CUSTOMER APPROVE

SPECIFICATION

FOR

DOUBLE LIN TFT- LCD MODULE

Edition : Preliminaryspec 1 . 0

Date of issue : 2022-05-03

Product No. :T320HVN05.6

APPROVED	CHECKED	PREPARED
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Revision History

Date	Rev.	Page	Old Description	New Description	Remark
2022-05-03	1.0	All	The specification was first issued		

CONTENTS

1. General Description

This specification applies to the 32” inch wide Color a-Si TFT-LCD Module T320HVN05.6
The display supports the Full HD - 1920(H) x 1080(V) screen format and 16.7M colors (8 bits+Hi-FRC).
The input interface is Dual channel LVDS and this module doesn’t contain an driver board for backlights.

The following items are characteristics summary on the table under 25℃condition:

ITEMS	Unit	SPECIFICATIONS
Screen Dingonal	[mm]	32
Active Area	[mm]	698.4 (H) ×392.85 (V)
Pixels H x V	-	1920 x 3(RGB)×1080
Pixels Pitch	[um]	363.75(per one triad) ×363.75
Pixels Arrangement	-	R.G.B. Vertical Stripe
Display Mode	-	AHVA Mode,Nomrally Black
White Luminance(Center)	[cd/m2]	750 (Typ.)
Contrast Ratio	-	4000 (Typ.)
Response Time	[msec]	8ms (Typ.on/off)
Viewing Angle	[degree]	89/89/89/89
Outline Dimension	[mm]	725.2(H) x 422.7(V) x 14.9(D) (Typ.)
Electrical Interface	-	Dual Channel LVDS
Support Color		16.7M colors
Surface Treatment		SAG25% 3H
Temperature Operating Range Storage(Shipping)	 [oC] [oC]	 0 to +50C -20 to+60C

2. Absolute Maximum Rating

The followings are maximum values which, if exceeded, may cause faulty operation or damage to the unit or the unrecoverable damage on the device.

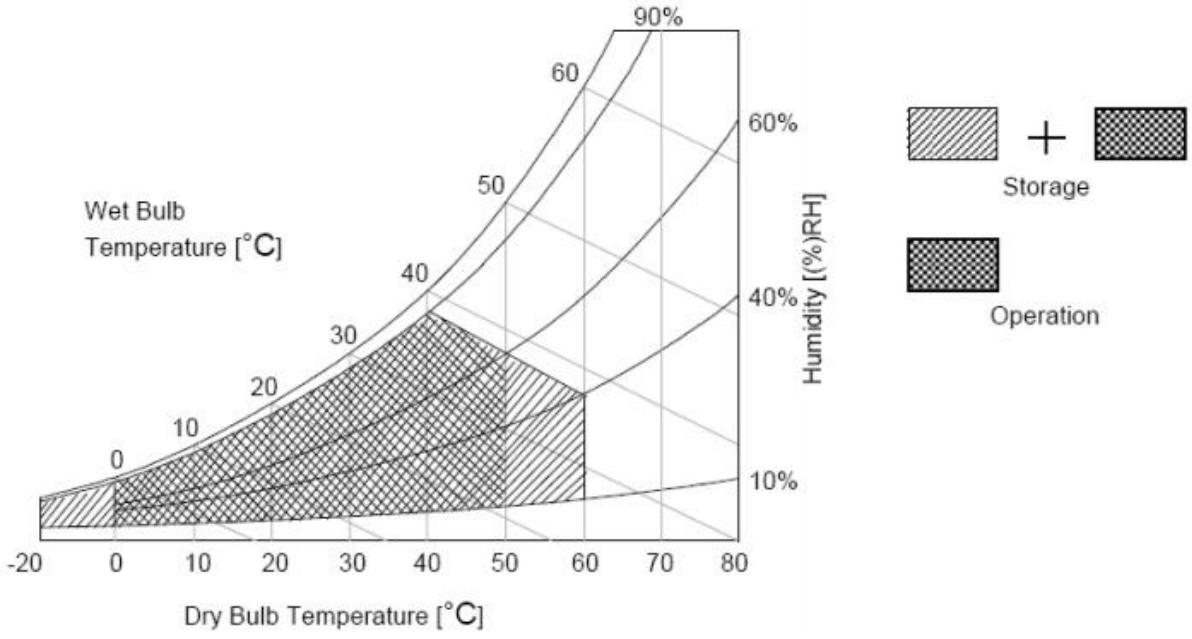
Item	Symbol	Min.	Max.	Unit	Conditions
Logic/LCD Drive Voltage	VDD	-0.3	14	[Volt] DC	Note 1
Input Voltage of Signal	Vin	-0.3	4	[Volt]DC	Note 1
Operating Temperature	TOP	0	+50	[℃]	Note 2
Operating Humidity	HOP	10	90	[%RH]	Note 2
Storage Temperature	TST	-20	+60	[℃]	Note 2
Storage Humidity	HST	10	90	[%RH]	Note 2
Panel Surface Temperature	PST		65	[℃]	Note 3

Note 1: Duration:50 msec.

Note 2: Maximum Wet-Bulb should be 39℃ and No condensation.

The relative humidity must not exceed 90% non-condensing at temperatures of 40℃ or less. At temperatures greater than 40℃, the wet bulb temperature must not exceed 39℃.

Note 3: Surface temperature is measured at 50℃ Dry condition



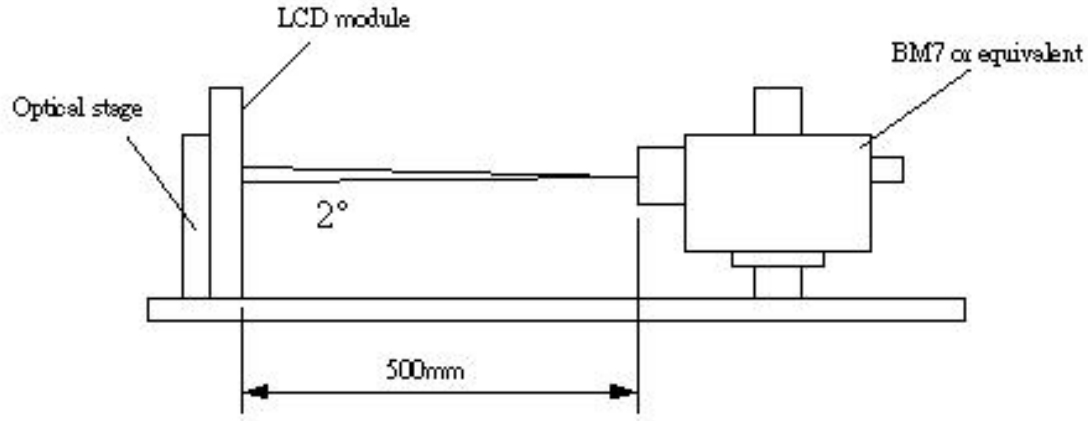
3. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 45 minutes in a

dark environment at 25°C. The values specified are measured on the center of active area and at an approximate

distance 500 mm from the LCD surface at a viewing angle of φ and θ equal to 0°

Fig.1 presents additional information concerning the measurement equipment and method.



Parameter		Symbol	Condition	Values			Unit	Notes
				Min	Typ	Max		
Contrast Ratio		CR	SR3, TRD-100	3000	4000	-		1,2
Response Time (G to G)		Tγ		-	6.5	-	ms	3
Color Chromaticity								4
	Red	Rx	With SR3 Standard light source "C"	Typ.-0.03	0.649	Typ.+0.03		
		Ry			0.342			
	Green	Gx			0.285			
		Gy			0.656			
	Blue	Bx			0.147			
		By			0.070			
	White	Wx			0.275			
		Wy			0.343			
	Viewing Angle		SR3					1,5
	x axis, right(φ=0°)	θr		-	89	-	degree	
	x axis, left(φ=180°)	θl		-	89	-	degree	
	y axis, up(φ=90°)	θu		-	89	-	degree	
	y axis, down (φ=270°)	θd		-	89	-	degree	

1. Light source here is the BLU of AUO module (film structure: two diffuser sheets).
2. Contrast Ratio (CR) is defined mathematically as:

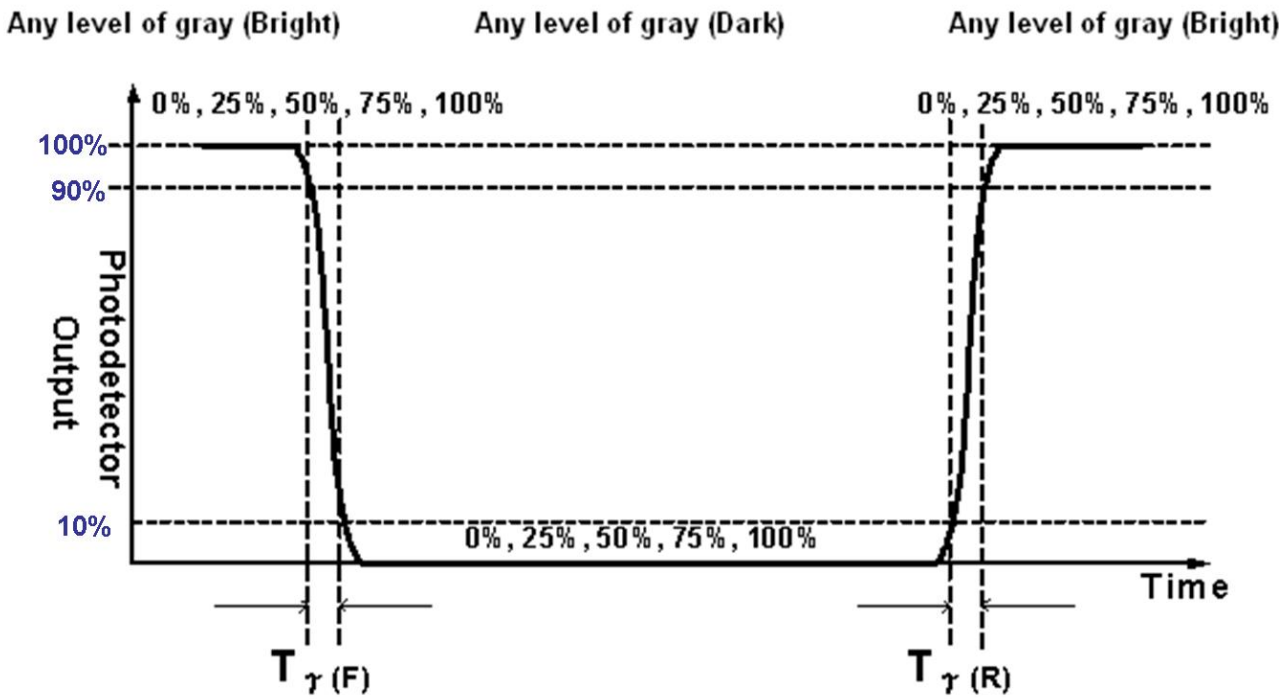
$$\text{Contrast Ratio} = \frac{\text{Surface Luminance at center location of all white pixels}}{\text{Surface Luminance at center location of all black pixels}}$$

3. Response time Tγ is the average time required for display transition by switching the input signal for five luminance ratio (0%,25%,50%,75%,100% brightness matrix) and is based on Frame rate = 60Hz to optimize.

Measured Response Time		Target				
		0%	25%	50%	75%	100%
Start	0%		0% to 25%	0% to 50%	0% to 75%	0% to 100%
	25%	25% to 0%		25% to 50%	25% to 75%	25% to 100%
	50%	50% to 0%	50% to 25%		50% to 75%	50% to 100%
	75%	75% to 0%	75% to 25%	75% to 50%		75% to 100%
	100%	100% to 0%	100% to 25%	100% to 50%	100% to 75%	

Tγ is determined by 10% to 90% brightness difference of rising or falling period. (As illustrated)
The response time is defined as the following figure and shall be measured by switching the input signal for "any level of gray(bright) " and "any level of gray(dark)".

FIG.3 Response Time

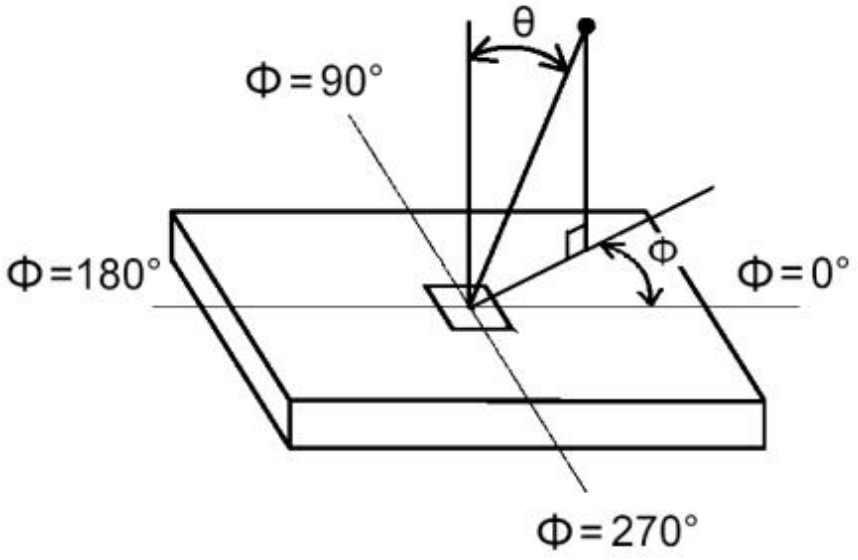


4. Light source here is the standard light source "C" which is defined by CIE and driving voltages are based on suitable gamma voltages. The calculating method is as following：

A. Measure the "Module" and "BLU" optical spectrums (W, R, G, B).
B. Calculate cell spectrum from "Module" and "BLU" spectrums.

C. Calculate color chromaticity by using cell spectrum and the spectrum of standard light source “C”.

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 surface. For more information see FIG4.



4. Interface Specification

4.1 Input power

The T320HVN05.6 Open Cell Unit requires power input which is employed to power the LCD electronics and to drive the TFT array and liquid crystal.

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Input Voltage		V_{DD}	10.8	12.7	14	V	1
Power Supply Input Current	Black pattern	I_{DD}	-	0.29	0.3	A	2
	White pattern		-	0.3	0.31	A	
	H-strip pattern		-	0.45	0.49	A	
Power Consumption	Black pattern	P_C	-	3.81	4.57	Watt	
	White pattern		-	3.94	4.73	Watt	
	H-strip pattern		-	6.22	7.464	Watt	
Inrush Current		I_{RUSH}	-	-	4	A	3

Note1.

The ripple voltage should be fewer than 5% of VDD.

Note2.

Test Condition:

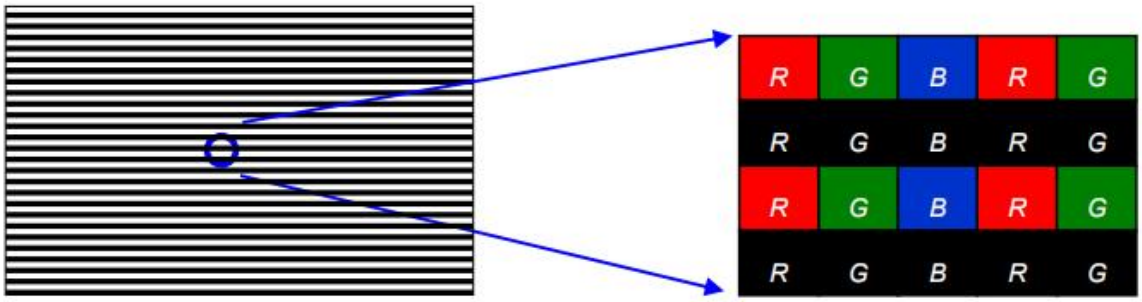
(1) VDD = 12.7V, (2) Fv = 60Hz, (3) Fclk= 74.25MHz, (4) Temperature = 25 ℃

(5) Power dissipation check pattern. (Only for power design)

a. Black pattern

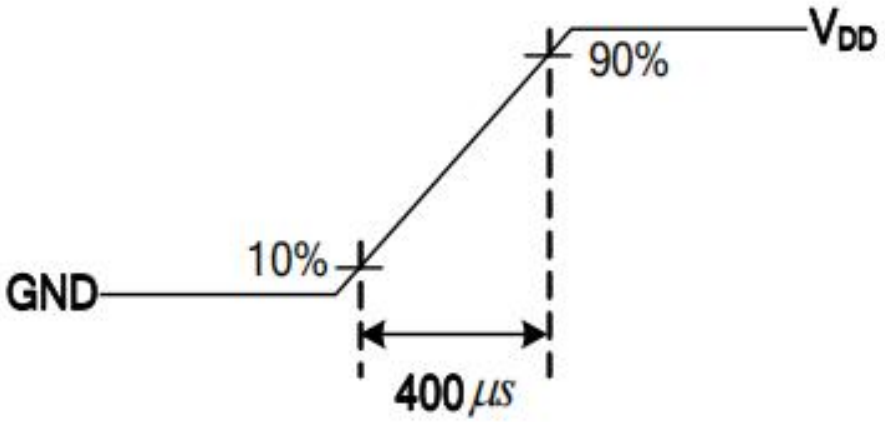
b. White pattern

c. H-Strip pattern



Note3.

Measurement condition : Rising time = 400us

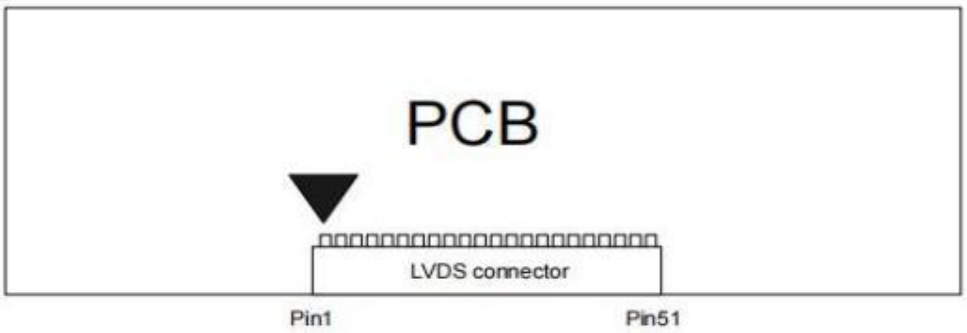


2.2 Interface Connection

LCD connector: JAE FI-RTE51SZ-HF

PIN	Symbol	DESCRIPTION	Note	PIN	Symbol	DESCRIPTION	Note
1	N.C.	No Connection	2	26	GND or N.C.	Ground No Connection	7
2	SCL	I2C Clock	3,4	27	N.C.	No Connection	2
3	WP	Write Protection	3,5	28	CH2 0-	LVDS Channel 2, Signal 0-	
4	SDA	I2C Data	3,4	29	CH2 0+	LVDS Channel 2, Signal 0+	
5	N.C.	No Connection	2	30	CH2 1-	LVDS Channel 2, Signal 1-	
6	RxOIN2-	No Connection	2	31	CH2 1+	LVDS Channel 2, Signal 1+	
7	LVDS SEL	LVDS data format selection	3,6	32	CH2 2-	LVDS Channel 2, Signal 2-	
8	N.C.	No Connection	2	33	CH2 2+	LVDS Channel 2, Signal 2+	
9	N.C.	No Connection	2	34	GND	Ground	
10	N.C.	No Connection	2	35	CH2 CLK-	LVDS Channel 2, Clock -	
1 1	GND	Ground		36	CH2 CLK+	LVDS Channel 2, Clock +	
12	CH1 0-	LVDS Channel 1, Signal 0-		37	GND	Ground	
13	CH1 0+	LVDS Channel 1, Signal 0+		38	CH2 3-	LVDS Channel 2, Signal 3-	
14	CH1 1-	LVDS Channel 1, Signal 1-		39	CH2 3+	LVDS Channel 2, Signal 3+	
15	CH1 1-	LVDS Channel 1, Signal 1+		40	N.C.	No Connection	2
16	CH1 2-	LVDS Channel 2, Signal 1-		41	N.C.	No Connection	2
17	CH1 2+	LVDS Channel 1, Signal 2+		42	GND	Ground	
18	GND	Ground		43	GND	Ground	
19	CH1 CLK-	LVDS Channel 1, Clock -		44	GND	Ground	
20	CH1 CLK+	LVDS Channel 1, Clock +		45	GND	Ground	
21	GND	Ground		46	GND	Ground	
22	CH1 3-	LVDS Channel 1, Signal 3-		47	N.C.	No Connection	2
23	CH1 3+	LVDS Channel 1, Signal 3+		48	VDD	Power Supply Input Voltage	
24	N.C.	No Connection	2	49	VDD	Power Supply Input Voltage	
25	N.C.	No Connection	2	50	VDD	Power Supply Input Voltage	
				51	VDD	Power Supply Input Voltage	

Note1. Pin number start from the left side as the following figure.



Note2. Please leave this pin unoccupied.It can not be connected by any signal(Low/GND/High).

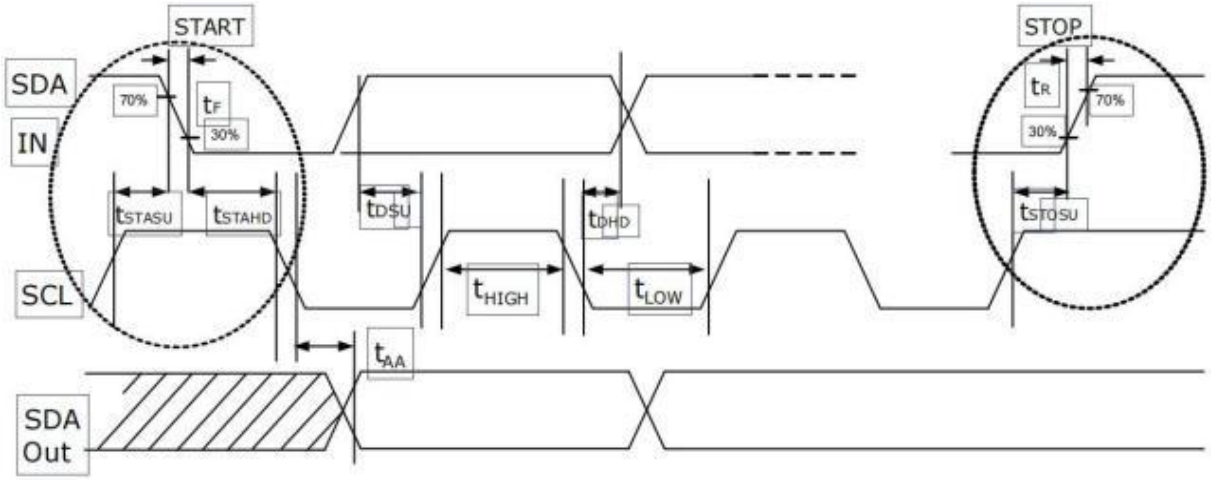
Note3. Input control signal threshold voltage definition

Item	Symbol	Min.	Typ.	Max.	Unit
Input High Threshold Voltage	VIH	2.7	-	3.6	V
Input Low Threshold Voltage	VIL	0	-	0.6	V

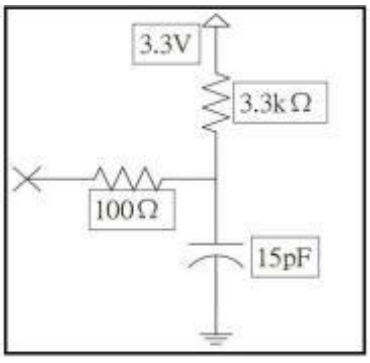
Note4. I2C Data and Clock

I2C Data and Clock timing

Parameter		Symbol	Min	Typ	Max	Unit
I2C	SCL clock frequency	fSCL	-	-	350	kHZ
	Clock Pulse Width Low	tLOW	1 85	-	-	us
	Clock Pulse Width High	tHIGH	0 4	-	-	us
	Clock Low to Data Output Valid	tAA	1 76	-	-	us
	Start Setup Time	tSTASU	0 6	-	-	us
	Start Hold Time	tSTAHD	0 6	-	-	us
	Stop Setup Time	tSTOSU	0 6	-	-	us
	Data In Setup Time	tDSU	0.1	-	-	us
	Data In Hold Time	tDHD	0	-	-	us
	SCL/SDA Rise Time	tR	-	-	0 3	us
	SCL/SDA Fall Time	tF	-	-	0.3	us



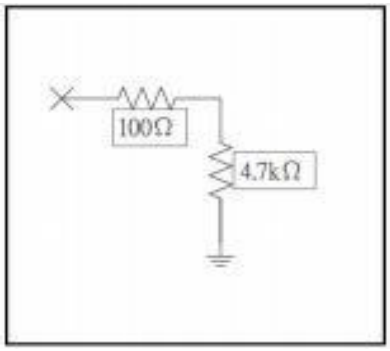
Input equivalent impedance of SDA/SCL pin



Note5. Write Protection
Mode selection

WP	Note
L or OPEN	Protection
H	Writable

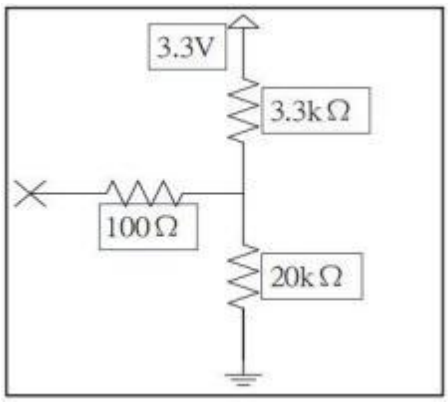
Input equivalent impedance of WP pin



Note6. LVDS data format selection

LVDS_SEL	Mode
H or OPEN	NS
L	Jeida

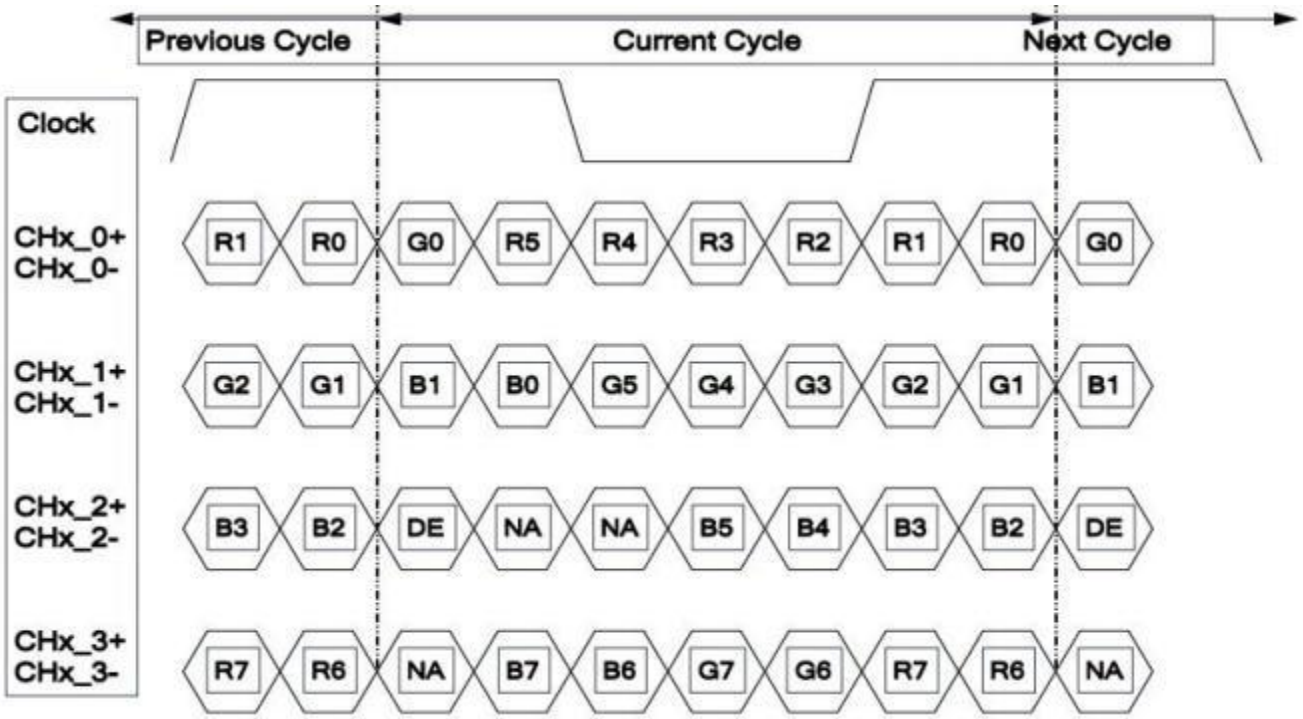
Input equivalent impedance of LVDE_SEL pin



Note7.Please leave this pin unoccupied or connect to ground.It can not be connected by any signal (Low/High).

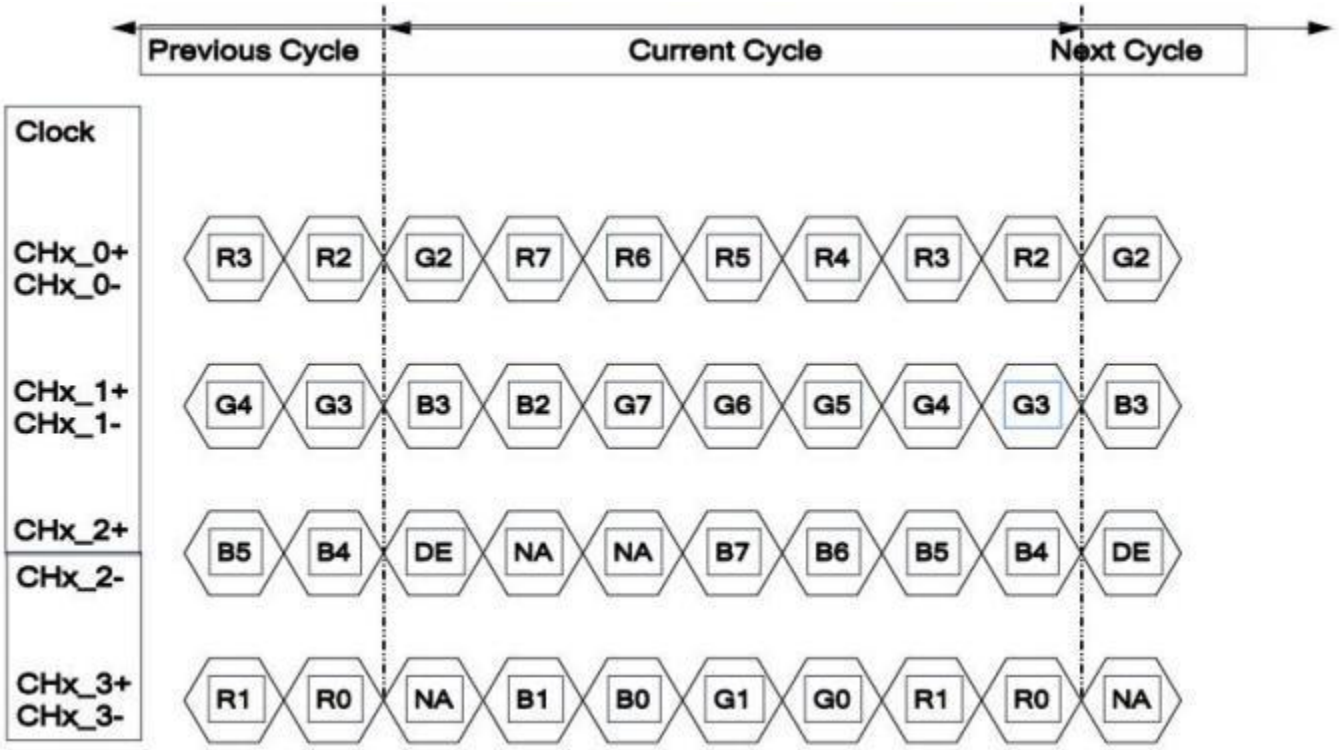
4.3 Input Data Format

4.3.1LVDS Option NS



Note :x= 1,2,3,4.....

LVDS Option JEIDA



Note: x = 1,2,3,4...

4.3.2 Color Input Data Reference

The brightness of each primary color (red, green and blue) is based on the 8bit gray scale data input for the color; the h igher the binary input, the brighter the color. The table below provides a reference for color versus data input.

COLOR DATA REFERENCE

Color		Input Color Data																									
		RED								GREEN								BLUE									
		MSB							LSB	MSB							LSB	MSB							LSB		
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0		
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0		
	Cyan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1		
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1		
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0		
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
R	RED(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	RED(001)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

	RED(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
G	Green(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Green(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		

	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0		
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0		
B	BLUE(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	BLUE(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		

	BLUE(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0		
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1		

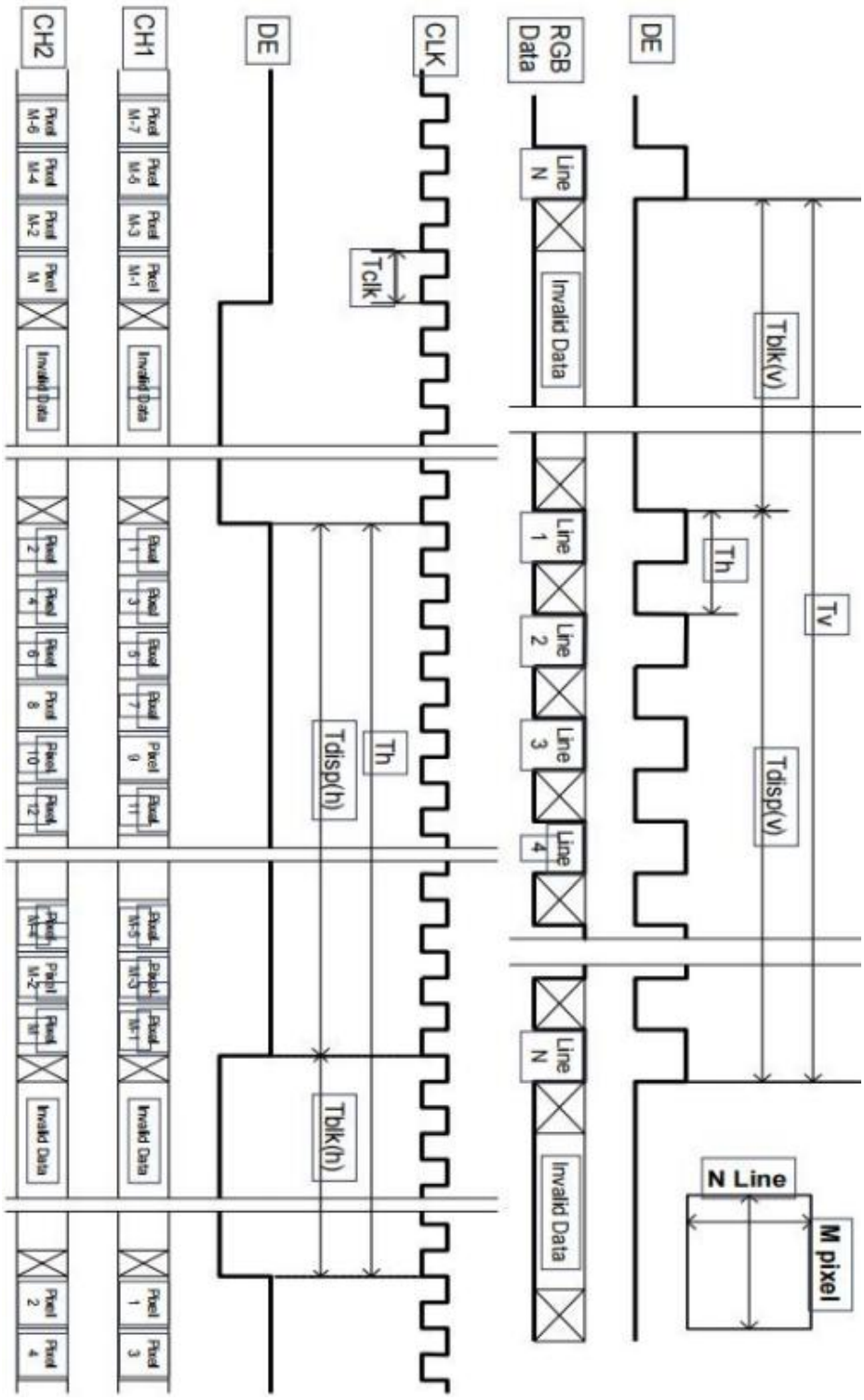
5. Signal Timing Specification

5.1 Input Timing

This is the signa timing required at the input of the user connector.All of the interface signal timing should be satisfied with the following specifications for its proper operation

Timing Table(DE only Mode)

S ignal	Ltem	Symbol	M i n .	Typ .	Max	Unit
Vertical Section	Period	Tv	1100	1125	1480	Th
	Active	Tdisp(v)		1080		
	Blanking	Tblk(v)	20	45	400	Th
Horizontal Section	Period	Th	1030	1100	1325	Tclk
	Active	T disp(h)		960		
	Blanking	Tblk(h)	70	140	365	Tclk
C l ock	Frequency	Fclk= 1/ Tcl	53	74 . 25	82	Tclk
Vertical Frequency	Frequency	Fv	47	60	63	Hz
Horizontal Frequency	Frequency	Fh	60	67 . 5	73	KHz



Note1.Display position is specific by the rise of DE signal only.
Horizontal display position is specified by the rising edge of 1st DCLK after the rise of 1st DE,is displayed on the left edge of the screen.

Note2.Vertical display positiong is specified by the rise of DE after a“Low”level period equivalent to eight time of horizontal period.The 1st data corresponding to one horizontal line after the rise of 1st DE is displayed at the top line of screen

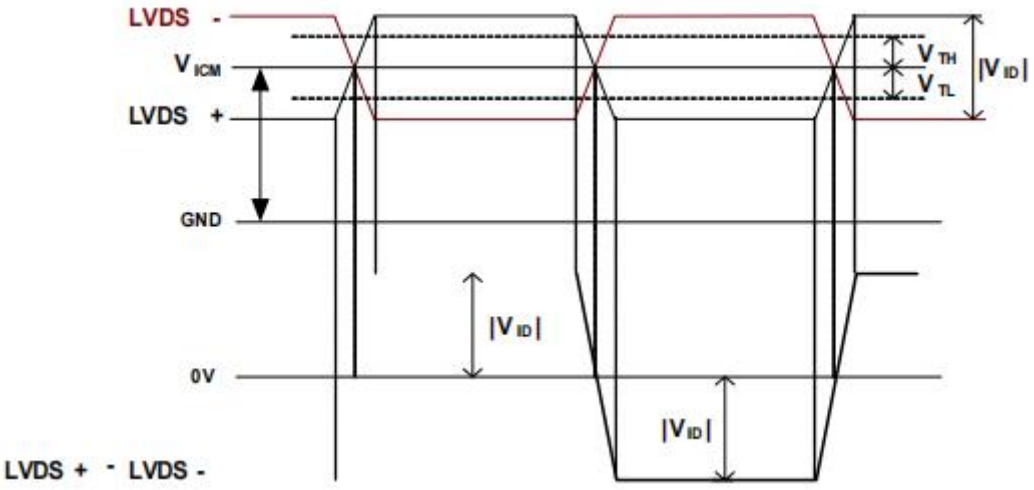
Note3.If a period of DE“High”is less than 1920 DCLK or less than 1080 lines,the rest of the screen displays black.

Note4.The display position does not fit to the screen if a period of DE“High”and the effective data period do not synchronize with each other.

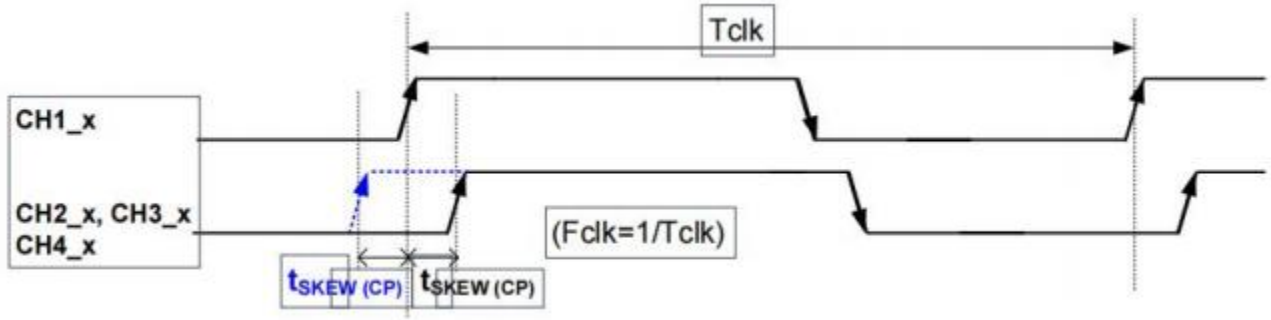
5.2 LVDS spec

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max		
LVDS Interface	Input Differential Voltage	| VID |	200	400	600	VDC m	1
	Differential Input High Threshold Voltage	VTH	+ 100	--	+300	VDC m	1
	Differential Input Low Threshold Voltage	VTL	-300	--	- 100	VDC m	1
	Input Common Mode Voltage	VICM	1.1	1.25	1.4	VDC	1
	Input Channel Pair Skew Margin	tSKEW(CP)	-500	--	+500	ps	2
	Receiver Clock:Spread Spectrum Modulation range	Fclk_ss	Fclk -3%	--	Fclk +3%	MHz	3
	Receiver Clock : Spread Spectrum Modulation frequency	Fss	30	--	200	KHz	3
	Receiver Data Input Margin Fclk = 85 MHz Fclk = 65 MHz	RMGt	-0.4 -0 5	-- --	0.4 0 5	ns	4

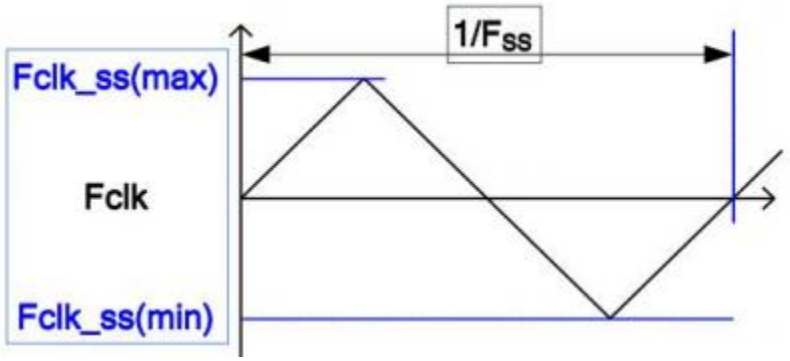
Note1. VICM = 1.25V



Note2. Input Channel Pair Skew Margin

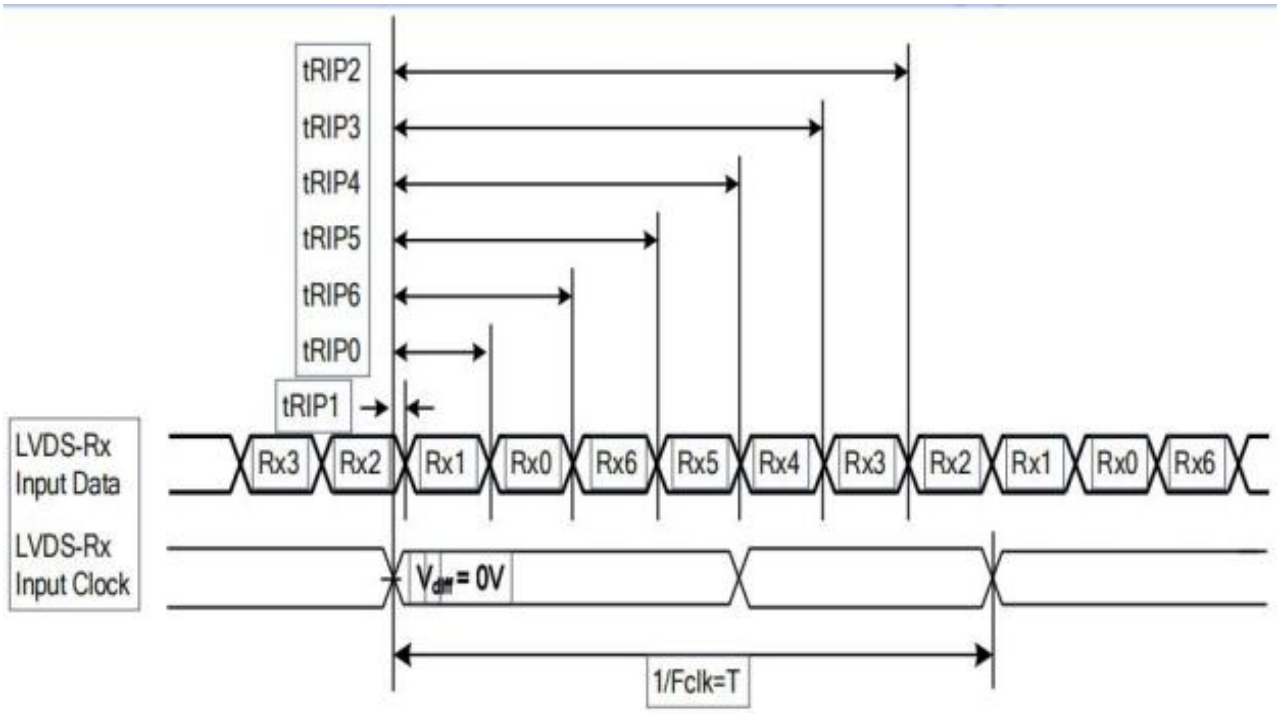


Note3. LVDS Receiver Clock SSCG (Spread spectrum clock generator) is defined as below figures .

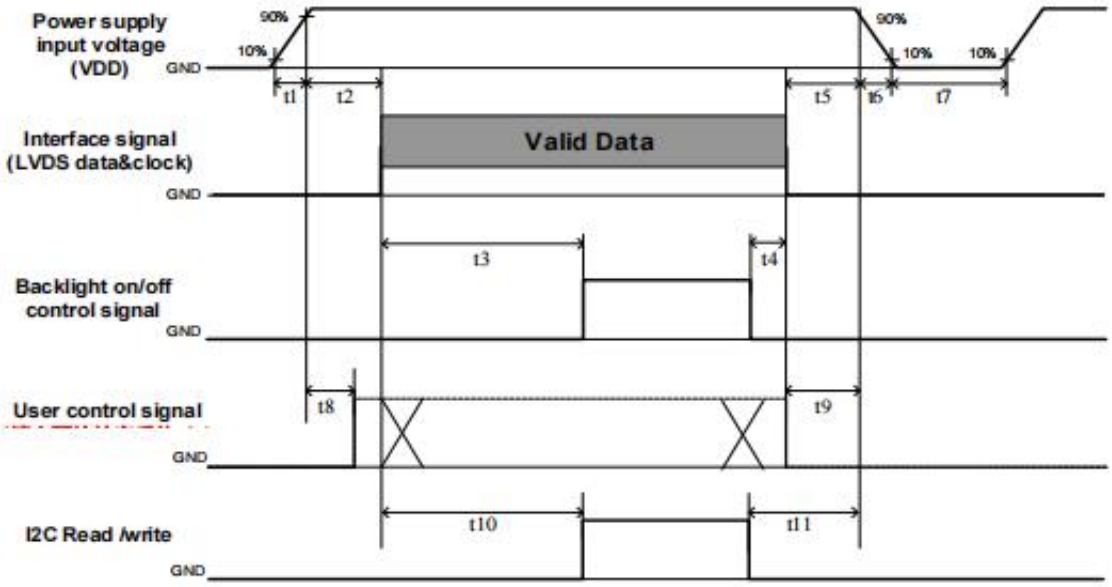


Note4. Receiver Data Input Margin

Parameter	Symbol	Rating			Unit	Note
		Min	Type	Fclk (max)		
Input Clock Frequency	Fclk	Fclk (min)	--	Fclk (max)	MHz	T= 1/Fclk
Input Data Position0	tRIP1	-|tRMG|	0	|tRMG|	ns	
Input Data Position1	tRIP0	T/7-|tRMG|	T/7	T/7+|tRMG|	ns	
Input Data Position2	tRIP6	2T/7-|tRMG|	2T/7	2T/7+|tRMG|	ns	
Input Data Position3	tRIP5	3T/7-|tRMG|	3T/7	3T/7+|tRMG|	ns	
Input Data Position4	tRIP4	4T/7-|tRMG|	4T/7	4T/7+|tRMG|	ns	
Input Data Position5	tRIP3	5T/7-|tRMG|	5T/7	5T/7+|tRMG|	ns	
Input Data Position6	tRIP2	6T/7-|tRMG|	6T/7	6T/7+|tRMG|	ns	



5.3 Power Sequence for LCD



Parameter	Values			Unit
	Min.	Type.	Max.	
T1	0.4	-	30	ms
T2	0.1	-	1500	ms
T3	400	-	-	ms
T4	0*1	-	-	ms
T5	0	-	-	ms
T6	-	-	-*2	ms
T7	1000*3	-	-	ms
T8	20*4	-	50	ms
T9	0	-	-	ms
T10	400	-	-	ms
T11	150	-	-	ms

Note:

(1) t4=0 : concern for residual pattern before BLU turn off.

(2) t6 : voltage of VDD must decay smoothly after power-off. (customer system decide this value)

(3) t7 : When the power supply input voltage(VDD) is off, be sure to pull down the valid and invalid data to 0V.

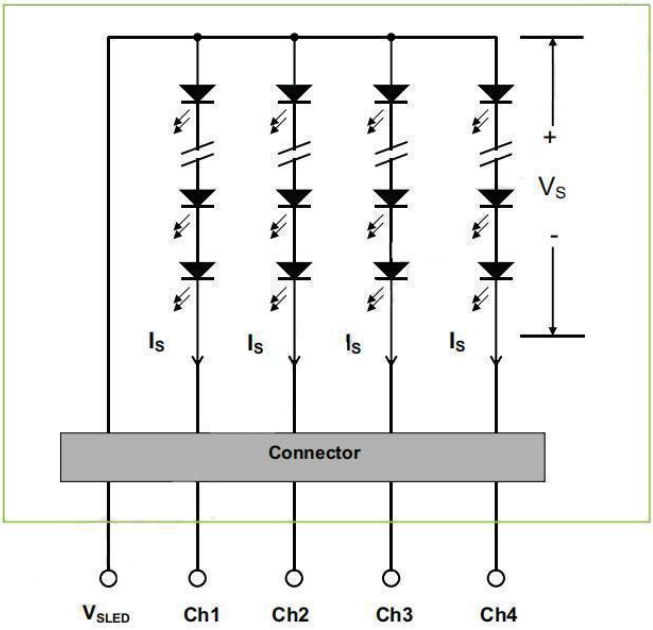
(4) When user control signal is N.C. (no connection), opened in Transmitted end, t8 & t9 timing spec can be negligible.

(5) If there is some dip from 12V, module can't guarantee any problem.

6. Backlight Unit

6.1 Block Diagram

it includes 90(7020)pcs LED in the LED light bar.(9 strings and 10 pcs LED one string).



6.2 Recommednded Operating Condition

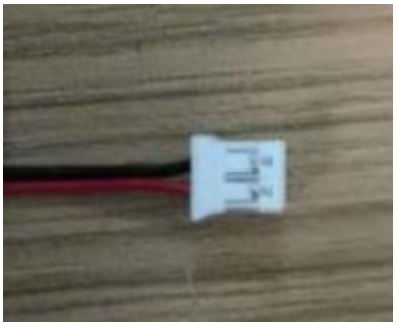
(Ta=25C)

Item	Symbol	Min.	Typ.	Max.	Unit
LED operation Voltage	V led	52.2	-	55.8	V
LED operation Curent	I led	-	700	-	mA
BackLinght Power	P_{BL}	36.54	-	39.06	W
Lumi nance	L	600	750		nit
LED Life Time		30000			Hrs
Luminance uniformity	△L	75	80		%

6.3 Backlight Electrical / Optical Characteristics

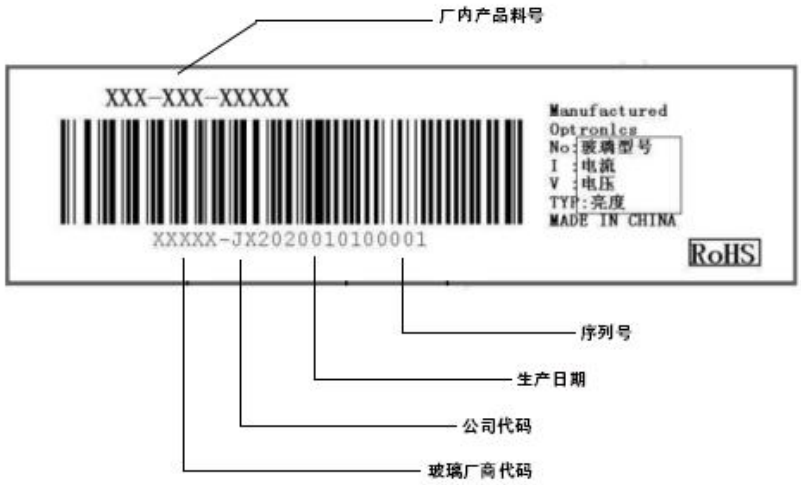
connector CN2 : PH-2P *2

Pin	Signal Name
1	VDD- (Black)
2	VDD+ (Red)

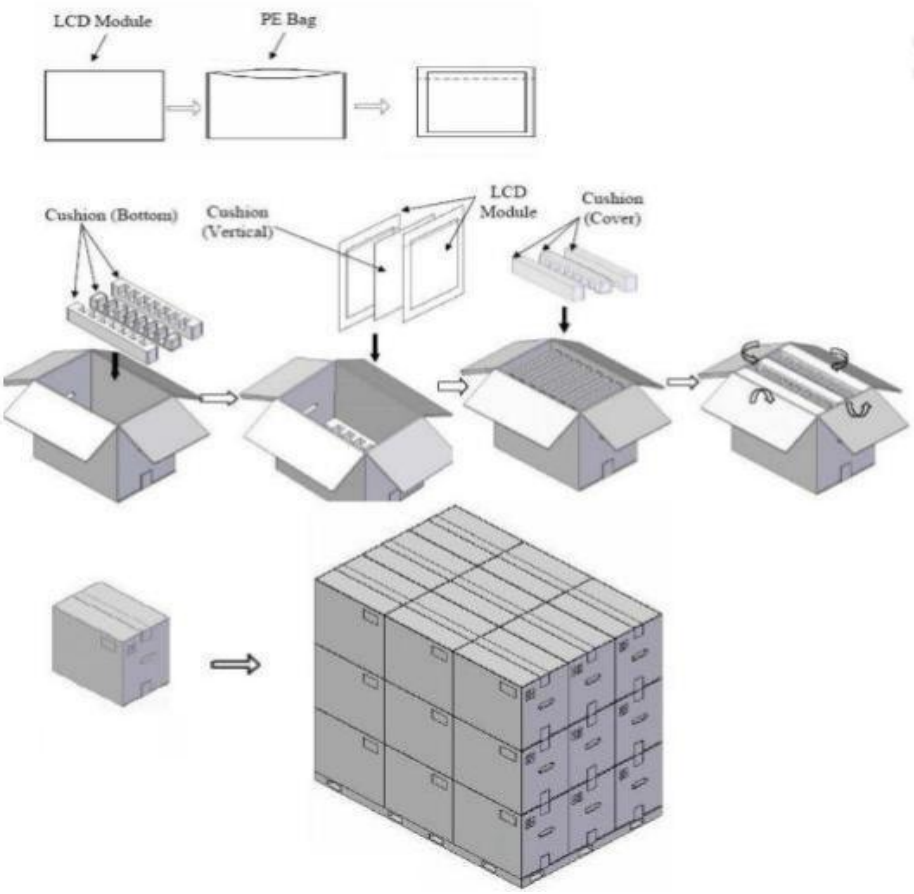


7. Shipping Label

The label is on the panel as shown below



Parameter	Packing box	Unit
Size	810(L) x230(W) x480(H) (typ.)	mm
Weight	3.88typ.)	Kg
Total weight	15.52 (typ.) (with 4 products)	Kg



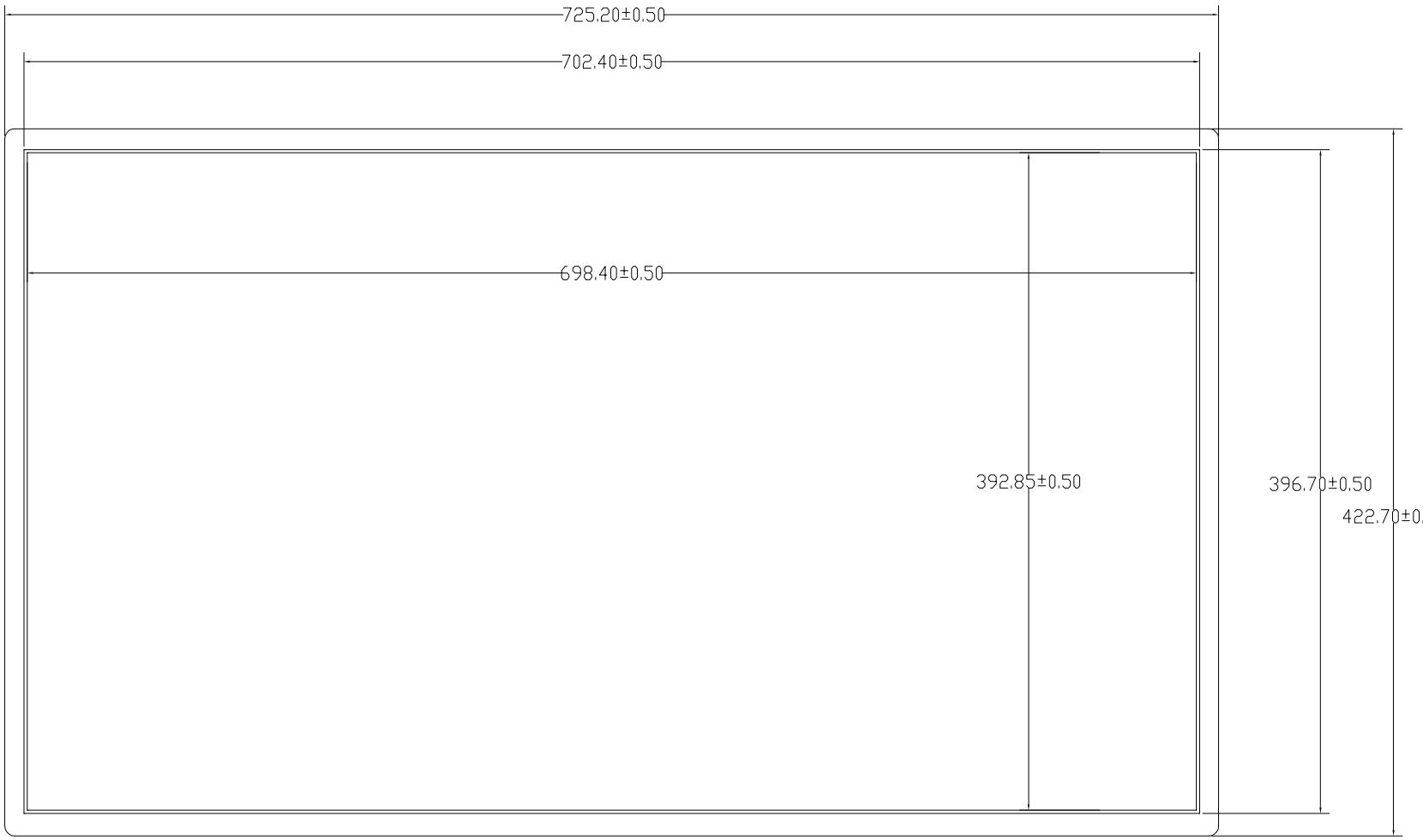
8. Precaution

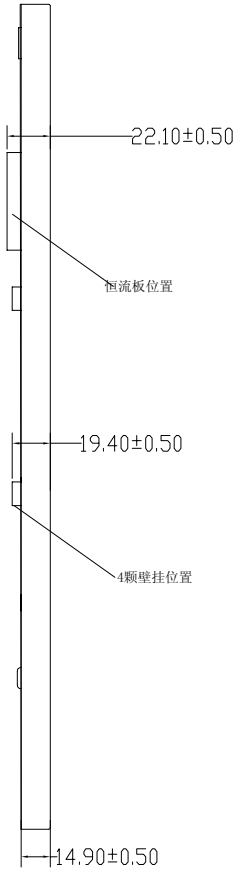
8.1 Assembly and handling precautions

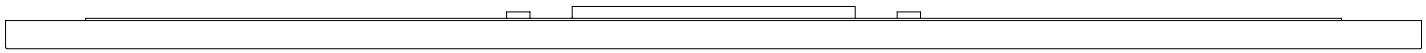
1. Do not apply rough force such as bending or twisting to the module during assembly.
2. To assemble or install module into user' s system can be in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
3. It' s not permitted to have pressure or impulse on the module because the LCD panel and Bac- klight will will be damaged.
4. Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch- up.
5. Do not pull the I/ F connector in or out while the module is operating . 6 6 . Do not disassemble themodule.
   Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very
6. soft and easily scratched.
7. It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
8. High temperature or humidity may reduce the performance of module. Please store LCD mo- dule within the specified storage conditions.
9. When ambient temperature is lower than 10 C may reduce the display quality. For example, the response time will become slowly.

8.2 Safety precautions

1. It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
2. If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth, in case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
3. After the modlule's end of life, it is not harmful in case of normal operation and stora.







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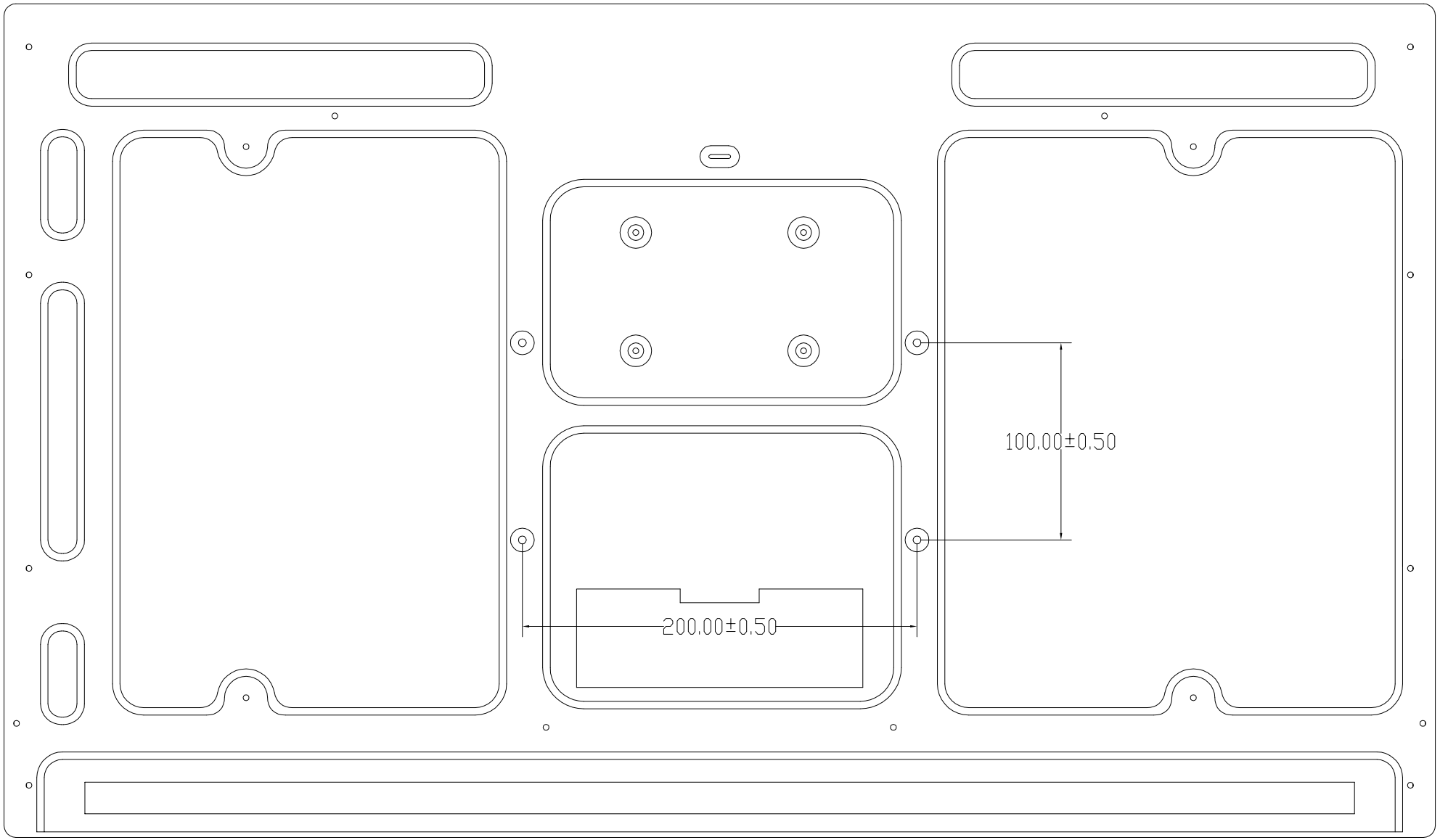

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