MODEL: SG2381B02-2

Ver. 2.1

Date: 2023.01.06

( ) Preliminary Specification
(√) Approval Specification

Customer's Approval	**CSOT**
Signature Date	Approved By Product Director Date Name: Dan Cao Signature:
	Reviewed By PM Manager Date Name: Xuetao Cai Signature:
	Reviewed By Project Leader Date Name: Wei Xiao Signature:
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Revision History

Version	Date	Page (New)	Section	Description	Revision by
Ver. 2.1	2022.10.03	All	All	Tentative Specification was First Issued	Wei Xiao
Ver. 2.1	2022.11.04	23	7.1	Mechanical Specification update	Wang Xin
Ver. 2.1	2023.01.06	All	All	Final Specification released	Wei Xiao

Contents

1. General Description

1.1 Overview

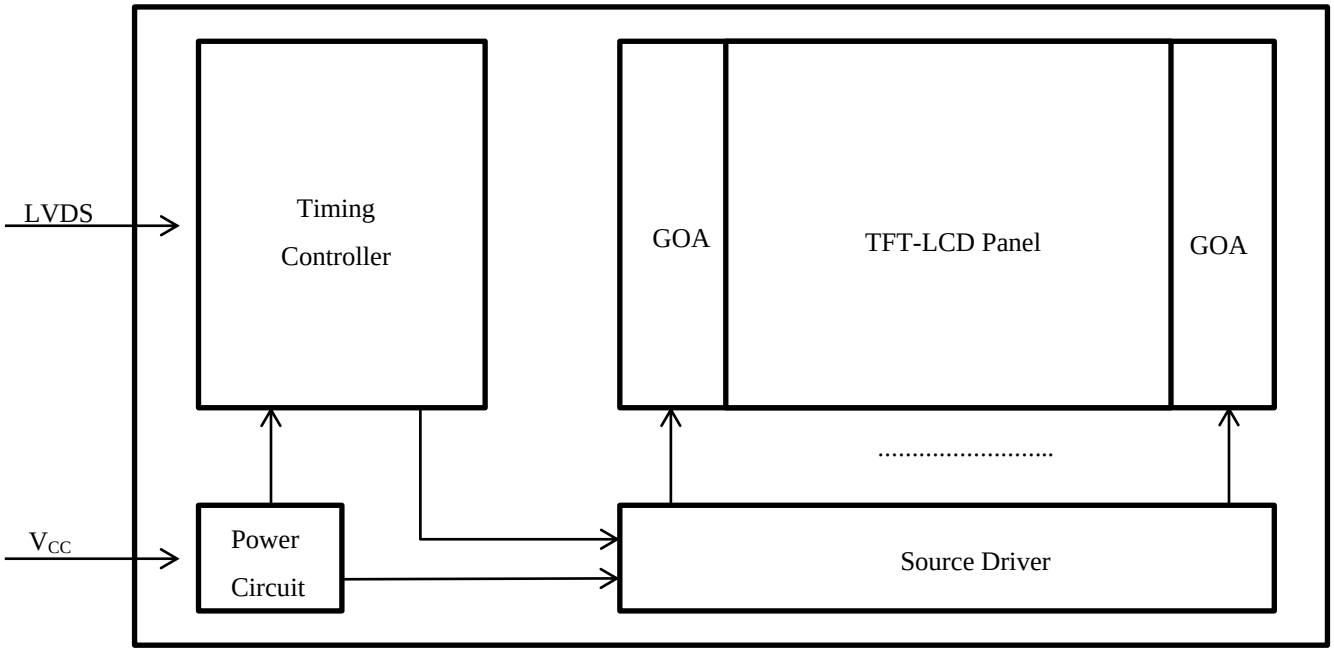
SG2381B02-2 is a diagonal 23.8" color active matrix LCD open cell with 2 Channel LVDS interface. This open cell is a transmissive type display operating in the normally black mode. It supports 1920 x1080 FHD resolution and can display up to 16.7M colors (6bit +FRC). Each pixel is divided into Red, Green and Blue sub-pixels which are arranged in vertical stripe. There is no backlight built-in.

This open cell dedicates for LCD Monitor products and provides excellent performance which includes high transmittance, ultra wide viewing angle and high color depth. CSOT open cell comply with RoHS for identification.

1.2 General Information

Item	Specification	Unit	Note
Active Area	527.04 (H) × 296.46 (V)	mm	
Cell Size	534.04 (H) * 307.76 (V) * 1.3 (D)	mm	
Weight	0.505	kg	Typ.
Driving Scheme	a-Si TFT Active Matrix	-	
Number of Pixels	1920 × 1080	pixel	
Pixel Pitch(Sub Pixel)	0.0915 (H) × 0.2745 (V)	mm	
Pixel Arrangement	RGB Vertical Stripe	-	
Display Colors	16.7 M	color	8 Bit (6 bit+FRC)
Display Mode	Transmissive Mode, Normally Black	-	
Glass thickness (Array / CF)	0.5/0.5	mm	
Color Chromaticity	R (0.649, 0.341) G (0.320, 0.622) B (0.150, 0.063) W (0.304, 0.324)	-	Typical value measured with CSOT's Flat Backlight at refresh rate F_R = 60Hz. (Wx= 0.289, Wy= 0.272)
Contrast Ratio	1000(Typ.)	-	
Cell Transmittance	4.8% (Typ.)	%	
View Angle (CR>10)	±89 (H), ±89 (V) (Typ.)	-	
Polarizer (CF side)	Anti-glare, Haze 25%, Hard Coating (3H)	-	
Interface	LVDS		
Mode	DE（Data Enable）		

1.3 Block Diagram



2. Absolute Maximum Ratings

2.1 Absolute Maximum Ratings

The followings are maximum values which, if exceeded, may cause damage to the unit.

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V_{CC}	-0.3	5.75	V	Ta=25℃
Input Signal Voltage	V_{IN}	-0.3	3.6	V	
Operating Temperature	T_{OP}	0	+50	℃	
Storage Temperature	T_{ST}	-20	+60	℃	

2.2 Environment Requirement

(1) Temperature and relative humidity range are shown as below.

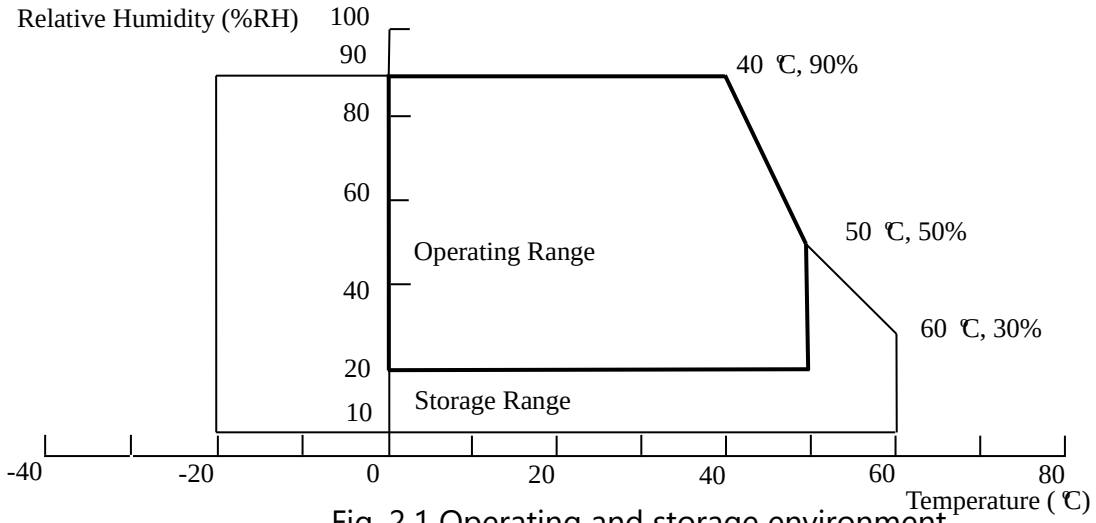


Fig. 2.1 Operating and storage environment

(a) 90%RH maximum (TA < 40 ºC).

(b) Wet-bulb temperature should be 39 ºC maximum.

(c) No condensation.

(2) The storage temperature is between - 20 ºC to 60 ºC, and the operating ambient temperature is between 0 ºC to 50 ºC.The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 65 ºC with LCD module in a temperature controlled chamber alone. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 65 ºC. The range of operating temperature may degrade in case of improper thermal management in the end product design.

(3) The rating of environment is based on LCD module. Leave LCD cell alone, this environment condition can't be guaranteed. Except LCD cell, the customer has to consider the ability of other parts of LCD module and LCD module process.

2.3 Package Storage

When storing open cell as spares for a long time, please follow the precaution instructions:

(1) Do not store the open cell in high temperature and high humidity for a long time. It is highly recommended to store the open cell with temperature from5ºC ~ 40ºC and humidity from 35%RH~75%RH with shipping package.

(2)The open cell should be keep at a circumstance shown below:

0-2months	2-3months	3-6months
No baking	50℃、10%RH，24hr	50℃、10%RH，48hr

3. Electrical Specification

3.1 Open Cell Power Consumption (TA = 25 ± 2 °C)

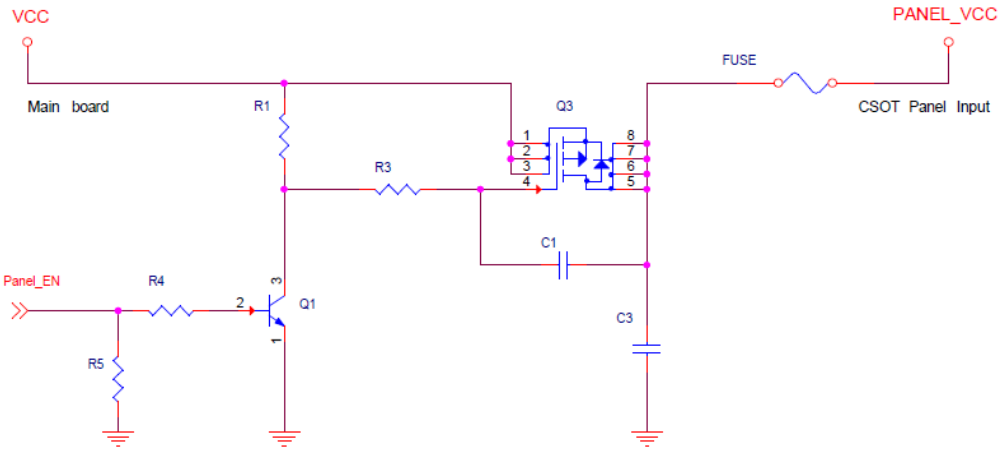
Parameter		Symbol	Value			Unit	Note	
			Min.	Typ.	Max.			
Power Supply Voltage		V_{CC}	4.5	5	5.5	Vdc	-	
Permissive Input Ripple Voltage		V_{RIPPLE}	-	-	500	mVp-p	(1)	
Rush Current		I_{RUSH}	-	-	3	A	(2)	
Power Supply Current	White Pattern	I_{CC}	-	0.43	0.52	A	60Hz	(3)
	Horizontal Stripe		-	0.61	0.73	A		
	Black Pattern			0.43	0.52	A		
	Mosaic Pattern(8*8)		-	0.43	0.52	A		
	White Pattern		-	0.47	0.56	A	75Hz	
	Horizontal Stripe		-	0.70	0.84	A		
	Black Pattern		-	0.47	0.56	A		
	Mosaic Pattern(8*8)		-	0.47	0.56	A		
Power Consumption	Horizontal Stripe	P_{CC}	-	3.05	3.66	Watt	60Hz	
			-	3.50	4.2	Watt	75Hz	

Note:

(1) The Ripple Voltage should be measured under the condition of V_{CC}(typ),TA=25±2℃,

F_R=Max.(Frame Rate)condition and at that time, we recommend the bandwidth configuration of oscilloscope is to be under 20MHz.

(2) Measurement condition: V_{CC} rising time = 470 μs.



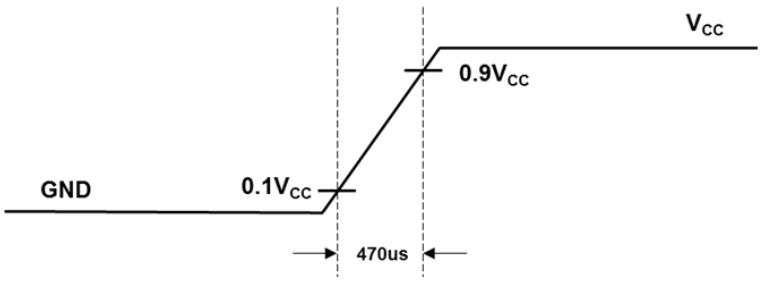


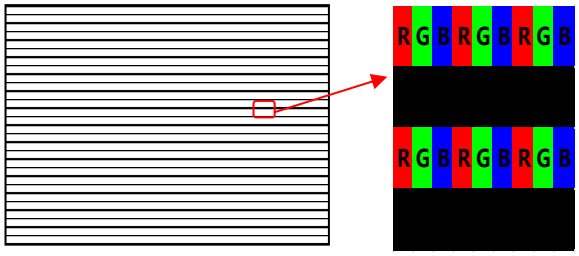
Fig. 3.1 V_{CC} rising time condition

(3) Measurement condition: V_{CC}= V_{CC}(typ), Ta = 25 ± 2 ºC, the test patterns are shown as below.

a. White Pattern

b. Black Pattern

c. Horizontal Stripe Pattern



d. Mosaic Pattern(8*8)

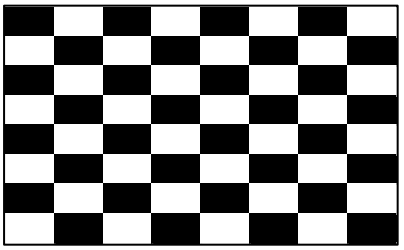


Fig. 3.2 Test patterns

3.2 LVDS Characteristics

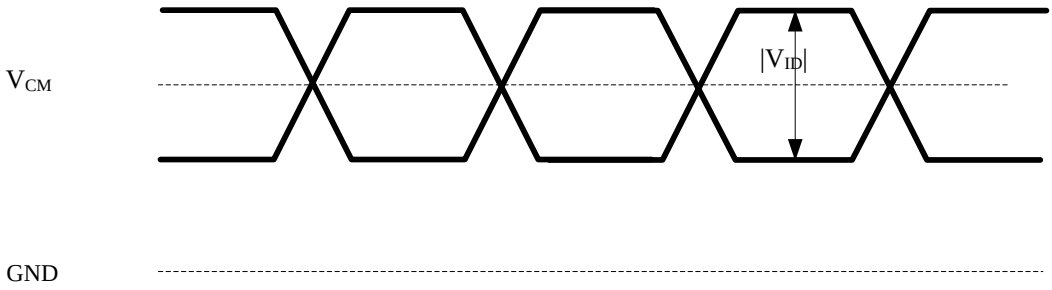
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
LVDS Interface	Differential Input High Threshold Voltage	V_{TH}	+100	-	-	mV	(1)
	Differential Input Low Threshold Voltage	V_{TL}	-	-	-100	mV	(1)
	Common Input Voltage	Vcm	1.0	1.2	1.4	V	(2)
	Differential Input Voltage	$\|V_{ID}\|$	100	-	600	mV	(3)
	Terminating Resistor	R_T	87.5	100	112.5	ohm	

Note:

(1) Condition: V_{CM}=1.2V

(2) The product should be always operated within above ranges.

(3) The LVDS input signal has been defined as follows:



Differential Signal

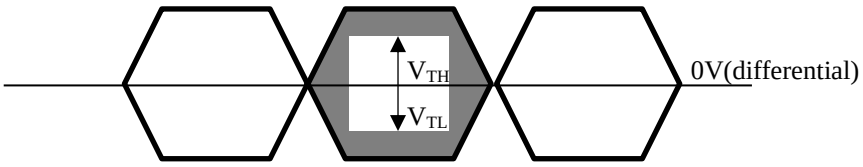


Fig. 3.3 LVDS input signal

3.3 Temperature Specifications

Parameter	Symbol	Specification			Unit	Recommended test pattern	Note
		Min.	Typ.	Max.			
Surface Temperature	T_{TCON}	-	-	100	℃	Horizontal Pattern	(1)
	T_{PMIC}			100		Horizontal Pattern	(1)
	T_{Driver}	-	-	115		Horizontal Pattern	(1)

Note:

(1) Any point on the IC surface must be less than Max. specification, If the surface temperature is out of the specification, thermal solutions should be applied to avoid be damaged. The IC surface temperature is measured at room temperature of 25℃.

4. Input Terminal Pin Assignment

4.1 Interface Pin Assignment

CN1: 187114-30091 (P2) or equivalent (see Note (1))

Pin No.	Symbol	Description	Note
1	LV1N0	Odd LVDS Signal -	
2	LV1P0	Odd LVDS Signal +	
3	LV1N1	Odd LVDS Signal -	
4	LV1P1	Odd LVDS Signal +	
5	LV1N2	Odd LVDS Signal -	
6	LV1P2	Odd LVDS Signal +	
7	GND	Ground	
8	LVCK1N	Odd LVDS Clock -	
9	LVCK1P	Odd LVDS Clock +	
10	LV1N3	Odd LVDS Signal -	
11	LV1P3	Odd LVDS Signal +	
12	LV2N0	Even LVDS Signal -	
13	LV2P0	Even LVDS Signal +	
14	GND	Ground	
15	LV2N1	Even LVDS Signal -	
16	LV2P1	Even LVDS Signal +	
17	GND	Ground	
18	LV2N2	Even LVDS Signal -	
19	LV2P2	Even LVDS Signal +	
20	LVCK2N	Even LVDS Clock -	
21	LVCK2P	Even LVDS Clock +	
22	LV2N3	Even LVDS Signal -	
23	LV2P3	Even LVDS Signal +	
24	GND	GND	
25	NC	No Connection, Please let it open	
26	NC	No Connection, Please let it open	
27	NC	No Connection, Please let it open	
28	VCC	Power Supply +5V	
29	VCC	Power Supply +5V	
30	VCC	Power Supply +5V	

Note (1): The direction of pin assignment is shown as below:

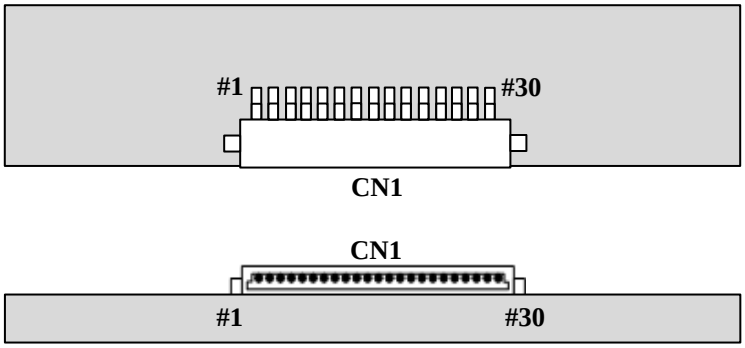


Fig. 4.1 Connector direction sketch map

4.2 Block Diagram of Interface

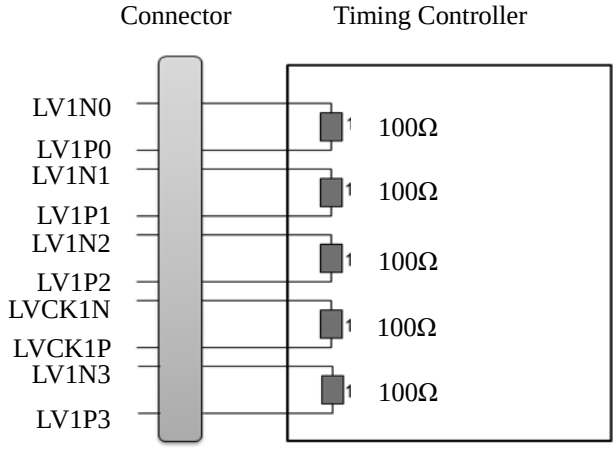


Fig. 4.2 Block diagram of interface

Attention:

(1) This open cell uses a 100 ohms (Ω) resistor between positive and negative lines of each receiver input.

(2) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line respectively.

4.3 LVDS Interface

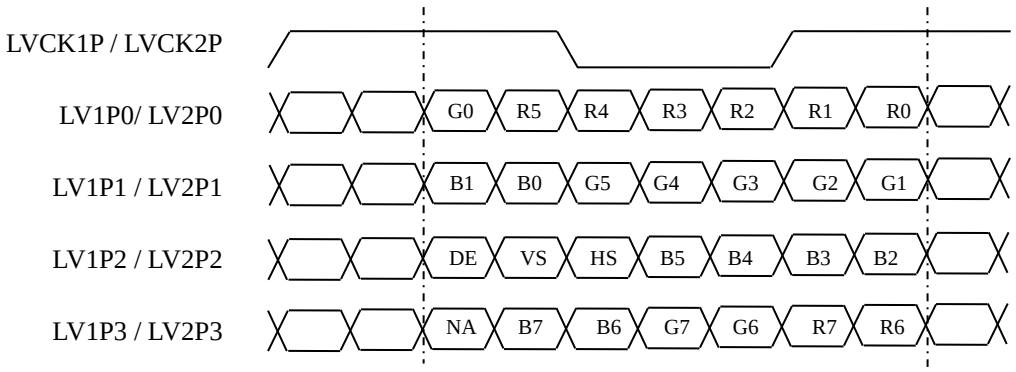


Fig. 4.3 VESA format

5. Interface Timing

5.1 Timing Table (DE Only Mode)

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Pixel clock frequency		D_{CLK}	52	74.25	96	MHz	(1)
Frame Rate		F_R	48	60	75	Hz	
Vertical Term	Total	Tv	1092	1125	1760	Line	$T_V = T_{VD} + T_{VB}$ (2)
	Active Display	T_{VD}	1080			Line	
	Blank	T_{VB}	12	45	680	Line	
Horizontal Term	Total	T_H	1042	1100	1174	Pixel	$T_H = T_{HD} + T_{HB}$
	Active Display	T_{HD}	960			Pixel	
	Blank	T_{HB}	82	140	214	Pixel	
LVDS Receiver Clock	Input cycle to cycle jitter	Trcl	—	—	200	ps	(3)
	Spread spectrum modulation range	Fclkin_mod	-3 %	—	+3 %		(4)
	Spread spectrum modulation frequency	FSSM	30	—	200	KHz	
LVDS Receiver Data	Receiver Skew Margin	TRSM	- 400	—	400	ps	(5)

Note:

(1) The TFT LCD open cell is operated in DE only mode, H sync and V sync input signal have no effect on normal operation.

(2) Dclk = $T_H \times T_V \times F_R$, T_H, T_V and F_R should operate within the range between Pixel clock frequency Min. and Pixel clock frequency Max..

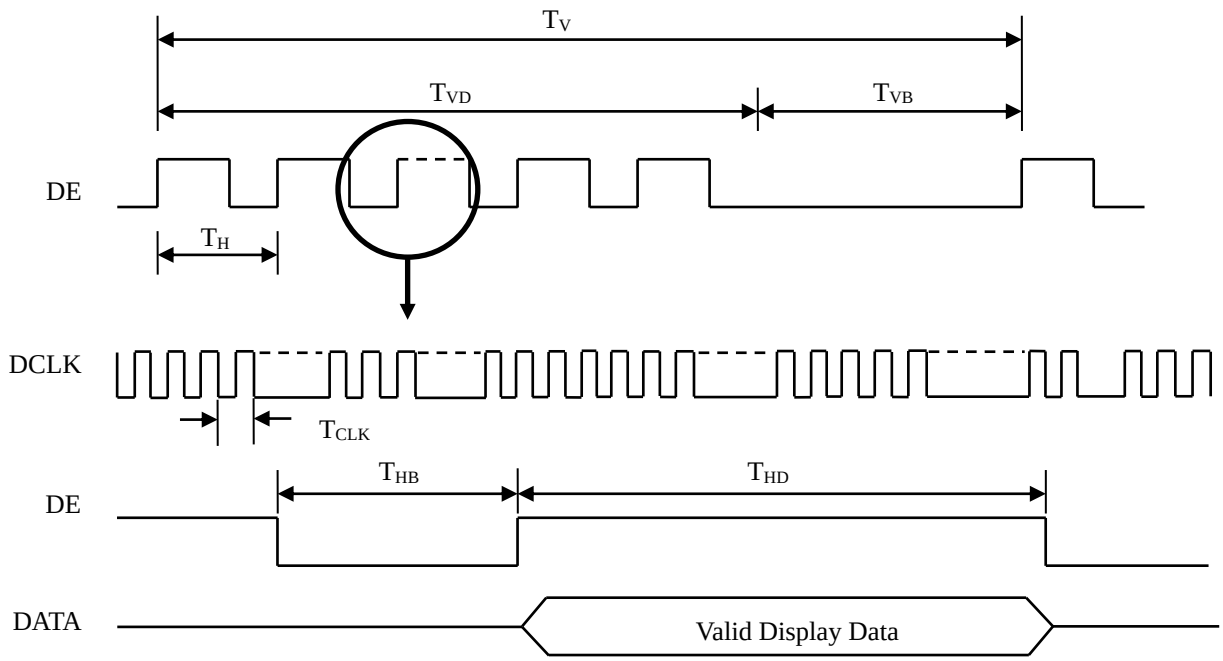


Fig. 5.1 Interface signal timing diagram

(3) The input clock cycle-to-cycle is defined as below figures.

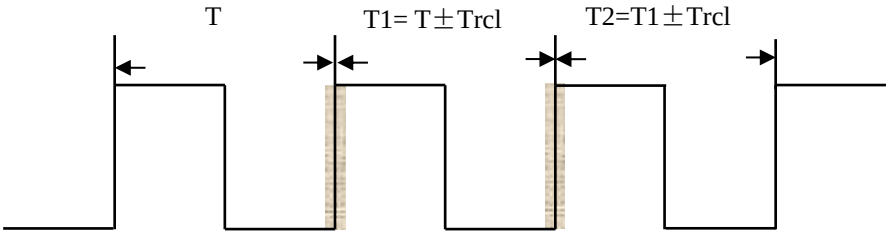


Fig. 5.2 Jitter

(4) The SSM (Spread Spectrum Modulation) is defined as the following figure.The LVDS SSM's suggestion is disabled by default; SOC board should test all validation if SOC board enables the LVDS SSM.

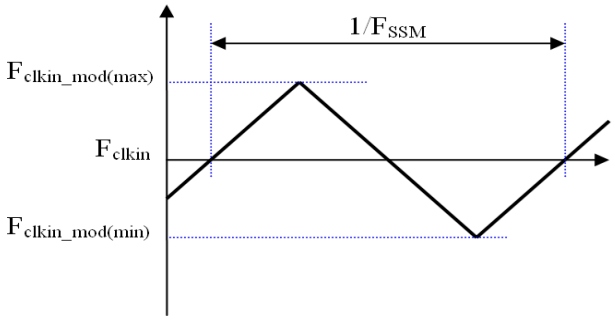


Fig. 5.3 SSM

(5) The LVDS timing diagram and setup/hold time is defined in the following figure.

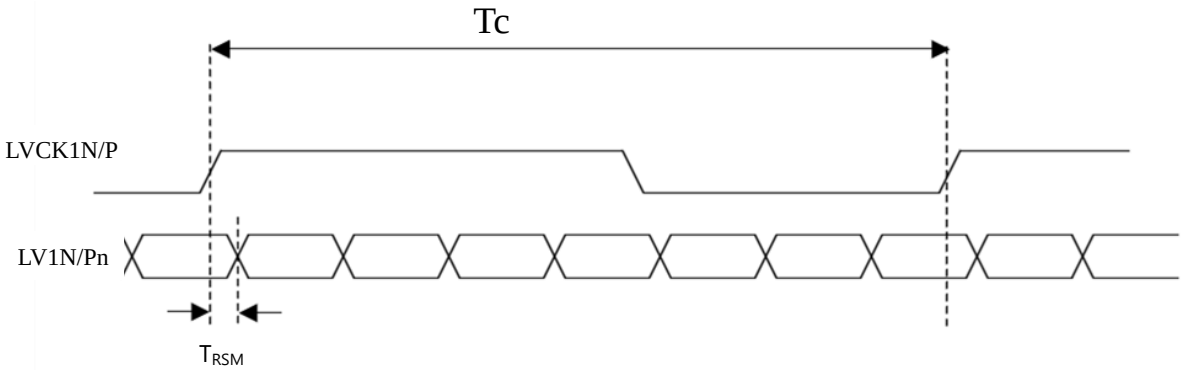


Fig.5.4 LVDS receiver interface timing diagram

5.2 Power On/Off Sequence

To prevent a latch-up or DC operation of LCD module, the power on/off change signal sequence should be as the diagram below.

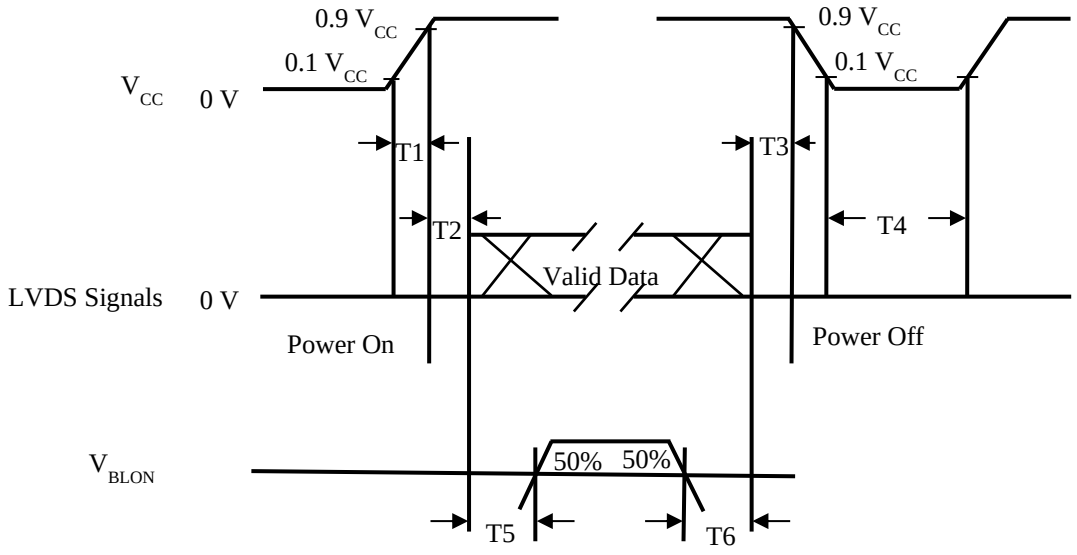


Fig. 5.5 Power on/off signal sequence

Parameter	Values			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	1000	-	-	ms
T5	500	-	-	ms
T6	100	-	-	ms

Attention:

(1) The supplied voltage of the external system for the open cell input should follow the definition of V_{CC}.

(2) When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

(3) In case that V_{CC} is in off level, keep the level of input signals on the low or high impedance. If T2 < 0, that may cause electrical overstress.

(4) T4 should be measured after the module has been fully discharged between power off and on period.

(5) Interface signal shall not be kept at high impedance when the power is on.

6. Optical Characteristics

6.1 Measurement Conditions

The table below is the test condition of optical measurement.

Item	Symbol	Value	Unit
Ambient Temperature	T_A	25 ± 2	ºC
Ambient Humidity	H_A	50 ± 10	% RH
Supply Voltage	V_{CC}	5	V
Driving Signal	Refer to the typical value in Chapter 3: Electrical Specification		
Vertical Refresh Rate	F_R	60	Hz

To avoid abrupt temperature change during optical measurement, it's suggested to warm up the LCD module more than 60 minutes after lighting the backlight and in the windless environment.

To measure the LCD cell, it is suggested to set up the standard measurement system as Fig. 6.1. The measuring area S should contain at least 500 pixels of the LCD cell as illustrated in Fig.6.2 (A means the area allocated to one pixel). In this model, for example, the minimum measuring distance Z is 370mm when θ is 2 degree. Hence, 500mm is the typical measuring distance. This measuring condition is referred to 301-2H of VESA FPDM 2.0 about viewing distance, angle, and angular field of view definition.

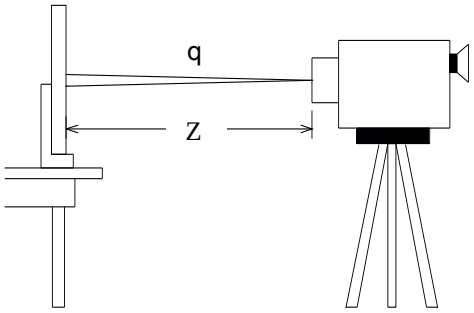


Fig. 6.1 The standard set-up system of measurement

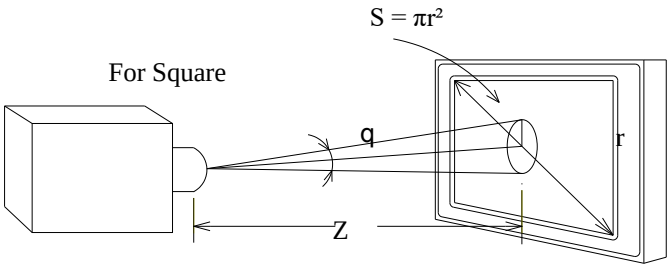


Fig. 6.2 The area S contains at least 500 pixels to be measured

$$N = \frac{S}{A} \geq 500 \text{ pixels}$$

N means the actual number of the pixels in the area S.

6.2 Optical Specifications

The table below of optical characteristics is measured by MINOLTA CS2000, MINOLTA CA310, ELDIM OPTI Scope-SA and ELDIM EZ contrast in dark room.

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Static Contrast Ratio		CR	$\theta_H = 0°, \theta_V = 0°$ Normal direction at center point with CSOT Flat BLU (Wx= 0.289 , Wy= 0.272)	700	1000	-	-	(1) (2)
Center Transmittance		T%		TBD	4.8	-	%	(2) (4)
Gamma Scale		-		1.9	2.2	2.5	-	(7)
Color Chromaticity (CIE1931)	Red	R_X		Typ. - 0.03	0.649	Typ. + 0.03	-	(2) (5)
		R_Y			0.341		-	
	Green	G_X			0.320		-	
		G_Y			0.622		-	
	Blue	B_X			0.150		-	
		B_Y			0.063		-	
	White	W_X			0.304		-	
		W_Y			0.324		-	
	Color Gamut	CG		-	72	-	% NTSC	
Response Time (without OD 5*5)		TL	F_R = 60 Hz		14	20	ms	(3)
			F_R = 75 Hz		14	20	ms	
Viewing Angle	Horizontal	θ_{H+}	CR ≥ 10	80	89	-	Deg.	(6)
		θ_{H-}		80	89	-		
	Vertical	θ_{V+}		80	89	-		
		θ_{V-}		80	89	-		

Note:

(1) Definition of static contrast ratio (CR):

It's necessary to switch off all the dynamic and dimming function when measuring the static contrast ratio.

$$\text{Static Contrast Ratio (CR)} = \frac{\text{CR-W}}{\text{CR-D}}$$

CR-W is the luminance measured by LMD (light-measuring device) at the center point of the LCD module with full-screen displaying white. The standard setup of measurement is illustrated in Fig. 6.3; CR-D is the luminance measured by LMD at the center point of the LCD module with full-screen displaying black. The LMD in this item is CS2000.

(2) The LMD in the item could be a spectroradiometer such as (KONICA MINOLTA) CS2000, CS1000(TOPCON), SR-UL2 or the same level spectroradiometer. Other display color analyzer (KONICA MINOLTA) CA210, CA310 or (TOPCON) BM-7 could be involved after being calibrated with a spectroradiometer on each stage of a product.

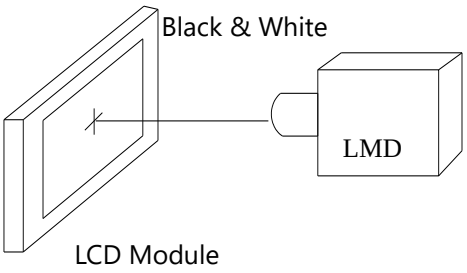


Fig. 6.3 The standard setup of CR measurement

(3) Response time T_L is defined as the average transition time in the response time matrix. The table below is the response time matrix in which each element $t_{X\ to\ Y}$ is the transition time from Gray level X to Y. X and Y are two different Gray levels among 0, 64, 128, 192, 255. The transition time $t_{X\ to\ Y}$ is defined as the time taken from 10% to 90% of the luminance difference between X and Y (X < Y) as illustrated in Fig.6.4. When X > Y, the definition of $t_{X\ to\ Y}$ is the time taken from 90% to 10% of the luminance difference between X and Y. The response time is optimized on refresh rate F_R = 60Hz& Max.

Measured Transition Time		**Gray level of Previous Frame**				
		0	64	128	192	255
Gray level of Current Frame	0		64 to 0	128 to 0	192 to 0	255 to 0
	64	0 to 64		128 to 64	192 to 64	255 to 64
	128	0 to 128	64 to 128		192 to 128	255 to 128
	192	0 to 192	64 to 192	128 to 192		255 to 192
	255	0 to 255	64 to 255	128 to 255	192 to 255	

$t_{X\ to\ Y}$ means the transition time from luminance ratio X to Y.

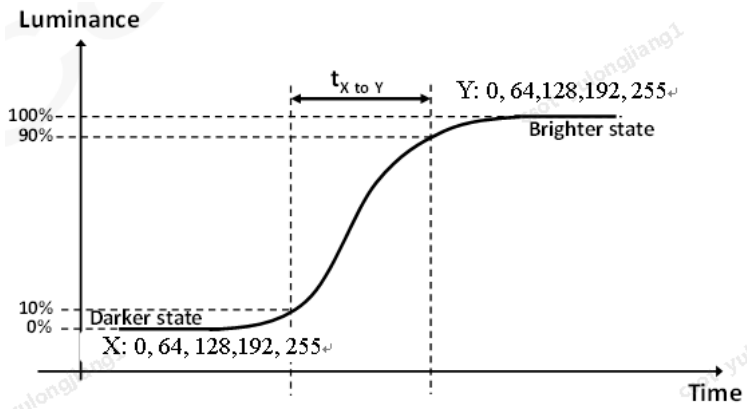


Fig. 6.4 The definition of $t_{X\ to\ Y}$

All the transition time is measured at the center point of the LCD module by ELDIM OPTI

Scope-SA with low-pass filter.

(4) Definition of center Transmittance (T%):

The transmittance is measured with full white pattern (Gray 255)

$$\text{Center Transmittance (T\%)} = \frac{\text{Luminance of LCD module}}{\text{Luminance of Backlight}}$$

(5) Definition of color chromaticity:

Each chromaticity coordinates (x, y) are measured in CIE1931 color space when full-screen displaying primary color R, G, B and white. The color gamut is defined as the fraction in percent of the area of the triangle bounded by R, G, B coordinates and the area is defined by NTSC 1953 color standard in the CIE color space. Chromaticity coordinates are measured by CS2000 and the standard setup of measurement is shown in Fig. 6.5.

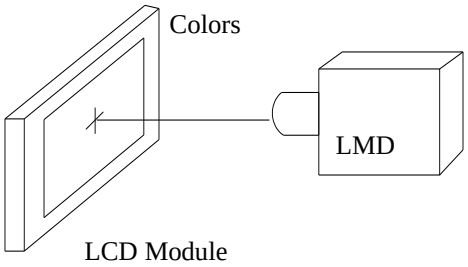


Fig. 6.5 The standard setup of color chromaticity measurement

(6) Definition of viewing angle coordinate system (θ_H, θ_V):

The contrast ratio is measured at the center point of the LCD module. The viewing angles are defined at the angle that the contrast ratio is larger than 10 at four directions relative to the perpendicular direction of the LCD module (two vertical angles: up θ_{V+} and down θ_{V-}; and two horizontal angles: right θ_{H+} and left θ_{H-}) as illustrated in Fig. 6.6. The contrast ratio is measured by ELDIM EZ Contrast.

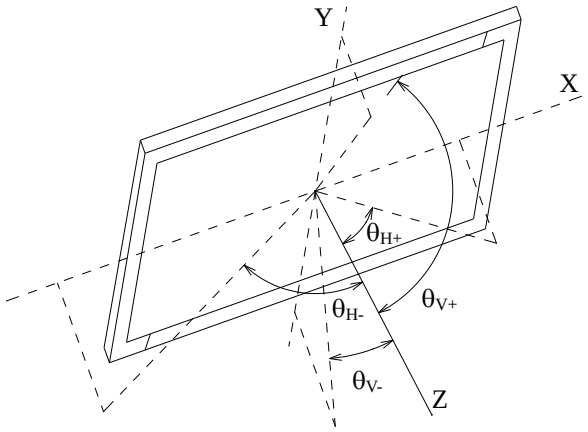
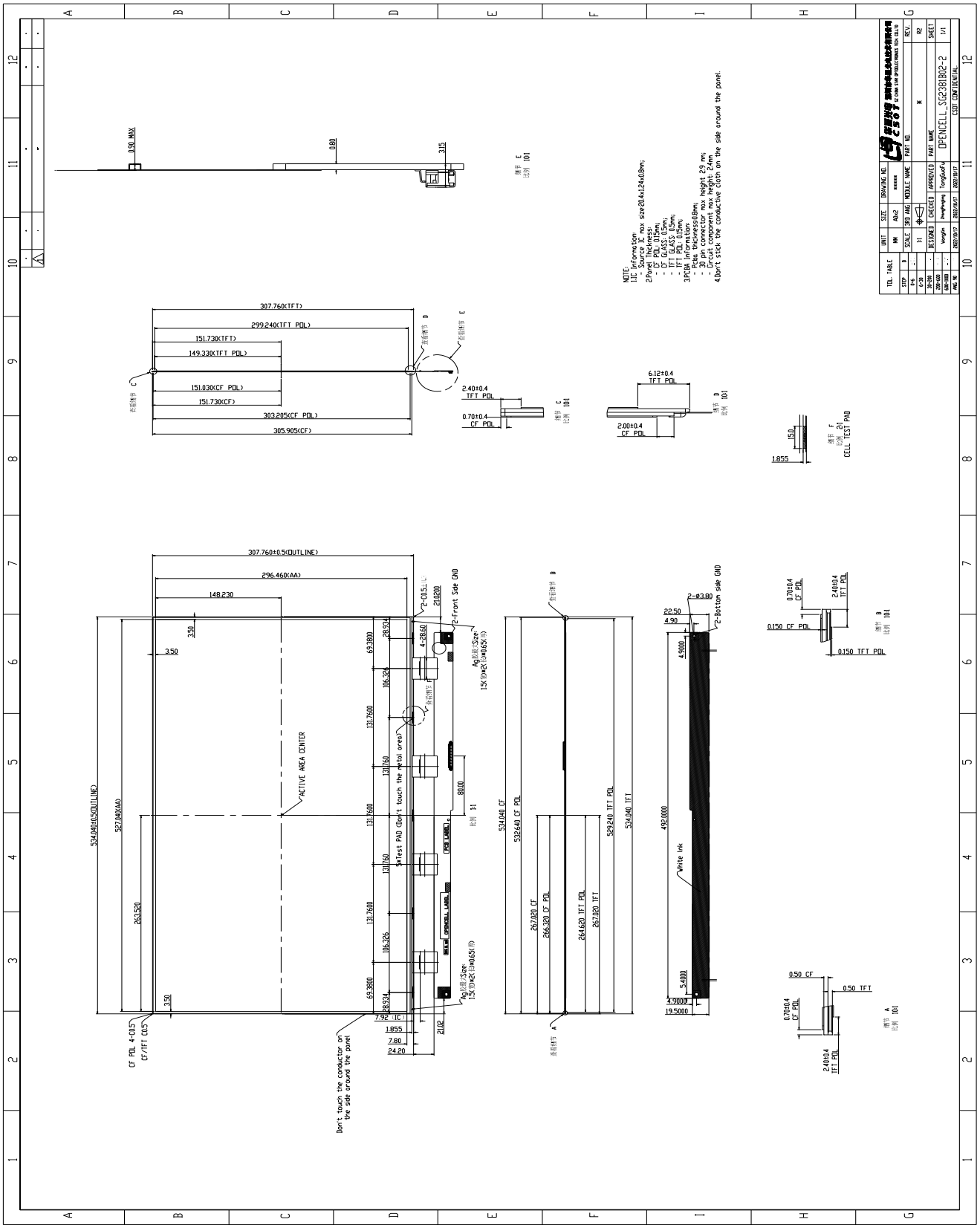


Fig. 6.6 Viewing angle coordination system

(7) Base on 50~128 gray，and CSOT will continuously monitor.

7. Mechanical Characteristics

7.1 Mechanical Specification



7.2 Packing

7.2.1 Packing Specifications

Item	Specification		
	Quantity	Dimension (mm)	Weight (kg)
Packing Box	20pcs/box	695 (L) x 510 (W) x 140 (H)	Net Weight: 10.8 Gross Weight: 12.1
Pallet	1	1420 (L) x 1120 (W) x 144 (H)	Net Weight: 17.5
Stack Layer	7		
Boxes per Pallet	28 boxes / pallet		
Pallet after Packing	560 pcs/pallet	1420 (L) x 1120 (W) x 1098 (H)	Gross Weight: 358
Pallet Stack Layer	2 layers/Warehouse, 2 layers/40GP, 2 layers/40HQ.		

7.2.2 Packing Method

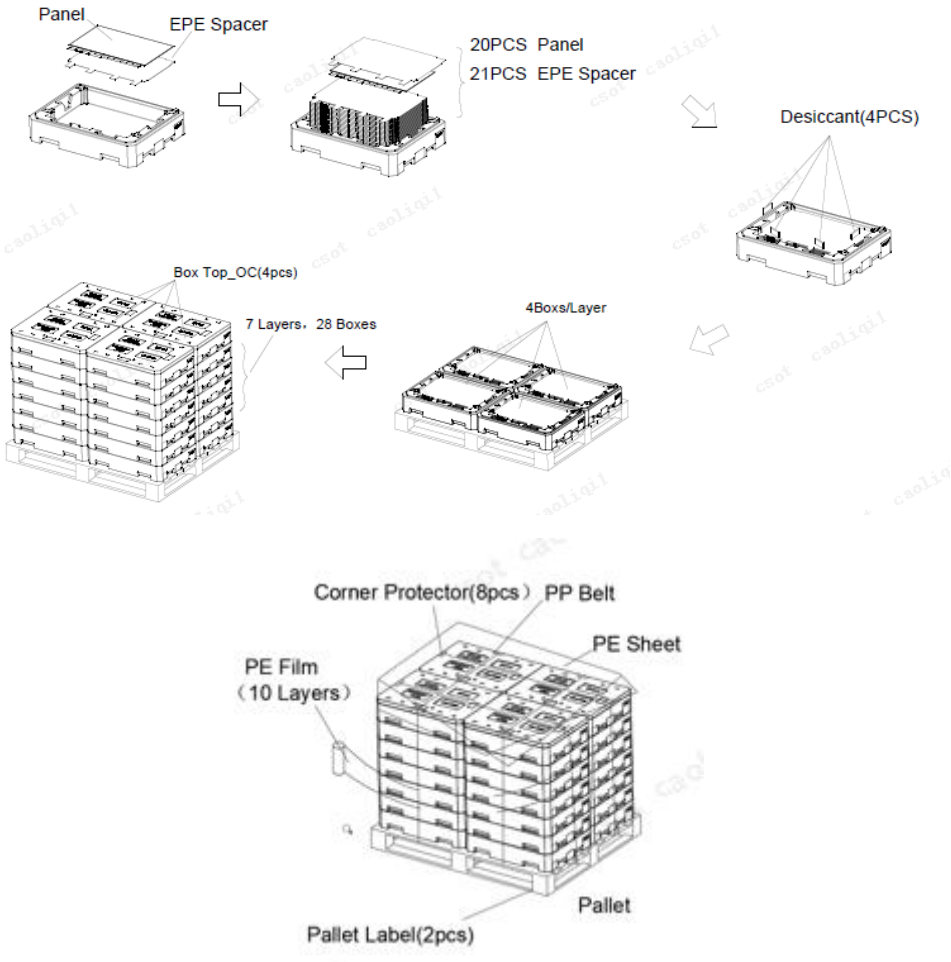
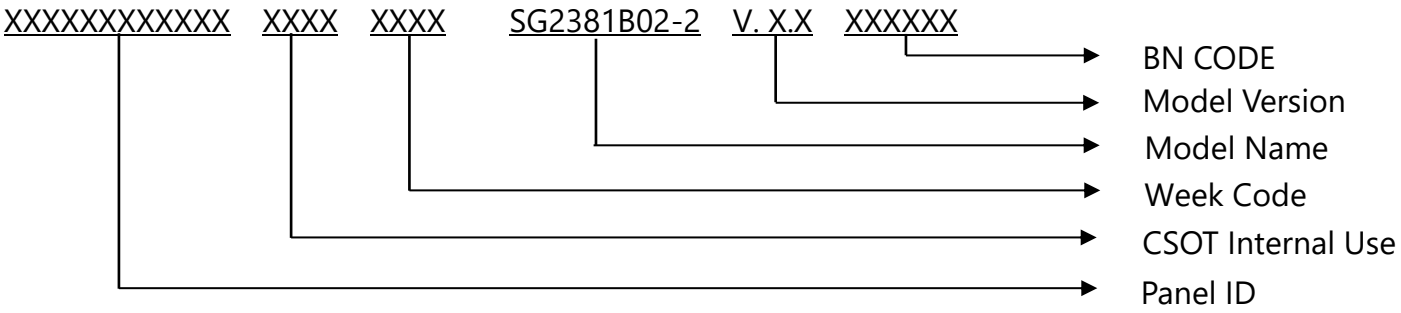


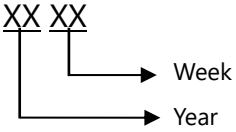
Fig. 7.1 Packing method

8. Definition of Labels

8.1 Open Cell Label



Week Code: XX XX



Year: 2010 =10, 2011 = 11 …2020= 20, 2021= 21…

Week: 01, 02, 03 …

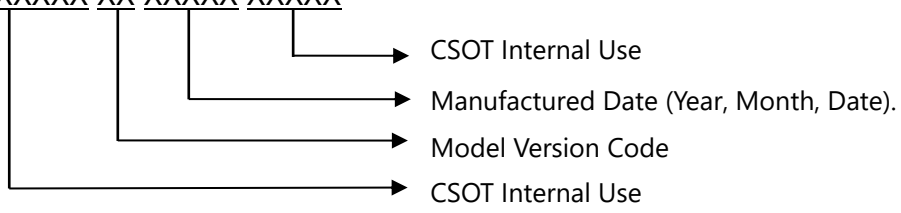
Model Name: SG2381B02-2

Ver.X.X: Version, for example: 0.1, 0.2, …,1.1, 1.2, …, 2.1, 2.2, …

8.2 Carton Label

For RoHS compliant products, CSOT will add RoHS for identification.

Serial Number: XXXXXXXX XX XXXXX XXXXX



Manufactured Date:

Year: 2010 = 10, 2011 = 11…2020 = 20, 2021 = 21…

Month: 1~9, A~C, for Jan. ~ Dec.

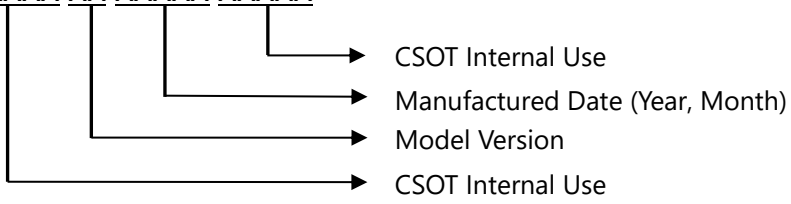
Date: 01~31, for 1st to 31st

Model Version Code: Version of product, for example: 01, 02, 11, 12…

8.3 Pallet Label

For RoHS compliant products, CSOT will add RoHS for identification.

Serial Number: XXXXXX XX XXXXX XXXXX



9. Precautions

9.1 Assembly and Handling Precautions

(1) The device listed in the product specification sheets was designed and manufactured for MNT application only.

(2) Do not apply rough force such as bending or twisting to the open cell during assembly.

(3) It is recommended to assemble or install an open cell into the user's system in clean working areas. The dust and oil may cause electrical short or damage the polarizer.

(4) Any attachment on polarizer of open-cell，such as tape，is forbidden and not recommend，especially under the high temperature and high humidity environment

(5) Do not apply pressure or impulse to the open cell to prevent the damage to the open cell.

(6) Always follow the correct power-on sequence. This can prevent the damage and latch-up to the LSI chips.

(7) Do not plug in or pull out the interface connector while the open cell is in operation.

(8) Use soft dry cloth without chemicals for cleaning because the surface of polarizer is very soft and easily be scratched.

(9) Moisture can easily penetrate into the open cell and may cause the damage during operation.

(10) High temperature or humidity may deteriorate the performance of the open cell. Please store open cell in the specified storage conditions.

(11) When ambient temperature is lower than 10 ºC, the display quality might be deteriorated. For example, the response time will become slow.

9.2 Safety Precautions

(1) 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 should be washed away thoroughly with soap.

(2) After the open cell end of life, it is not harmful in case of norm.

Appendix Input Connector