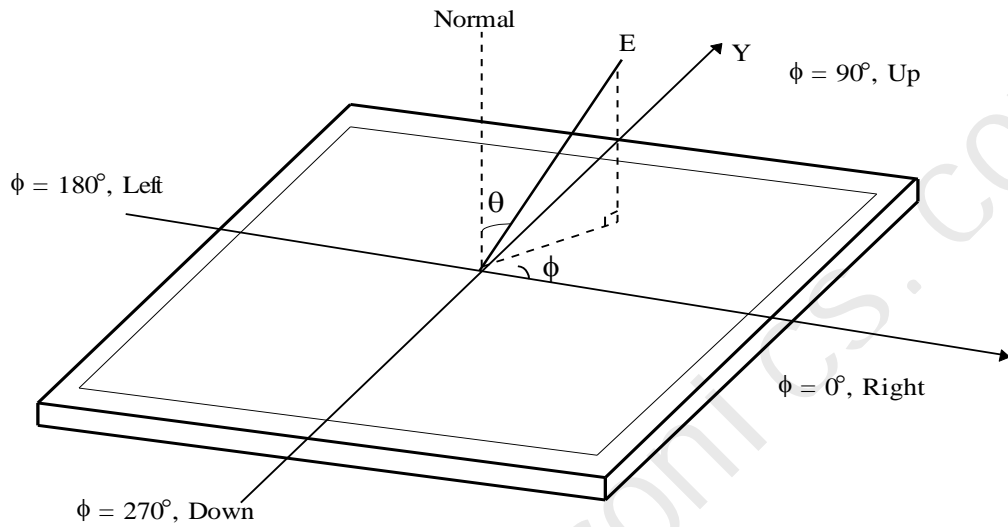**FIG. 9 Viewing Angle**

5. Mechanical Characteristics

Table 8 provides general mechanical characteristics.

Table 8. MECHANICAL CHARACTERISTICS

| Item	Value	
Outline Dimension	Horizontal	1461.2 mm
	Vertical	843.0 mm
	Depth	55.5 mm
Bezel Area	Horizontal	1433.4 mm
	Vertical	808.6 mm
Active Display Area	Horizontal	1428.48 mm
	Vertical	803.52 mm
Weight	21.5kg(Typ.) , 22.6kg(Max.)	
Case Top	Material	EGI, PCM
	Case Top Color	Black

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

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6. Mechanical Dimension

6-1. Board Assembly Dimension
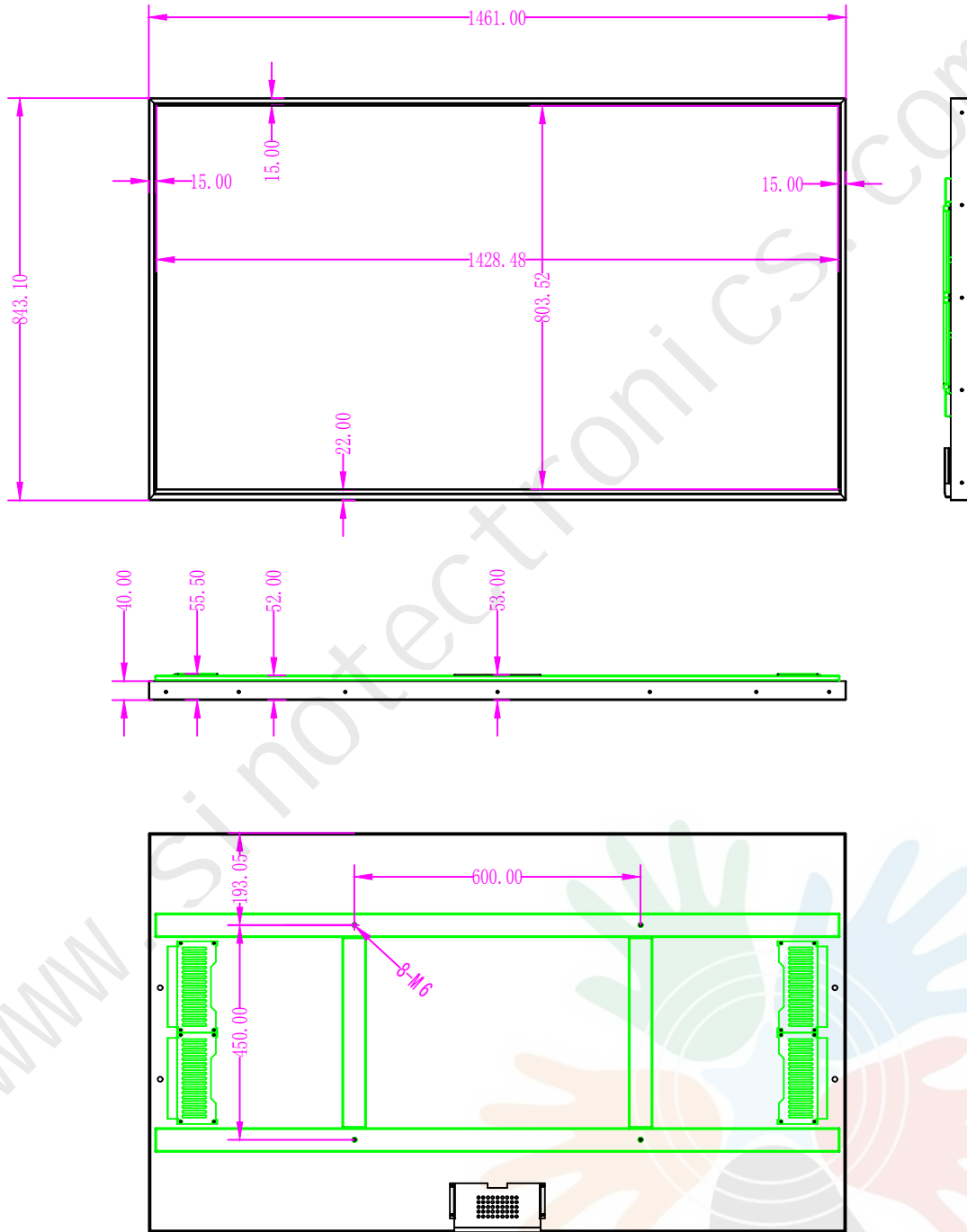
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7. Reliability

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

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