

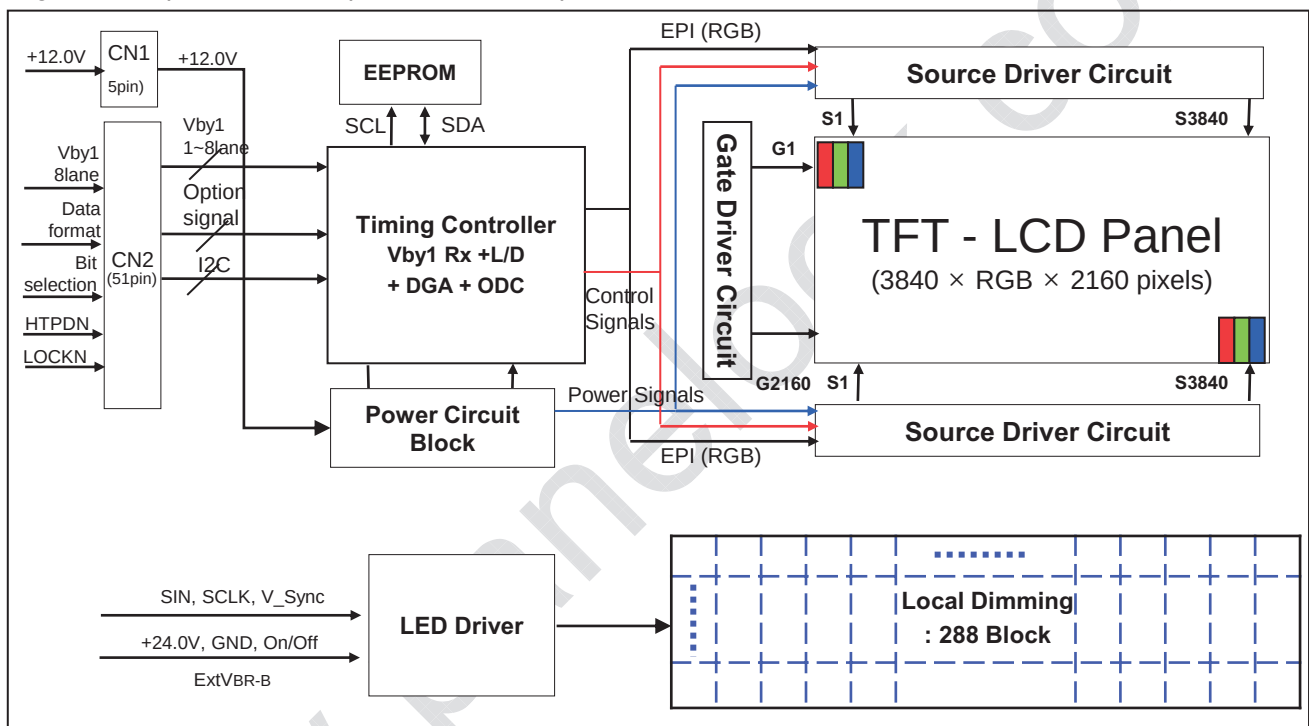
Product Specification

1. General Description

The LD980DQY 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 97.52 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 1.06Billion colors.

It has been designed to apply the 10-bit 8 Lane VbyOne 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.



Active Screen Size	97.52 inches(2476.95 mm) diagonal
Outline Dimension	2192.8(H) X 1248.4(V) X 63.5(B/D) (Typ.)
Pixel Pitch	0.5622mm x 0.5622mm
Pixel Format	3840 horiz. by 2160 vert. Pixels, RGB stripe arrangement
Color Depth	10bit(D), 1.06Billion colors
Luminance, White	2000 cd/m ² (Center 1point ,Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Min.), U/D 178 (Min.))
Power Consumption	Total 918.1W (Typ.) [Logic= 18.1W, LED Driver=900W (ExtVbr_B=100%)
Weight	66Kg (Typ.)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer (Haze 1%(Typ.))

Product Specification

2. Absolute Maximum Ratings

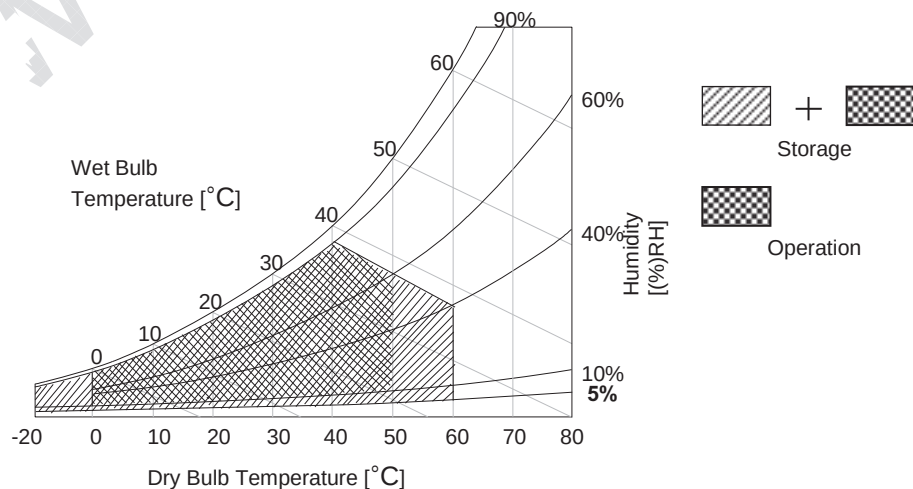
The following items are maximum values which, if exceeded, may cause faulty operation or permanent damage to the LCD module.

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
T-Con Option Selection Voltage		V _{LOGIC}	-0.3	+4.0	V _{DC}	
Operating Temperature		T _{OP}	0	+50	°C	2
Storage Temperature(without packing)		T _{ST}	-20	+60	°C	
Panel Front Temperature		T _{PT}	-	+68	°C	3
Operating Ambient Humidity		H _{OP}	10	90	%RH	2
Storage Humidity		H _{ST}	5	90	%RH	

Notes

1. Ambient temperature condition ($T_a = 25 \pm 2^\circ\text{C}$)
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

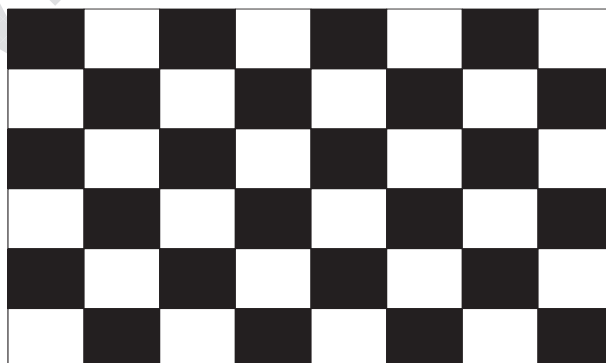
It requires two power inputs. One is employed to power for the LCD circuit. The other is used for the LED backlight and LED Driver circuit.

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}	-	745	969	mA	1
			-	2480	3224	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}	-	8.94	11.62	Watt	1
			-	29.76	38.68	Watt	2
Rush current		I _{RUSH}	-	-	15	A	3

Notes

1. The specified current and power consumption are under the V_{LCD}=12.0V, Ta=25 ± 2°C, f_v=120Hz condition, and mosaic pattern(8 x 6) is displayed and f_v is the frame frequency.
2. The current is specified at the maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power input is 0.5ms (min.).
4. Ripple voltage level is recommended under ±5% of typical voltage

White : 1023 Gray
Black : 0 Gray



Mosaic Pattern(8 x 6)

Product Specification

Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter			Symbol	Values			Unit	Notes
				Min	Typ	Max		
LED Driver :								
Power Supply Input Voltage			VBL	21.6	24.0	26.4	Vdc	1
Power Supply Input Current			IBL	-	37.5	-	A	1
Power Supply Input Current (In-Rush)			In-rush	-	-	26.7	A	VBL = 21.6V ExtVBR-B=100% 4
Power Consumption (Total)			PBL	-	900	930 W		1
Input Voltage for Control System Signals	On/Off	On	V on	2.5	-	3.6	Vdc	
		Off	V off	-0.3	0.0	0.7	Vdc	
	Brightness Adjust		ExtVBR-B	1	-	100	%	On Duty
	PWM Frequency for NTSC & PAL		PAL		100		Hz	
			NTSC		120		Hz	
	Pulse Duty Level (PWM)		HighLevel	2.5	-	3.6	Vdc	HIGH : on duty LOW : off duty
			Low Level	0.0	-	0.7	Vdc	
LED :								
Life Time				30,000	50,000		Hrs	2

Notes :

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



Product Specification

3-2. Interface Connections

This LCD module employs three kinds of interface connection, 5-pin connector, 51-pin connector and 41-pin connector are used for the module electronics and 14-pin,12-pin connector is used for the integral backlight system.

3-2-1. LCD Module

- LCD Connector(CN1) : 20037WR-H05 (manufactured by YEONHO)
- Mating Connector : SMH200-H05M (YEONHO) or compatible

Table 4-1. MODULE CONNECTOR(CN1) PIN CONFIGURATION

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

Product Specification

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

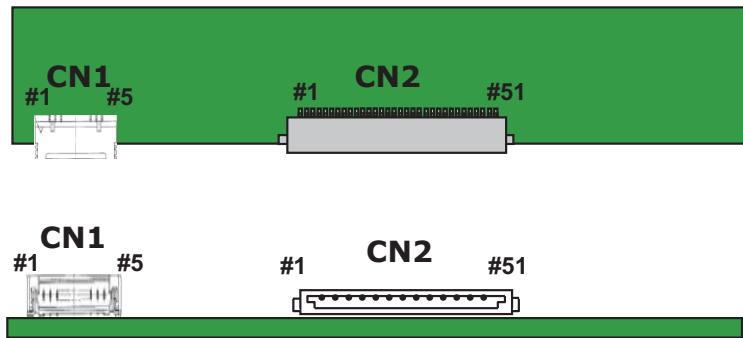
Table 4-2. MODULE CONNECTOR(CN2) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	NC	No Connection(Notes 2)	27	GND	Ground
2	NC	No Connection(Notes 2)	28	Rx0n	V-by-One HS Data Lane 0
3	NC	No Connection(Notes 2)	29	Rx0p	V-by-One HS Data Lane 0
4	NC	No Connection(Notes 2)	30	GND	Ground
5	NC	No Connection(Notes 2)	31	Rx1n	V-by-One HS Data Lane 1
6	NC	No Connection(Notes 2)	32	Rx1p	V-by-One HS Data Lane 1
7	NC	No Connection(Notes 2)	33	GND	Ground
8	NC	No Connection(Notes 2)	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	40	Rx4n	V-by-One HS Data Lane 4
15	NC	NO CONNECTION	41	Rx4p	V-by-One HS Data Lane 4
16	Data format	'L' : Non division, 'H' 2 division	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, 'L' = 8bit	47	Rx6p	V-by-One HS Data Lane 6
22	NC	NO CONNECTION	48	GND	Ground
23	RBF	'H' : AGP(Default), 'L' : NSB (No signal Black)	49	Rx7n	V-by-One HS Data Lane 7
24	NC	NO CONNECTION	50	Rx7p	V-by-One HS Data Lane 7
25	HTPDN	Hot plug detect	51	GND	Ground
26	LOCKN	Lock detect	-	-	-

notes

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. #1~#9, #14~#15, #17~#20, #22, #24 NC (No Connection) : These pins are used only for LGD (Do not connect)
4. About specific pin (#16), Please see the **Appendix V**.
5. Specific pin No. #23 is used for "No signal detection" of system signal interface.
It should be GND or NC for NSB (No Signal Black) while the system interface signal is not.
If this pin is "H", LCD Module displays AGP (Auto Generation Pattern).

Product Specification



Rear view of LCM

Product Specification

3-2-2. Backlight Module

LED Driver Connector

: 20022WR - H14B2(Yeonho) , 20022WR-H12B2(Yeonho)

Mating Connector

: 20022HS-H14B2(Yeonho) or compatible, 20022HS-H12B2(Yeonho) or compatible

Table 5-1. LED DRIVER CONNECTOR PIN CONFIGURATION

Pin No	Symbol	Description (CN1001)	Description (CN1002)	Note
1	VBL	Power Supply +24.0V	Power Supply +24.0V	
2	VBL	Power Supply +24.0V	Power Supply +24.0V	
3	VBL	Power Supply +24.0V	Power Supply +24.0V	
4	VBL	Power Supply +24.0V	Power Supply +24.0V	
5	VBL	Power Supply +24.0V	Power Supply +24.0V	
6	GND	Backlight Ground	Backlight Ground	1
7	GND	Backlight Ground	Backlight Ground	
8	GND	Backlight Ground	Backlight Ground	
9	GND	Backlight Ground	Backlight Ground	
10	GND	Backlight Ground	Backlight Ground	
11	Status	Backlight Status	Don't care	2
12	VON/OFF	Backlight ON/OFF control	Don't care	
13	NC	Don't care		
14	EXTVBR_B	External PWM		3

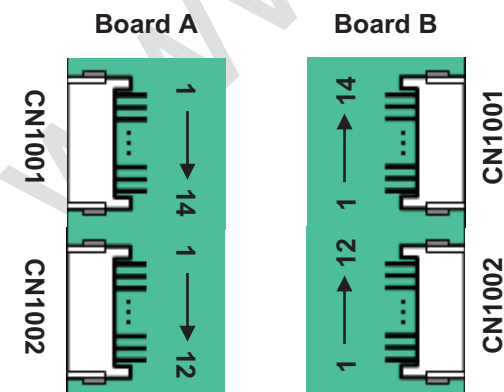
Notes : 1. GND should be connected to the LCD module's metal frame.

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

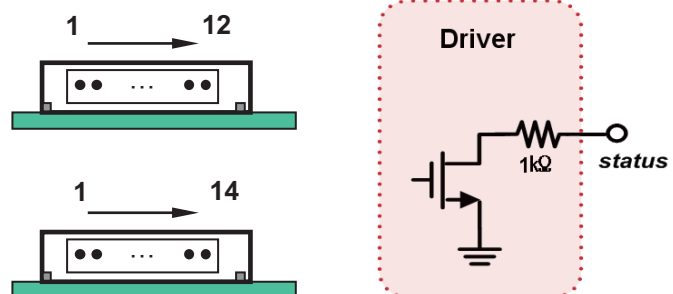
3. High : on duty / Low : off duty, Pin#14 can be opened. (if Pin #14 is open , EXTVBR-B is 100%)

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

◆ Rear view of LCM



◆ Status



Product Specification

3-3. Signal Timing Specifications

Table 6 shows the signal timing required at the input of the LVDS 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}	240	240	240	t_{CLK}	3840/16
	Blank	t_{HB}	25	35	60	t_{CLK}	1
	Total	t_{HP}	265	275	300	t_{CLK}	
Vertical	Display Period	t_{VV}	2160	2160	2160	Lines	
	Blank	t_{VB}	40 (456)	90 (540)	172 (600)	Lines	1
	Total	t_{VP}	2200 (2616)	2250 (2700)	2332 (2760)	Lines	

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

Notes:

1. The input of HSYNC & VSYNC signal does not have an effect on normal operation (DE Only Mode). If you use spread spectrum of EMI, add some additional clock to minimum value for clock margin.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate and the horizontal frequency

※ Timing should be set based on clock frequency.

Product Specification

3-4. V by One input signal Characteristics

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

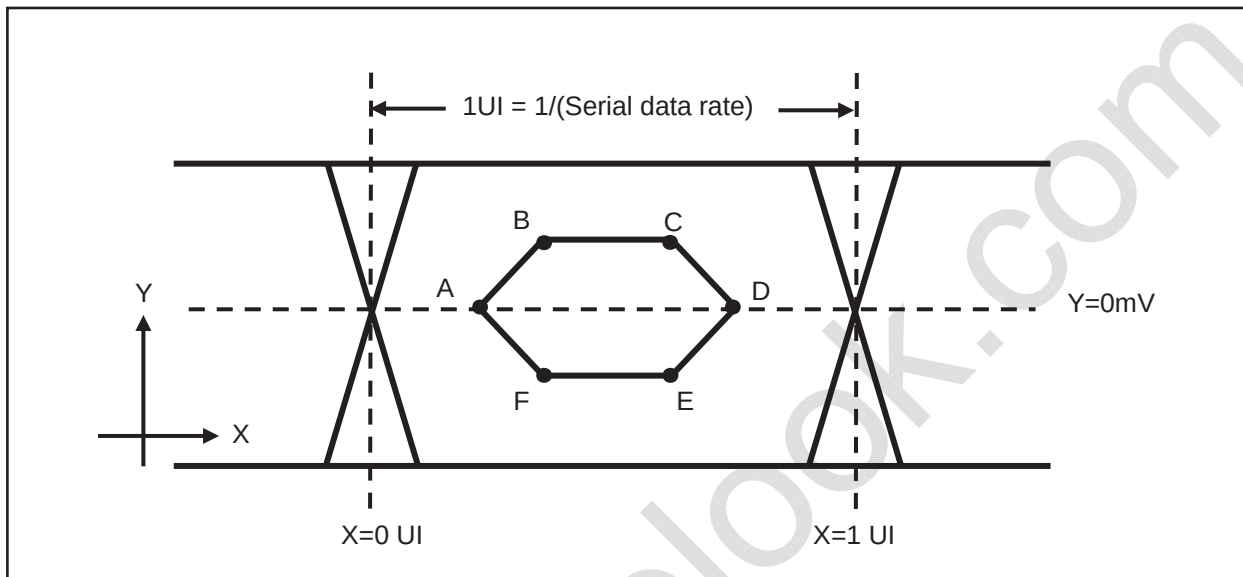


Table7. Eye Mask Specification

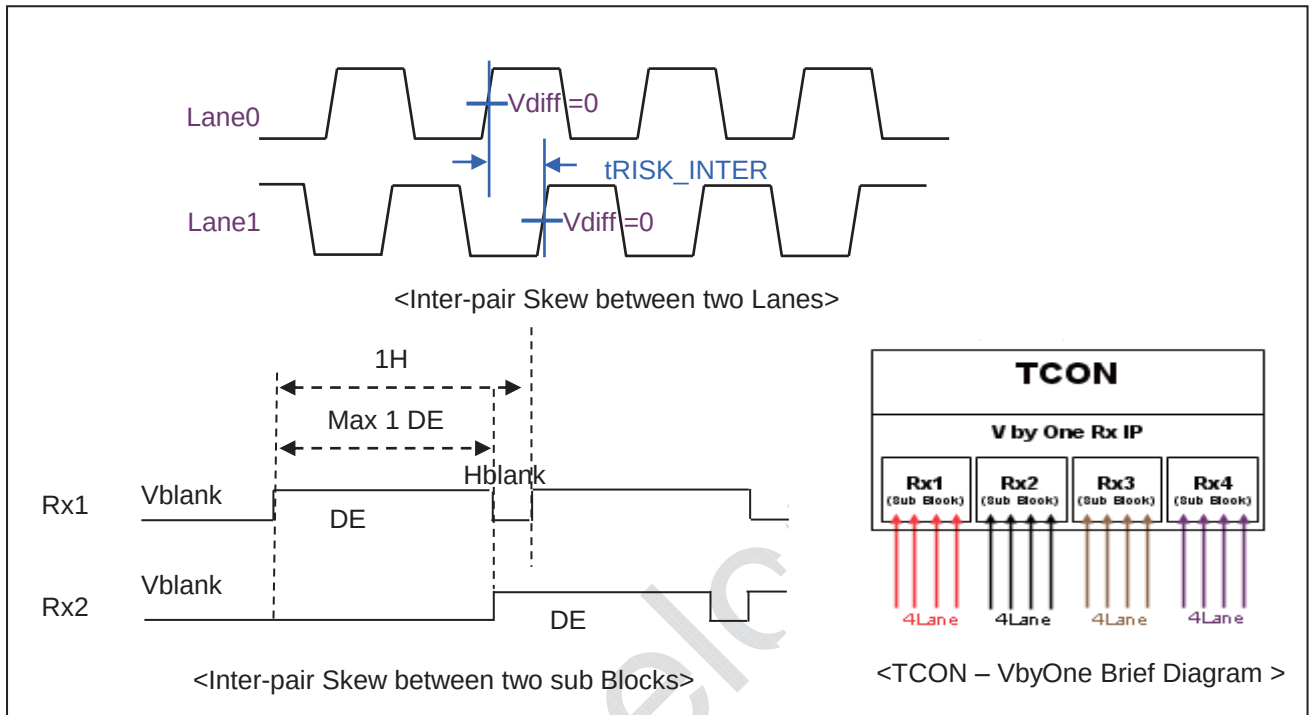
	X[UI]	Note	Y[mV]	Note
A	0.25 (max)	2	0	-
B	0.3 (max)	2	50	3
C	0.7(min)	3	50	3
D	0.75(min)	3	0	-
E	0.7(min)	3	-50	3
F	0.3(max)	2	-50	3

Notes

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

Product Specification

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



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

Notes

- 1.1UI = 1/serial data rate
2. it is the time difference between the true and complementary single-ended signals.
3. it is the time difference of the differential voltage between any two lanes in one sub block.
4. it is the time difference of the differential voltage between any two blocks in one IP.

Product Specification

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]	

Notes 1. 30bpp RGB (10bit) is 4 byte mode, otherwise (24bpp RGB) 3byte mode

Product Specification

3-6. Power Sequence

3-6-1. LCD Driving circuit

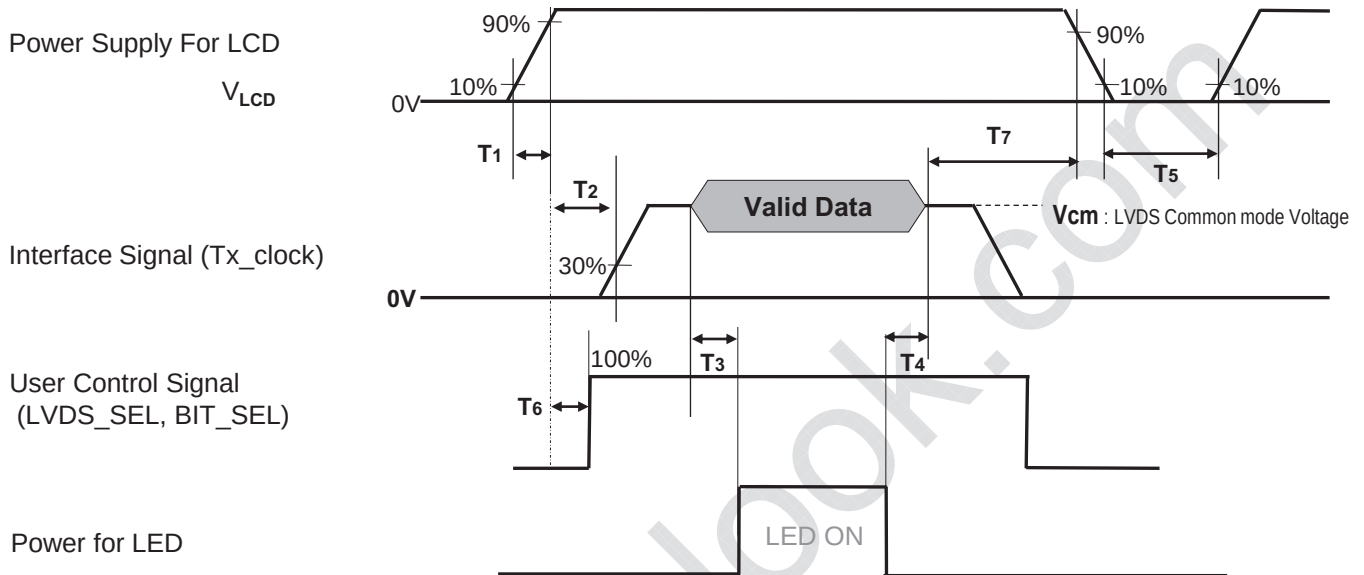


Table 9. POWER SEQUENCE

Parameter	Value			Unit	Note
	Min	Typ	Max		
T1	0.5	-	20	ms	1
T2	100	-	-	ms	2
T3	400	-	-	ms	3
T4	100	-	-	ms	3
T5	1.0	-	-	s	4
T6	0	-	T2	ms	5
T7	0	-	-	ms	6

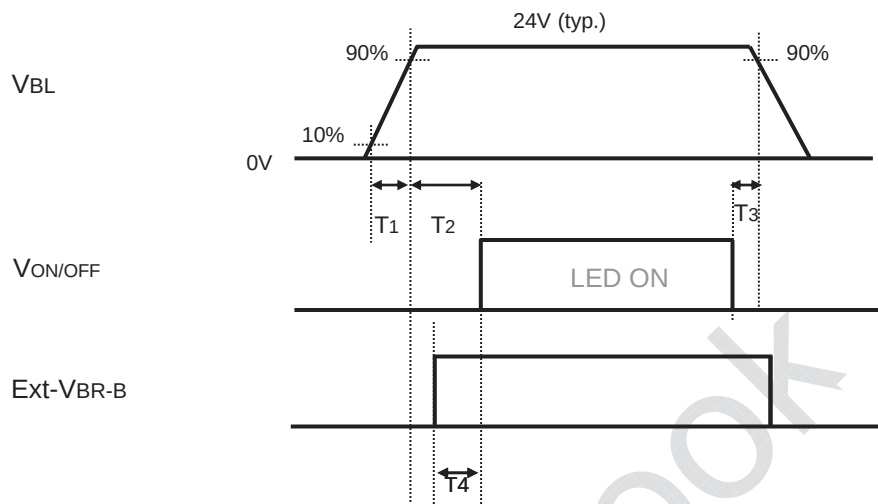
Notes

- Even though T1 is over the specified value, there is no problem if I2T spec of fuse is satisfied.
 - If T2 is satisfied with specification after removing LVDS Cable, there is no problem.
 - 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.
 - T5 should be measured after the Module has been fully discharged between power off and on period.
 - 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.
 - 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.

Product Specification

3-6-2. Sequence for LED Driver

Power Supply For LED Driver



3-6-3. Dip condition for LED Driver

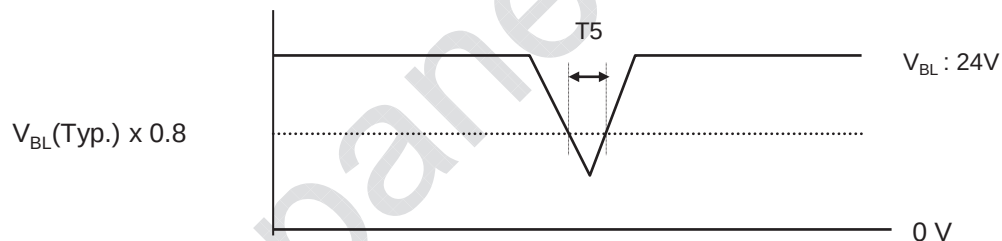


Table 10. Power Sequence for LED Driver

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

Notes

1. T1 describes rising time of 0V to 24V and this parameter does not applied at restarting time.
Even though T1 is over the specified value, there is no problem if I²T spec of fuse is satisfied.

Product Specification

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.

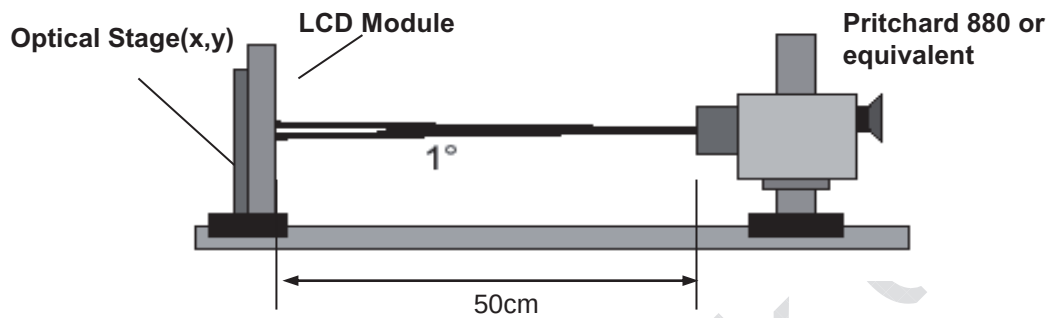


FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 11. OPTICAL CHARACTERISTICS

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

$\text{EXTV}_{\text{BR-B}} = 100\%$

Parameter		Symbol		Value			Unit	notes
				Min.	Typ.	Max.		
Contrast Ratio		CR		900	1300	-		1
Surface Luminance, white		L _{WH}	2D		1000	cd/m	²	2
Luminance Variation		δ _{WHITE}	9P	75			%	3
Response Time	Gray-to-Gray	G to G		-	8	12	ms	4
	Uniformity	G TO G		-	-	1		
Color Coordinates [CIE1931]	RED	Rx		Typ -0.03	0.656	Typ +0.03		
		Ry			0.333			
	GREEN	Gx			0.312			
		Gy			0.597			
	BLUE	Bx			0.151			
		By			0.058			
	WHITE	Wx			0.281			
		Wy			0.288			
Color Temperature					10,000		K	
Color Gamut					72		%	
Viewing Angle (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

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 :
 $\delta \text{ WHITE}(9P) = \text{Minimum (Lon1, Lon2~ Lon8, Lon9)} / \text{Maximum (Lon1, Lon2~ Lon8, Lon9)} * 100$
 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°
 ※ . Gray to Gray / Response time uniformity is Reference data. Appendix VI
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 12.

Table 12. GRAY SCALE SPECIFICATION

Gray Level	Luminance [%] (Typ)
L0	0.077
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.

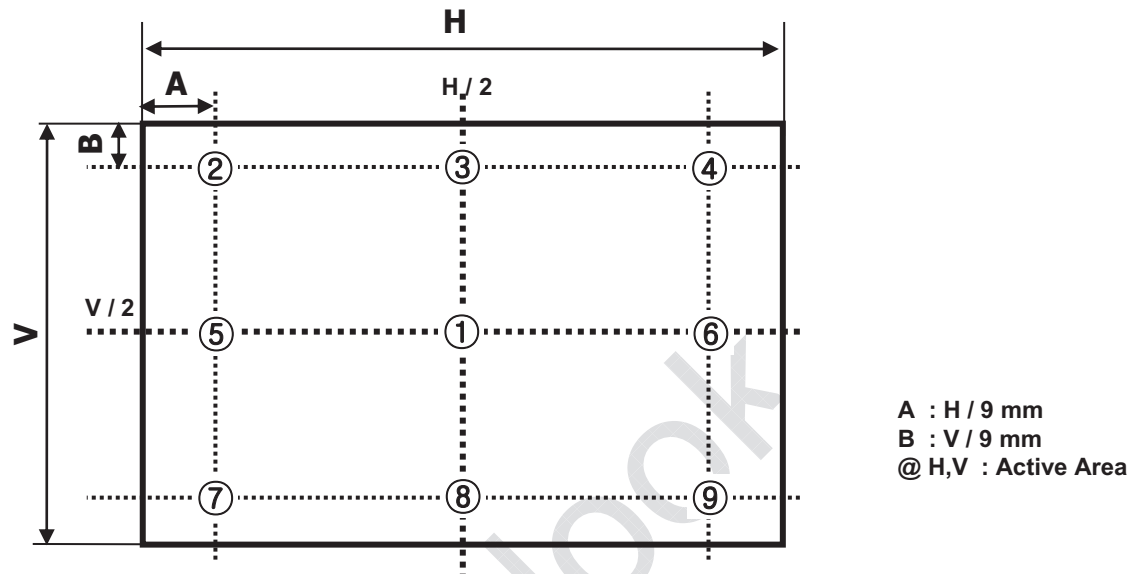


FIG. 2 9 Points for Luminance Measure

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

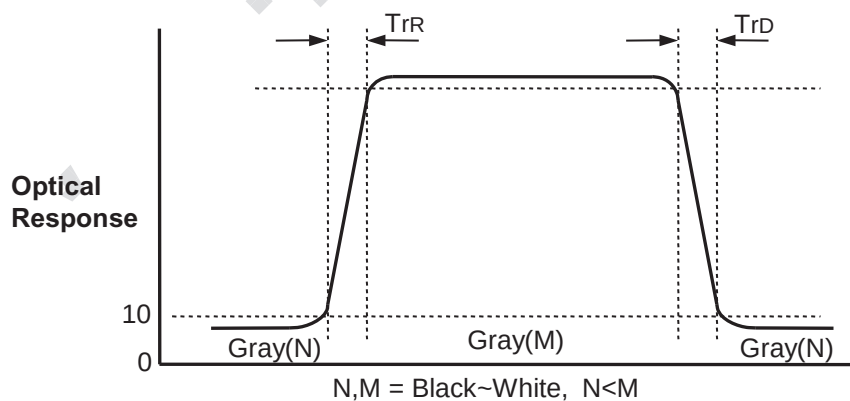


FIG. 3 Response Time

Product Specification

Dimension of viewing angle range

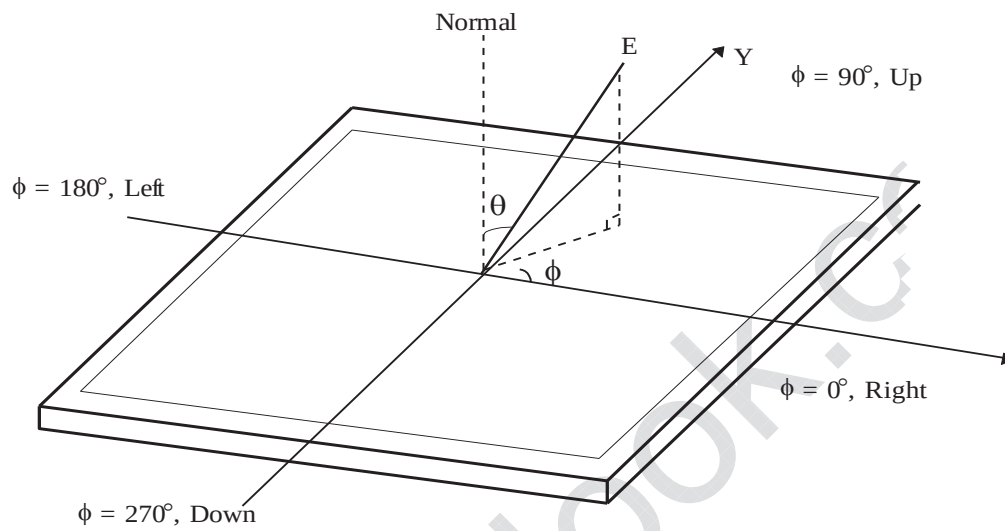
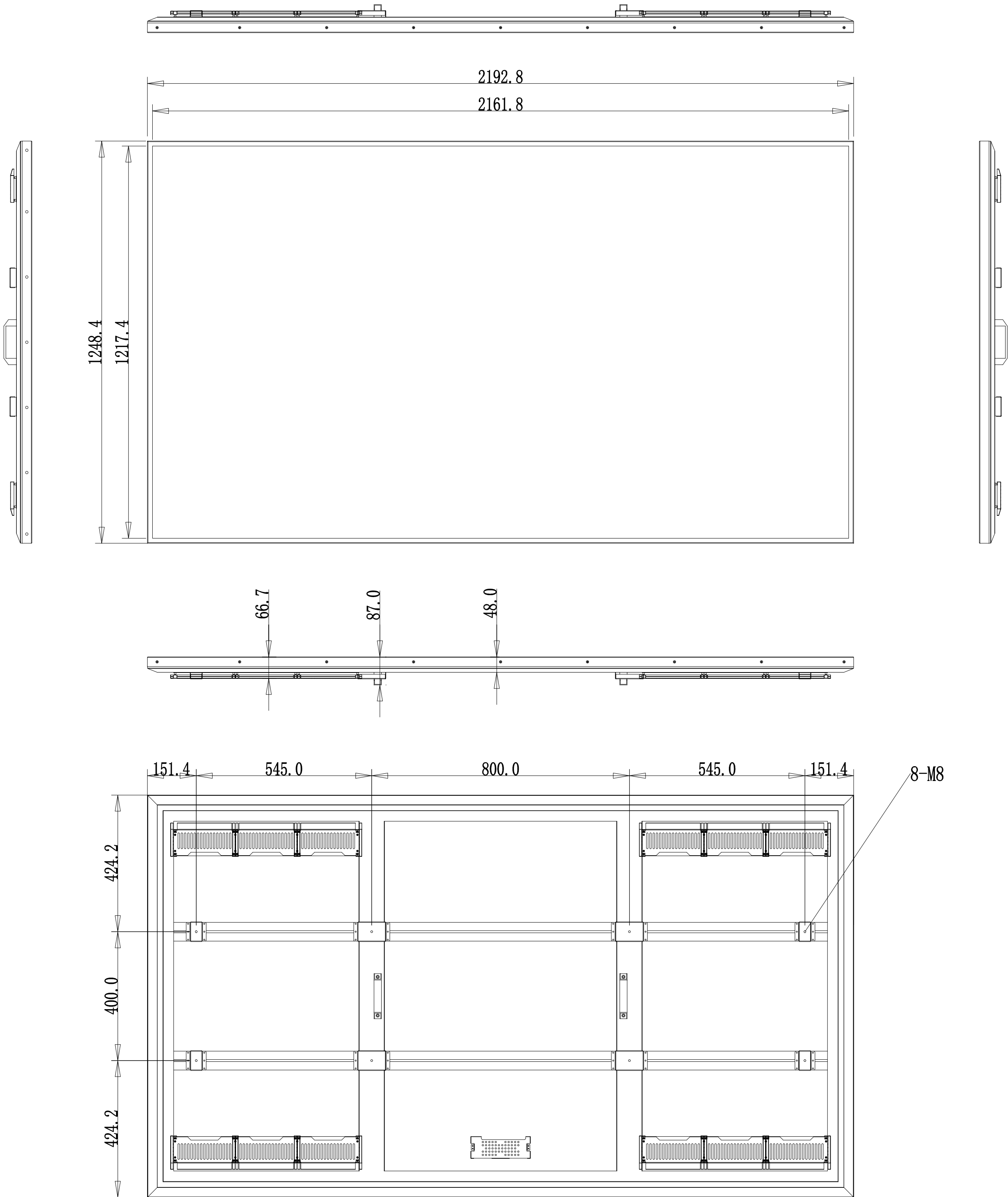
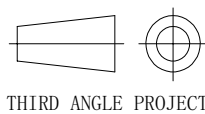


FIG. 4 Viewing Angle



x.	±0.50	 THIRD ANGLE PROJECTION	未标注尺寸以 测量尺寸为准	项目:98寸-显示屏	
. x	±0.30			产品名称: 总装图	
. xx	±0.15	零件图号:		材料:	
. xxx	±0.05	批准:	日期:	工艺:	
x. °	±2.0°	审核:	日期:	单套数量:	
. x °	±1.0°	制图:	日期:	单位: MM	
. xx°	±0.5°	设计:	日期:	比例: 1:1	页数:

Product Specification

5. Mechanical Characteristics

Table 13 provides general mechanical characteristics.

Table 13. MECHANICAL CHARACTERISTICS

Item	Value	
Outline Dimension	Horizontal	2192.8 mm
	Vertical	1248.4mm
	Depth	63.5 mm
Bezel Area	Horizontal	2162.0mm
	Vertical	1217.0 mm
Active Display Area	Horizontal	2158.848mm
	Vertical	1214.352 mm
Weight	56kg (Typ.), 59 kg (Max.)	

Notes

1. Please refer to a mechanical drawing in terms of tolerance at the next page.

Product Specification

6. Reliability**Table 14. 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

Notes

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